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Why are Stabilisations delayed - an experiment with an application to all pay auctions

Oliver Kirchkamp*

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*Sonderforschungsbereich 504, email: oliver@kirchkamp.de

Universität Mannheim
L 13,15
68131 Mannheim

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Abstract

We study with the help of experiments a two-player second-price all-pay auction. Such an auction describes e.g. the situation of a country where stabilisations are achieved through tax increases that eliminate a budget deficit. If these tax increases have distributional implications then stabilisation may be delayed (Alesina and Drazen, 1991).

We find (1) under-dissipation and not over-dissipation of rents which is in contrast to other all-pay auction experiments. (2) Underdissipation decreases with increasing cost of distortionary taxation and increases with bidding cost. (3) Bidding is closer to the equilibrium on the individual than on the aggregate level. (4) The speed of stabilisations is smaller than the risk neutral Bayesian equilibrium and reacts less sensitively to changes in the cost of distortionary taxation.

Keywords: War of attrition, all-pay auction, stabilisation, experiment
JEL classification C72, C92, D44, E62, H30

1 Introduction

The aim of this paper is twofold. We want to understand a mechanism behind fiscal policy. We do this by establishing a link to auction theory and to the experimental method. The framework that we are studying, a two-player second-price all-pay auction, can be usefully applied in many other situations which resemble a war of attrition.

Alesina and Drazen (1991) study the situation of a heterogeneous population which is deadlocked and divided over the question who shall bear the burden of a stabilisation. Examples they give are France, Germany and Italy after World War I. In these countries it was clear after the war that a fiscal stabilisation was necessary and that the huge deficit that the countries had accumulated during the war had to be reduced. However, different parties favoured different solutions. Conservative parties preferred a solution where the

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stabilisation was financed with the help of proportional income taxes and indirect taxes. Left wing parties preferred a solution where the stabilisation was financed with the help of progressive income taxes and capital taxes. For years parties were struggling and waiting for the other to concede and to bear the larger part of the burden of the stabilisation. A driving force behind this struggle was the polarisation of the society, i.e. the impossibility to find a symmetric solution for the conflict. One party would always bear only a small share and the other a substantially larger share of the cost of the stabilisation.

In real life there may be other factors that influence political stabilisations. Within the context of Alesina and Drazen (1991)'s model we will concentrate only on the time consuming struggle over an unequal but necessary allocation of a burden and abstract all other factors away. These kind of struggles are not restricted to stabilisation of fiscal policy. Other examples include academics trying to allocate administrative duties in endless committee meetings. Everybody knows that the duty has to be done by somebody. Nobody enjoys sitting and waiting endlessly. Still, participants in these meetings often try to hold out and wait for the others to give up first. Similar problems arise in lobbying, rent-seeking, contests etc.

Technically the problem is a special case of an all-pay auction. An all-pay auction is an institution where several bidders i choose bids or efforts b_i at an individual cost $c_i(b_i)$. Different bidders may have different cost functions c_i. The bidder with the highest b_i wins a prize, the others do not win anything, but still pay the cost of their effort. The winner pays either the cost of his own effort (in a first-price all-pay auction) or the cost of the effort of the second bidder (in a second-price all-pay auction).

In the stabilisation problem the effort would be the time that parties wait before they concede and accept to bear the larger share of the cost of the stabilisation. The cost is the burden of the distortionary tax that has to be payed before the stabilisation occurs. The prize is obtained by the party who does not concede, thus, bearing only a smaller part of the cost of the stabilisation while obtaining the full benefit.

Institutions: We distinguish three institutions of all-pay auctions. First-price, second-price and stochastic all-pay auctions.

- In a first-price all-pay auction the highest bidder obtains the prize and each bidder pays the own bid. A first-price all-pay auction is suited to model a situation like a contest where participants simultaneously invest effort.

  Since the highest bidder obtains the prize with certainty we also call this auction a perfectly-discriminating auction[1].

- In a second-price all-pay auction the highest bidder obtains the prize but pays only the second highest bid. All other bidders pay their own bid. A second-price all-pay auction is closer to a situation where participants may drop out one after the other, until only one bidder remains. This last bidder would then be the winner of the auction. We often call this situation a *war of attrition*.

  Also the second-price all-pay auction is a perfectly-discriminating auction.

[1] In Krishna and Morgan (1997) only this case is called an *all-pay auction*.

- In a stochastic all-pay auction all bidders pay their own bid, and the probability of winning the item is proportional to the bid. This situation is often called *rent-seeking* and has been studied first by Bishop, Canning, and Smith (1978) and Tullock (1980)[2].

The stabilisation problem described by Alesina and Drazen (1991) is a second-price all-pay auction. As soon as one party concedes and accepts the burden of the higher tax the problem is solved. The other party does not bear any further cost. Also some meetings of academic committees look similar to second-price all-pay auctions. The group who holds out longest wins, but spends only an epsilon more of their time than the others.

Information: An important ingredient of a model of stabilisation like the one of Alesina and Drazen is uncertainty about the bidding cost of the opponent. While opponents are waiting for a stabilisation they bear different cost. The cost is known to the individual party, but the opponent only knows a distribution. More generally, in a war of attrition waiting cost often differ among participants and are often not publicly known[3].

Among the few experiments that are done with all-pay auctions, however, several assume publicly known (and often identical) bidding cost for all participants (Potters, de Vries, and van Winden 1998, Davis and Reilly 1998).

Prizes: So far we assumed that there is only one prize. Since among the few experimental studies a substantial part concentrates on situations with more than one prize we will briefly discuss these situations:

Equilibrium bidding functions for situations with more than one prize are derived in Holt and Sherman (1982). The problem of the optimal allocation of several prizes in contests is studied theoretically by Moldovanu and Sela (2001). Related experiments have been done by Barut, Kovenock, and Noussair (2002) and Müller and Schotter (2003). Barut, Kovenock, and Noussair (2002) study a situation where six bidders compete for four prizes. Müller and Schotter (2003) are concerned with a problem where four bidders compete for either one or two prizes.

The result of these experiments does not deviate much from experiments with all-pay auctions with only one prize (Potters, de Vries, and van Winden 1998, Davis and Reilly 1998). In particular Barut, Kovenock, and Noussair (2002) and Müller and Schotter (2003) find also in their experiment that bids in the experiment are higher than they are in the risk neutral Bayesian equilibrium.

Plan of the paper: In the following we will concentrate on a war of attrition with a single prize and only two bidders. That is sufficient to describe the stabilisation problem studied by Alesina and Drazen.

From other experiments (Potters, de Vries, and van Winden 1998, Davis and Reilly 1998, Barut, Kovenock, and Noussair 2002, Müller and Schotter 2003) we should ex-

[2] In the formulation of Tullock first-price all-pay auctions actually are a special case.

[3] A theoretical analysis of this case and a comparison of the revenue of different auction formats can be found in Krishna and Morgan (1997).

pect that bids are higher in the laboratory than they are in the risk neutral Bayesian equilibrium.

From Müller and Schotter's findings we should expect discontinuous individual bidding functions and what Müller and Schotter call a 'bifurcation of effort', a step-shaped bidding function where bidders with a high cost make small or no bids at all while bidders with a small cost bid too much.

From the theoretical analysis of Alesina and Drazen (1991) we should expect that with increasing cost of distortionary taxation the waiting time decreases.

We will proceed as follows: In the next section we will briefly summarise Alesina and Drazen's model. In section 3 we explain how and why we adapt this model to the laboratory, we derive the equilibrium bidding functions, and we describe the experimental procedures. Sections 4 presents the results and section 5 concludes.

2 Stabilisation and the war of attrition in the model of Alesina and Drazen

In the Alesina and Drazen model before the stabilisation takes place a fraction γ of government expenditure g_0 is covered by distortionary taxation τ, and a fraction $1-\gamma$ is financed through debt. All payoffs are discounted with a constant interest rate r.

