Allocating Conference Displays: A Natural Field Experiment*

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Abstract

In this note I report field-experimental results from two real-life allocation mechanisms utilized by a leading economic association to assign physical exhibition displays to publishing companies and think tanks during its annual conferences. Traditionally the association relies on arbitrary (or more or less rationalized) despotism as its main allocation mechanism but ran a competitive multi-object-multi-unit auction for one annual conference. The results highlight that competitive mechanisms can substantially improve both, allocative efficiency and revenue. Specifically, the auction increased realized revenue by 172% and allocative efficiency is estimated to have increased by 42%. This suggests that competitive mechanisms constitute a worthwhile alternative to arbitrary allocation mechanisms not only for big-ticket objects (e.g., radio spectrum) but also for low-stake items as traded in the present case.

JEL classification: C92, D44
Keywords: field experiment, multi-object multi-unit auction, conference, exhibition displays.

1 Introduction

Whenever heterogenous physical displays used for exhibitions are assigned to exhibitors, there arises a complex allocation problem of multiple objects, each coming in multiple units. The assignment of displays to publishing companies for exhibition during an academic conference is one case in point. If all presentation areas happen to be homogenous in terms of quality (e.g., all displays located in the center of some sufficiently large hall that is also used for coffee breaks), organizers typically fix a unit price. Then the allocation is efficient if the unit price does not lead any exhibitor to abstain from the conference despite available exhibition capacity that would allow for its accommodation. The problem is only interesting if the supply of exhibition area is heterogeneous (e.g., due to dispersion such that presentation areas differ in quality) and if high-quality displays are scarce; imagine, e.g., an exhibition area dispersed on two floors while coffee is available on one of them only. With heterogenous exhibition area, organizers have to match exhibitors to presentation displays that differ in quality and differences in quality can be reflected in quality-dependent unit prices. Solving

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this allocation problem is not trivial since exhibitors' preferences over presentation areas is typically not known by the organizer. Practically, organizers arbitrarily fix prices and provide a matching on the basis on intransparent and personal criteria (e.g., publisher S receives the best spot since it is the largest company, or due to tradition, it publishes the organizers' newest book.) As a result, large inefficiencies may occur.

The purpose of this note is to compare the outcome of the allocation method of arbitrary (or more or less rationalized) despotic decisions to that of a competitive, transparent, and fair auction mechanism. For that I rely on data generated by experimenting with an auction mechanism in the field.[1] In particular, I designed and implemented a sequential auction of heterogenous exhibition area for a leading European association of economists for an annual conference with well beyond 600 participants.[2] Anticipating results, I shall draw the conclusion that a fitting auction mechanism can substantially increase allocative efficiency and revenue. Furthermore the auction provides valuable information about market prices of presentation areas that might be useful to future despots.

The remainder is organized as follows: Section 2 introduces the setting of the field experiment, describes the objects to be allocated, and considers allocation mechanisms. Section 3 reviews the implemented sequential auction mechanism, section 4 provides results on bidding activity, revenue, and allocative efficiency. Finally section 5 concludes.

2 Setting of the field experiment

For one large academic conference of a leading European association of economists, eight publishing companies and seven economic think tanks, in total 15 well-known exhibitors, had to be allocated to presentation areas that differed in size and quality. For preceding conferences, organizers did not pay much attention to the assignment of exhibitors to displays and regarded it as a problem of low stakes. Whenever high quality areas were scarce, then leading publishing companies were typically assigned to the better spots. In particular, representatives of a think tank complained to me about the outcome of the allocation procedure employed for the preceding conference that was based on (more or less rationalized) despotic decision-making. As a response, I designed a competitive and transparent auction mechanism that was fair in the sense that assignment to areas were only made on the basis of bids and the anonymous mechanism. The resulting auction mechanism was implemented for one conference.

