

Individuals and teams in UMTS-license auctions[#]

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Abstract: We examine bidding behavior of individuals and teams in an experimental auction that resembles UMTS-license auctions. Even though in reality teams – rather than individuals – were the bidding agents, experimental studies on bidding in auctions have so far relied on individual bidders. Our results show that teams stay on average longer in an (ascending sealed-bid English) auction and pay significantly higher prices than individuals. Consequently, teams make smaller profits and suffer more often from the winner's curse. The auction's efficiency is nevertheless higher with teams, since the bidders with the highest valuation are more likely to win the auction when teams bid rather than individuals.

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1 Introduction

In the years 2000 to 2002, many European countries conducted auctions to allocate licenses for operating UMTS mobile telephony (or more general 3G services). These auctions have caught considerable attention from the media, the public as well as the scientific community. Economists have been involved in designing the auctions and have also analyzed the influence of the design on outcomes, e.g. in terms of revenues for the auctioneer, bidding behavior or in terms of efficiency (see, e.g., Binmore and Klemperer, 2002; Börgers and Dustmann, 2005; Klemperer 2002a, 2002b; Milgrom, 2004).

In the wake of designing the auctions and when analyzing their outcomes, many researchers have relied on the method of experimental economics in order to study subjects' behavior under different auction designs (see, e.g. Abbink et al., 2005; Plott and Salmon, 2004; Seifert and Erhart, 2005). Surprisingly enough, all experimental studies on bidding behavior in UMTS-license auctions have used individual bidders, even though in reality bidders were actually teams.¹ In fact, bidding companies typically assembled a group of experts that was responsible for the company's bidding strategy (see, e.g. Börgers and Dustmann, 2002).² Given that individual and team decisions have been shown to differ in a broad range of economic situations (see, e.g., Blinder and Morgan, 2005; Cooper and Kagel, 2005; Kocher and Sutter, 2005), it is an open question whether bidding behavior in UMTS-auctions has been adequately captured by relying on representative individual bidders in existing experimental studies. In view of the huge amount of money that was at stake at the UMTS-auctions and that are at stake in many other large-scale auctions potential differences between the two types of decision-makers may matter a lot in terms of final outcomes.

In this paper, we will present a systematic experimental test of differences in bidding behavior between individuals and teams. More precisely, we study individual and team bidding behavior in an experimental auction which captures some features of the British

¹ We are only aware of a single paper that deals with teams and individuals in auctions (however with a completely different auction design). Cox and Hayne (2002) have explored decision-making of teams and individuals in common value auctions. The paper yields rather inconclusive results since the existence of differences between individuals and teams seems to depend crucially on the amount of information available to bidders. When bidders have a rather good knowledge of the distribution of the values, teams suffer from a 'disadvantage' of information, i.e. they overbid more often and achieve smaller profits.

² UMTS-auctions are, however, not the only example for teams – instead of individuals – making bids. Oil companies, for instance, typically rely on groups of geologists and managers to formulate bidding strategies for bidding on offshore oil leases (Capen et al., 1971; Hoffman et al., 1991).

UMTS-auction³ and which is based on a previous study by Abbink et al. (2005). We will compare individuals and teams as bidders according to (1) the number of bidding rounds, (2) the prices for the auctioned good and, hence, profits, as well as (3) the efficiency of the resulting allocations.

Abbink et al. (2005) have analyzed three different types of auctions (a uniform auction as well as a discriminatory auction of the Anglo-Dutch format and an ascending sealed-bid English auction) in an experimental study before the British UMTS-auction was conducted in March 2000. The main feature of their auction designs is to combine a private and common value component in order to determine a bidder's valuation of the good.⁴ The common value component captures the general profit prospects in an industry, whereas the private value component accounts for possible advantages of market incumbents over new market entrants. Since Abbink et al. (2005) have not found significant differences in bidding behavior across their three different designs, we will concentrate on a single design to focus on our main research question, i.e. whether individuals and teams bid differently in auctions.

Unfortunately, economic theory largely remains silent on the influence of the type of decision-maker on actual decisions and, therefore, offers no predictions on possible differences between individuals and teams. Thus, it seems reasonable to resort to stylized facts from experimental studies which have found that small unitary teams⁵ act differently from individuals in games in which rationality and reasoning are the predominant task characteristics and social preferences are of minor importance. The general pattern emerging from these studies is that teams are more competitive, closer to standard game-theoretic predictions and better in anticipating other players' moves than individuals. Cooper and Kagel (2005) have shown that teams are better in exploiting the strategic opportunities in signalling games. Kocher and Sutter (2005), Kocher et al. (2006) and Sutter (2005) have found teams to be more successful than individuals in beauty-contest games. According to Bornstein et al. (2004) teams exit the centipede game considerably earlier than individuals, mainly because they expect other teams to do the same. This leads to obvious efficiency losses in their team treatments as a consequence of the more competitive behaviour among teams.⁶

³ The British UMTS-auction was the first European UMTS-auction and is probably the best studied in terms of experiments conducted. For the sake of succinctness we do not go into the details of the actual British UMTS-auction, the experimental studies commissioned in its forefront and its result. Overviews are provided in Abbink et al. (2005), Binmore and Klemperer (2002) as well as Börgers and Dustmann (2005).

⁴ For a theoretical treatment of auctions with private and common values see also Goeree and Offerman (2003).

⁵ "Unitary" teams are teams that do not face an internal conflict in terms of payoffs and have to come up with a joint decision after a deliberation process.

⁶ There is also some evidence that teams are more "rational" players – in the sense of making decisions closer to the standard gametheoretic predictions – in two-person bargaining games (see Bornstein and Yaniv, 1998, on

Social psychology has offered several explanations for the higher competitiveness, respectively lower cooperation levels of teams in situations where there is a strategic conflict. The phenomenon is referred to as the “discontinuity effect” (see, e.g., Insko et al. 1987, 1988, 2001; Schopler et al. 2001). Three prominent hypotheses have been formulated in order to explain the discontinuity effect (Wildschut et al., 2001, 2003). First, the *identifiability hypothesis* proposes that in inter-*individual* interactions subjects assume that they are identifiable and thus can be held accountable if they make a competitive choice. In inter-*team* interactions it is less clear who is responsible for the competitive choice, because it is made by a team. Therefore, team membership provides a shield of anonymity that makes it easier for team members to propose and make a competitive choice, since they cannot be made responsible for it directly. Second, the *greed hypothesis* argues that inter-team behavior is more competitive than inter-individual behavior, because team members provide each other with social support for the competitive pursuit of immediate self-interest (Insko et al., 1990). This social support for self-interested behavior is unavailable for individuals and hence they are less competitive. Finally, the schema-based *distrust or fear hypothesis* proposes that group behavior is more competitive, because the anticipation of interacting with another team activates an out-group schema consisting of learned beliefs or expectations that inter-team interactions are competitive, deceitful and aggressive (Pemberton et al., 1996).

If we consider the evidence from experimental economics referred to above and the discontinuity effect from social psychology we might expect teams to behave more competitively in auctions than individuals. A more competitive behavior obviously implies higher bids in order to win the auction when teams interact with each other. This expectation is actually confirmed by our experimental results. Indeed, (1) teams stay on average longer in the auction than individuals; (2) they pay significantly higher prices and, thus, earn significantly lower profits than individuals; but (3) the allocation of the auctioned goods is more efficient with team bidders, since the bidders with the higher valuations actually get the licenses significantly more often when teams bid than when individuals bid.