The tax τ is assumed to be distortionary. The utility loss from distortionary taxes for each party i is $K_i(t) = \theta_i \tau(t)$. The factor θ_i is known to members of group i but not to members of the other group. The latter only know the distribution $f(\theta)$ with support on $[\underline{\theta}, \bar{\theta}]$. Neglecting the (constant) income, and assuming the tax to be constant over time $\tau(t) = \gamma g_0$ the utility of group i in each period before the stabilisation takes place is

$$u_i = -\gamma g_0 \left(\theta_i + \frac{1}{2}\right) \tag{1}$$

A stabilisation takes place as soon as one party concedes, i.e., agrees to pay a share $\alpha > 1/2$ of the cost of the stabilisation through a non-distortionary tax. The value α is exogenously given and describes the polarisation of the society. If stabilisation occurs at date T then life time utility of the winner W and of the loser L is given by

$$U^j(T) = \int_0^T u_j e^{-rx} dx + e^{-rT} V^j(T) \quad \text{with } j \in \{W, L\} \tag{2}$$

$V^j(T)$ are discounted lifetime utilities after the stabilisation took place:

$$V^L = -\frac{\alpha g_0}{r} \qquad V^W = -\frac{(1-\alpha) g_0}{r} \tag{3}$$

where the winner and the looser are denoted with a superscript W and L. Each party chooses $T(\theta)$ before the game. Alesina and Drazen find that equilibrium bids fulfil the condition

$$\gamma(\theta + \frac{1}{2} - \alpha) = -\frac{f(\theta)(2\alpha - 1)}{F(\theta) T'(\theta) r} \tag{4}$$

with $T(\bar{\theta}) = 0$.

Alesina and Drazen derive a couple of conclusions from their analysis.

- The higher the utility loss or cost of distortionary taxation (measured as γ), the earlier the stabilisation takes place.
- The larger the polarisation of the society (measured as α) the later is the expected date of the stabilisation.
- A larger inequality in income need not lead to a quicker stabilisation. Actually, a mean preserving spread of the distribution of income may delay stabilisation.

In our experiment we will concentrate on the first effect and study the impact of γ on the timing.

3 Implementation of the model in the experiment

3.1 The model

In our experiment we study a special and slightly simplified case of Alesina and Drazen's model.

- The parameter θ_i that describes how the utility losses of distortionary taxation are experienced by group i is drawn from a uniform distribution over $[\underline{\theta}, \bar{\theta}]$ where $\bar{\theta} = 3\underline{\theta}$.
- The interest rate r is zero, and different utilities for the two groups after stabilisation are enjoyed only for a finite number of periods.

While the first assumption is just a choice of parameters that tries to keep the experiment simple, the second assumption deserves more discussion.

In Alesina and Drazen's model past payoffs or debt bear an interest $r > 0$. Future payoffs or debt are discounted with the same parameter. Such a discount factor would make the payoffs in the experiment difficult to describe to the participants. A constant payoff or cost in each step of the bidding process makes the experiment much easier to understand. We choose, therefore, $r = 0$. This, however, leads to a problem. If $r = 0$, and if benefits of stabilisation are enjoyed for an infinite number of periods (as they are in the original model), utility of stabilisation is infinitely high. We, thus, have to deviate from Alesina and Drazen's model and assume that benefits of stabilisation last only for a limited number of A periods.

Hence, the life time utility of the looser and the winner from the date of stabilisation T onward is

$$U^j(T) = Tu_j + V^j(T) \quad \text{with } j \in \{W, L\} \tag{5}$$

with utilities for the looser L and the winner W after the stabilisation are

$$V^L = -A\alpha g_0 \qquad V^W = -A(1-\alpha)g_0 \tag{6}$$

Denoting the distribution and density function of the choice of T of the opposing party with $H(T(\theta))$ and $h(T(\theta))$, and writing $F(\theta) = 1 - H(T(\theta))$ we obtain the expected utility

$$EU(\hat{\theta}) = F(\hat{\theta})Tu_i + \int_0^{T_i} V^W(T) - V^L(T)\, dT \tag{7}$$

With the difference $V^W(T) - V^L(T)$ then

$$V^W(T) - V^L(T) = (2\alpha - 1)g_0 A \tag{8}$$

and from the first order condition we derive the following condition to hold in equilibrium

$$-\frac{f(\theta)}{F(\theta)}\frac{1}{T'(\theta)}(2\alpha - 1)A = \gamma\left(\frac{1}{2} + \theta\right) \tag{9}$$

where the left expression denotes the expected gain from waiting another instant to concede while the expression on the right is the associated cost.

With θ being uniformly distributed over $[\underline{\theta}, \bar{\theta}]$ this expression can be solved for $T'(\theta)$ to yield

$$T'(\theta) = -\frac{1}{\theta - \underline{\theta}} \cdot \frac{A(2\alpha - 1)}{\gamma\left(\frac{1}{2} + \theta\right)} \tag{10}$$

Integrating by partial fractions yields the equilibrium bidding function

$$T(\theta) = \frac{A(2 \cdot \alpha - 1)}{\gamma \cdot (\frac{1}{2} + \underline{\theta})}\left(\ln\frac{\gamma \cdot (\frac{1}{2} + \theta)}{\gamma \cdot (\frac{1}{2} + \bar{\theta})} - \ln\frac{\theta - \underline{\theta}}{\bar{\theta} - \underline{\theta}}\right) \tag{11}$$

3.2 Experimental procedures

In the introduction we mentioned some experiments who study similar problems. We will discuss our setup with the help of table 1.

	institution	bidding	uncertainty	contestants	prizes	repetitions in a group	periods	result
Davis and Reilly (1998)	stochastic and first-price	sealed bid	—	5	1	1	15	over-dissipation
Potters, de Vries, and van Winden (1998)	stochastic and first-price	sealed bid	—	2	1	1	30	over-dissipation only in the stochastic case
Barut, Kovenock, and Noussair (2002)	first-price	sealed bid	valuation	6	2 or 4	1	20 or 50	over-dissipation
Müller and Schotter (2003)	first-price	sealed bid	cost	4	2	1	50	over-dissipation, bifurcation
our experiment	second-price	ascending clock	cost	2	1	6,1	24	under-dissipation, no bifurcation

Table 1: Comparison with other experiments

- Other experiments choose either a stochastic or a first-price all-pay auction. A stochastic auction can be regarded as a model of lobbying, a first-price auction represents a contest where players irrevocably invest effort before the game ends. For the war of attrition that we want to study here, a second-price all-pay auction is more appropriate. The winner waits only an epsilon longer than the second bidder.

- Other experiments choose a bidding process that uses sealed bids. This facilitates the implementation in the laboratory. A technical disadvantage of an ascending clock auction is the waiting time. If one group of bidders decides to make high bids, all the other groups wait for this group.

  Nevertheless, we find the explicit passing of time together with the visibly increasing cost an essential ingredient of the war of attrition that we want to study. Theoretically the two processes might be similar, but behaviourally the difference might be substantial.

  Our choice to model the passing of time explicitely means that we have to normalise time separately from payoffs in the experiment. We will explain in section 3.3 how we deal with this issue.

- The next three assumptions are determined by the model that we want to study. Uncertainty about opponents' cost is essential for our equilibrium bidding function and is, hence, reflected in the experiment. Consistent with the original model of Alesina and Drazen we chose to have only two bidders. With two bidders there is no reason to give more than one prize.

- A difficult choice is the number of repetitions in a group. The war of attrition is typically seen as a one shot game. After the stabilisation has taken place the world ends and the players will never interact again. Similar assumptions are made in the reference models of other experiments. The obvious choice would be to play a sequence of one shot games with random matching of players between each round. We include, therefore, one treatment with random matching in our results and will discuss this treatment in section 4.3. However, the larger part of the paper discusses treatments with a larger number of repetitions. Choosing a larger number of repetitions does not necessarily mean that we are not faithful to the model. As long as the number of repetitions is common knowledge the repetition of the equilibrium of the stage game in each stage of the repeated game is still an equilibrium of the repeated game. However, this is not the main reason why we decided to rematch players randomly only every six rounds.

  An essential aspect of every experiment is that players have to find out what their opponents are going to do and then determine what might be a best reply against this behaviour. In some situations finding out what opponents do might be an obvious task, in other situations it might be a challenge. Increasing the number of repetitions means simplifying this task and also reducing frustration of participants in the experiment.

