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An empirical examination of repeated auctions for biodiversity conservation contracts

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Abstract

The European Union's Council Regulation on support for rural development by the European Agricultural Fund for Rural Development has introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts for the recent multi-annual budgetary plan. This paper therefore deals with the conception and results of two case study auctions for conservation contracts. Results of two field experiments show much differentiated bid prices in the model-region and budgetary cost-effectiveness gains of up to 21% in the first auction and up to 36% in the repeated auction. Besides these promising results, some critical aspects as well as lessons to be learned will also be discussed in this paper to improve the design and performance of upcoming conservation auctions.

Keywords: agri-environmental policy, discriminatory-price auction, multi-unit auction, ecological services, plant biodiversity, experimental economics

JEL-Classification: C93, D44, H41, Q24, Q28, Q57, R52

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1. Introduction

Since the reform of the Common Agricultural Policy (CAP) in 1992, agri-environmental schemes have been supported by the EU within the framework of the second pillar of the CAP. In this context, it is the norm that ecological services provided by agriculture are predominantly rewarded action-orientated and by the use of a single, fixed payment for compliance with a predetermined combination of management prescriptions. Even though the discussion concerning the use of economic instruments in environmental policy has already expanded in the 1990s, the diffusion of innovative policy design had been slow. Most states had still relied on regulatory, not on market-based policies and even though this strategy had yielded some success, it became clear that market-based strategies and instruments could be more effective for certain applications (Latacz-Lohmann and Hodge, 2003).

In the case of plant biodiversity in Europe the problem of increasingly endangered biodiversity is to a growing extent recognised, but the question of how to address this challenge appropriately has yet to be answered (Kleijn and Sutherland, 2003). One of the suggested approaches is the strengthening of incentive measures and market-creation. The European Union's Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) has introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts for the current multi-annual budgetary plan (article 39, Council Regulation (EC) No 1698/2005). However, in the range of policy options aimed at the conservation and protection of biological diversity, market-based instruments have only recently gained more attention. The implementation of this institutional reorientation in Europe is still characterised by a serve shortage of knowledge and practical experiences.

Since 1986 the U.S. Department of Agriculture has been awarding land retirement contracts for the Conservation Reserve Program (CRP) based on a competitive bidding mechanism. Farmers bid to obtain CRP cost share assistance, which is allocated to them based on a so-called Environmental Benefits Index (Reichelderfer and Boggess, 1988; Szentandrasi et al., 1995; Babcock et al., 1996; Smith, 2003). In Australia, auctions are used in areas such as salinity control, nutrient control and conservation of native vegetation where land use change is required to accomplish environmental improvement as part of the BushTender trials and other projects as part of the Market-based Instruments Pilot Program (Stoneham et al., 2003; Grafton, 2005; National Market

Based Instrument Working Group, 2005). In Europe, a conservation scheme combining auctioning and fixed-price payments had been used in two counties in the state of North Rhine-Westphalia, Germany (Holm-Müller and Hilden, 2004). Moreover, the Challenge Fund in the UK was based on auctioning to encourage additional afforestiation on private areas (CJC Consulting, 2004).

The case study presented in this paper focuses the specific mechanism of auctioning conservation contracts in biodiversity protection efforts. The survey mainly sets out to discuss the first sole real-life implementation of auctioning plant biodiversity on grassland sites in Europe within a case study area in Germany. Due to restriction and necessary compromises as part of an interdisciplinary research project, the case study auctions could not completely be designed according to theoretical evident guidelines and in a way the author would have done independently from an environmental and resource economist's point of view. These aspects will also be reflected briefly in the remainder of the paper.

The paper is structured as follows. The second section takes a brief look at general considerations on the application of auctioning conservation contracts. Section three presents the case study background. The main results of both field experiments are discussed in the fourth section. Section five concludes and briefly highlights additional need for research.

