

**LOCK-IN EFFECTS IN COMPETITIVE
BIDDING SCHEMES FOR PAYMENTS
FOR ECOSYSTEM SERVICES**

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Lock-in effects in competitive bidding schemes for payments for ecosystem services

Revisiting the fundamental transformation

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Abstract: Competitive bidding is considered to be a cost-effective allocation mechanism for payments for ecosystem services. This article shows that competition is not a necessary condition for sustaining cost-effectiveness in the long run. In a repeated conservation auction, learning, specific investments and the creation of social capital bias the chances of winning a follow-up contract in favour of former auction winners. Applying the concept of fundamental transformation (Williamson 1985), we argue that this asymmetry weakens competition and leads to lock-in effects between the auctioning agency and a stable pool of sellers with uncertain consequences for cost-effectiveness. We compare data from two laboratory experiments on auction-based conservation programmes and show under which conditions lock-in effects are likely to occur in a controlled environment. Our findings demonstrate lock-in effects do not erode the effectiveness of an auction but change the rules of the game towards more favourable conditions for the provision of the targeted good or service. In view of the empirical evidence for a superior performance of long-term contract relationships compared to low-cost short-term contracting, we discuss directions for follow-up empirical work.

Keywords: trust, social capital, asset specificity, cost-effectiveness, conservation auctions, payments for ecosystem services

1. Introduction

The creation of monetary incentives for the provision of environmental services and formation of competitive structures among the recipients of payments are drivers of cost-effective conservation of biological diversity in developing and developed countries (Engel et al. 2008, IUCN 2009, OECD 2010). Following Wunder et al. (2005, p. 3), we define payments for ecosystem services as “(a) a voluntary transaction where (b) a well-defined environmental service [...] or a land use likely to secure that service (c) is being ‘bought’ by a (minimum one) service buyer (d) from a (minimum one) service provider (e) if and only if the service provider secures service provision (conditionality).” Since the financial resources dedicated to conservation issues are mostly limited, cost-effectiveness becomes a crucial criterion for buyers of environmental goods and services, e.g. environmental agencies.

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Cost-effectiveness implies that the available funds are allocated to the sellers who generate the highest conservation outcome per currency unit spent. Payment differentiation is one means of achieving cost-effectiveness as it takes into account that heterogeneous sellers can have different opportunity costs (Ferraro et al. 2008, Wunder et al. 2008). These costs can be revealed to the buyer with a sealed, competitive bidding mechanism, i.e. similar to a procurement auction. The economic rationale for the use of competitive bidding is that they create incentives for sellers to offer bids close to their true opportunity costs of programme participation. This enables buyers to select the cheapest sellers. Moreover, sellers face a trade-off between a higher net-gain from a higher bid and decreased competitiveness (e.g. Latacz-Lohmann and van der Hamsvoort 1997, 2005). The present article discusses shortcomings of this logic and shows that, in the long run, competition is not a necessary condition for sustaining cost-effectiveness.

Conservation auctions, i.e. payments for ecosystem services allocated on the basis of competitive bidding, are an established and well-researched policy instrument. They are being or were operated on a large-scale in the United States (USDA Conservation Reserve Program, running since 1985), Australia (e.g. BushTender, EcoTender and ALR – Auction for Landscape Recovery), and on smaller-scale projects around the globe (e.g. Challenge Funds in Scotland, Southern Rivers Bush Incentives in New South Wales Australia). Moreover, the experience with auction-based conservation programmes is increasing in developing countries (e.g. Jindal et al. 2013). Some of these conservation auctions have been run over several contract periods, i.e. contracts were auctioned regularly amongst varying groups of sellers (for instance annually as in the USDA Conservation Reserve Program). From a conservation point of view, a long and stable contract relationship is preferential to the one-shot case (IUCN 2009). However, the economic consequences and inherent dynamics of repeated auctioning and contracting in long-term conservation programmes have not been sufficiently addressed.

Field and experimental studies have focused on auction metrics (Reeson et al. 2011a, Rolfe et al. 2009), examined bidding behaviour in conservation auctions (Cason and Gangadharan 2004, Schilizzi and Latacz-Lohmann 2007) and also highlighted their social dimension (Greiner and Stanley 2013, Jindal et al. 2013, Lockie 2013, Reeson et al. 2011b, Vogt et al. 2013, Zammit 2013). A research focus on repeated bidding and contracting poses some challenges to the underlying theoretical framework because the one-shot auction format (mostly treated in the literature) converts to a repeated auction scenario, i.e. an indefinite sequence of separate auctions². Assuming rational behaviour and symmetry of bidders, game-theoretic auction models (Latacz-Lohmann and van der Hamsvoort 1997, Milgrom 2004) are suitable for one-shot auctions, but do not yield tractable results in a repeated auction context (Hailu and Schilizzi 2004, Reeson et al. 2012, Rolfe et al. 2009). Repeated interaction brings about learning effects, reputation effects and intertemporal competition concerns which can hardly be captured in an analytical model but require a more holistic approach. Therefore, we use transaction cost economics, complemented by the dimension of social capital, to offer a comprehensive explanatory approach to the effects of repeated auctioning of conservation contracts.