  Increasing the number of repetitions means also being faithful to the many application of our problem. Groups are typically playing a war of attrition more than once. The stabilisations after World War I were not the last ones in Europe. Repeated interaction might support collusive behaviour among the parties and should be reflected in the experiment.

To better understand the impact of this assumption we will study in section 4.3 a treatment where players are randomly rematched after each round.

Implementation The experiment was implemented with the help of the software z-Tree (Fischbacher 1999) and carried out at the experimental laboratory of the SFB 504 at the University of Mannheim.

Groups of 10 to 14 participants would read instructions (see section B in the appendix), answer computerised control questions to check whether they understood the experiment, and would be matched randomly in pairs to bid for a prize. During the bidding process participants see information similar to the following on the screen:

round: 2 of 24	remaining time [sec]: 2987
The value of the prize is 100	
The cost of the other bidder is between 1.8 and 3.6 per second	
Your cost is 3.59 per second	
You are now bidding the following number of seconds for the prize:	4.00
You have, hence, bid the following amount this auction:	14.36
To leave the auction, press the bottom left button	
	I stop bidding

The number of seconds and the bid is updated every second. As soon as one bidder stops bidding the other is declared winner of the auction. On the screen the participants see information similar to the following.

round: 2 of 24					remaining time [sec]: 17	
The other bidder has won the auction						
auction	your cost per second	other bidder's cost per second	your cost (total)	other bidder's cost (total)	your profit in this auction	new balance of your account
2	3.59	2.91	14.36	11.64	-14.36	1876.54

To make sure that participants remain attentive they were asked to copy this information manually to a table on their desk.

Participants play a sequence of six rounds with the same partner. Then they are matched again randomly for another six rounds. This procedure is repeated for 24 rounds. At the end of the experiment participants have to fill in a questionnaire, and receive their earnings from the experiment in sealed envelopes. Each session lasts for about 75 minutes. The initial endowment as well as the conversion rate in the experiment is given in table 2. The cumulative distribution of payoffs at the end of the experiment is shown in figure 1.

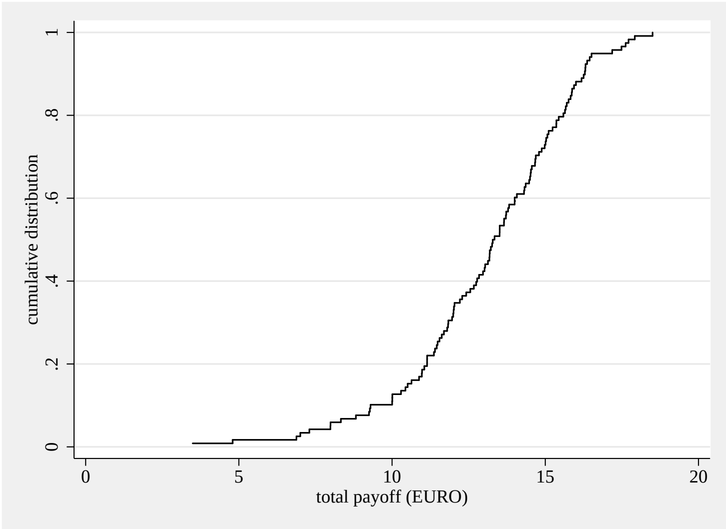


Figure 1: Cumulative distribution of payoffs

3.3 Normalisations

If we translate the stabilisation problem into an all pay auction then, depending on the parameterisation, prizes, bidding cost and the length of the auction may vary in a wide range, a range too wide to be implemented in the laboratory. We therefore normalise prizes and time. The prize (according to equation (8) will be normalised to a fixed number of P units of the experimental currency (ECU).

$$P \text{ ECU} = (2\alpha - 1) g_0 A \tag{12}$$

The length of a period will be normalised such that with equilibrium bids a constant fraction σ of all auctions will last for s' seconds or more. In our experiment we will have $P = 100$ ECU, $\sigma = 9/10$, $s' = 2$ seconds. We define

$$\theta_\sigma = \underline{\theta} + \sqrt{\sigma} \cdot (\bar{\theta} - \underline{\theta}) \tag{13}$$

and call s the length of one period in seconds. Then we require

$$s' \text{ seconds} = s \cdot T(\theta_\sigma) \tag{14}$$

Now we can transform the values from the original model into values in the experiment as follows: The cost per period is given by equation (1) to be $u_i = -\gamma g_0 \left(\theta_i + \frac{1}{2}\right)$. With equations (12) and (14) this becomes the cost in ECU per second

$$c = \frac{P\gamma \left(\theta_i + \frac{1}{2}\right)}{(2\alpha - 1)A} \frac{T(\theta_\sigma)}{2} \frac{\text{ECU}}{\text{second}} \tag{15}$$

using equation (11) and (13) this can also be expressed as

$$c = \frac{P \cdot (1 + 2\theta)}{s'\gamma(1 + 2\underline{\theta})} \ln \frac{2(\bar{\theta} - \underline{\theta}) + \frac{1+2\theta}{\sqrt{\sigma}}}{1 + 2\bar{\theta}} \frac{\text{ECU}}{\text{second}} \tag{16}$$

Substituting $\theta = \underline{\theta}$ and $\theta = \bar{\theta}$ we find the minimal and maximal cost per second in the experiment

$$c_{\min} = \frac{P}{s'\gamma} \ln \frac{2(\bar{\theta} - \underline{\theta}) + \frac{1+2\theta}{\sqrt{\sigma}}}{1 + 2\bar{\theta}} \qquad c_{\max} = \frac{P(1+\bar{\theta})}{s'\gamma(1+\underline{\theta})} \ln \frac{2(\bar{\theta} - \underline{\theta}) + \frac{1+2\theta}{\sqrt{\sigma}}}{1 + 2\bar{\theta}} \tag{17}$$

In the experiment we will have to start with simple numbers for $\underline{c}$ and $\bar{c}$ and then solve for γ and $\bar{\theta}$ as a function of $\underline{c}, \bar{c}, P, s', \sigma$ and, actually $\underline{\theta}$:

$$\gamma = \frac{P}{s'\underline{c}} \ln \left(1 - \frac{\underline{c}\left(1 + \frac{1}{\sqrt{\sigma}}\right)}{\bar{c}} \right) \qquad \bar{\theta} = \frac{\bar{c} \cdot (1 + 2\underline{\theta})}{2\underline{c}} - \frac{1}{2} \tag{18}$$

Substituting into equation (11) allows us to describe equilibrium bids in seconds either as a function of θ

$$t_\theta(\theta) = \frac{s' \ln \frac{(\bar{\theta}-\underline{\theta})\left(\frac{1}{2}+\theta\right)}{(\theta-\underline{\theta})\left(\frac{1}{2}+\bar{\theta}\right)}}{\ln \frac{2(\bar{\theta}-\underline{\theta})+\frac{1+2\underline{\theta}}{\sqrt{\sigma}}}{1+2\bar{\theta}}} \tag{19}$$

or as a function of c

$$t_c(c) = \frac{s' \ln \frac{c(\bar{c}-\underline{c})}{(c-\underline{c})\bar{c}}}{\ln \frac{\bar{c}+\underline{c}\left(\frac{c}{\sqrt{\sigma}}-1\right)}{\bar{c}}} \tag{20}$$

Choices of parameters in the experiment In all experiments we will have $P = 100$, $s' = 2$ and $\sigma = \frac{9}{10}$ (i.e. the prize is always 100 ECU and 90% of all auctions should last for more than 2 seconds in equilibrium).

We study four different sets of parameters. For three experiments we $\underline{\theta}$ and $\bar{\theta}$ are keept fixed and only γ is varied. In a fourth experiment we increase the ratio $\underline{\theta}/\bar{\theta}$. A list is given in table 2. The parameters of the individual sessions are given in section A in the appendix.