2. Auctioning conservation contracts

2.1 Main considerations

The potential benefit of auctions in allocating contracts is evident and well analysed by auction theory (Latacz-Lohmann and Van der Hamsvoort, 1997; Latacz-Lohmann and Van der Hamsvoort, 1998; Klemperer, 1999; Klemperer, 2002; Krishna, 2002; Chan et al. 2003; Jehiel and Moldovanu, 2003). The main reason why auctions are of interests in this case is the presence of an information asymmetry between the farmers and the administration (Latacz-Lohmann and Van der Hamsvoort, 1997). This is the case since these goods and services are often generated by lands that are private property. A farmer, in this case, usually knows his own land as the base of production opportunities better than any public agency (Fraser, 1995; Wu and Babcock, 1996). Landowners will therefore calculate based on their individual costs and a price for the trades goods will emerge, which enables a more efficient use of public funds as if the administration would fix flat-rate payments without considering differences in the farmers' production costs. From a policy-maker's point of view, auctions to buy ecological services from landowners focus on budgetary cost-effectiveness and the possibility to gather information about the production costs of agricultural firms.

Standard selling auctions can be adopted as procurement or reverse auctions, like in the case of auctioning ecological services. But as especially Latacz-Lohmann and Schilizzi (2005) point out, auctions for ecological services differ from basic auction design in many respects. Thus auction theory is not well developed for this kind of specific auctioning and offers little guidance for designing conservation auctions in practice.

One aspect is that conservation auctions are usually repeated auctions and bids for the same ecological service on one site are invited in a sequence of various bidding rounds instead of a one-shot auction. This allows bidders to learn from the results of previous auctions and to adjust their bids (Reichelderfer and Boggess, 1988; Hailu and Schilizzi, 2004). Also to be mentioned is the number of goods traded simultaneous and therefore we have to distinguish between single-unit auctions and multi-unit auctions (Kagel and Levin, 2001; Hailu and Thoyer, 2006). Auction theory mainly deals with the case of single-unit selling auctions, but conservation auctions are multi-unit procurement auctions and the administration selects various farmers with numerous heterogeneous sites to take part in the auction. Furthermore, it needs to be considered that conservation auctions can be used either as budget-constraint auctions or as target-constraint auctions (Latacz-Lohmann and Schilizzi, 2005). The budget-constraint auction is the usual case that agri-environmental schemes have a limited budget to spend and therefore applicants are accepted until the budget is exhausted. Another aspect of designing auctioning schemes is the question of whether a reserve price should be set. A reserve price is a price limit that defines the maximum amount that the administration is willing to accept (Stoneham et al., 2003; Latacz-Lohmann and Schilizzi, 2005).

2.2 The payment format

To analyse bid values, standard auction theory has employed two basic models. In the private-value model each bidder has an individual knowledge about the value of the object in question. This value remains private information and is not revealed in the auctioning process. In contrast, in the common-value model the value of the object is equal for all bidders involved in the auction. However, the bidders have different private information about what that value actually is. In this case, bidders change their estimates if they learn other bidders' signals via bids. In contrast, the values in the private-value case would not change based on additional information by other bidders' preferences or bids (Klemperer, 1999).

Landholders in practise are assumed to have independent private values. This seems to encourage a single round of bidding in connection with the expectation that bids will be based on individual opportunity costs. But in practice the administration usually needs repeated auctions and a common-value element may easily arise; landholders might analyse the results of previous auctions and accordingly update their bids (Latacz-Lohmann and Van der Hamsvoort, 1997). As long as no official information on how the conservation agency values the sites with respect to their conservation value is available, the landholders will have different assumptions on the relative value of their land.

In order to avoid the appropriation of information rents and collusion, it has to be considered carefully what kind of information will be given to bidders. Consequently and due to the fact that only sealed-bid auctions are of interest in this case, there are two basic payment formats to be used within repeated multi-unit auctions for ecological services. Both payment formats will now be briefly discussed, in particular regarding strategic incentives and the expected farmers' bidding behaviour (McAfee and McMillian 1987; Milgrom, 1989; Latacz-Lohmann and Van der Hamsvoort, 1997; Cason and Gangadharan, 2004; Cason and Gangadharan, 2005; Stoneham et al., 2003; Latacz-Lohmann and Schilizzi, 2005):

i. In the uniform-price sealed bid auction a sealed bid is submitted by each bidder, stating the individual price for a specific ecological service. The good is then bought at a price determined by the price of the highest winning bid or the lowest rejected bid. All successful bids are paid equal. Thus the individual bid price just determines the probability of acceptance, but not the final payment. The optimal bidding strategy therefore is to reveal the accurate opportunity costs.
ii. In the discriminatory-price sealed bid auction also a sealed bid is submitted for every site, but all accepted bids are receiving payments according to the individual bid price. This creates incentives for bidders to bid a price above the individual opportunity costs and to ensure themselves information rents if the bid finally is successful.