Taking into account laboratory and field data, we identify learning effects, social capital and asset specificity as the three dimensions in which repeated conservation auctions differ from the one-shot case. We discuss how these aspects create asymmetry amongst successful and non-successful bidders over time. Applying the concept of the fundamental transformation (Williamson 1985), we argue that repeated conservation auctions bear the risk of reduced competition and lock-in effects between the auctioning agency and a stable pool of bidders. Finally, we compare data from two laboratory experi-

² This format needs to be distinguished from a sequential auction where bidders play several bidding rounds until the auction ends.

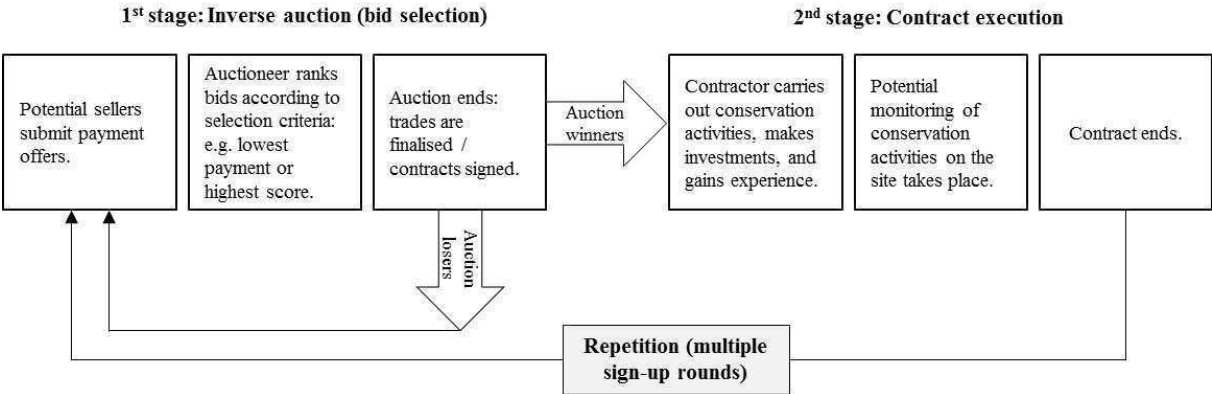
ments on auction-based conservation programmes and show under which conditions lock-in effects are likely to occur in a controlled environment. In view of the empirical evidence for a superior performance of long-term contract relationships compared to short-term contracting, we discuss directions for follow-up empirical work.

2. Sources of bidder asymmetry in repeated auction-based conservation programmes

Consider a simple, hypothetical government programme that targets the conservation of biological diversity on arable land by paying landholders for the provision of clearly defined conservation services for a limited time period. Due to budget constraints, there is an upper limit to the available number of contracts and the environmental agency must apply a selection mechanism that identifies some farmers as being preferential to others. Thus, the agency decides to differentiate payments by holding an inverse auction.

As can be seen from figure 1, there are two main stages of a conservation auction. The first stage is the inverse auction that serves to identify the optimal contractors according to a ranking rule. Interested landholders are invited to submit their individual bid proposals, i.e. the amount necessary to cover their cost of programme participation. Then, the conservation agency selects the most cost-effective bids and enters into a contractual relationship with these sellers who are paid their bids (discriminatory auction format). Secondly, the ecological goods and services are provided by the contractors at the specified price in the contract stage. Complete monitoring is too costly to implement and it takes place with a small probability. Contract duration is fixed to a limited time period.

Figure 1: Stages of an auction-based conservation programme



Under these circumstances, only in the first auction round bidders are symmetric as to their chances of winning a contract (notwithstanding differences in their opportunity cost or ecological value). With the agency’s decision being based on only two selection criteria – an ecologic and an economic component –, bidders initially operate on parity since only cost-benefit ratios count for programme participation (Groth 2010). Once all bids are ranked and contracts are made and executed for the first time, the auction logic will lead to two groups of landholders: those accepted to carry out the conservation service and those rejected. Given a stable pool of bidders both groups can compete again for contracts in the follow-up auction rounds.

This raises two questions: Firstly, how will experienced and non-experienced bidders differ subsequently in their probability of winning a conservation contract? And secondly, which economic and ecological effects result from potential differences? We hypothesise that starting with round two of the auction bidders are increasingly asymmetric with regard to three aspects:

- Learning: with regard to actual costs, foregone profit and bid caps, enabling price adjustments,
- Social capital and reputation: reflecting the history of contracts,
- Specific assets: programme-specific investments made in a previous round, not being part of future bid calculation.

2.1. Learning

Empirical results indicate that bidders learn from previous bidding rounds and that this has a significant impact on the bid proposals (Cason and Gangadharan 2004, Hailu and Schilizzi 2004, Reeson et al. 2011a, 2012, Rolfe et al. 2009, Schilizzi and Latacz-Lohmann 2007). Experience with the USDA Conservation Reserve Program (CRP) has shown that bidders quickly learn to adjust their bids. For the 1986 CRP sign-up rounds, Reichelderfer and Boggess (1988) reported that the distribution of bids decreased over the course of the sign-up period after decisions of the CRP authorities became publicly announced. Kirwan et al. (2005) found empirical evidence for increasing premiums (net-gains) of landholders who participated in CRP sign-ups between 1997 and 2003.