The conference venue offered 273 m^2 of exhibition area in total. The entire area consisted of 15 individual presentation areas differing in quality and size. Presentation areas were dispersed across two buildings and various floors. Using four criteria (contact frequency, contact density, length of stay per contact, and visibility) allows to classify presentation areas into four categories of quality designated A-D. Presentation areas of quality A score high on each criterion. They are centrally located and frequently contacted during coffee breaks. Presentation areas scoring low on one of the criteria but high otherwise are grouped in category B, while category C requires areas to

[1] This setting qualifies as a natural field experiment according to the taxonomy proposed in Harrison and List (2004).

[2] The president of the association asked me to not reveal details independently of circumstance, hence, my vague descriptions of event and exhibitors.

score low on two or three criteria. The least appealing areas are classified as quality D. There were twelve presentation areas in building P (P1-P12) that hosted contributed sessions and coffee breaks and three areas in building M (M1-M3) used for plenary sessions. Table 1 summarizes supply information. It provides the quality for any presentation area together with aggregate capacity by quality. The table indicates that the available supply of presentation areas of highest quality was

Quality	Capacity [m^2]	Presentation area
A	36	P1, P2, P3
B	62	P4, P8, P9, M2, M3
C	125	P5, P6, P10, P11, P12, M1
D	50	P7

TABLE 1: Capacity by quality level

36 m^2. Considering that aggregate demand for areas during the conference in the preceding year was 102 m", presentation areas of highest quality were very scarce. Indeed aggregate demand in the year under consideration slightly increased to 109 m^2. As table 1 shows, the combined capacity available for qualities A and B is not sufficient to cover demand so that there was a strong conflict of interest among exhibitors.

3 Auction design for the field

The conference venue was characterized by presentation areas differing in quality (multiple objects) and sizes (multiple units), hence, a multi-object-multi-unit auction was designed.[3] Clearly, radio spectrum auctions held worldwide are among the most prominent applications of this type of auctions that are intensely discussed in the literature.[4]

Careful consideration of demand and supply structures reveal that there are two main differences between license auctions and the case of auctioning exhibition area that both decisively affect the design of the auction mechanism. Firstly, any publishing company requires a single display only so that it demands a share of a single divisible object. It follows that heterogenous presentation areas can be viewed as substitutes. Another characteristic of the demand structure is that, practically, there is no scope for strategic demand reduction (see, e.g., Ausubel and Cramton, 2002) since presentation facilities are rather fixed in size so that the display size demanded is not variable. Secondly, radio spectrum is a big-ticket item whereas the exhibition area for a single academic conference can be considered a low-stake commodity. The implication here is that transaction

[3]See Krishna (2002), Jehiel and Moldovanu (2003), Klemperer (1999), or Wolfstetter (2003) for an introduction to multi-object auctions. For experimental research see, e.g., Alsemgeest (1998), Damianov et al. (2007), Engelmann and Grimm (forthcoming), and Kagel and Levin (2001).

[4]Mueller (1991) describes the radio spectrum auction in New Zealand. McMillan (1994), McAfee and McMillan (1996), and Milgrom (2000) discuss the first wave of license auctions in the US in 1994, Jehiel and Moldovanu (2003) and Klemperer (2002a) focus on European 3G/UMTS auctions. The two biggest European auctions are covered in detail by Binmore and Klemperer (2002b) and Grimm et al. (2002); the former considers the British experience, the latter the German case. Klemperer (2002b) summarizes key issues for the design of license auctions.

costs of preparing and conducting the auction on both market sides form a crucial factor when designing the auction, particularly ruling out time-consuming simultaneous auctions with multiple rounds.

The idea of appealing to an auction procedure to solve the allocation problem was novel to all exhibitors. To avoid losing exhibitors due to the novelty of the allocation mechanism, the auction was embedded in a richer three-stage mechanism as follows. In the first stage any exhibitor could declare itself as an active bidder at no cost. The second stage was the auction stage were all active bidders could compete for the best presentation areas available. In the third stage all non-active bidders and all active bidders that did not obtain a display in the auction stage were assigned to a presentation area that remained available after the auction stage. Independently of the auction stage, any exhibitor had to pay a basic unit charge per m^2. Active bidders that obtained a display of their choice in the auction stage had to pay an additional price premium per unit that was endogenously determined in the auction stage.