The theory of budget-constrained auctions suggests that it is optimal for bidders in a discriminatory-price auction to overbid relative to their true costs of providing the ecological good (Latacz-Lohmann and van der Hamsvoort, 1997; Cason and Gangadharan, 2005). The bid curve does not therefore represent the true cost curve; it rather contains a rent for the bidder. Hence the supply curve is not identical within discriminatory-price auctions and uniform-price auctions, whereby the true opportunity costs, in theory, equal the bid prices within a uniform-price auction. The latter is based on the true marginal cost curve of environmental service provision, without a rent element. A discriminatory-price auction does thus reveal differences in opportunity costs, but only imperfectly so, because of the incentive to overbid.

On the basis of theoretical considerations the payment format of a uniform-price auction seems to be the best choice since it creates no incentives for overbidding the individual opportunity costs. But particularly facing the practical considerations of a case study implementation some further aspects need to be considered.[1]

A main argument against uniform-price auctions, taken into account within the case study, is that farmers with low opportunity costs would benefit disproportional from a higher payment, because the strike price reflects the required compensation for owners of more productive sites. In contrast, a discriminatory-price auction does not pay landholders more than what they bid and the critical incentive on overbidding the individual opportunity costs in discriminatory-price auctions could be reduced to some degree by using flexible reserve prices or budget-constraints.

Uniform pricing also seems to be more complex and more difficult to comprehend than the discriminatory-price auction. This may act as a barrier for farmers to participate, particularly within the first-time ever implementation of a conservation auction. In addition, uniform-price auctions expose bidders to greater risk as not only the acceptance probability is unknown but also the final payment.

Moreover, it was expected in this small case study that within repeated uniform-price auctions bidders would learn the uniform price paid for successful bids in previous auctions and adjust their bids in the next auction. This kind of bidders' learning will most probably lead to negative effects on the efficiency of the repeated auction performance and was decided to be avoided by any means in the field experiment. The argumentation is also based on findings by Cason et al. (2003). They used laboratory experiments to examine bidding behaviour in an auction when the value of the output

[1] The discussion follows and complements Latacz-Lohmann and Schilizzi (2005).

was known, compared with when it was not. The experiments indicate that when bidders did not know the value of output, their bids tended to be based on the opportunity costs. By contrast, when bidders were given information about the significance of their biodiversity assets, they tend to raise bids and secure themselves information rents.

The choice between both payment formats is obviously controversial in practise. In the case study the discriminatory-price auction appealed to be the appropriate payment format against the background of repeated auctions as well as the objective of a high acceptance by farmers.

3. Case study background

3.1 Payment scheme and auction design

The interdisciplinary payment scheme is a research programme, designed to reward environmental services in agriculture. It deals with the objectives of enhancing efficiency and acceptance of agri-environmental programmes by the use of an innovative market-orientation. Four main aspects make this transdisciplinary payment scheme different from actual programmes: It is outcome-based, decentralised according to the European principle of subsidiarity, market orientated by the use of auctioning and participatory by the integration of a regional advisory board.[2]

This paper basically deals with the aspect of market creation by the use of conservation auctions. Within the payment scheme regional-specific environmental goods of plant biodiversity – voluntary provided by the farmers – are rewarded as results of environmental services of agriculture. The prerequisite for a market-based support of environmental benefits is that ecological services need to be standardised according to their ecological quality and must meet certain conditions and requirements. This implies that ecological services are valuable goods and could be detected without complicated methods. Furthermore, the ecological goods should act as an indicator and – in addition to their actual usefulness – should imply positive effects on other natural resources.

The overall objective is to reward landowners for their provision of environmental services, whereas the payment is – contrary to the majority of current agri-environmental programmes in the EU – not based on actions undertaken by the farmers

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[2] The empirical work presented in this paper arises from research the author carried out at the Department for Agricultural Economics and Rural Development at the University of Goettingen in the time period 2004-2006.