The distribution of information between sellers and buyers in environmental markets plays a crucial role (Latacz-Lohmann and van der Hamsvoort 2005). If not managed correctly, leakage of information on the average winning bids, the ranking criteria or the budget ceiling can incentivise strategic bidding in a repeated auction. As a consequence, the auction loses efficiency: If sellers inflate their bids (beyond their actual cost), less conservation can be financed per dollar. On the other hand if sellers underbid, the quality of the provided conservation service might suffer. These two sides are reflected in the experimental literature: While Cason and Gangadharan (2004), Hailu and Schilizzi (2004), Schilizzi and Latacz-Lohmann (2007), and Reeson et al. (2011a) all supported the positive correlation between sharing and distributing of information and efficiency losses in a repeated auction, Reeson et al. (2012), Rolfe et al. (2009) and Vogt et al. (2013) reported that learning led to improved auction outcomes.

The main reason for potential efficiency gains in repeated bidding rounds is the possibility for sellers to better understand and gain experience with the calculation of their opportunity costs. Depending on the conservation service aimed at in the programme, landholders may be more or less familiar with the required management activities and related cost. For instance, up to 50% of all participants of the Southern Rivers Bush Incentives Programme (Australia) stated in follow up interviews that they had difficulties in calculating and estimating their cost. Overbidding can be reduced by multiple bidding rounds that enable sellers to learn the payments structure and to improve (reduce) their bids (Rolfe et al. 2009). But also inefficient underbidding can be reduced by the dissemination of information resulting from communication between auctioneer and each individual bidder (Vogt et al. 2013).

Competitive advantages caused by information spill-over are in three ways different for the two groups of landholders (those rejected and those participating). Who benefits most depends on the flow of information inside and outside the auction. In very closed-off auction schemes, where the administrative agencies do not announce average winning bids or other criteria of the selection procedure ex-post, only the auction winners have information rents. This advantage vanishes with the amount of information publicly available (cf. Latacz-Lohmann and van der Hamsvoort 2005). However, auction winners have a second competitive advantage to non-winners since they gain experience in providing the conservation service. This enables them to improve their skills and to mirror their bid calculation to their actual cost. Auction losers do not have the possibility to learn about their potential costs of

contract execution. A third disadvantage for outsiders is the lacking possibility to build social capital with the agency and other participating landholders.

2.2. Trust, reputation and social capital

Social capital is crucial for the successful management of natural resources and also a significant parameter for the effectiveness of market-based instruments (Jones 2010, Ostrom 2003, Zammit 2013). As a multidimensional concept, social capital comprises social and institutional trust, norms of reciprocity, and embeddedness in groups, networks or institutions (Jones 2010, Pretty and Ward 2001). Social capital positively influences the willingness to engage for conservation activities, increases cooperation, and reduces uncertainty. More precisely, it addresses adverse selection and opportunism, which is of particular relevance in the context of an auction-based conservation programme.

Although the definition of payment for ecosystem services (PES) requires the environmental service to be “well-defined”, in practice contracts on natural resources management are in many cases incomplete³, making trust between contractors a necessary component for cooperation. In conservation contracts, often neither the exact quantity nor quality of the targeted ecological good can be defined in specified terms. Moreover, conservation outcomes are difficult to measure and monitor, creating uncertainty and a potential for opportunistic behaviour. Consequently, for the agency high-priced bids are risky if they cannot rely on their contractors’ performance.⁴ This can easily lead to a “market for lemons” outcome with suboptimal conservation effort (Arnold et al. 2013, Vogt et al. 2013). Such an inferior auction result can be overcome if the agency puts enough trust in the participating landholders and if they reciprocate with non-opportunistic behaviour.

Trust can be understood as an investment decision that leads to a positive return if the trustee reciprocates the trust placed on him (Ostrom and Walker 2003). Trust is reciprocated because of incentives or social norms (Hardin 2003). If the trustee’s preferences are encapsulated in the ones of the trustor, the trustee has an interest to reciprocate and continue the relationship. If not, the trustee may still feel morally obligated to honour the trust bestowed on him. Moreover, embeddedness in networks or groups can create social pressure for compliance (Jindal et al. 2013). In either way, reciprocity of trust increases connectedness between the stakeholders, self-enforces cooperation and leads to additional positive conservation outcomes (Pretty and Ward 2001, Zammit 2013).

Contrary to a one-shot auction where trust can be betrayed without future consequences, a repeated auction works in a different time frame, allowing sanctioning and reputation-building. Auction winners can build a reputation of trustworthiness based on past activities, demonstrated motivation and capabilities, permitting credible expectations about their future behaviour. Hence, for the agency it pays off to re-conclude contracts with trustworthy bidders, who are intrinsically motivated, have a great sense of environmental responsibility or receive private benefits from the conservation service (Lockie 2013). However, the rationale of an auction still requires selecting the most competitive candidates, who might not be identical to those with the highest reputation. It is thus questionable whether a highly competitive selection mechanism jeopardises these benefits of social capital or if the existence of trust erodes the effectiveness of the auction.

³ A contract is considered incomplete if it is not as fully contingent on all states of the world as the contracting parties would like it to be (Maskin 2002).

⁴ In this context, neo-classical theory predicts selfish behaviour due to the lack of credible commitments. However, a well-established branch of experimental literature provides empirical evidence on trust and reciprocity of trust in incomplete contractual agreements (e.g. Fehr et al. 1997).