The rest of the paper is organized as follows. In section 2 we introduce the details of the experimental design. Section 3 presents the experimental results. Section 4 discusses our results and concludes the paper.

the ultimatum game). However, the evidence is mixed (see Cason and Mui, 1997, who report teams to be more generous in dictator games). Hence, there is no consensus yet on whether and how team decisions differ from individual ones in situations where social preferences – like fairness or inequity aversion – play a major role. Note that social preferences are – at most – of only minor importance in auctions.

2 Experimental Design

2.1 The basic setup

In our experiment we let 4 bidders make bids in 15 consecutive and independent ascending sealed-bid English auctions. The set of 4 bidders will be referred to as a “market” in the following. The only experimental treatment variation is the type of bidders that we consider. In the INDIVIDUALS treatment, the 4 bidders in a market are individuals, whereas in the TEAMS treatment the 4 bidders are teams of three subjects each. In the latter case the three subjects have been seated together to discuss their bids and strategies before they had to enter a joint decision on a computer (using the software z-Tree by Fischbacher, 1999).⁷ Neither individual bidders nor team bidders have been able to communicate with other bidders in their “market”. In order to keep per-capita incentives constant across treatments, we paid each member of a team the amount that an individual would have won with the same decisions in its market.

Each bidder’s valuation of a license is determined as the sum of a common and a private value component. The *common value component* (*cvc*) is identical for all bidders and is randomly drawn for each auction from the integers in the interval $[1000; 1500]$. Note, however, that bidders do not know the actual *cvc* or the interval from which it is drawn when they submit their bids. Rather, each bidder receives a private signal on the common value component, the so-called *estimated common value component* (*ecvc*). Bidders know that this signal is randomly and independently drawn for all bidders from the integers in the interval $[cvc - 200; cvc + 200]$.

The *private value component* (*pvc*) for each bidder is an integer number that is also randomly drawn from the interval $[-100; +100]$. Its realization depends on a bidder’s type. In each market two of the four bidders are *type A* and two are *type B* bidders, which is common knowledge. The types are randomly assigned to bidders at the beginning of the experiment and remain fixed throughout the whole experiment. The *private value component* for type A bidders is randomly drawn from the interval $[0; +100]$ with a probability of 80% and from the interval $[-100; 0]$ with a probability of 20%. For type B bidders the probabilities are reversed, i.e. they have an 80% chance that the *pvc* is drawn from the interval $[-100; 0]$ and a 20%

⁷We did not set a time limit for submitting a bid.

chance that it is drawn from the interval $[0; +100]$. The different probabilities should reflect the advantages of incumbents (type A bidders) over new market entrants (type B bidders).⁸

In order to keep the experimental conditions identical across our two treatments, we randomly drew the actual common value component (*cvc*), the estimates of the common value component (*ecvc*) and the actual private value component (*pvc*) for each single bidder in advance. Thus, we used a predetermined (yet randomly drawn) set of variables for the 15 auctions in each experimental session. To ensure that our results do not depend on a specific set of variables we drew 10 different sets of variables for the 15 auctions.⁹ Each set was used for one market with 4 individual bidders and one market with 4 teams as bidders. The behavior of individuals and teams in a given set of variables therefore constitutes a matched observation that can be used to test for differences between individuals and teams in a highly controlled setting. In total we had 160 participants in our experimental sessions, which lasted about 1.5 hours. The average payoff for subjects was 21.4 €

2.2 Rules for bidding in an auction

2.2.1 Minimum bids

At the beginning of each auction bidders are informed about the estimates of the common value component (*ecvc*) and their private value component (*pvc*). Each auction can have several bidding rounds. A bidder can either quit an auction (without the possibility to re-enter in a later round of a given auction) or submit a bid to remain “active” in the auction. In each round a minimum bid has to be met (or exceeded) by any bidder who wants to stay in the auction.¹⁰ In the very first round of an auction, the minimum bid is positively correlated with the actual *cvc*. The minimum bid in the first round was determined by taking 80% of the *cvc* and adding a randomly drawn integer from the interval $[-100, 100]$. Subjects were not aware of this rule. All minimum bids for the first round were also predetermined to make the starting

⁸ Incumbents might have a better knowledge of the market and a better reputation with future customers. Therefore, a UMTS-license might be more valuable for them than for new market entrants. Nevertheless, in our design type B bidders can also receive a positive *pvc*, which reflects the possibility that new entrants could make more efficient use of a license. One could have also assumed, as in Klemperer (1998), that incumbents always have a higher actual total value than new entrants. While the assumption about private values is, of course, an important question for designing an auction, it is of minor importance in the context of our research objectives.

⁹ A table with all values in the 10 sets as well as the raw data of the actual bids is included for referees' convenience at the end of the paper in a Supplement.

¹⁰ In the experimental instructions (see Appendix) we informed participants that there is a maximum bid of 2000 which cannot be exceeded. This kind of liquidity constraint prevented bidders from submitting ruinously high bids, possibly made by error. It nevertheless allows overbidding since the maximum bid was well above bidders' valuations in each single case. In fact, we did not observe maximum bids.

conditions in a given set of variables completely identical in the treatments INDIVIDUALS and TEAMS. In all subsequent rounds the minimum bid is determined as the third highest bid of the preceding round, plus an increment. The increment depends on the number of bidders still active in the auction and the difference between the current round's minimum bid and the previous round's minimum bid. Table 1 summarizes the rules for determining the increment. Note that the increment is larger when more bidders are still active and when the increase in the minimum bid from the previous to the current round is relatively smaller. This rule prevents an excessive number of bidding rounds when bidders would submit bids that are close or equal to the prevailing minimum bid.

Table 1: Bidding increments

Increment	Condition	Number of bidders active in auction
100	Minimum bid [†] in current round = minimum bid in previous round + 150	4
50	Minimum bid in current round > minimum bid in previous round + 150	4
25	always	3

[†]The minimum bid in the current round is determined as the third highest bid of the preceding round, plus the increment.

2.2.2 End of an auction and determination of the price

At the beginning of each round bidders are informed about the number of active bidders and about the type of bidders that have already quit the auction. An auction continues until only two bidders are left who have made a valid bid in the current round. Each of these two bidders receives one of the two licenses and pays the third highest bid from the previous round as the price.¹¹

If there are fewer than two bidders active in a given round, then the auction ends, and the active bidder (if any) receives a license. The second license (or both licenses in case all bidders have left the auction in the same round) is allocated randomly to one of the bidders who has submitted a valid bid in the previous round. The price for the license is then the minimum bid of the previous round. If there are fewer than two bidders active after the first

¹¹ This price is equivalent to the minimum bid in the current round minus the increment.

round, the bidder with a valid bid gets a license and has to pay the minimum bid of the first round. All other bidders who quit the auction already in the first round receive nothing.¹²

2.2.3 Payoffs in the auction

Bidders who do not get a license receive no payoff for this auction. Bidders who get a license have the following payoff:

$$\text{Payoff} = cvc + pvc - \text{price}$$

In the instructions – that did not include any reference to spectrum license auctions – we have pointed out explicitly that negative payoffs are possible if the price of a license exceeds the sum of the private and the actual common value component of a bidder. Losses from one auction can be balanced with profits from other auctions. Bidders have received an initial endowment of 500 points (the experimental currency unit) at the beginning of the session in order to prevent overall losses. All points earned in the 15 auctions have been added up and converted into real money at a rate of 50 points for 1 €

3 Results

3.1 Number of bidding rounds and bidding behavior

In Figure 1 we show the average number of bidding rounds in all 15 auctions. The overall average is 4.74 bidding rounds in INDIVIDUALS, and 5.12 bidding rounds in TEAMS. Hence, teams stay about 8% longer in an auction than individuals do. According to a Wilcoxon signed ranks test¹³ the difference is not significant, though ($p > 0.1$; $N = 10$).