(Kleijn and Sutherland, 2003), but result-orientated, based on specify ecological services. These ecological services are defined as ecological goods of plant biodiversity (Bertke, 2005). Ecological goods have to be clearly defined by transparent floristic criteria, so farmers are able to prove their fulfilment and a justifiable control of the supplied ecological goods can take place as part of the payment scheme. In this case the production of the so-called ecological goods 'grassland' aims at the protection of regional endangered plant communities, the preservation of grassland on marginal sites and the promotion of species-rich grassland. Therefore the number of species per plot and a catalogue of grassland species that are adapted to extensive grassland management and characteristic for regional plant communities are suitable for the definition of ecological goods grassland. Related to the ecological quality the following three categories were defined: grassland I, grassland II and grassland III, whereas grassland III represents the highest quality of ecological services (Gerowitt et al., 2003; Bertke, 2005).

The production of ecological goods shall achieve i) the maintenance of grassland on marginal sites, ii) the promotion of regional species-rich types of grassland and iii) the conservation of rare plant associations. Important is either the number of different species per control plot (circle with 2m radius = $12.6m^2$) as well as the existence of regional defined target species of extensive grasslands. The ecological goods and their represented ecological quality are defined as follows: grassland I: number of species >= $8/12.6m^2$; grassland II: number of species >= $8/12.6m^2$ + 2 target species; grassland III: number of species >= $8/12.6m^2$ + 4 target species. The definition of the ecological goods grassland used in the case study is based on the work of Bertke (2005) and has been designed in a previous conceptual project period.

From an economic point of view, the bid price per hectare is taken into account. The ecological evaluation is based on the quality of the produced ecological services represented by the classification grassland I, grassland II and grassland III. Thus within every category of ecological goods different prices are paid for the same quantity of a (heterogeneous) good based on the bid prices per hectare.

The specific auction design is a repeated sealed-bid discriminatory-price multi-unit auction, with a separate budget-constraint for each quality of ecological goods. It therefore aims at budgetary cost-effectiveness as well as the possibility for the auctioneer to learn about differences of farmers' opportunity costs revealed by individual bid prices for every grassland site. The regional demarcation corresponds to a uniform exclusion border. To safeguard a high number of participants and low possibilities for collusion, all farmers were allowed to take part with all their grassland sites located in the case study area. In both auctions the same (potential) cohort of farmers was part of the field experiment mainly to learn about the bidding behaviour and the practical performance of repeated auctions as well as to collect data on further aspects not discussed in this paper (for example to measure the private transaction costs in both auctions). Furthermore, there was no possibility to run another auction in another case study area with different farmers and a changed auction design due to financial and organisational restrictions.

Hence the bidders are bidding on one of three ecological goods, which are defined by the number of plant species targeted as well as the ecological quality of species specific to the region. If landowners do not exactly meet the ecological requirements of the ecological good the bid is targeted on, they will not be paid at all. Thereby it is left to the farmers to decide how to achieve the desired grassland I, II or III status. The results were assessed by a ground control on the grassland site at the end of the contract period. As part of the ground control the number and quality of different species were evaluated by counting them in control plots representative for the whole grassland site.[3] Successful farmers got paid in both auctions.

Since bidding behaviour is very sensitive to the type and amount of information communicated to farmers, no information except the definition of the ecological goods as part of the specification of services and the terms to be maintained was given to potential bidders in both auctions. The budget also was not pre-announced in both auctions and the potential bidders for the second auction were not informed about the highest accepted bid prices. They were only able to learn by the evaluation of their bids within the first auction. Due to the fact that both auctions were part of a research project, an interdisciplinary group of researchers acted as the auctioneer and evaluated the bids.

3.2 Timetable

The case study enfolded two field auctions. Below the basic proceeding and the timetable of both auctions will be described.

[3] The ground control was part of a separate work area within the research project and will not be examined in this paper.

I. The first auction (2004/2005)

All conventional and ecological farmers with managed grassland sites in the model-region were qualified to submitted bids within the first auction, starting in the beginning of June 2004. In June 2004 three information meetings were held to inform interested farmers about the basic procedure and the necessary documents. The deadline for submitting bids ended after six weeks and the bids were evaluated within one week. The contracts were closed in the middle of July 2004. According to the outcome-orientation, the ground control took place until the end of July 2005 and successful farmers got paid in August 2005.

II. The second auction (2006)

The basic auction design was the same within the second auction, except for a change that needed to be done due to a short-term safeguarding of the auction budget. This adaptation refers to the circle of eligible farmers and the auction was limited to those farmers already participated in the first auction. Therefore, the documents were immediately sent to the relevant farmers in the middle of February 2006. The bids had to be received until the end of March 2006 and were evaluated in one week. The ground control took place by the end of July 2006 and after a successful control, the farmers got paid in August 2006.