2.3. Asset specificity

Depending on the targeted conservation outcome, contract execution may require monetary or non-monetary investments during the contract period. These investments (or assets) constitute a third source of bidder asymmetry if they are specifically dedicated to the conservation programme. Asset specificity is a concept to describe the extent to which an investment is specialised to a particular contractual agreement. An asset is considered to be highly specific if changing from the originally intended usage to alternative applications leads to high losses in asset value⁵.

In the context of agri-environmental programmes with uniform payments, asset specificity negatively influences contract adoption (Ducos and Dupraz 2007, Rørstad et al. 2007). Often required for more targeted policy measures, specific assets increase on-farm transaction costs (Rørstad et al. 2007). Since participation in a conservation programme is usually voluntary, high asset specificity bears the risk of low participation rates. However, a farmer's willingness to participate in a programme associated with highly specific assets depends on the amount of (institutional) trust in the environmental agency or other administrative stakeholders (Ducos and Dupraz 2007).

In contrast to a one-shot conservation scheme with uniform payments where specific assets reduce the gains from participation, repeated competitive bidding enables bidders to endogenise the cost of specific assets. This creates ex-post advantages for auction winners against losers if they compete for contracts in another auction round (Groth 2010). Since winners had already invested in specific assets and factored them into their bid calculation in the previous auction and contract period, *ceteris paribus*, their bids become more competitive against other bidders in the next round.

Williamson (1983) lists four dimension of asset specificity that can be adapted to conservation programmes. We add reputational aspects as a fifth dimension⁶:

- Human asset specificity: Highly specialised skills that arise from learning, practical experience or professional training,
- Physical asset specificity: Special machines or tools, which cannot be used for other purposes,
- Dedicated assets: Discrete investments in generalised production capacity only made for the purposes of the transaction (e.g. specific changes in production methods),
- Site specificity: the distinct value of land for conservation purposes,
- Relational specificity⁷: The degree of successful interaction of contractors in the past, incorporating the reputation of trustworthiness. Relationship-specific assets are created through social interaction, and their degree of specificity is determined by the length and mutually assessed value of that interaction.

2.3.1. Specific assets of sellers (landholders)

⁵ The difference in values is called transaction-specific quasi-rent. Quasi-rents rise with increasing specificity of assets.

⁶ As Williamson points out (1985, p. 62), additional transaction-specific savings can form at the interface between transaction partners as regards economies through familiarity, institutional and personal trust.

⁷ The terms "relationship-specific investments", "relational assets", "R-assets" or "relational capital" have been used interchangeably mainly in a management-related context, describing "the level [and value] of mutual trust, respect, and friendship that arises out of close interaction at the individual level between alliance partners" (cf. Kale et al. 2000, p. 218).

Participation in a conservation auction requires a good understanding of the administrative procedure, and interested landholders might be unfamiliar with the payment mechanism (cf. Rolfe et al. 2009). Therefore, often preparatory meetings, mock-auctions or on-site assessments are held before the first auction takes place. For landholders these meetings cost time and effort and have only limited use in a non-auction related context. However, understanding the auction procedure is an initial investment in human capital and related transaction costs are no longer incurred in subsequent sign-up periods (cf. McCann et al. 2005). Information meetings or on-site assessments actively support the formation of social capital. Landholders interested in a long-term contract relationship need to signal commitment to the agency and make relationship-specific investments. The more often buyers and sellers of conservation services interact, the more specific their relationship gets, providing opportunities to observe each other's actions, motivation and capabilities.

The level of physical asset specificity highly depends on the conservation measure and the local context (Mettepenningen et al. 2009). While the USDA CRP is based on land set-aside, some conservation programmes require the one-time purchase of specific equipment, e.g. a mechanical weeder, or specific plants, e.g. for the re-vegetation of bush land as in the EcoTender (cf. Eigenraam et al. 2006). Besides potential physical investment, farmers need to dedicate assets in terms of changed production cycles or work assignment (e.g. postponed mowing of grassland). Narrow conservation targets reduce options for establishing standardised routines; this implies increased asset specificity on the farm level (Rørstad et al. 2007).

In order to provide the targeted ecological good or service, landholders need to dedicate land. If it can be put under conservation measure depends on the requirements of the programme, e.g. the presence of certain species, or location in a catchment area. More targeted programmes require specific areas (Mettepenningen 2011). However, there are other dimensions how land can become specific to the conservation programme. Often, the conservation value of a site rises with the time being under protection (Kleijn et al. 2006), thus re-enrolment could be preferable to starting from scratch on another patch. Moreover, connectivity between sites increases the contribution of individual conservation actions (Reeson et al. 2011a).

Whether specific patches of land generate competitive advantages within the auction largely depends on the auction metric and its capacity to differentiate between land types. Some conservation auctions rank bids on the basis of a multi-criteria index (e.g. the Environmental Benefit Index in the CRP or the Biodiversity Benefits Index used in the BushTender), others are based on site-assessments and individual management plans (e.g. Southern Rivers Bush Incentives Programme, New South Wales Australia) to find a better balance between ecological and economic ranking.