To minimize transaction cost, we conducted a sequence of uniform-price sealed-bid auctions. To facilitate easy bid submission once and for all before the auction sequence, it was possible to submit bids for each auction of the sequence where all bids in later auctions were eliminated if the bidder was successful in an auction before. There was a single sealed-bid auction for each presentation area. Hence, there were 15 auctions in total. The order of auctions was determined by the quality of presentation areas. We auctioned off the best presentation area first followed by the second-best area etc. The bid in a single auction was two-dimensional: it consisted of the largest price the bidder would be willing to pay per unit (m^2) and the demand for display size measured in m^2. To allocate the area, bids were ordered descendingly in terms of prices. Beginning at the top of the list, the right of using the presentation area was awarded to bidders as long as their combined demand in size did not exceed capacity. The uniform market price per m^2 of the auctioned presentation area was given by the bid with the highest maximum price that lost the auction. In case there was no highest losing bid, the market price was set to 75% of the maximum price indicated in the lowest winning bid.

The main reason to impose a minimum price was to avoid a price of zero for the right to select a presentation area. Clearly a constant minimum price could have been set before the auction, however, due to incomplete information about publishing companies' preferences over heterogeneous presentation areas, it was not obvious at all what minimum price(s) to fix at the outset. To resolve this issue, we relied on the 75%-rule that endogenizes this problem. The reason why we selected precisely 75% is due to the facts that we wanted to have a prominent number, that we intended to signal that the price indicated in the bid could be close to the unit price to be paid ($> 50\%$) in order to avoid overbidding valuations[5], and that we intended to signal that the auction is not about revenue maximization in the first place ($< 100\%$). At the outset we anticipated that the 75%-rule would not be binding in any auction of quality A areas and also not be binding for the major part of quality B auctions.

Immediately upon conclusion of any auction, the outcome was emailed to all exhibitors that submitted a bid. The outcome was also publicly posted in the Internet. The announcement

[5]In related second-price auctions of a single object. overbidding valuations occurs frequently, see, e.g., Kagel and Levin, 1993, Andreoni et al., 2007, Cooper and Fang, 2008.

consisted of the uniform price premium for the associated presentation area and the identity of exhibitors that obtained a display on the corresponding presentation area.

To clarify the employed auction rules, consider a hypothetical example with four bidders, 1-4, two presentation areas, A and B, that differ in quality and size. The set of submitted bids is summarized in table 2. Since the quality of presentation area A is assumed higher than that of

Bids for area A (20 m^2)				Bids for area B (6 m^2)			
bidder	quantity	price	award	bidder	quantity	price	award
1	6	100		1	6	50	x
2	6	150	x	~~2~~	~~6~~	~~80~~	
3	12	200	x				
4	6	40		4	6	20	

TABLE 2: Example: Bids for two hypothetical presentation areas A and B

area B, the auction for A is conducted first. By construction, this area has a size of 20 m^2 and there are four bids. The two highest bidders, bidders 2 and 3, are awarded a display on area A. Their combined demand for size is 18 m^2 so that 2 m^2 remain available. The next-highest bidder, bidder 1, demands 6 m^2 which is not feasible. The premium price per m^2 of area A equals the price submitted by the highest losing bidder which is 100 EUR. Next there is the auction of area B. First, the bid of bidder 2 is eliminated since she was already assigned a better display in the first auction. Since area B is rather small, it can accommodate a single exhibitor only, here bidder 1, at a unit price premium of 20 EUR.

4 Field-experimental results

In total 10 out of 15 publishing companies and think tanks actively participated in the auction stage. Five publishing companies designated by C1-C5 and five think tanks designated by T1-T5 submitted bids for various presentation areas. The remaining five exhibitors did not submit bids and were allocated to displays remaining available after the auction. The next subsection provides an overview of bidding activity before results on revenue and efficiency are reported.