Result 1. On average, teams stay longer in an auction than individuals do, but not significantly so.

¹² It never happened that no license was sold in an auction, i.e. that none of the four bidders submitted a bid in the first round, and there was only one case where only one license was auctioned.

¹³ All tests in this paper rely on a two-sided, non-parametric Wilcoxon signed ranks test. Recall that we have 10 different sets of variables (cvc , $ecvc$, pvc) which yield 10 independent matched pairs of observations where one ‘market’ in the INDIVIDUALS treatment is matched with the corresponding ‘market’ (with the same set of variables) in the TEAMS treatment. For statistical testing, we only consider the overall average across all 15 auctions (concerning, for instance, the number of bidding rounds or the prices) in a given market and treatment and match it with the overall average in the matched market in the other treatment. Such a pair then constitutes one independent matched pair.

Figure 1 about here (Number of bidding rounds)

Before examining the prices resulting from bidding in the different treatments, we would like to analyze bidding behavior with respect to the minimum bid in a given round. For this purpose we define the *relative bid* as the ratio of a submitted bid to the minimum bid in a given round.¹⁴ For the first two rounds of each auction we do not find any significant difference in the relative bids of individuals and teams. From the third to the sixth round¹⁵, however, teams have significantly smaller relative bids than individuals ($p < 0.05$ in each round; Wilcoxon signed ranks test; $N = 10$). Teams obviously recognize faster that it does not make much sense to submit higher bids than the minimum bid (so-called “jump bids”) because it suffices to submit the minimum bid to stay in the auction. Yet, in absolute terms the differences in relative bids are rather small, since relative bids of teams from round 3 on are in the range [1.003, 1.009], whereas individuals’ relative bids are in the range [1.009, 1.021]. On average, teams submit a bid which is about one half percentage point above the minimum bid, and individuals submit a bid about 1.5 percentage points above the minimum bid.

3.2 Prices and profits

Figure 2 displays average prices in the 15 auctions. In each single auction teams pay higher prices for the licenses than individuals. The largest price difference is 15.3% in auction 6. Across all 15 auctions, the average price paid by teams is 1247 units of money, but for individuals it is only 1193 units, which is about 4.3% lower. Prices paid by teams are actually significantly higher than those paid by individuals ($p < 0.05$; Wilcoxon signed ranks test; $N = 10$).

Recall that we have perfect control over the common value and private value components for our matched observations of individual and team bidders. Hence, the difference in prices paid by individuals and teams cannot arise from differences in the underlying valuations of the good. It, therefore, indicates that teams are willing to pay more in order to succeed in the auction. It is interesting to note that the size of the effect does not decline in later auctions. Hence, the observed difference is not a transitory phenomenon that vanishes with experience, but seems to reflect a persistent behavioral pattern.

¹⁴ Comparing absolute bids only makes sense in the first round of each auction, because after the first round absolute bids are obviously path-dependent.

¹⁵ Due to the small number of auctions with 7 or more bidding rounds, we did not analyze differences in relative bids in these rounds.

Result 2a Teams pay significantly and persistently higher prices in our auctions than individuals.

Figure 2 about here (Average prices)

Closely related to the finding of higher prices paid by teams are significantly lower average profits for teams when they win the auction ($p < 0.05$; Wilcoxon signed ranks test; $N = 10$).¹⁶ Figure 3 displays average profits in single auctions. Profits for teams start out with an average of 130 units in the first auction and decline to an average *loss* of 6 units in the last auction. Hence, the aggressive bidding of teams strongly diminishes profits, in particular in the last four auctions. The average profits for individuals decline from 148 in the first auction to 83 units in the last auction. Sustaining positive profits even at the end of the experiment indicates that competition among individual bidders is not as strong as competition among team bidders.

Result 2b. Teams make significantly lower profits than individuals. In the course of the experiment average profits of teams go down to zero.

Figure 3 about here (Average profits)

Concerning the frequency of experiencing a loss after having received a license, we find that teams incur a loss in 28% of cases, and individuals in 19%. If losses were due to errors, the frequency of making losses should go down over time due to more experience. Yet, we observe the contrary. In INDIVIDUALS (TEAMS), the relative frequency of incurring a loss increases from 15% (28%) in auctions 1-5 to 22% (35%) in auctions 11-15.

Result 2c. On average, teams incur losses more often than individuals, but not significantly so.

¹⁶ Note that in both treatments type A-bidders (the incumbents) win the auction significantly more often than type B-bidders ($p < 0.05$ both in INDIVIDUALS and TEAMS; Wilcoxon signed ranks test; here we matched type A-bidders with type B-bidders in a respective treatment). Overall, 57% of type A-bidders win in INDIVIDUALS, and 59% in TEAMS.

3.3 Efficiency

The efficiency of an auction depends upon whether the bidders with the higher valuations actually get a license. Therefore, we measure efficiency by the relative frequency with which the two bidders with the highest actual valuation succeed in the auction. In TEAMS, 71% of the two highest bidders actually get a license, but in INDIVIDUALS only 64% ($p < 0.05$; Wilcoxon signed ranks test; $N = 10$). From this perspective, we may conclude that TEAMS is the better treatment in assigning licenses to the bidders which value them most.¹⁷ The stronger competition in TEAMS – yielding higher prices and lower profits – therefore promotes a more efficient allocation of licenses.¹⁸

Result 3. The allocation of licenses is more efficient in the TEAMS treatment, because there the bidders with the highest valuations win the auction significantly more often than in the INDIVIDUALS treatment.

4 Discussion and conclusion

We have analyzed differences in bidding behavior of individuals and teams in an experimental ascending sealed-bid English auction. This type of auction has some resemblance with the British UMTS-auction in the year 2000, which has caught considerable interest in the scholarly economics literature. Even though in reality teams – rather than individuals – were the bidding agents, the experimental studies associated with the European UMTS-auctions have exclusively relied on representative individual bidders.

Our experiment provides conclusive evidence for several differences in the bidding behavior of individuals and small teams. Teams stay on average longer in an auction, but submit bids which are closer to the prescribed minimum bid in most bidding rounds. The

¹⁷ Recall from footnote 16 that the fraction of type A-bidders (the incumbents) who win the auction does not differ between our two treatments. However, type A-bidders who win an auction need not necessarily be the bidders with the highest valuation, because their actual private value component (*pvc*) might be lower than the one of a type B-bidder. If the latter constellation applies, the type B-bidders with the higher valuation get the license more often in TEAMS than in INDIVIDUALS, which causes the higher overall efficiency in TEAMS.