2.3.2. Specific assets of the buyers (environmental agency)

The agency in charge of executing the auction must dedicate financial and personal resources to the conceptualisation, administration, processing, and monitoring of the programme. Moreover, advertising is necessary to attract a large pool of bidders. Some practitioners argue that the running of an inverse auction and related cost-effectiveness gains are set off by increased transaction and human resources costs. These cost rise with the complexity of the environmental policy measure (Mettepenningen et al. 2011) and with individualised procedures, e.g. on-site assessments or information meetings. However, these meetings provide opportunities to build social capital with the participating landholders, which can induce better compliance in the contract phase.

From the agency's perspective, concluding a contract with a seller also implies a site-specific investment. Given the positive correlation between duration of a conservation contract and its ecological benefits, the site value increases with the time enrolled in a programme. Contract expiration and termination of payments often results in farmers returning to their previous practices (IUCN 2009, Sullivan et al. 2004, OECD 2010). Consequently, losing a seller can lead to ecological costs for the agency.

3. The fundamental transformation, lock-in effects and the role of social capital

A repeated conservation auction establishes bidder asymmetry: A previous contracting history leads to competitive advantages due to programme-relevant experience, reputation as a contractor, and specific assets already factored into bids in earlier bidding rounds. As a consequence, we argue that there is a risk for conservation auctions to degenerate into a rather symbolic act involving only the "usual suspects" in the long-run. Reeson et al. (2012) report that strong heterogeneity in environmental values can lead to the dominance of "a small number of bidders" over time. Groth (2010) also sees potential for gradually reduced competition in repeated auction-based conservation schemes, contradicting the rationale of an inverse auction.

According to Oliver Williamson's conclusions on the subject of contractual relationships between sellers and buyers (1985), competition transforms into a bilateral monopoly for transactions involving specific assets (known as the "fundamental transformation"). Williamson notes that "such investments are [...] risky, in that specialised assets cannot be redeployed without sacrifice of productive value if contracts should be interrupted or prematurely terminated" (1985, p. 54). As a consequence, contractors can be locked-in in the sense that the potential benefit of continuing the transaction relationship is higher than terminating and switching to other partners.

We argue that participation in a conservation programme involves specific assets on the sellers' side, including the dedication of acreage, adaptation of managerial practices and acquisition of specific knowledge. Once enrolled in a programme, landholders become more competitive in subsequent auctions compared to previously unsuccessful bidders but incur losses through quasi-rents if the contract is not renewed. As a consequence, landholders interested in a long-term contract relationship have clear incentives to make relationship-specific investments and reciprocate with non-opportunistic behaviour.

As to the agency acting as buyer, we argue that the building of social capital and institutional trust is crucial for the conservation outcome. While there is an initial need to identify cost-effective bidders, periodic re-enrolment is valued by the agency since it creates trust and reduces uncertainty about the quality of the provided conservation service. In order to achieve effective results, the agency becomes likewise dependent on the programme participants and on their specific acreage.

Hence, with the beginning of the second competitive sign-up for conservation contracts, bidders are asymmetric with regard to specific assets, learning experience, and reputation. Inequality amongst bidders is maintained and consolidated in subsequent rounds, leading to increasingly asymmetric chances of winning the contract and the dominance of some bidders. Moreover, the agency has a two-fold interest in maintaining long-term contract relationships: increasing social capital (reducing opportunism) and avoiding ecological costs, which would be incurred with programme withdrawal. As a consequence, neither agency nor contracting landholders should face incentives to terminate an on-going contract relationship, which results in the establishment of long-term contract relationships.

3.1. Expected impact of lock-in effects on auction performance

Whether lock-in effects constitute challenges or opportunities depends on their effect on the conservation output (ecological effectiveness), on the competition amongst bidders, and on the cost-effectiveness criterion (Table 1). The existing empirical evidence points towards the fact that learning effects, specific investments and strong social capital, benefit the ecological effectiveness of conservation measures. However, they all bear the risk of reduced competition as they create advantages for insiders against outsiders. Learning effects can decrease the auction's cost-effectiveness if they imply strategic bidding and inflated bids, but can also increase cost-effectiveness if they reflect an improved understanding of procedures and costs. Once they are sunk, specific investments in physical assets, human capital and changed management practices increase the cost-benefit ratio but their initial costs are high.

Still, the effect of social capital is unclear. Bidders with high reputation might not be the lowest-priced suppliers and, consequently, the auction could set perverse incentives and destroy relationship-specific assets. Hence, social capital leads to improved cost-effectiveness only if landholders in long-term contract relationships are incentivised to refrain from opportunism.

Table 1: Typology of influential variables for the performance of conservation programmes

Impact factor	Learning	Specific assets	Social capital
Ecological effectiveness	+	+	+
Competition	- /+	-	-
Cost-effectiveness	- /+	+	?

(-) negative; (+) positive; (-/+) both directions possible; (?) uncertain

3.2. Empirical evidence for lock-in effects in laboratory auctions

In the following section, data from two laboratory experiments (Vogt et al. 2013; Vogt, in preparation) provide empirical evidence on the conditions under which lock-in effects in repeated conservation auctions are likely to occur. Both experiments have a different research focus from the question scrutinised here, however, their unique experimental market design enables us to draw conclusions in the context of repeated auctioning. Both experiments are based on an inverse auction market for the provision of a public good that is produced in an effort-level game (cf. Fehr et al. 1997), and represent key features of auction-based conservation programmes.