4.1 Bidding activity and bidder heterogeneity

From an efficiency point of view, there is no need to run an auction if there was no potential for serious inefficiencies. Indeed if there was either no bid submission at all, suggesting rather homogenous presentation areas so that quality differences are negligible, or if bids and bidding approaches were identical across all bidders, suggesting identical preferences, then an auction mechanism could not generate efficiency gains and any other arbitrary allocation mechanism would do well. In contrast to both of these special cases, the collected data on bids reveal that bidders have heterogenous preferences and that they do not follow the same approach of bidding which justifies usage of the auction mechanism.

Finding 1. *Bidders were heterogeneous and adopted different bidding approaches.*

Table 3 summarizes the number of bids that were submitted during the auction stage. While the average bidder submitted 5.3 bids, there emerged two groups of bidders, publishers on the one hand and think tanks on the other one, that pronouncedly differ in bidding activity: publishers submitted only 30% of all bids while think tanks accounted for the remainder of 70%. Further, bidding behavior was highly selective in the sense that presentation areas of different quality did not attract the same number of bids. In particular, auctions of high quality areas (A or B) attracted the major part of bids, the share of bids for high quality displays is 70%. Inspecting the number

Exhibitor	C1	C2	C3	C4	C5	T1	T2	T3	T4	T5	Total
Quality A/B	2	3	4	4	1	6	2	6	8	1	37
Quality C	1	0	0	1	0	2	1	5	5	0	15
Building M	0	1	1	0	0	3	0	0	3	0	8
Building P	3	2	3	5	1	5	3	12	10	1	45
Total	3	3	4	5	1	8	3	12	13	1	53

TABLE 3: Submitted bids by exhibitor

of bids submitted by building (table 3) reveals that exhibitors adopted different approaches to bidding. While some of them (C1, C4, T2, and T3) primarily bid for presentation areas located in building P (that hosted contributed sessions and coffee breaks), others (C2, C3, and T1) focus their bidding activity on presentation of highest quality independently of building.

Finding 2. *Bidders viewed presentation areas as heterogenous objects and differentiate when bidding.*

Table 4 provides summary statistics of bidding behavior by presentation area. The order of columns is chronological such that the presentation area that was auctioned off first (P1) is located at the left and that one auctioned off last (P7) is given at the right margin. As the table illustrates, the average bid and the number of bids tend to be higher for presentation areas of higher quality. However, the measures of standard deviation and the coefficient of variation indicate that there is much variation of bids submitted by different exhibitors for a given presentation area further supporting the finding of bidder heterogeneity.

Area	P1	P2	P3	P8	P4	P9	M1	M2	M3	P10	P11	P12	P5	P6	P7
Quality	A	A	A	B	B	B	C	B	B	C	C	C	C	C	D
#Bids	7	5	5	4	5	4	2	3	4	1	2	3	4	3	1
Av. Bid	44	69	74	37	67	48	66	79	62	25	34	54	46	21	25
Std. Dev.	55	61	66	25	45	36	2	53	54	-	13	30	40	6	-
Var.Coeff.	1.24	.88	.88	.65	.67	.73	.03	.67	.87	-	.37	.55	.85	.28	-

Note: All numbers rounded up to the nearest integer except for the coefficients of variation.

TABLE 4: Summary statistics of bids by area

4.2 Revenue

Finding 3. *The auction mechanism increased the revenue from the exhibition of publishers and think tanks by 172%.*

Table 5 summarizes the price premium fixed in the auction stage for the right to select a presentation area. All actively bidding exhibitors were assigned a display over the course of the auction. Nine bidders were successful in capturing the most attractive presentation areas of qualities A and B. Only one of the bidders failed to obtain at least an area of quality B and had to accept a display of quality C. Briefly before the auction for this presentation area, the bidder was running out of bids and submitted an aggressive bid for the C rated presentation area to ensure to be assigned a display of his choice and to avoid worse presentation areas. Of course the bidder could not know that he was the only active bidder remaining in the auction. In total the auction mechanism

Presentation Area	P1	P2	P3	P8	P4	M2	P6
Quality	A	A	A	B	B	B	C
Price Premium per m^2	25.00	27.50	25.00	3.75*	12.50	7.50*	18.75*
Usage (m^2)	21	6	6	9	20	6	8

*) calculated with 75%-rule.