¹⁸ There are several other ways of measuring efficiency. One alternative to our measure could be called *surplus extraction ratio* (SER) which is defined as $(SV_{act} - SV_{min}) / (SV_{max} - SV_{min})$, where SV_{act} denotes the sum of valuations of the two bidders who actually got the license; SV_{max} (SV_{min}) denotes the maximum (minimum) sum of valuations of two out of four bidders. TEAMS yields an SER of 76%, INDIVIDUALS one of 67% ($p < 0.05$; Wilcoxon signed-ranks test).

latter behavior seems to support the hypothesis that teams act more “rationally” than individuals, because in our design it suffices to submit exactly the minimum bid in order to stay in an auction. However, due to staying on average longer in the auction, in the end teams pay significantly higher prices and, thus, make significantly smaller profits. This is a consequence of the stronger competition among teams. It even drives down average profits to zero by the end of the experiment in the TEAMS treatment. As a matter of fact, teams also incur losses more often than individuals. Put differently, the lack of precise knowledge of the common value component leads to a more frequent occurrence of the winner’s curse in TEAMS. Our results, therefore, reinforce the so-called discontinuity effect (Insko et al., 1987, 1988).¹⁹ Finally, our experiment shows that the stronger competition among teams actually is associated with a more efficient allocation of the auctioned goods. The two bidders with the highest actual valuations receive the licenses significantly more often in the TEAMS treatment than in the INDIVIDUALS treatment.

Our results provide important implications both for real-world (license) auctions and for the analysis of general differences between individual and team decision making. We discuss both implications in turn.

Regarding real-world (license) auctions, our results suggest that the high prices for UMTS-licenses paid in the first auctions in Europe (in particular those in the U.K. and in Germany) might at least partly be due to teams rather than individuals submitting bids. Of course, most experimental studies commissioned for the UMTS-auctions were mainly interested in the proper auction design to yield the highest possible revenues for the treasury – which they obviously achieved. But these studies have nevertheless missed the differences in the bidding behavior of individuals and teams.

Given the amounts at stake at large-scale auctions like those on UMTS-spectrum licenses, even seemingly small relative differences in final prices caused by individual or team bidders (of about 4.3% in our design) yield substantial absolute differences in revenues

¹⁹ In the context of our auction setting, the greed hypothesis and the distrust and fear hypothesis raised as possible behavioral explanation for the discontinuity effect seem to be most relevant for explaining the more aggressive and competitive bidding behavior of teams. From casual observation of team discussions, we realized that teams discussed much more often how to win an auction rather than which price to pay (or bid). Many teams seemed to prefer a rather small expected profit over making no profit at all in the case of quitting the auction. This casual evidence supports the greed hypothesis. The feedback on the remaining number of bidders after each round might have elicited behavior which is consistent with the distrust and fear hypothesis. If a bidding team sees that there are still two other teams active in the auction, this might be perceived as an indication of aggressive bidding of the other bidders, which in turn might induce the bidding team to bid aggressively itself – as the distrust and fear hypothesis would predict [0]. Of course, the same line of reasoning can, in principle, be applied to the INDIVIDUALS treatment as well. But note that individuals drop out from the auction a little bit earlier than teams. Hence, individuals experience less often that two or three other bidders are still active. This might actually induce a relatively lower degree of competition among individuals.

from an auction. Even though the higher prices paid by teams may have been bad for them – in the experiment teams made losses in single auctions quite often, and in reality the winning contestants have not yet amortized their investments into UMTS-spectrum licenses²⁰ – the allocation of licenses has been more efficient among teams than among individuals. This result shows that the stronger competition among teams actually has not only been beneficial for the auctioneers, but also for the overall efficiency of the auctions.

In the light of these findings it is, of course, important to ask why companies usually delegate teams of experts rather than individual representatives to decide on bidding strategies in large-scale auctions. Recall here that we have simplified the decision making situation by giving all team members the same pieces of information, yet with some uncertainty regarding the real parameters of the auction. In the real-world, bidding teams are usually assembled in order to reflect different fields of expertise. Hence, teams without internal conflicts in terms of payoff may be viewed as units that aggregate valuable private information of the team members quickly and efficiently. Whether the advantage from information aggregation within teams outweighs the disadvantage from more aggressive bidding is beyond the scope of this paper and has to be left to future research. However, it also seems at least possible to supply a single representative with all the necessary information *before* the start of the auction in order to avoid potentially adverse effects from team bidding. Companies probably refrain from this strategy either because they are not aware of the adverse effects of delegating teams to bid in auctions or because they believe that individuals are not able to respond adequately to all contingencies in the course of an auction.

Given that it is impossible to derive a theoretical benchmark for our auction design, we cannot infer from our data whether individual or team outcomes are closer to game-theoretic predictions. Taking the frequent occurrence of losses as an indication, however, it becomes rather clear that teams are worse bidding agents than individuals in large-scale auctions from the viewpoint of companies.

An important complementary finding in that respect comes from Cox and Hayne (2002). In this only other experimental study on the differences between individual and team bidding in auctions that we are aware of Cox and Hayne (2002) show that teams suffer more often from the winner's curse with more information. Hence, their findings for common value auctions surprisingly suggest that more information is even worse for teams than for individuals. Since the auction design of Cox and Hayne (2002) deviates considerably from

²⁰ Note though that it has also been argued (e.g., by Klemperer, 2002a) that at the time of the auctions bidders did not bid more than they thought the licenses were worth to them.

ours and from license auctions, one has to be cautious in interpreting possible similarities in results. However, they are at least able to show that *more* information does not have to be an advantage in bidding from a behavioral point of view.

Regarding the growing literature on differences between individuals and small teams in economic decision making and behavior our results add an important piece of evidence to existing studies. The issue of team decision making and behavior has attracted increasing attention among economists recently²¹ because many economic decisions are actually taken by small teams that share a joint goal rather than by individuals. Prime examples are families, boards of directors, juries and committees. Thus, a more profound knowledge of team decisions is clearly desirable in economics, especially in view of the mounting evidence for the actual existence of systematic and persistent differences between individual and team decisions.

It can be considered a stylized fact in the literature that teams are generally closer to game-theoretic predictions than individuals in (interactive) games in which rationality and correct reasoning are the predominant task characteristics.²² We also know from our results and several earlier studies predominantly on the prisoner's dilemma game that tougher competition exists when teams interact with teams than when individuals interact with individuals (Bornstein, 2003). Teams obviously strive to "win" in strategic interactions, and this motivation is stronger among teams than among individuals.

It is straightforward that the higher competitiveness of teams can be a two-edged sword for a team's profits, though, depending upon the task. As already mentioned, in signaling games teams are more successful in exploiting the strategic opportunities of signaling a specific type (Cooper and Kagel, 2005). Teams outperform individuals in direct interaction in a beauty-contest game, where teams win the contest almost twice as often as individuals (Kocher and Sutter, 2005; Kocher et al., 2006). In such types of games, teams earn more. In the centipede game, however, teams earn less, because they exit the game earlier than individuals (Bornstein et al., 2004). The same negative effect of team decision making on teams' profits has been found in our auction experiment. Therefore, our experiment clarifies the relative magnitude of the winning (or competitive) motive against the profit maximization motive among teams in auctions. Obviously, in our setup the higher competitiveness of teams drives up prices and leads to lower profits. Hence, the winning motive is more important in our auction than profit maximization considerations. Interestingly, the prevalence of the

²¹ Camerer (2003) even rates this issue among the top ten open research questions in behavioral game theory.

²² We are referring to games with a strong "heureka"-component here, which means that once the correct solution is raised, it is easy to see for anybody (also called the "truth wins"-characteristic).

winning motive has been found to increase the auctions' efficiency in allocating licenses significantly. As a consequence, we conclude that team decision making is beneficial not only for auctioneers, but also for an auction's overall efficiency. These benefits come at the costs of teams paying higher prices and earning lower profits.