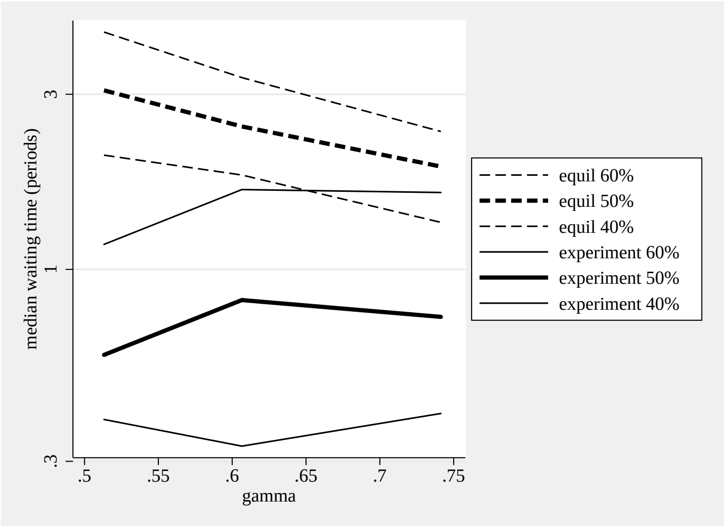
γ	$\bar{\theta}$	$\underline{c}$	$\bar{c}$	prize	repetitions in a group	participants
.741305	$\frac{1}{2} + 2\underline{\theta}$	1.80	3.60	100	6	36
.606523	$\frac{1}{2} + 2\underline{\theta}$	2.20	4.40	100	6	46
.513211	$\frac{1}{2} + 2\underline{\theta}$	2.60	5.20	100	6	36
.898468	$\frac{131}{38} + \frac{150}{19}\underline{\theta}$	0.38	3.00	100	6	34

Table 2: Parameters for different treatments

4 Results

4.1 Bidding

We will start with the first conclusion that Alesina and Drazen drew from equation (4): The higher the utility loss or cost of distortionary taxation (measured as γ), the earlier the stabilisation takes place. Figure 2 shows how the winning bid (in periods) depends on the parameter γ. The dashed three lines indicate the 40, 50, and 60% quantiles of the equilibrium outcome, i.e. the equilibrium bid of the bidder who would, in equilibrium, loose the auction. The three solid lines indicate the corresponding quantiles for the



The vertical axis shows median bids (log scale) in periods. The dotted lines show the distribution of equilibrium bids. The solid lines show the distribution of bids in the experiment. We see that underbidding is persistent for all values of γ, but most noticeable when γ is small.

Figure 2: Median bids

experimental outcome, i.e. the period where the looser of the auction in the experiment decided to leave the auction.

We see two things:

- Bids in the experiment are much lower than equilibrium bids.
- We do not find support for the predicted negative impact of γ on the stabilisation time.

To facilitate the comparison of the first three treatments we will mainly refer to the equilibrium bidding function $t^*_\theta(\theta)$ given in equation (19). This allows us to represent bidding cost on a common scale from $\underline{\theta}$ to $\bar{\theta}$ for these treatments.

In figure 3 we show the bids of the looser of the auction, i.e. the time that the bidder who conceded first stayed in the auction. The left diagram in figure 3 shows bids in seconds, the right diagram shows bids in periods, using the normalisation from equation

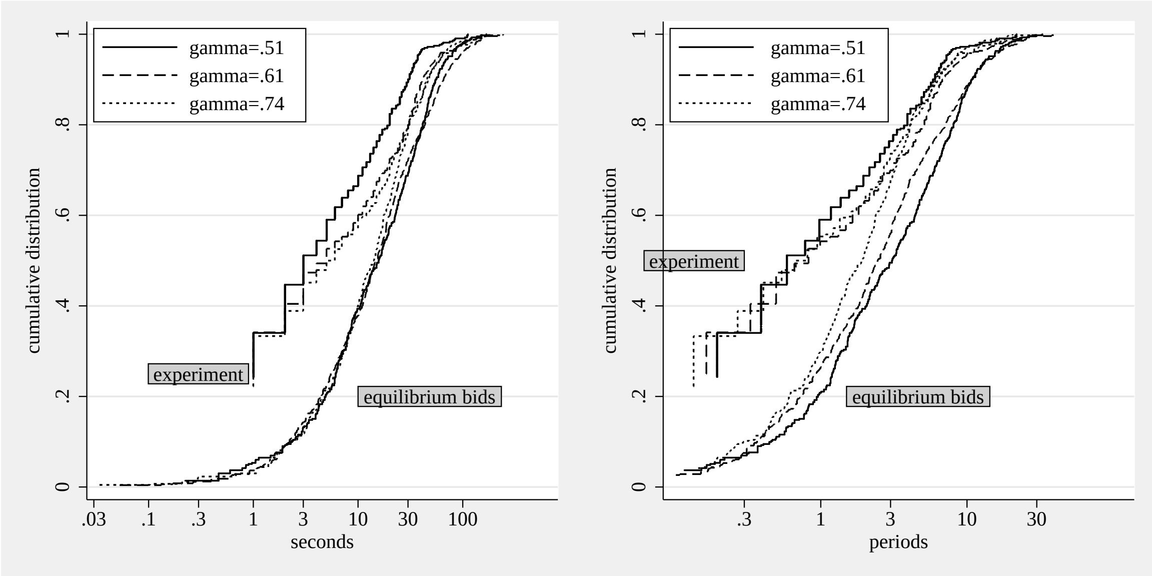


Figure 3: Cumulative distribution of bidding time in seconds for different values of γ

(14). Let us start with the left diagram. The three curves with steps to the left are the distributions of bids in our experiment for different γs, the three smooth curves to the right are the theoretical distributions that we should expect if bidders would follow the equilibrium bidding functions. In the right diagram we show the same distributions, now not normalised to seconds, but in periods from the original model. We see that there is serious underbidding. Bidders leave the auction earlier that they should in equilibrium. The relative difference between equilibrium bids and bids in the experiment decreases with increasing cost of distortionary taxation γ. To explore this phenomenon in more detail we will look at estimates of bidding functions in the next section.

4.2 Comparison with equilibrium bids

We estimate an aggregate bidding function

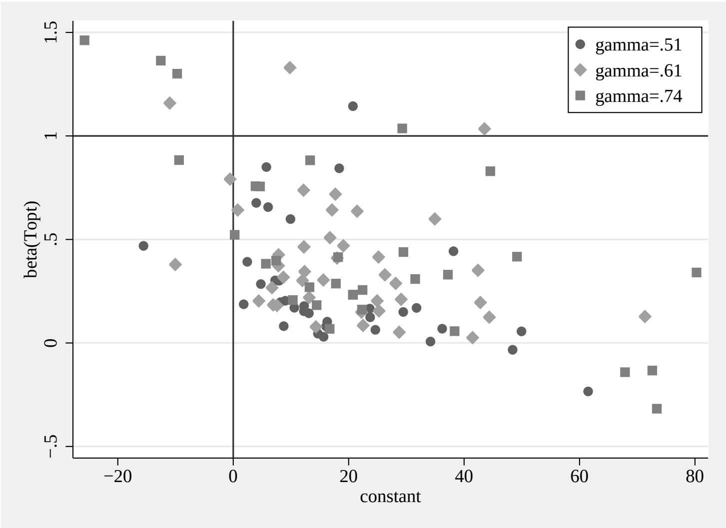
$$b(\theta, \gamma) = \beta_t t^*(\theta, \gamma) + \beta_0 + u \tag{21}$$

and individual bidding functions for each bidder i

$$b_i(\theta, \gamma) = \beta_{t,i} t^*(\theta, \gamma) + \beta_{0,i} + u \tag{22}$$

If all bidders follow the equilibrium bidding function we should find $\beta_t = \beta_{t,i} = 1$ and $\beta_0 = \beta_{0,i} = 0$ for all bidders i.