In both experiments, one round of the game consists of a bid selection and a contract stage. In the bid selection stage, a fixed number of bidders compete for contracts with an auctioneer who chooses bidders on the basis of their sealed offers. There is no formalised auction metric, though, the auctioneer is endowed with a budget and keeps the residual amount. In the contract stage, the successful bidder individually decides on a performance level, which determines the part of the received payment the bidder will re-invest to fulfil the contract. In this way, the contracting bidder's investment generates a public good that is split amongst all participants of the market. The more the bidder invests, the higher the share of the public good for everyone. The inherent moral hazard problem requires the auctioneer to put trust in the bidder's offer signal and the bidder to reciprocate and perform non-selfishly, otherwise the level of the public good is socially suboptimal. In Vogt et al., 2013 (hereafter COM), text-based bilateral communication prior to the bidding phase allows for cheap talk between bidders and auctioneers; while in Vogt, in preparation (hereafter RISK), contract performance can be affected by a

probabilistic effort transformation that is known ex ante to the contracting bidder but unverifiable ex post by the auctioneer⁸. Table 2 summarises the two experimental treatments.

Both experiments employ treatments with repetition and fixed identities, enabling us to compare repeated bidding and the iterative selection of contractors over several periods. A locked-in contract relationship is measured by its consecutive (uninterrupted) length given the random chance of concluding a contract. Favouring the same bidder over more than two periods implies that an auctioneer does not want to trade the established payment-profit ratio of the on-going relationship for a risky alternative. Measured by the random chance of winning a contract per period, both markets are similarly competitive in terms of rivalry amongst bidders⁹. However, they differ in their possibility to learn and build social capital.

Table 2: Overview of the experimental treatments

	Market-based provision of public goods with	
	Communication (Vogt et al., 2013)	Environmental Risk (Vogt, in prep.)
Participants (subset)	66	52
Sessions (subset)	4	4
Number of markets	11	13
Market size	6 (1 buyer, 5 bidders)	4 (1 buyer, 3 bidders)
Contracts allocated per period	2	1
Random chance of contracting	40 %	33,3 %
Periods played*	12	20
Feedback	Incomplete	Incomplete
Fixed player types	Yes	Yes
Fixed IDs	Yes	Yes
Test design	Within-subject**	Between-subject
Time of experimentation	February 2012	November-December 2012

Note: Only subsets of data are reported as relevant here, data in the second column corresponds to the communication in the first phase of market interaction (C1) treatment of Vogt et al, 2013., data in the third column corresponds to the fixed identities and effort multiplier (MFID) treatment of Vogt, in prep. Both computerised experiments were conducted in the Goettingen Laboratory of Behavioural Economics, based on z-tree software, participants were mostly students with different academic backgrounds. *The total number of periods was not announced to avoid end-game effects. ** First treatment phase reported here.

Learning has been identified as one substantial cause of bidder asymmetry since successful bidders are able to re-adjust their bids in subsequent rounds based on previous contracting experience. In both experimental auction markets, the cost associated to different performance levels is common knowledge and identical for every bidder in both experiments, but the feedback mechanism to the auctioneer and non-contracting bidders is incomplete¹⁰. Hence, only bidders who enter the contract stage gain experience with the interplay of performance and payment structure and can adjust their bids subsequently. These benefits of learning are reduced in the RISK market, as the random multiplier intro-

⁸ The risk parameter {0.5, 1.0, 1.5} models environmental risk common in land management and agricultural production, it was evenly distributed and had an expected value of 1. Hence, auctioneers should not alter their strategies.

⁹ While in COM two contracts are allocated amongst five bidders (40 %), in the RISK treatment three bidders compete for one contract (33.3%).

¹⁰ In COM only the sum of both contracts' effort is announced and in RISK only the contracting bidder knows which random event took place.

duces cost uncertainty that applies to every bidder in the bidding stage. Hence, only in the COM market learning takes place effectively (Hypothesis 1).

Social capital and its components trust, reputation and networking have been identified as a second source of bidder asymmetry provoking lock-in effects. In the RISK market, fixed identities allow the re-identification of market participants over time while other forms of direct interaction amongst players are unavailable. In contrast, the COM market with its bilateral chatting tool offers substantial opportunities for bidders to interact with the auctioneer, and vice versa. Every bidder is granted the same access to the auctioneer but the total chatting time is limited to three minutes per period, inducing potential variation in the amount of communication with the single bidders. Although non-binding and text-based, communication simplifies the creation of trust amongst players and improves the formation of reputation despite the incomplete feedback mechanism. Hence, the COM market is characterised by longer-lasting contract-relationships than the RISK market (Hypothesis 2).