Due to the involvement of the auctions in a research project and resulting restrictions, the contract period was one year or shorter and not five years, as usual in agri-environment schemes. Therefore the aspect of windfall profits might be discussed, but since the payment scheme is result-orientated, corresponding criticism should be small; but still kept in mind.

4. Results – auction performance

4.1 Submitted and successful bids

To participate, landowners had to submit an individual bid for every grassland site, whereas every farmer was qualified to submit a various number of bids for all categories of ecological services. Main results of the case auctions area are presented in table 1.

Table 1. Results of both auctions for the ecological goods grassland I, II and III (submitted bids)

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		

- Range of prices in €/ha	40 – 250 (Ø 100.92; SD 47.18)	25 – 160 (Ø 93.94; SD 29.47)
- Number of sites	130	216
- Hectare	221.16	340.65
- Number of farmers	27	26
Grassland II		
- Range of prices in €/ha	55 – 300 (Ø 141.75; SD 59.55)	75 – 300 (Ø 147.67; SD 46.92)
- Number of sites	32	56
- Hectare	53.33	82.58
- Number of farmers	16	18
Grassland III		
- Range of prices in €/ha	100 – 350 (Ø 202.78; SD 78.73)	150 – 450 (Ø 257.35; SD 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

Source: own. Note: Ø = mean; SD = standard deviation.

The offer includes the choice of the ecological good (grassland I, grassland II or grassland III), the calculation of the price per hectare as well as the description of the grassland site. Analysing the wide ranges and standard deviations of individual bid prices within each category of ecological goods and both auctions, it becomes clear that the farmers were confronted with different opportunity cost for the provision of an in each case equal quality of ecological services. Within currently used fixed price payment schemes in the European agri-environmental policy these cost differentials remain unknown to the administration and could therefore not be considered for conservation contracting.

Looking at the development from the first to the second auction, the range of prices expanded only within the highest quality of ecological services – the ecological goods grassland III. For both ecological goods grassland II and grassland I the range of prices decreased on small scale and for the latter the influence of the strike price on bidders' learning becomes apparent. In the first auction all bids up to a price of €145 per hectare were accepted for the ecological goods grassland I. In the second auction especially the former rejected farmers learned and either reduced the bid prices or – if a reduction of the bid prices was not possible due to higher opportunity costs – did not supply the specific grassland site again. Thus the highest bid price in the second auction was adjusted to €160 per hectare. Furthermore, the above findings on submitted bids show that even if the range of prices decreased for the ecological goods grassland I and (slightly) for the ecological goods grassland II, there is still no collusion with negative monetary effects. As expected, the price level increased within both auctions from good grassland I about good grassland II up to good grassland III.

Finally, the development of the number of bids as well as the number of participating farmers from 2004/2005 to 2006 will be included. It becomes obvious that the number of sites (the number of bids) especially arose for the relatively lowest quality of ecological services, but also within all other classes of ecological goods. It this case it needs to be mentioned that in consequence of changing the auction design in 2006 the number of eligible farmers was limited to those farmers who had already participated in the first auction. Hence the increase of submitted bids from the first to the second auction can be interpreted as a rising acceptance of auctioning as a new policy instrument.

Besides the submitted bids, the paper will now turn to answer the question what kind of bids could finally be accepted. Therefore the most important results of the successful bids are presented in table 2 for both auctions and all three categories of ecological goods. Firstly, it needs to be remembered that both auctions are budget-constraint auctions with no reserve price and therefore the main influence on the number of accepted bids is the budget-restriction for every ecological good. The total budget restriction of €30,000 for the first auction was basically decided to be spend on two-thirds (€20,000) for the ecological goods grassland I and both on one-sixth (€5,000) for the ecological goods grassland II and grassland III, but with the option of shifting some of the budget to higher-quality goods, depending on the number and size of sites. For the second auction a total budget of €26,000 was available and this time the budget was decided to be spent equally (about €8,667) for all three ecological goods.
In consequence of the total budget-restriction of €30,000 not all bids of the total amount of €33,747.91 could be accepted within the first auction. Finally, 159 sites by 28 farmers – covering an area of 288.56 hectare – were taken under contract. With a total bid sum of €51,481.23 the budget-restriction of €26,000 was also exceeded in the second auction and therefore altogether 164 sites by 21 farmers were accepted. This covers species-rich grassland of 238.46 hectare.