Since we can not observe bids of the winner of the auction we have to use an interval regression (Tobin 1958, Amemiya 1973, Amemiya 1984). We assume that the winner of the auction makes a bid that is bounded below by the looser's bid which we can precisely observe. Individual estimates of equation (22) are shown in figure 4.2. Table 3 shows aggregate estimates $\hat{\beta}_t$ and $\hat{\beta}_0$ as well as medians and means of individual estimates $\hat{\beta}_{t,i}$ and $\hat{\beta}_{0,i}$. The cumulative distribution of the individual estimates $\hat{\beta}_{t,i}$ is shown in figure



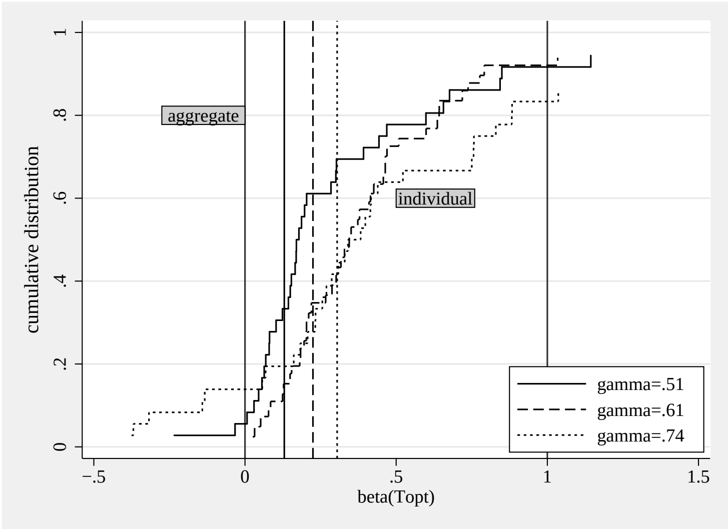
Outliers have been eliminated using Hadi's method (Hadi 1992, Hadi 1994)

Figure 4: Individual estimates of equation (22)

				aggregate	individual		aggregate	individual	
γ	$\bar{\theta}$	$\underline{c}$	$\bar{c}$	$\hat{\beta}_t$	median$(\hat{\beta}_{t,i})$	mean $\hat{\beta}_{t,i}$	$\hat{\beta}_0$	median$(\hat{\beta}_{0,i})$	mean $\hat{\beta}_{0,i}$
.741305	$\frac{1}{2}+2\underline{\theta}$	1.80	3.60	.2265084	.2895919	.4656144	40.52927	20.28199	107.4329
.606523	$\frac{1}{2}+2\underline{\theta}$	2.20	4.40	.0935509	.208241	.3475332	42.65441	20.0824	95.75112
.513211	$\frac{1}{2}+2\underline{\theta}$	2.60	5.20	.0137083	.0739829	.2263395	33.34752	18.40205	21.09349
.898468	$\frac{131}{38}+\frac{150}{19}\underline{\theta}$	0.38	3.00	.3741656	.5314418	.669349	39.1546	16.62696	25.02175

Since a small number of the individually estimated bidding functions show really large estimated parameters we show here medians and averages. The averages are shown only for completeness.

Table 3: Aggregate and individual estimates of equation (21)



Vertical lines denote aggregate estimates (see table 3), curves show the cumulative distribution of individual estimates (see figure 4.2)

Figure 5: Cumulative distribution of bidding time in seconds for different values of γ

3. The straight lines in the figure show as a reference estimates of the aggregate bidding parameter $\hat{\beta}_t$. Three points are worth noting:

- Similar to Müller and Schotter (2003) individual coefficients are significantly larger than coefficients of the aggregate estimate.[4] This might, however, be an artifact of the specification of the model. In a linear model, where each individual has different parameters, the approach that wrongly assumes this parameter to be constant across individuals underestimates (other things equal) the parameter.

- Participants in our experiment react less sensitively to their bidding cost θ than they should in the risk neutral Bayesian equilibrium.[5] This is in contrast to most other experiments with all pay auctions.

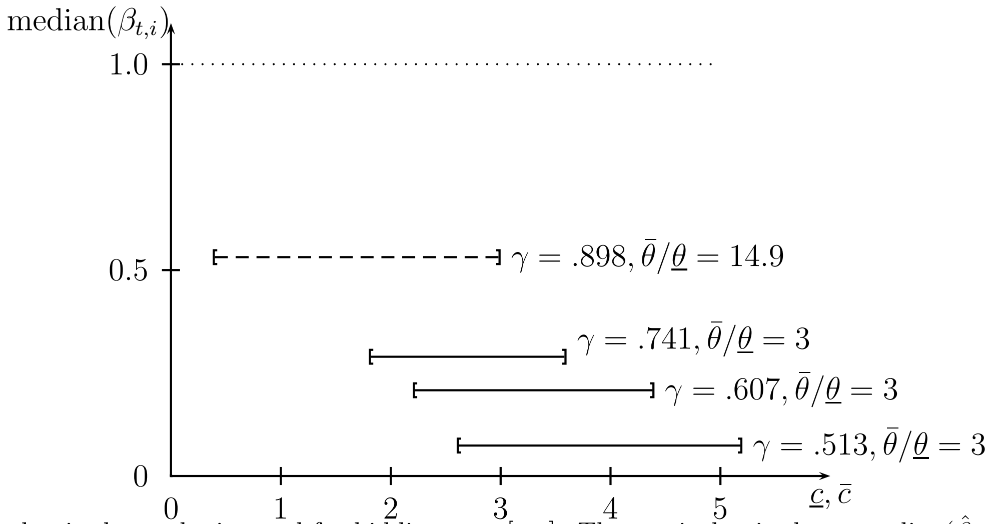
- We find it interesting that with larger γ the sensitivity β_t for θ decreases.[6] This means that the theoretical effect, that an increase in γ speeds up stabilisation, may be weakened, if not reversed, as we have seen in figure 2.

  Figure 6 supports this finding. Here we show on the vertical axis the median of the estimated coefficient $\beta_{t,i}$ for different ranges of the bidding cost which is shown on the horizontal axis. In addition to the three treatments that we discussed above (which all have $\bar{\theta}/\underline{\theta} = 3$) the figure also shows the result of a treatment with a higher value of γ and $\bar{\theta}/\underline{\theta} = 14.9$. As with the previous experiments we see again that with a higher value of γ, i.e. with a lower range for bidding cost the amount of underbidding decreases.

[4] Parametric test: $t = 6.69, P_{>|t|} = 0.000$, nonparametric binomial test: $P = 0.0000$.

[5] Parametric F-test for the individual coefficients (allowing for correlations within sessions) $F_{1,15} = 300.13$, $P_{>F} = 0.0000$, non-parametric binomial test $P = 0.0000$.

[6] Parametric t-test $t = 5.65$, $P_{>|t|} = 0.000$, nonparametric Cuzick-Altman test $z = 3.16$, $P_{>|z|} = 0.00$.



The horizontal axis shows the interval for bidding cost $[\underline{c}, \bar{c}]$. The vertical axis shows median($\hat{\beta}_{t,i}$) from table 3 which should be 1.0 in equilibrium. We see that players bid less than in equilibrium. In particular they deviate further from the equilibrium the higher their cost interval $[\underline{c}, \bar{c}]$, and the lower the cost of distortionary taxation γ for a given interval $[\underline{\theta}, \bar{\theta}]$.

Figure 6: Underbidding depends on the cost of distortionary taxation and bidding cost

4.3 Collusion

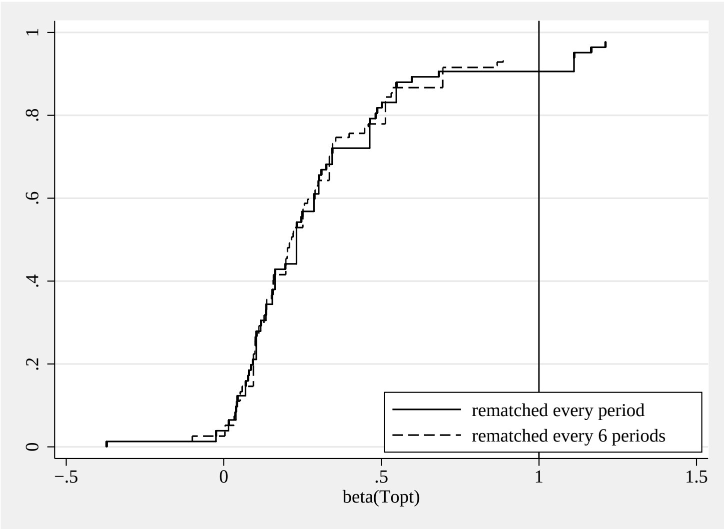
In the previous sections we have seen that players bid less than they would bid in the risk neutral Bayesian equilibrium. A possible explanation could be cooperative behaviour. With a small number of players in a group (only two) and repeated interaction for six periods in this group there is room for collusion. On the other hand it is not easy to coordinate collusive efforts in this particular game. There will always be one winner and one looser. The measure the degree of collusive behaviour due to the repetition we have run one treatment where players are rematched after each auction (and not only every six auctions as in all other treatments). Figure 7 compares the distribution of $\hat{\beta}_{t,i}$ in a treatment where players are repeatedly matched for six periods with a treatment where players are randomly rematched after each interaction.[7] We see that there is no difference between the two treatments. In particular in both treatments most players have a $\hat{\beta}_{t,i} < 1$, i.e. less than the equilibrium value.