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Figures

Figure 1. Average number of bidding rounds

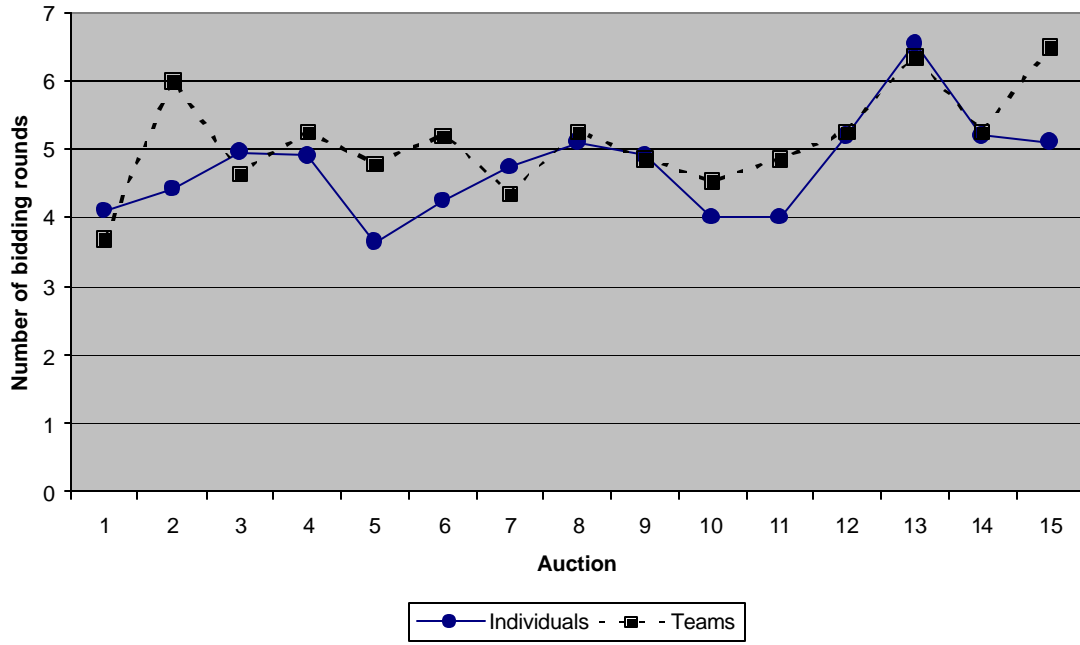


Figure 2. Average prices

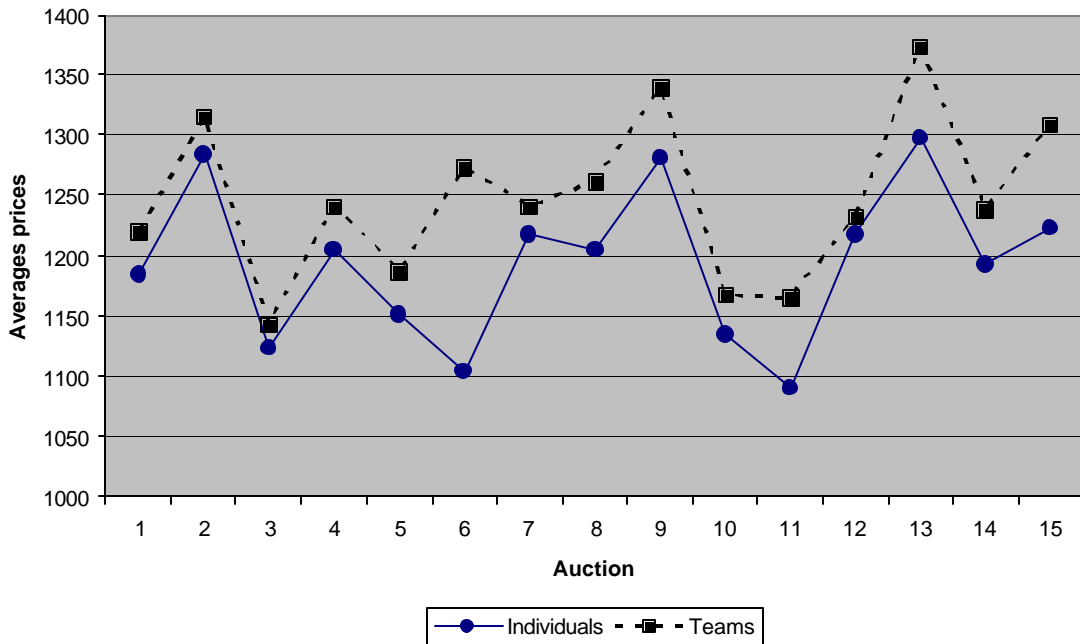
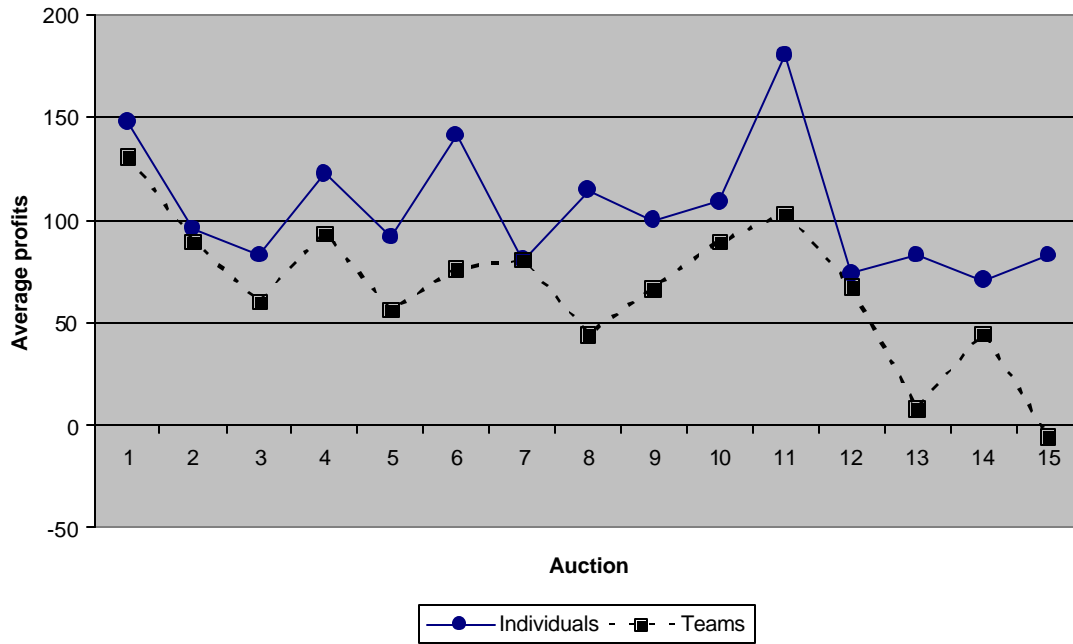


Figure 3. Average profits



Appendix – Instructions for TEAMS (not necessarily for publication)

(Instructions were the same for individual bidders and bidder teams; we only used the expression “bidder” instead of “bidder group” in the INDIVIDUALS instructions.)

Welcome to the experiment and thank you for your participation!

Please do not talk with other participants from now on!

Instructions

This experiment analyzes economic decision making. During the experiment you and the other participants will make decisions and you will earn money. The amount of money you earn depends on your own decisions as well as the decisions of the other participants and is determined by the rules of the game that will be explained in the following paragraphs. At the end of the experiment your total profit will be paid to you privately in cash.

The whole experiment will last about 2 hours. If you have any questions after reading the instructions please raise your hand. One of the experimenters will come to you and answer your questions privately. All participants receive the same instructions.