TABLE 5: Auctioned presentation areas with market price excluding basic tariff

generated a revenue of 5,481.25 EUR. The revenue realized with the exhibition of the preceding conference was 2,012.50 EUR. Thus, the auction mechanism increased revenue by 172% while the demand for exhibition area slightly increased by 7%.

4.3 Allocative efficiency

Finding 4. *Despotic or random decision making would have lead to major inefficiencies that were avoided by the auction design. The auction mechanism yielded an estimated efficiency rate of 98.2% while random decisions would have lead to substantially smaller efficiency rates.*

Here I quantify the degree of efficiency that the auction design achieved as compared to despotic decision making or random selection of allocations. Let the efficiency rate E^I of allocation I be defined as the ratio of total surplus generated by the implemented allocation, W^I, and the largest total surplus given valuations, $W^{\max}$, formally: $E^I = W^I/W^{\max} \in [0,1]$. Quantifying efficiency rates with the given data (that were not induced as in laboratory settings) requires the following five assumptions:

A1 Active bidders are myopic and bid their true valuation.

A2 Non-active bidders are indifferent between any pair of presentation areas.

A3 There are no externalities.

A4 Transaction costs are negligible.

A5 The basic charge is equal to the reservation price of non-active bidders.

Given assumptions A1-A5, efficiency rates can be inferred from the available data. Figure 1 provides the histogram of efficiency rates for all possible allocations (roughly $1.5 \cdot 10^{12}$ combinations) that are reasonable.[6] The probability that a random allocation had yielded an efficiency rate exceeding

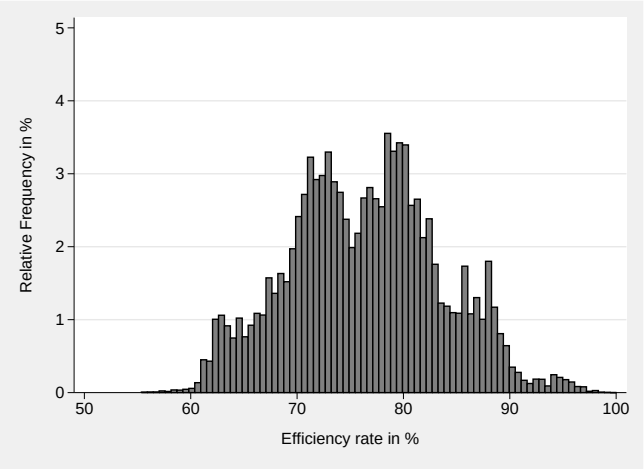

FIGURE 1: Distribution of efficiency rates

90% is only 3.4% and the probability that it had yielded an efficiency rate smaller than 80% is 69.4%. With these results in hand, it is possible to set the performance of the auction mechanism into perspective. The added value of the implemented allocation was 7,836 EUR while the most efficient allocations yield a total surplus of 7,980 EUR. It follows that the efficiency rate of the allocation selected by the auction is 98.2%.

5 Conclusion

The natural field experiment reported here illustrates that simple but competitive mechanisms can substantially improve allocative efficiency and revenue as compared to rationalized despotic decisions or random selection of allocations if bidder's preference are private and the allocation decision is non-trivial – even in situations of low stakes. In the present case, the auction increased revenue by 172% and realized an efficiency rate of 98% which would most likely not have been achieved by rationalized despotic decision making. The traditional way of allocating exhibition displays would have created a large loss in efficiency. The main source of this loss stems from the procedure of favoring publishers over think tanks whereas the field-experimental results allow to infer that think tanks valued exhibition area of high quality much more than publishers which was not known ex ante. Indeed, the opposite was believed and the strength of true relation was a big surprise. The auction procedure avoided this inefficiency and also the problem of fixing prices for 15 presentation areas that differed in quality not knowing anything about the value of this commodity for exhibitors. Another important advantage of the auction mechanism was that it transparently and fairly solved conflicts of interests among exhibitors by assigning them to presentation areas on the basis of their own decisions.