Table 2. Results of both auctions for the ecological goods grassland I, II and III (successful bids)

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		
- Range of prices in €/ha	40 – 145 (Ø 84.59; SD 26.45)	25 – 90 (Ø 66.86; SD 15.56)
- Number of sites	109	89
- Hectare	198.25	130.05
- Number of farmers	20	10
Grassland II		
- Range of prices in €/ha	55 – 300 (Ø 141.75; SD 59.55)	75 – 200 (Ø 137.87; SD 30.92)
- Number of sites	32	52
- Hectare	53.33	76.80
- Number of farmers	16	17

Grassland III		
- Range of prices in €/ha	100 – 350 (Ø 202.78; SD 78.73)	150 – 450 (Ø 257.35; SD 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

Source: own. Note: Ø = mean; SD = standard deviation.

Looking at the price ranges and standard deviations of the successful bids and their relevance for the final payment, the results clarify a still wide difference between individual bid prices and thus the consequences of discriminatory-price auctions for the final design of conservation contracting.

The additional analysis of accepted bid price levels in both auctions also shows an increase from the ecological goods grassland I about the ecological goods grassland II up to the ecological goods grassland III. From the first to the second auction the price level decreased both for the ecological goods grassland I and grassland II mainly due to an adjustment by reducing the specific budget-constraint.

On the other hand, the price level and the highest successful bid-price per hectare for the peak quality of biodiversity – represented by the ecological goods grassland III – increased from the first to the second auction. This development is caused by the adjustment of the subdividing of the total budget-restriction on the three categories of ecological goods in the second auction. As a reaction concerning an unexpected high amount of bids for the ecological goods grassland III in the first auction, the specific budget-restriction and the valuation of the highest-quality grassland sites was enhanced absolutely as well as compared to the remaining two classes of ecological goods.

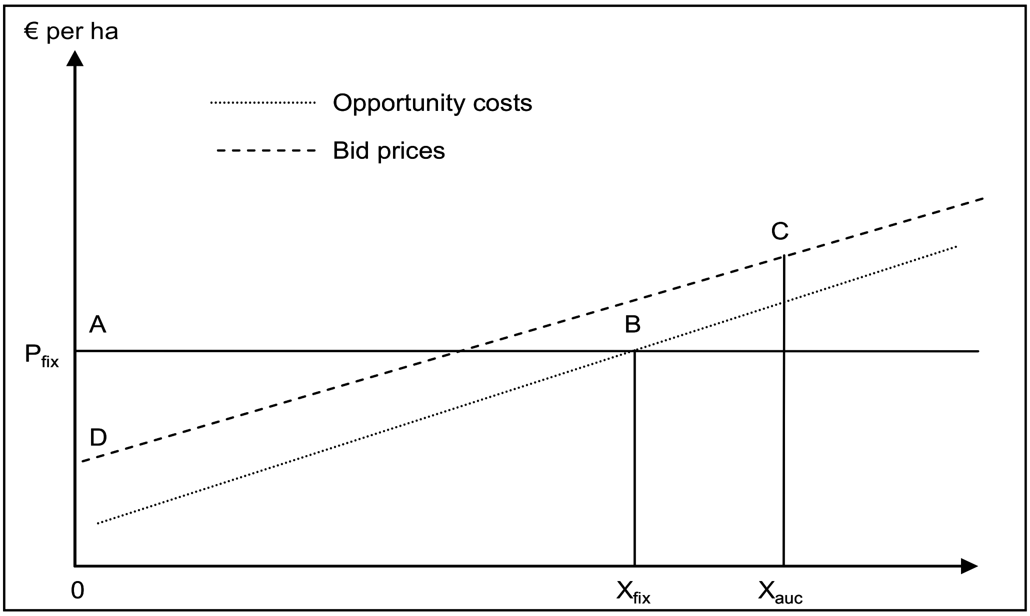
Due to the fact that the whole budget was spend for every ecological good, a comparison of table 1 and table 2 suggests that there was no real competition for the grassland II and III contracts, since all applicants but one won a contract. This must have had a negative effect on bidding behaviour, especially compared to grassland I contracts for which there was a lot of competition. To avoid this rise of accepted bid prices and to increase competition among farmers, a reserve price of for example €300 per hectare should have been used for grassland III. But based on controversial discussions within the research project the idea of using reserve prices – at least in the second auction and based on the results of the first auction as well as other information – was rejected by the majority, bringing forward the argument that the main objective should be to take as much high-quality grassland sites under contract as possible; without considering a potential rise in prices and less budgetary cost-effectiveness. This needs to be mentioned as a challenge of interdisciplinary decision making and as a problem or restriction within the case study auctions.