You are member of one of **4 bidder groups** who participate in an auction. Each bidder group consists of 3 members and has a bidder number that remains the same for the whole experiment. Each bidder group receives an endowment of € 10 (= 500 points) per member. We assign participants randomly to the groups.

In the auction **2 identical goods** are auctioned. The goods are not divisible. Each bidder group can only buy one of the goods in each auction. There will be **15 auctions**. Each auction consists of several rounds. You will make your decisions together with the same other two subjects in a bidder group in all 15 auctions. The composition of the other 3 bidder groups also remains the same during the experiment. Your bidder group is also linked with the same 3 bidder groups during the whole experiment.

There are **2 types of bidder groups**, type A and type B. Bidder groups with numbers 1 and 2 are of type A, bidder groups 3 and 4 of type B. You will be informed about your type and your bidder number at the beginning of the experiment in the heading line on the screen. Your bidder number and therefore your type remains the same for all 15 auctions.

Common value of the goods

Each good has a *common value*. This value is identical for both goods. The bidder groups do not know the common value of the goods during the auction. However, each bidder group receives an *estimation of the common value* that is determined by adding a integer randomly drawn from the interval [-200; + 200] to the real common value. That means that the estimation of the common value is at most 200 points higher or lower than the real common value. The estimation of the common value is different for the four bidder groups, but the real common value is the same for the 4 bidder groups. Each bidder group gets its estimation for the common value at the beginning of each auction.

Private value of the goods

Each bidder group will be informed about its private value of the goods at the beginning of each auction. This value is different for each bidder group. The private value for each bidder group is randomly drawn from the interval $[-100; +100]$ in the following way.

For bidder groups of **type A** (bidder 1 and 2) the private value is randomly drawn from the interval $[0; +100]$ with a probability of 80 %. With a probability of 20 % the private value is from the interval $[-100; 0]$. That means that in 8 out of 10 cases the private value of bidder groups of type A is positive, in the remaining 2 cases it is negative.

For bidder groups of **type B** (bidder 3 and 4) the private value is randomly drawn from the interval $[0; +100]$ with a probability of 20 %. With a probability of 80 % the private value is from the interval $[-100; 0]$. That means that in 8 out of 10 cases the private value of bidder groups of type B is negative, in the remaining 2 cases it is positive.

Rounds in each auction

At the beginning of each auction you will be informed about your private value and your estimation of the common value.

At the beginning of each round you will additionally be informed about the *current price* in the auction and the status of the other bidder groups, i.e. if the particular group is still participating in the auction or if it has already quit the auction.

In the first round the current price equals the *minimum sales bid*. The minimum sales bid is randomly drawn. From the second round on the current price is the third highest bid from the preceding round. That means that for example in round 3 the current price is the third highest bid from round 2.

The *minimum bid* that is valid for this particular round is announced at the beginning of each round. In the first round the minimum bid equals the minimum sales bid. From round 2 on the minimum bid rises according to a fixed scheme:

$$\text{Minimum bid} = \text{current price} + \text{increment}$$

Increment	Condition	Number of bidders left in auction
100	Current price this round = (current price preceding round + 150)	4
50	Current price this round > (current price preceding round + 150)	4
25	always	3

Each bidder group can decide to either make a bid that is at least as high as the minimum bid or to quit the auction. The maximum bid is 2000 points. If a group has quit the auction it can only participate again in the next auction but not at the remaining rounds of the current auction. Therefore, getting back into an auction after having quit once is not possible.

End of the auction

The auction ends if there are exactly 2 bidder groups left who make a valid bid. Each of these groups gets one of the goods and pays the current price for it.

If a group has quit the auction it usually cannot buy a good anymore. However, if there are less than 2 bidder groups left who have made a valid bid in a particular round this rule is not applied. In this case, a group gets one of the goods if it has made a valid bid. The remaining good (respectively goods if nobody has made a bid in this round) is randomly allocated to one

(two) group(s) who has (have) made a valid bid in the preceding round. All bidder groups who receive a good pay the current price of the last round for it.

Exception: If less than 2 bidder groups have made a valid bid already in round 1, the group who has made a valid bid gets a good and pays the minimum sales bid. Therefore, it is possible that in this case only one or even no good is sold.

Payoff

Common value, estimation of common value, private value, current price, increment, minimum sales bid and minimum bid are all given in points. Also bids have to be made in points. The conversion ratio is:

$$100 \text{ points} = 2 \text{ Euro}$$

Note that each group member receives the stated number of points earned during the whole experiment plus the initial endowment of €10 (500 points) as final payoff.

A bidder group who buys one of the goods receives the following payoff in the respective auction:

$$\text{Payoff} = \text{common value} + \text{private value} - \text{price for the good}$$

Note that the private value may be negative.

A bidder group who did not buy a good in an auction does not get any payoff in the respective auction.

Attention!

Note that losses are possible in this auction! If you pay a higher amount for one of the goods in an auction than the sum of real common value and private value, your payoff will be negative in this auction!

Note especially that your estimation of the common value can be higher than the real common value. You will be informed about your private value at the beginning of each auction. If your private value is negative it will be subtracted from the common value if you buy a good.

Losses will be subtracted from profits you have made so far and the initial endowment of 500 points. If you have made a total loss at the end of the 15 auctions, this loss has to be paid to the experimenters!

The common value, your estimation of the common value and your private value are randomly and completely independent drawn at the beginning of each auction from the respective intervals. That means that these values usually differ between the auctions.

Bidder numbers and type remain the same for all auctions.

Summary of values

- Common value

Value of each of the goods. Is unknown during the auction, but you will be informed about it at the end of each auction. It is used to calculate the payoff.

- Estimation of the common value

Each bidder group is informed about it at the beginning of each auction and it is randomly taken from the interval [-200; + 200] around the common value.

- Private value

Each bidder group receives information about it at the beginning of each auction. It is added to (subtracted from) the common value when calculating payoffs. It lies in the interval [-100;

+100]. For bidder groups of type A it is positive with a probability of 80 %, for type B bidders this probability is 20 %.

- Minimum sales bid

Minimum bid in the first round. It is randomly determined and will be announced at the beginning of each auction.

- Current price

Third highest bid from the preceding round (except round 1 where the minimum sales bid applies)

- Minimum bid

The minimum acceptable bid from round 2 on. Minimum bid = current price + increment (increments are calculated according to the table on page 3 of the instructions).

If you still have questions, please raise your hand. One of the experimenters will come to you and answer your question(s) privately.

Thank you for participating!

Supplement – Sets of variables and raw data

(for referees' convenience – not for publication)

The 10 different sets of variables (column "Set") were randomly drawn before running the experimental sessions. Each set consists of 15 auctions (column "Auction") in which four bidders (column "Bidder") of two different types (column "Type") are assigned a common value component (not revealed until the end of an auction; column "cvc"), an estimated common value component (known to bidders; column "ecvc") and a private value component (column "pvc") before starting to bid. The actual bids in the various bidding rounds are included under the labels "R1", "R2" ... 14 rounds was the maximum number. A "0" indicates that a bidder did not submit a bid.