4.4 Bifurcations

In their experiments Müller and Schotter (2003) observe what they call bifurcations of bidding functions. If bidding is expensive, bidders underbid, if bidding is cheap, bidders overbid. Moreover, for each bidder there is a threshold that determines when to switch from under-bidding to over-bidding.

We want to find out whether this is a stable pattern that repeats in our experiment.

[7]We did this treatment only with parameters $\gamma = .7766545$, $\bar{\theta}/\underline{\theta} = 3$ and use only the corresponding treatment with the same parameters (except for the rematching).



The figure compares the distribution of $\hat{\beta}_{t,i}$ in a treatment where players are repeatedly matched for six periods with a treatment where players are randomly rematched after each interaction. In equilibrium $\hat{\beta}_{t,i}$ should be one in both treatments.

Figure 7: Collusion

To test this, we use a switching regression approach similar to Müller and Schotter:

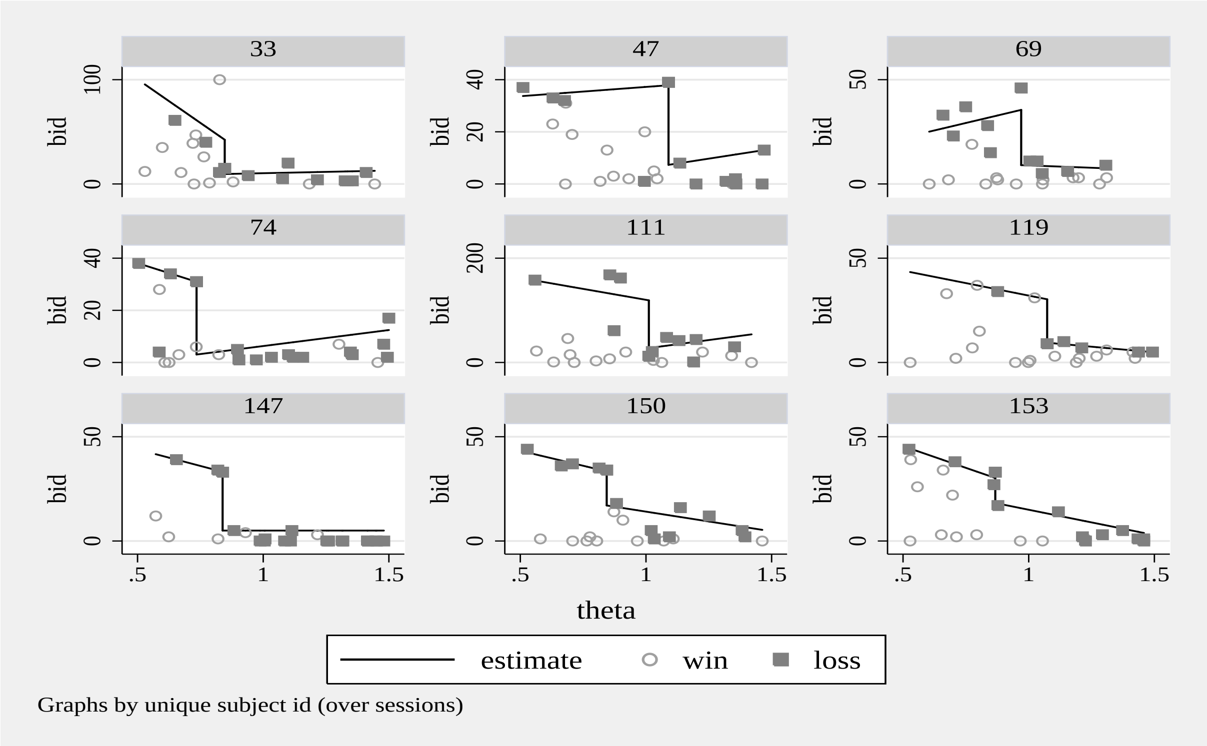
$$b_i(\theta) = \begin{cases} \beta_{t,i}\theta + \beta_{0,i} + u & \text{if } \theta \leq \hat{\theta}_i \\ \gamma_{t,i}\theta + \gamma_{0,i} + u & \text{if } \theta > \hat{\theta}_i \end{cases} \tag{23}$$

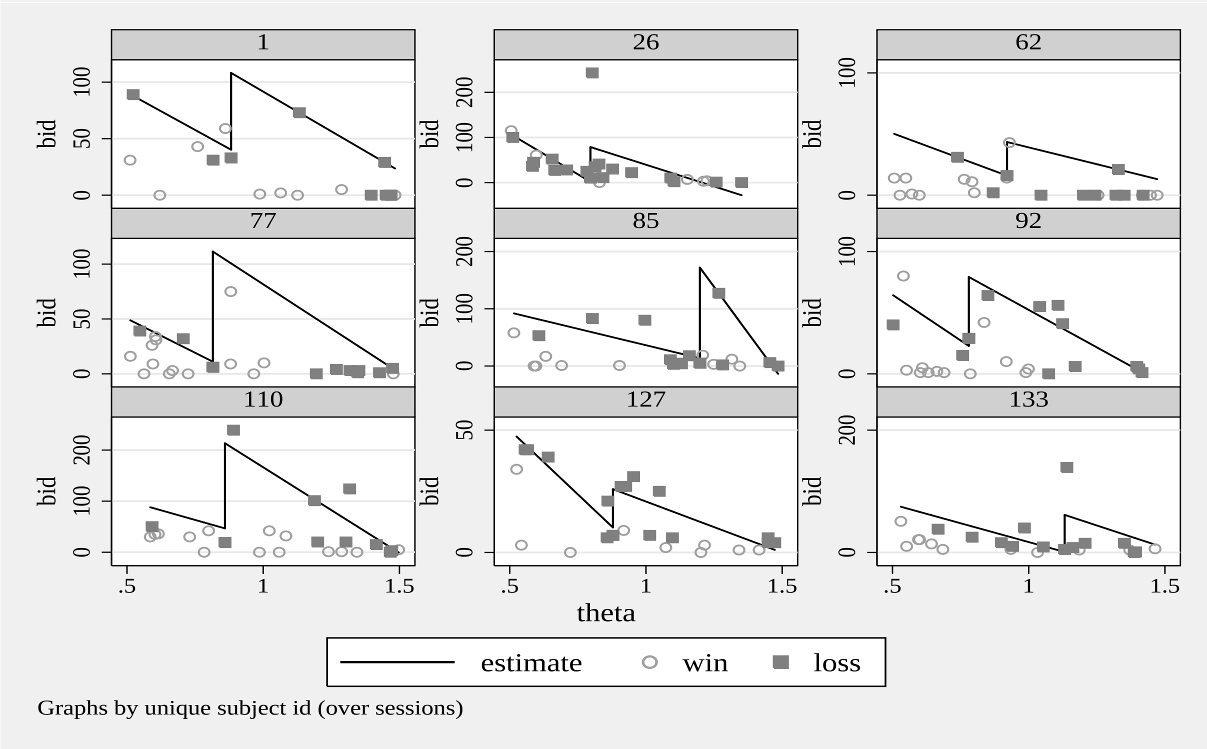
For each individual i we estimate $\hat{\beta}_{t,i}, \hat{\beta}_{0,i}, \hat{\gamma}_{t,i}, \hat{\gamma}_{0,i}$ with the help of an interval regression (Tobin 1958, Amemiya 1973, Amemiya 1984) while choosing the $\hat{\theta}_i$ such that the likelihood ratio of the interval regression is maximised. Given that we have a smaller number of observations per participant than Müller and Schotter (2003) and, furthermore, given that the interval regression is numerically less stable than the OLS method that is used by Müller and Schotter (2003)[8] we could not estimate equation (23) for 16 of our 118 participants. In the following we concentrate on the 102 participants where equation (23) could be estimated. Figure 8 show several examples for an individual bidding function. The upper part of the figure shows bidding functions which correspond to the description of Müller and Schotter. For low cost, the bidding is relatively high, at the threshold value there is a drop to a segment that is lower. Other participants are described by bidding functions like the ones in lower part of figure 8. They do not show a drop in the bidding function at the threshold, but, instead, an increase. In figure 9 we show the cumulative distribution of the step size, i.e., the difference