4.2 Efficiency gains by auctioning compared to fixed flat-rate payments

Besides the analysis of bids and especially bid prices per hectare, practical efficiency gains by auctioning instead of fixed flat-rate payments in the model-region will be discussed.

It is important to remember that the opportunity cost curve is the relevant supply curve when a fixed flat-rate payment is offered. Then all landowners with opportunity costs below the fixed payment gain from participating in the payment scheme. The marginal participant is the one whose opportunity cost is equal to the payment rate offered. Thus, under the fixed-price scheme, X_{fix} hectare of species rich grassland will be traded at the price P_{fix} (figure 1). The total budget-constraint is represented by the area $0ABX_{fix}$. Under a discriminatory-price auction, the ordered bids represent the supply curve, not the opportunity cost curve. The auction therefore creates incentives for landowners to shade their bids above their true opportunity costs and thereby to secure themselves an information rent. Bidders are accepted in the order of their bids until the budget is exhausted. The budget-constraint is represented by the area $0DCX_{auc}$. Assuming the same budget as under the fixed-price scheme, X_{auc} hectare of species rich grassland can be taken under contract. The cost-effectiveness of the auction thus depends on the degree of bid shading. One would normally expect bid shading to be low and the auction to be superior to the fixed-price scheme. However, if bidders learn the bid caps from previous auctions, bid shading can result in poor auction performance. Figure 1 shows the example of how a discriminatory-price auction is more cost-effective than a fixed-price scheme for the same given budget, whereby linear instead of convex cost curves are assumed for reasons of a simplified illustration.

Figure 1. Hypothetical cost-effectiveness of a discriminatory-price auction vs. a fixed flat-rate payment



Source: own, based on Latacz-Lohmann and Schilizzi, 2005.

The evaluation of efficiency gains of the auction vis-à-vis a fixed-price scheme therefore should be done against a supply curve reflecting true marginal costs. An auction does reveal differences in opportunity costs, but only imperfectly so. Because of incentive to overbid, the true opportunity costs could not be identified within the case study and remain subject to asymmetric information – and thus unknown to the author – in any field experiment. An appropriate comparison of the auction performance and a fixed-price scheme thus is difficult, based on data generated by field experiments. A precise comparison requires the use of laboratory experiments where the true marginal costs are perfectly controlled for and known to the experimenter. These limitations should be considered for the latter of this section.

If we assume that the bid prices within the case study auctions are equal to the true opportunity costs, a comparison with a fixed flat-rate payment scheme will at least give a clue on efficiency gains by the use of auctioning.

Due to the specific auction design (outcome orientation, definition of the ecological goods grassland I, grassland II and grassland III) it needs to be considered that – at the time the case study took place – no agri-environmental programme exactly fits to the ecological goal of the case study auctions. Therefore the 'Lower Saxony agri-environmental programme, measure B: support of extensive grassland use' [*Niedersächsische Agrarumweltprogramme, Maßnahme B: Förderung extensiver Grünlandnutzung*] will be consulted. This support of an extensive use of grassland fits best to the ecological good grassland I, whereas the latter even represents a higher ecological quality because the auction rewards an extensive use of grassland sites plus the proof of a specific amount of plant biodiversity indicated by eight different species. By the time the case study took place, farmers where paid within the agri-environmental programme by a fixed payment of €103 per hectare. In the remainder of the section the budget spent within both auctions will be compared to the budget that would have been needed to take same area under contract by using the flat-rate payment. Thereby the impact on practical efficiency gains by the use of auctioning will be discussed. Farmers participating in the case study were not allowed to take part in the agri-environmental programme with grassland sites taken under contract within the auction.