Table 3: Time trends and means of key market variables

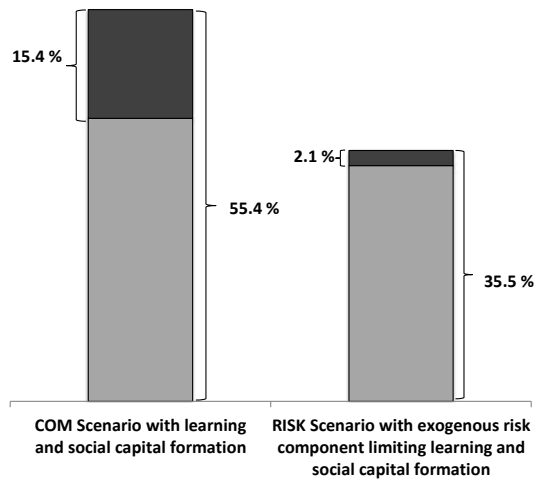
	COM		RISK	
	Mean	Trend	Mean	Trend
Offers made by bidders	167.9 (2.3)	↑ (3.38)	175.6 (1.5)	↗ (0.96)
Payments to auction winners	176.3 (2.3)	↑ (3.38)	161.8 (2.4)	↘ (- 0.17)
Performance of auction winners (effort levels)*	73.0 (1.8)	↑ (4.30)	64.9 (1.7)	↗ (0.82)

Note: Mean values are presented with standard errors in parentheses. The direction of the arrow symbolises the direction of the time trend, lopsided arrows show tendency. The t statistics of a linear regression of period on the respective variable is reported in parentheses (estimated over 12 periods for COM and 20 periods for RISK). * Untransformed effort levels are reported in the RISK scenario. Data originally published in Vogt et al., 2013, and Vogt, in prep.

In both markets the social optimum is achieved if the auctioneer makes a payment of 200 and bidders reciprocate with a performance level of 100. The COM market outperforms the RISK market with regard to higher payments and performance levels, while bidders made higher offers in the RISK scenario (Table 3). It is striking that auctioneers favoured higher to lower offers if they were able to communicate with their bidders, but vice versa, if they were deprived of communication and moreover faced additional output uncertainty.

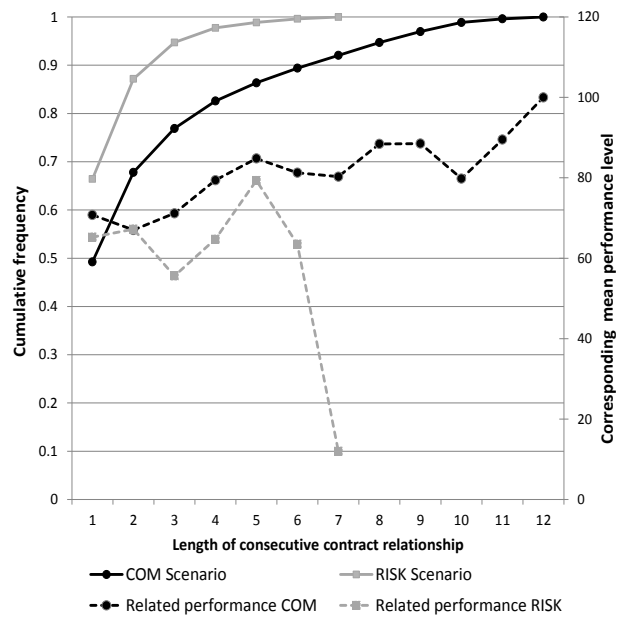
As the establishment of the social optimum is counterintuitive to the competitive logic of an inverse auction, we approximate learning effects by the time trends of the market variables: offers made by bidders, payments and performance levels of auction winners (cf. table 3). All three key variables follow a strong positive time trend in the market with communication, while the picture is ambiguous and insignificant in the market struck by risk. This confirms our first hypothesis on the limited learning effects in the RISK scenario. Moreover, it shows the benefits associated with learning in the auction with communication. Since offers and performance increase simultaneously, learning effects do not lead to efficiency losses and strategic bidding but cause a “social gift exchange” instead (cf. Vogt et al., 2013). The establishment of such a mechanism is much more difficult if a random factor affects the output and contractors have no possibility to exchange experience with the auctioneer. The results of the RISK market show that auctioneers then rather apply market principles and choose lower-priced bidders, leading to suboptimal performance levels (cf. Vogt, in prep.). Similar to a market for lemons low payments yield low re-investments by bidders since higher performance levels cannot be financed. Under these conditions, any learning experience gained by contracting bidders is ineffective.

Figure 2: Probability of re-concluding a contract in a repeated inverse auction



Note: The grey shaded parts denote the random probability (resulting from the number of bidders and contracts) of every bidder to conclude a contract. The darker shaded parts show the excess probability. The total percentage share gives the probability of consecutive contracting. Data originally published in Vogt et al., 2013; cf. Vogt, in preparation.

Figure 3: Cumulative frequency of contract relationships of different lengths and related effort levels in a repeated inverse auction



Note: Number of observations is 264 in the COM and 265 in the RISK scenario. Maximum length of contract relationship is 12 in the COM and 20 in the RISK scenario. Data originally published in Vogt et al., 2013; cf. Vogt, in preparation.

If social capital accounts for the establishment of bidder asymmetry and relationship-specific assets generate lock-in effects, auctioneers should follow distinct selection strategies in each experimental scenario. Indeed, this is the case. Bidders in the inverse auction with social capital formation had a clearly higher probability to re-conclude a contract with the auctioneer (Figure 2). In contrast to the RISK market where contract allocation was almost entirely random, the random chance was exceeded by 15.4 percentage points in the market with communication.