$$\Delta_i = \hat{\beta}_{t,i}\hat{\theta}_i + \hat{\beta}_{0,i} - (\hat{\gamma}_{t,i}\hat{\theta}_i + \hat{\gamma}_{0,i}) \tag{24}$$

This difference should be positive if participants have a bifurcated bidding function like in Müller and Schotter. As we see in the figure, however, there is no clear trend. Only about half of the Δ_i are positive, the rest is negative. Hence, we find no support for Müller and Schotter's theory in our experiment.

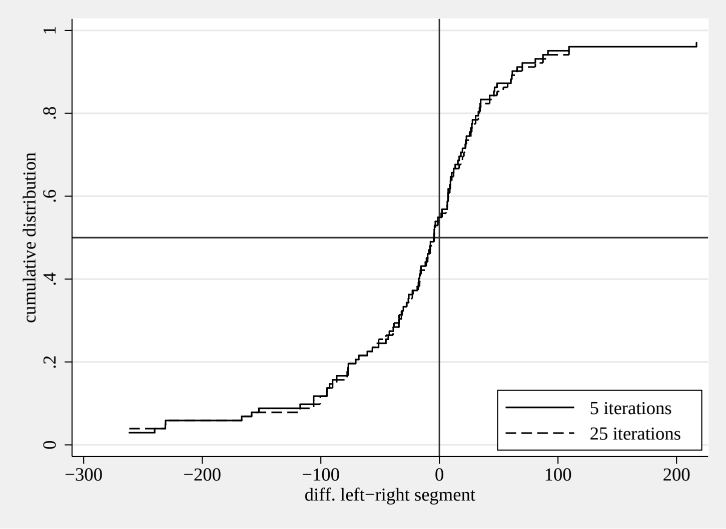
[8]They can use this method since they have chosen to run the auction in a sealed bid format.





Actual bidding is approximated with stepwise linear functions. Some bidding functions drop from the left to right (as the ones in the top graph), but others have an increasing step (as the ones in the bottom graph). The ones in the top graph are consistent with Müller and Schotter's findings, the others are not.

Figure 8: Bifurcated bidding functions for 18 participants in our experiment



The graph shows the cumulative distribution of the step size. Only positive step sizes are consistent with Müller and Schotter. In the graph we see that about every second participant has a negative step size.

Figure 9: Bifurcation, the distribution of Δ_i

4.5 Learning

To see whether players change their behaviour during the experiment we estimate equation (21) for different points in time and for different values of γ. Figure 10 show the result.

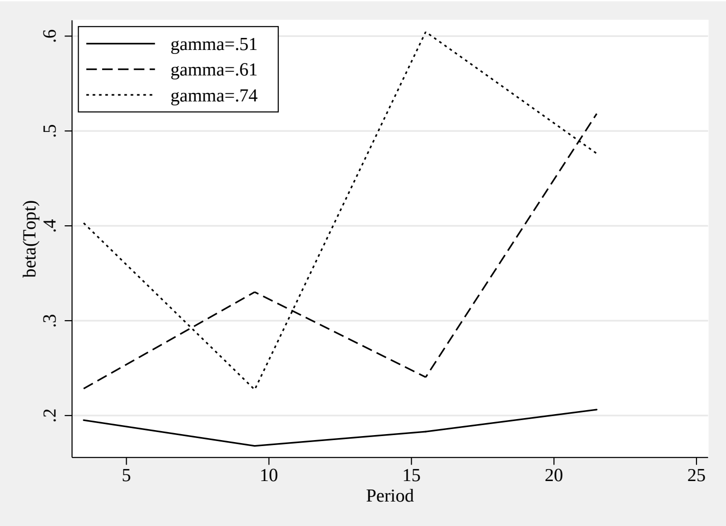


Figure 10: Development of β_t (equation (21)) for different values of γ

There is no clearly visible trend. Also a censored regression that includes the period as one parameter does not show a significant effect. To test this we regress the coefficients on the period and find $t = 0.98$, $P_{>|t|} = 0.350$.

5 Concluding remarks

There are a couple of hypotheses that we can derive from the theory of Alesina and Drazen and from other experiments (Potters, de Vries, and van Winden 1998, Davis and Reilly 1998, Barut, Kovenock, and Noussair 2002, Müller and Schotter 2003) which we all can compare with our setup. One of the basic properties of Alesina and Drazen can be found in our experimental results. The higher the bidding cost θ, i.e. the individual disutility from a distortionary taxation, the higher is the bid, i.e. the willingness to wait for the other party to concede.

However, there are some significant deviations from the theory. Some of these deviations are also not in line with what we should expect from other experiments. Consistently other experiment with all pay auctions found bids that are higher in the laboratory than they are in the risk neutral Bayesian equilibrium. This was not the case in our experiment. Instead, bids in our experiment are significantly smaller. Why could this be the case?

Anderson, Goeree, and Holt (1998) develop a model of boundedly rational bidders which explains over-dissipation of rents. One conclusion of their model is that if we find over-dissipation then we should find more with a larger number of bidders. Indeed, we have a smaller number of bidders in our experiment than the other experiments mentioned above. Still, we find not only a smaller degree of over-dissipation, as would be consistent with Anderson, Goeree, and Holt (1998), but even under-dissipation.

From (Müller and Schotter 2003)'s findings we should expect discontinuous individual bidding functions and what Müller and Schotter call a 'bifurcation of effort', i.e. a step shaped bidding function where bidders with a high cost make small or no bids at all (these are the 'drop outs' in Müller and Schotter's story) while bidders with a small cost bid too much (the 'workaholics'). We did not find these types in our experiment. When we introduce bidding functions that allow for steps we find steps going in all directions and not predominantly decreasing steps that we should expect following Müller and Schotter.

Experiments are, however, not the only reference point. One starting point of this project was the theoretical analysis of Alesina and Drazen (1991). As one result we should expect with decreasing cost of distortionary taxation an increase in the waiting time. In our experiments we have found that with a decreasing cost of distortionary taxation γ bidders will increasingly shade their bids, which, in total seems to cancel the effect from Alesina and Drazen.

While our study answers some questions it also opens a couple of new ones. We found unexpected results and we haven't yet been able to identify all causes. So far the number of experiments with all-pay auctions and wars of attrition is small. The experiments that we used for comparison differ in particular in the format and in the bidding procedure. They are first-price or stochastic all-pay auctions while we look at second-price all-pay auctions. They use a sealed-bid process to submit bids while we use an open-bid ascending clock procedure. We would be surprised if it were really the format of the auction that accounts for all the difference. It is rather the bidding mechanism that we consider to be responsible for the differences in the results. Still, here we have to do more experiments. Nevertheless, our experiment shows that it is possible to study stabilisation processes in the lab and opens some room for further research.