[6] Allocations are discarded if not all exhibitors receive a display or if capacity of quality levels A or B is left idle though another exhibitor could be accommodated there.

References

[1] Alsemgeest, P., C. Noussair and M. Olson (1998), Experimental Comparisons of Auctions under Single and MultiUnit Demand, *Economic Inquiry* 36(1), 87-97.

[2] Andreoni, J., Y.K. Che and J. Kim (2007), Asymmetric information about rivals' types in standard auctions: An experiment, *Games and Economic Behavior* 59, 240-259.

[3] Ausubel, L.M. and P. Cramton (2002), Demand reduction and inefficiency in multi-unit auctions, University of Maryland Working Paper 96-07.

[4] Binmore, K. and P. Klemperer (2002), The biggest auction ever: The sale of the British 3G telecom licenses, *Economic Journal* 112, C74-C96.

[5] Cooper, D.J. and H. Fang (2008), Overbidding in second price auctions: An experimental study, *Economic Journal* 118(532).

[6] Damianov, D.S., J. Oechssler and J.G. Becker (2007), Uniform vs. Discriminatory Auctions with Variable Supply? Experimental Evidence, Working paper, University of Heidelberg.

[7] Engelbrecht-Wiggans, R. and C.M. Kahn (1998), Multi-Unit Auctions with Uniform Prices, *Economic Theory* 12(2), 227-258.

[8] Engelmann, D. and V. Grimm (forthcoming), Bidding Behavior in Multi-Unit Auctions An Experimental Investigation, *Economic Journal*.

[9] Grimm, V., Riedel, F. and E. Wolfstetter (2002), The third generation (UMTS) spectrum auction in Germany, ifo Studien 48(1).

[10] Harrison, G. and J. List (2004), Field Experiments, *Journal of Economic Literature* 42(4), 1009-1055.

[11] Jehiel, P. and B. Moldovanu (2003), An Economic Perspective on Auctions, *Economic Policy* 36, 271-308.

[12] Kagel, J. and D. Levin (1993), Independent private value auctions: Bidder behaviour in first-, second- and third-price auctions, *Economic Journal* 103(419), 868-879.

[13] Kagel, J.H. and D. Levin (2001), Behavior in Multi-Unit Demand Auctions: Experiments with Uniform Price and Dynamic Auctions, *Econometrica* 69(2), 413-454.

[14] Klemperer, P. (2002a), How (not) to run auctions: The European 3G telecom auctions, *European Economic Review* 46, 829-845.

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

[16] Krishna, V. (2002), *Auction Theory*, San Diego et al.: Academic Press.

[17] McAfee, R.P. and J. McMillan (1996), Analyzing the Airwaves Auction, *Journal of Economic Perspectives* 10, 159-175.

[18] McMillan, J. (1994), Selling Spectrum Rights, *Journal of Economic Perspectives* 8, 145-162.

[19] Mueller, M. (1991), Reform of Spectrum Management: Lessons from New Zealand, Policy Insight No. 135.

[20] Noussair, C. (1995), Equilibria in a Multi-Object Uniform Price Sealed Bid Auction with Multi-Unit Demands, *Economic Theory* 5(2), 337-351.

[21] Wolfstetter, E. (2003), Auctions, http://www2.wiwi.hu-berlin.de/wt1/staff/wolfstetter/chap-08-new.pdf, revised chapter 8 in E. Wolfstetter (1999): *Topics in Microeconomics*, Cambridge: Cambridge University Press.