Further differences across markets are shown in figure 3 (solid lines), which illustrates the composition of consecutive contract relationships in both markets. Auctioneers facing environmental risk swapped bidders more often than they did in the scenario with communication, resulting in the termination of almost 90 % of contract relationships after not more than two consecutive contracts. Being able to communicate, auctioneers more often contracted with the same bidder, repeatedly. Hence, in the COM market roughly 30 % of all relationships exceeded two consecutive contracts. Interestingly, although every bidder had the same access to the chatting tool, the amount of conversation varied substantially¹¹. Indeed, the number of chat lines sent to the auctioneer before issuing an offer had a significant positive impact on the probability of receiving a contract (cf. Vogt et al., 2013). The variation in the amount of conversation, an increased re-acceptance probability and relationship lengths point towards a reduced bidding competition under social capital formation and bring up the question of opportunistic bidder behaviour in locked-in relationships.

But, reduced competition does not necessarily lead to poorer performance in an inverse auction for a public good. Quite the contrary is true; relationship length and performance level are positively correlated in the market scenario with social capital formation (cf. figure 3, dashed line in black). The more

¹¹ In the respective subsample treatment of Vogt et al., 2013, the mean number of chat lines sent per period was 1.8 for bidders (standard deviation= 2.4) and 7.1 for auctioneers (standard deviation= 4.0).

locked-in a relationship between bidder and auctioneer becomes in the COM market, the higher the resulting performance. This strong relationship is not observed in the market with RISK although there is some evidence for a positive length-performance-correlation in contract relationships based on three to five consecutive contracts (cf. dashed line in grey).¹² In sum, Hypothesis 2 can be confirmed: Social capital resulting from bilateral communication favours the establishment of locked-in relationships. Moreover, long-term relationships pay off with regard to the provision of the public good.

4. Conclusion

If cost-effective conservation instruments to safeguard ecological goods are to be established with the support of the relevant stakeholders, the role of relationships between them should not be neglected. We provide conceptual-theoretical as well as initial empirical support to the discussion on the long-term performance of repeated conservation auctions using a transaction cost economics approach complemented by the dimension of social capital. We pointed out that learning, specific assets, and social capital have the potential to generate asymmetries amongst bidders who repeatedly participate in conservation auctions. We reviewed the relevant empirical literature on auction-based conservation programmes and showed where in the tendering and contracting process learning effects, social capital formation and specific assets play a role. Applying Williamson's concept of the fundamental transformation of a competitive process into bilateral monopolies (1985), we argued that repeated conservation auctions bear the risk of lock-in effects which affect the auction's competition, cost-effectiveness and ecological effectiveness.

By comparing laboratory data from two experimental inverse auctions based on a contract selection and a contract execution stage, we provided initial empirical evidence for the conditions under which lock-in effects in inverse auctions occur and how they affect contract performance. In the experimental auction characterised by a constant experimental environment, learning effects fostered the gradual adjustment of key market variables towards the socially optimal performance level. Moreover, a communication channel between auctioneer and bidders actively encouraged the creation of social capital. We demonstrated that in this experimental auction relationship-specific investments significantly affected contracting behaviour of auctioneers, leading to long-term contract relationships with particular bidders. However, these locked-in relationships were characterised by superior performance levels.

Compared to the experimental auction with communication, in the second scenario without communication but with environmental risk auctioneers did not develop preferences for specific bidders. Instead of allowing direct interaction, the experimental scenario introduced additional output uncertainty for the auctioneer by means of a probabilistic effort transformation only known to the contracting bidder. We showed that this parameter destroys positive learning effects and also induces auctioneers to select bidders rather randomly. While competition could be maintained in the inverse auction, the overall performance of the market was inferior with a suboptimal provision of the public good. Hence, a lack of trust in the bidders significantly reduced the auction's cost-effectiveness.

Our findings demonstrate that lock-in effects do not erode the effectiveness of an auction but change the rules of the game towards more favourable market conditions for the provision of the public good. Thus, auctioning is not only about finding the lowest-cost supplier but also identifying those who are intrinsically motivated (cf. Lockie 2013). This is especially important in view of the second market

¹² Though, only based on three observations, the data shown in figure 3 indicates that mean performance declines with longer contract relationships.

scenario. Since environmental risk is an integral component of every conservation effort involving resource and land management, the mediocre performance of the second experimental scenario is an alarm signal. Trust-based working relations and long-term contract relationships would have been necessary to overcome the challenges posed by random performance shocks. But the market scenario did not provide opportunities for direct interaction. Therefore, the most important lesson for designers of contracts for payments for ecosystem services is the necessity to build sufficient social capital with conservation stakeholders in order to effectively deal with situations characterised by high environmental risk and uncertainty.

As the creation of social capital amongst the landholders and the environmental agency is important for effective conservation programmes, programme designers should focus more on establishing long-term contract relationships, for instance, by means of differential treatment or longer contract durations. If contract re-enrolment would be excluded from the competitive sign-up and made conditional on other criteria, social capital indicators could become an institutionalised feature of contract allocation. Differential treatment would enable the agency to safeguard attained ecological goals and keep bidding competition for new participants. Another possibility to (implicitly) address bidder asymmetry is contract duration. A longer contract (10 to 15 years) reduces the frequency of re-enrolment and increases the time span in which land is covered under a conservation measure.

Especially, laboratory experiments are suited to pre-test new design elements as they provide the controlled environment to thoroughly differentiate between contract allocation and contract execution. Future research activity should thus be directed towards further empirical work on the distinct sources of bidder asymmetry and behavioural implications, to further improve the effectiveness of incentive-based conservation programmes.

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