Treatment INDIVIDUALS – Set 1

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)													
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
1	1	1	A	1110	999	-65	0													
1	1	2	A	1110	1158	-87	0													
1	1	3	B	1110	1255	-61	900													
1	1	4	B	1110	946	-64	898													
1	2	1	A	1318	1514	92	1100	1270	1250											
1	2	2	A	1318	1489	98	1100	0	0											
1	2	3	B	1318	1294	-83	1070	1170	0											
1	2	4	B	1318	1410	-41	1080	1180	1195											
1	3	1	A	1420	1310	72	1250	1330	1450	1470	1490									
1	3	2	A	1420	1550	6	1230	1331	0	0	0									
1	3	3	B	1420	1409	42	1250	1330	1430	1455	0									
1	3	4	B	1420	1488	-4	1230	1330	1430	1455	0									
1	4	1	A	1423	1343	-78	1180	1280	0											
1	4	2	A	1423	1321	80	1175	0	0											
1	4	3	B	1423	1232	67	1200	1275	0											
1	4	4	B	1423	1571	-70	1180	1280	1380											
1	5	1	A	1240	1418	55	950	1050	1150	1250	1275									
1	5	2	A	1240	1384	7	930	1035	1135	1255	1280									
1	5	3	B	1240	1328	-99	1000	1100	1170	0	0									
1	5	4	B	1240	1412	-54	930	1030	1200	1300	0									
1	6	1	A	1328	1340	42	1150	1240	0											
1	6	2	A	1328	1259	17	1140	1240	0											
1	6	3	B	1328	1229	20	1150	1240	1340											
1	6	4	B	1328	1252	-36	1140	1240	0											
1	7	1	A	1025	1035	14	776	876	976	0										
1	7	2	A	1025	1031	12	776	876	976	1001										
1	7	3	B	1025	880	-35	776	880	0	0										
1	7	4	B	1025	1131	-27	850	900	980	1002										
1	8	1	A	1315	1509	-60	1000	1100	1125	1125	1150									
1	8	2	A	1315	1401	83	975	1075	1100	1125	1150									
1	8	3	B	1315	1171	-7	1000	1100	1100	1125	0									
1	8	4	B	1315	1157	-100	1000	0	0	0	0									
1	9	1	A	1209	1227	21	1037	0												
1	9	2	A	1209	1118	-8	1037	0												
1	9	3	B	1209	1348	-61	1150	1200												
1	9	4	B	1209	1357	-83	1100	1140												
1	10	1	A	1448	1548	24	1141	1241	1341											
1	10	2	A	1448	1397	2	1141	1241	1341											
1	10	3	B	1448	1352	-79	1200	1280	1341											
1	10	4	B	1448	1393	-66	1200	1250	1341											
1	11	1	A	1285	1381	21	1071	1171	1196	1221	1246	0								
1	11	2	A	1285	1102	20	1071	0	0	0	0	0								
1	11	3	B	1285	1219	55	1100	1200	1200	1250	1270	1280								
1	11	4	B	1285	1435	-31	1300	1300	1200	1250	1250	1280								
1	12	1	A	1262	1146	13	915	1015	0	0	0									
1	12	2	A	1262	1236	61	915	1015	1115	1140	1165									
1	12	3	B	1262	1208	-13	1000	1100	1200	1150	1185									
1	12	4	B	1262	1205	-49	1000	1100	1120	1140	0									
1	13	1	A	1393	1444	-56	1106	1206	1306	1331	1356									
1	13	2	A	1393	1286	33	1106	1206	0	0	0									
1	13	3	B	1393	1382	-45	1250	1250	1350	1350	0									
1	13	4	B	1393	1285	-11	1110	1210	1310	1340	0									
1	14	1	A	1405	1221	22	1090	1190	0	0	0									
1	14	2	A	1405	1341	65	1090	1190	1290	1315	0									
1	14	3	B	1405	1289	30	1200	1250	1300	1350	1340									
1	14	4	B	1405	1464	-7	1200	1200	1400	1320	1350									
1	15	1	A	1495	1433	25	1147	1247	1347	0										
1	15	2	A	1495	1355	68	1147	1247	1347	0										
1	15	3	B	1495	1441	81	1300	1300	1400	1450										
1	15	4	B	1495	1583	91	1300	1300	1400	1500										

Supplement

Treatment TEAMS – Set 5

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)													
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
5	1	57	A	1278	1115	-16	949	0												
5	1	58	A	1278	1082	57	950	1051												
5	1	59	B	1278	1260	-96	987	0												
5	1	60	B	1278	1189	50	1000	1051												
5	2	57	A	1348	1475	23	1275	1200	1150	1130	1154	1180	1205	1230	1255					
5	2	58	A	1348	1317	14	1050	1076	1102	1128	1154	1181	1210	1231	1260					
5	2	59	B	1348	1346	-97	1100	1125	1125	1128	1156	1180	1206	1230	0					
5	2	60	B	1348	1377	-93	0	0	0	0	0	0	0	0	0					
5	3	57	A	1073	1015	-18	929	954	0											
5	3	58	A	1073	1172	-27	930	960	980											
5	3	59	B	1073	1246	-11	940	955	980											
5	3	60	B	1073	1067	-58	0	0	0											
5	4	57	A	1266	1191	90	1029	1054	1079	1104	1129	1154								
5	4	58	A	1266	1186	95	1030	1060	1080	1110	1130	1156								
5	4	59	B	1266	1095	-69	0	0	0	0	0	0								
5	4	60	B	1266	1206	99	1030	1055	1080	1106	1130	0								
5	5	57	A	1013	928	14	893	918												
5	5	58	A	1013	1146	98	900	920												
5	5	59	B	1013	825	-25	895	0												
5	5	60	B	1013	897	-25	0	0												
5	6	57	A	1034	1207	8	800	900	1000											
5	6	58	A	1034	852	85	802	902	0											
5	6	59	B	1034	1161	-61	820	910	1007											
5	6	60	B	1034	1029	-12	800	900	0											
5	7	57	A	1454	1356	92	1258	1283	1308	1333	1358									
5	7	58	A	1454	1651	-8	1260	1290	1310	1340	1360									
5	7	59	B	1454	1534	-23	1260	1284	1310	1335	0									
5	7	60	B	1454	1470	-83	0	0	0	0	0									
5	8	57	A	1415	1560	32	1207	1307	1407	1507										
5	8	58	A	1415	1401	20	1210	1310	1408	0										
5	8	59	B	1415	1486	-41	1210	1308	1407	0										
5	8	60	B	1415	1573	-14	1208	1310	1410	0										
5	9	57	A	1491	1307	68	1186	1286	1386	1486	0									
5	9	58	A	1491	1481	94	1190	1290	1390	1487	1590									
5	9	59	B	1491	1533	94	1186	1288	1386	1486	1586									
5	9	60	B	1491	1634	-28	1190	1290	1390	1490	0									
5	10	57	A	1139	1055	-60	828	928	0											
5	10	58	A	1139	985	-37	829	929	0											
5	10	59	B	1139	1133	-10	828	928	1028											
5	10	60	B	1139	1282	-25	830	930	1030											
5	11	57	A	1126	1217	18	925	950	975	1000	1025									
5	11	58	A	1126	965	48	930	951	976	1001	0									
5	11	59	B	1126	1098	45	925	950	975	1000	1025									
5	11	60	B	1126	954	-7	0	0	0	0	0									
5	12	57	A	1433	1614	70	1231	1331	1356	1381										
5	12	58	A	1433	1292	-49	1240	0	0	0										
5	12	59	B	1433	1462	-69	1231	1331	1356	0										
5	12	60	B	1433	1588	-79	1232	1332	1360	1383										
5	13	57	A	1397	1446	64	1045	1070	1095	1120	1145	1170	1195	1220	1245	1270				
5	13	58	A	1397	1507	-77	1050	1080	1100	1130	1150	1180	1200	1230	1250	0				
5	13	59	B	1397	1506	-53	1045	1070	1095	1120	1145	1170	1195	1220	1245	1270				
5	13	60	B	1397	1302	-78	0	0	0	0	0	0	0	0	0	0				
5	14	57	A	1210	1253	22	1029	1129	1229	1254										
5	14	58	A	1210	1332	-9	1030	1130	1230	1260										
5	14	59	B	1210	1369	-53	1029	1129	1229	0										
5	14	60	B	1210	1313	-11	1030	1130	0	0										
5	15	57	A	1338	1526	99	1113	1138	1163	1188	1213	1238	1263	1288	1313	1338	1363			
5	15	58	A	1338	1521	50	1120	1140	1170	1200	1220	1250	1270	1300	1330	1340	1370			
5	15	59	B	1338	1368	61	1113	1138	1163	1188	1213	1238	1263	1288	1313	1338	0			
5	15	60	B	1338	1205	-80	0	0	0	0	0	0	0	0	0	0	0			