In the first auction (2004/2005) 198.25 hectare were taken under contract, whereas the relevant budget sums up to €16,100.84. To achieve the equivalent area by using a fixed payment of €103 per hectare a total budget of €20,419.75 would have been needed. Auctioning does in this case lead to savings of €4,318.91 or in other words efficiency gains of 21.2%.
The similar comparison for the second auction approves, and even strengthens, this positive evaluation. Using the fixed payment of €103 per hectare, a budget of €13,395.15 must be paid to realise the ecological goal of 130.05 hectare grassland taken under contract in 2006. In contrast this objective has been achieved by auctioning with a budget of €8,527.30, which equals savings of €4,867.85 or 36.3%.
To sum up under consideration of all unavoidable empirical inaccuracy, these results point out the specific real-life economic potential of auctioning and support the hypothesis of efficiency gains by the use of auctions compared to fixed flat-rate payments.

5. Conclusion

As agri-environmental agencies in Europe and around the world look for more efficient ways of contracting landowners for the provisions of ecological services, some clear conclusions emerge from this case study. Even if the auctioning scheme is a comparatively simple case study, the results are sufficient to point out a potential for a more efficient spending of public funds compared to traditional measures in environmental and biodiversity conservation policy. Keeping in mind the empirical difficulties of field experiments in comparison to laboratory experiments, the empirical work indicates cost advantages of auctioning in comparison to fixed flat-rate payment schemes of up to 36%, depending on which scenario is chosen as reference. These findings as well as a relative high number of farmers participating in the case study point out that auctioning conservation contracts became popular with landowner and that the topic of biodiversity conservation turned from a primary complex and somewhat diffuse idea to practical actions and monetary incentives for farmers.

Still there is little evidence about the efficiency gains of auctions compared to payment schemes using fixed-prices. Furthermore, reported results on cost-effectiveness gains greatly vary as for example Stoneham et al. (2003) mention that the first auction within the BushTender trial had lead to an amount of biodiversity that would have cost up to seven times more if a fixed-price payment scheme had been used instead of the auction. A simulation of farmers' bidding behaviour within a hypothetical payment scheme auctioning conservation contracts by Latacz-Lohmann and Van der Hamsvoort (1997) points out efficiency gains – depending on the auction design – from 16% to 29%. Within the Catchment Care Program as part of the National Market-based Instruments Pilot Program in Australia an auction for biodiversity and water quality – ones in place – is expected to be between 23% and 34% more cost-effective than the former fixed price scheme (National Market Based Instruments Working Group, 2005). An evaluation of the Central Scotland Forest and Grampian Challenge Fund for the Forestry Commission Scotland by CJC Consulting (2004) reports efficiency gains in the range of 33% to 36%. Therefore the results from this case study fit well to cost-effectiveness gains mentioned for the Central Scotland Forest and Grampian Challenge Fund (CJC Consulting, 2004) as well as for the Catchment Care Program (National Market Based Instruments Working Group, 2005).

Even though the case study presented in this paper had yielded promising results while a real life repeated auctioning format was successfully implemented, there are also critical lessons to be learned and to be considered to improve upcoming conservation auctions. One main aspect is the fact that the ecological quality was measured within the case study by the number of different species and the use of specific classifications of ecological goods. This very simple way of evaluating the value of plant biodiversity was necessary since the first time ever implementation of the payment scheme had to be simple. But this categorisation of output quality needs to be criticised for several reasons, as follows. The bid valuation based on the number and quality of different species and the bid price per hectare i) disregards other more differentiated and important criteria, ii) there is no clear linkage between the amount of plant biodiversity and the final payment, iii) the bid valuation is not representative for the needs of the majority of conservation schemes and iv) the bid valuation does not use a reserve price as a maximum bid price to be paid. A promising solution to resolve these problems, and meet the practical requirements of most repeated conservation auctions, seems to be the use of an environmental index.

Thus the author is currently working on additional aspects in the field of auctioning conservation contracts. This short-term research mainly comprises of a worldwide comparative study of conservation auctions, the question of how to deal with information and ecological stock dynamics within repeated conservation auctions under uncertainty as well as the development of a specific environmental benefits index for plant biodiversity. Thereby, it also needs to be analysed, in which circumstances auctioning is not feasible or will not lead to efficiency gains and a payment scheme only using fixed prices or a combination of both instruments is the appropriate way within the European agri-environmental policy for the period 2007 to 2013 and beyond.

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