A List of experiments

	Date	γ	$\underline{c}$	$\bar{c}$	$\bar{\theta}/\underline{\theta}$	repetitions in a group	periods	participants
1.	20040116-10:39	.606523	2.2	4.4	3	6	18	10
2.	20040116-14:09	.606523	2.2	4.4	3	6	18	10
3.	20040120-10:31	.606523	2.2	4.4	3	6	24	14
4.	20040120-12:25	.606523	2.2	4.4	3	6	24	12
5.	20040120-13:57	.513211	2.6	5.2	3	6	24	12
6.	20040122-14:01	.513211	2.6	5.2	3	6	24	12
7.	20040122-15:53	.513211	2.6	5.2	3	6	24	12
8.	20040123-10:31	.741305	1.8	3.6	3	6	24	12
9.	20040123-12:19	.741305	1.8	3.6	3	6	24	12
10.	20040123-16:07	.741305	1.8	3.6	3	6	24	12
11.	20040219-10:31	.606523	2.2	4.4	3	1	24	12
12.	20040219-13:35	.606523	2.2	4.4	3	1	24	12
13.	20040219-15:49	.606523	2.2	4.4	3	1	24	12
14.	20040220-10:23	.898468	.38	3	14.91106	6	24	8
15.	20040220-12:25	.898468	.38	3	14.91106	6	24	12
16.	20040220-16:17	.898468	.38	3	14.91106	6	24	14

The experiment was carried out in the experimental laboratory of the SFB 504 at the University of Mannheim. All sessions were done in german. In section B you find a translation of the instructions.

B Instructions to the experiment

Welcome to a strategy experiment

This strategy experiment is financed by the University of Mannheim and the Deutsche Forschungsgemeinschaft (DFG). The instructions are easy when you read them carefully. If you decide considerately and put yourself in the position of the other players you have the opportunity to gain a considerable amount of money. You receive the money at the end of the game. The profit is related to your performance during the game.

During the experiment you participate in an auction about prizes which are valued in "Experimental Currency Units" (ECU). During the auction your bids are also in ECU. At the end of the auction you will be paid in Euro. Thereby, 200 ECU equal 1 Euro. We have already held experiments similar to this one. Due to our experience we expect an average profit of 12 Euro, dependent on your strategy. We have no interest in paying you less money than you are entitled to. The amount of money not used will be returned to the Deutsche Forschungsgemeinschaft (DFG).

During the experiment talking and communicating between the bidders is strongly prohibited. Your are not allowed to take any notes, books, and cell phones into the experiment laboratory. Moreover, you are not allowed to start other programmes on the computers. If you don't follow the rules we have to exclude you from the experiment and you won't get any payment.

Instructions The auction is held between two bidders. The bidders are randomly and anonymously assigned to each other. Each pair of bidders play 6 rounds together. Four times during the experiment you get an new partner, randomly selected. In total you will play 24 rounds, thereof 6 sequenced rounds with the same partner. One round corresponds to one auction in which one prize is sold. The value of the auction prize is in all 24 rounds and for all participants 100 ECU.

The proceeding of the auction is as follows: In every second, you and your partner simultaneously pay a certain amount until one of the bidders is not willing to increase her bid. In the beginning of each auction you will be informed of your bidding amount per second which corresponds to the amount of ECU you bid every second. During each round the bidding cost per second are constant. At the beginning of every round each player randomly receives new bidding cost per second to participate in the auction of the prize. The bidding cost per second for both players are continuously distributed between 1.80 and 3.60 ECU but you have no information about the exact bidding cost per second of your partner.

round: 2 of 24	remaining time [sec]: 2987
The value of the prize is 100	
The cost of the other bidder is between 1.8 and 3.6 per second	
Your cost is 3.59 per second	
You are now bidding the following number of seconds for the prize:	4.00
You have, hence, bid the following amount this auction:	14.34
To leave the auction, press the bottom left button	
	I stop bidding

Each period, the screen shows the value of the prize which is constantly 100 ECU. Furthermore, the screen displays your bidding cost per second and reminds you that the bidding cost per second is an amount between 1.80 and 3.60. In addition, you will be informed about how many seconds you have already bid and what your total cost of the current auction are. After 10 seconds a "Stop"-button with the title "I stop bidding" appears down right. You should use the countdown (10 seconds) to plan your optimal bidding strategy. Press the "Stop"-button if you don't want to proceed bidding and leave the auction. As soon as you leave the auction your partner wins the prize. Likewise, you win the prize if your partner leaves the auction earlier as you. **As long as you don't press the "Stop"-button, your are still bidding for the prize. The auction ends for both bidders as soon as the first bidder presses the "Stop"-button.**

For every second you bid, you have to pay the bidding cost per second. These cost occur independently of who (you or your partner) wins the auction.

In the beginning of the experiment your account balance is 2300 ECU. Your cost will be subtracted from the account balance. If you win the auction, the prize with the value of 100 ECU will be credited to your account. Your account balance at the end of auction is calculated as follows:

Account balance before the start of the auction
− (Number of bidding seconds) × (Bidding cost per second)
+ Value of the prize, if you win the auction
= Account balance after the auction

The account balance at the end of the auction is your account balance in the beginning of the following auction. The account balance at the end of the 24th auction is your payoff for the participation of the experiment. Thereby, you receive 1 Euro for 200 ECU.

At the end of each auction both players will be informed about their current account balance and who has won the prize. Furthermore, each player gets the information about the bidding cost per second of her partner in the previous auction.

During the experiment please fill in the table below at the end of each auction. So you always know the bidding cost per second and the total cost of you and your partner. Also, you have an overlook of your benefit and the development of your personal account balance.

If you have any questions, please don't hesitate to rise your hand. We will be glad to come to your seat and answer your questions.

Thank you very much for your participation!

References

Alesina, A., and A. Drazen, 1991, Why are stabilizations delayed?, *American Economic Review*, 81, 1170–1188.

Amemiya, T., 1973, Regression analysis when the dependent variable is truncated Normal, *Econometrica*, 41, 997–1016.

——— , 1984, Tobit models: a survey, *Journal of Econometrics*, 24, 27–34.

Anderson, S. O., J. K. Goeree, and C. A. Holt, 1998, Rent Seeking with Bounded Rationality: An Analysis of the All-Pay Auction, *The Journal of Political Economy*, 106(4), 828–853.

Barut, Y., D. Kovenock, and C. N. Noussair, 2002, A Comparison of Multiple-Unit All-Pay and Winner-Pay Auctions under Incomplete Information, *International Economic Review*, 43(3), 675–708.

Bishop, D. T., C. Canning, and J. M. Smith, 1978, The war of attrition with random rewards, *Journal of Theoretical Biology*, 74, 377–388.

Davis, D. D., and R. J. Reilly, 1998, Do Too Many Cooks Always Spoil the Stew? An Experimental Analysis of Rent-Seeking and the Role of a Strategic Buyer, *Public Choice*, 95(1-2), 89–115.

Fischbacher, U., 1999, z-Tree. Toolbox for Readymade Economic Experiments, Working paper 21, IEW, University of Zurich.

Hadi, A. S., 1992, Identifying multiple outliers in multivariate data, *Journal of the Royal Statistical Society*, 54(B), 561–771.

——— , 1994, A modification of a method for the detection of outliers in multivariate samples, *Journal of the Royal Statistical Society*, 56(B), 393–396.

Holt, Charles A, J., and R. Sherman, 1982, Waiting-Line Auctions, *Journal of Political Economy*, 90(2), 280–294.

Krishna, V., and J. Morgan, 1997, An Analysis of the War of Attrition and the All-Pay Auction, *Journal of Economic Theory*, 72(2), 343–362.

Moldovanu, B., and A. Sela, 2001, The Optimal Allocation of Prizes in Contests, *American Economic Review*, 91(3), 542–558.

Müller, W., and A. Schotter, 2003, Workaholics and Drop Outs in Optimal Organizations, CentER for Economic Research Discussion Paper 2003-43, Tilburg University.

Potters, J., C. G. de Vries, and F. van Winden, 1998, An Experimental Examination of Rational Rent-Seeking, *European Journal of Political Economy*, 14(4), 783–800.

Tobin, J., 1958, Estimation of relationships for limited dependent variables, *Econometrica*, 26, 24–36.

Tullock, G., 1980, Efficient Rent Seeking, in *Toward a theory of the Rent-seeking Society*, ed. by J. M. Buchanan, R. D. Tollosin, and G. Tullock, pp. 97–112. A&M University Press.

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