Supplement

Treatment TEAMS – Set 6

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)														
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	
6	1	61	A	1428	1410	77	1150	1300	1500	1380											
6	1	62	A	1428	1335	62	1200	1250	1350	0											
6	1	63	B	1428	1551	-100	1200	1250	0	0											
6	1	64	B	1428	1424	-36	1202	1303	1450	1375											
6	2	61	A	1496	1359	-72	1200	0	0	0	0	0									
6	2	62	A	1496	1427	98	1199	1300	1325	1350	1376	1405									
6	2	63	B	1496	1418	-37	1200	1300	1330	1360	1380	0									
6	2	64	B	1496	1422	-39	1201	1301	1351	1352	1385	1405									
6	3	61	A	1016	907	-30	829	930	955	980	1005	0									
6	3	62	A	1016	837	-22	828	0	0	0	0	0									
6	3	63	B	1016	1172	-91	1000	1000	1000	1000	1050	1050									
6	3	64	B	1016	1188	32	999	1001	1011	1050	1061	1062									
6	4	61	A	1488	1634	-28	1175	1280	1380	1405	1430										
6	4	62	A	1488	1673	75	1200	1280	1380	1407	1450										
6	4	63	B	1488	1473	-60	1200	1280	1400	1410	0										
6	4	64	B	1488	1352	-2	1202	1280	0	0											
6	5	61	A	1202	1331	77	1060	1160													
6	5	62	A	1202	1091	11	1060	0													
6	5	63	B	1202	1054	49	1060	0													
6	5	64	B	1202	1320	-17	1060	1220													
6	6	61	A	1489	1419	-97	1135	1235	1335	0	0	0									
6	6	62	A	1489	1598	-9	1200	1250	1335	1435	1460	1485									
6	6	63	B	1489	1448	-14	1200	1250	1350	1450	1500	0									
6	6	64	B	1489	1556	85	1165	1250	1350	1475	1495	1506									
6	7	61	A	1171	1158	-52	1032	1057													
6	7	62	A	1171	1074	-99	0	0													
6	7	63	B	1171	1061	-61	1032	0													
6	7	64	B	1171	1296	-72	1035	1065													
6	8	61	A	1231	1299	42	910	1010	1110	1210	1310	1410	0								
6	8	62	A	1231	1296	63	910	1010	1110	1210	1310	1410	1435								
6	8	63	B	1231	1269	-38	1100	1100	1200	1220	1320	0	0								
6	8	64	B	1231	1363	-41	920	1030	1160	1225	1333	1421	1446								
6	9	61	A	1286	1450	81	1120	1220	1320	1345	1370	1395									
6	9	62	A	1286	1233	36	1116	1220	0	0	0	0									
6	9	63	B	1286	1443	-82	1350	1350	1350	1350	1400	0									
6	9	64	B	1286	1211	87	1125	1240	1340	1355	1381	1402									
6	10	61	A	1184	1051	4	883	983	1083	0											
6	10	62	A	1184	1166	52	883	983	1083	1108											
6	10	63	B	1184	1159	-84	1000	1000	1100	0											
6	10	64	B	1184	1102	-65	890	995	0	0											
6	11	61	A	1306	1136	32	1091	1191	0												
6	11	62	A	1306	1342	48	1091	1192	1216												
6	11	63	B	1306	1186	-92	1100	0	0												
6	11	64	B	1306	1161	-6	1101	1202	1229												
6	12	61	A	1008	1170	69	797	897	997	1022											
6	12	62	A	1008	1004	9	797	897	997	0											
6	12	63	B	1008	913	-55	800	900	0	0											
6	12	64	B	1008	1017	-47	800	909	1017	1031											
6	13	61	A	1462	1433	68	1078	1178	1278	1387	1487	1512									
6	13	62	A	1462	1419	10	1078	1178	1287	1387	0	0									
6	13	63	B	1462	1549	-84	1400	1400	1400	1400	1500	0									
6	13	64	B	1462	1487	3	1200	1199	1299	1399	1499	1521									
6	14	61	A	1194	1304	43	983	1083	1183												
6	14	62	A	1194	1100	51	983	1083	0												
6	14	63	B	1194	1311	-30	1200	1200	1200												
6	14	64	B	1194	1232	-79	1100	1111	0												
6	15	61	A	1296	1144	48	1024	1124	1149	1174	1199	1224	1249	1274	1299	0					
6	15	62	A	1296	1109	-15	1024	0	0	0	0	0	0	0	0	0					
6	15	63	B	1296	1461	-6	1400	1400	1200	1200	1200	1225	1250	1275	1300	1325					
6	15	64	B	1296	1307	-24	1050	1133	1166	1199	1212	1235	1266	1299	1305	1333					

Supplement

Treatment TEAMS – Set 7

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14					
7	1	65	A	1341	1219	91	1280	1157	1280																
7	1	66	A	1341	1476	31	1056	1350	1350																
7	1	67	B	1341	1505	-79	1100	1160	0																
7	1	68	B	1341	1150	56	1056	1156	0																
7	2	65	A	1244	1087	1	1100	1210	0																
7	2	66	A	1244	1317	56	1200	1210	1301																
7	2	67	B	1244	1430	53	1150	1250	1240																
7	2	68	B	1244	1096	-7	1055	0	0																
7	3	65	A	1216	1059	24	1200	1100	1111																
7	3	66	A	1216	1267	31	1152	1153	1185																
7	3	67	B	1216	1023	-11	0	0	0																
7	3	68	B	1216	1079	-50	1055	1085	0																
7	4	65	A	1024	1157	64	800	790	830	850	880	920	928												
7	4	66	A	1024	1191	41	900	901	950	903	966	933	980												
7	4	67	B	1024	960	-94	0	0	0	0	0	0	0												
7	4	68	B	1024	1016	-26	760	790	820	855	876	902	0												
7	5	65	A	1400	1574	83	1250	1350																	
7	5	66	A	1400	1530	-22	1301	1351																	
7	5	67	B	1400	1476	-49	1220	0																	
7	5	68	B	1400	1326	-2	1220	0																	
7	6	65	A	1329	1396	82	1070	1180	1276	1302	1330														
7	6	66	A	1329	1195	28	1111	1205	1340	1340	1340														
7	6	67	B	1329	1517	-51	1070	1175	1280	1303	0														
7	6	68	B	1329	1195	-36	1070	1171	0	0	0														
7	7	65	A	1326	1293	98	1000	1089	1190	1215															
7	7	66	A	1326	1237	-16	1066	1088	1211	1214															
7	7	67	B	1326	1282	-47	988	1090	0	0															
7	7	68	B	1326	1358	-81	987	1089	1189	0															
7	8	65	A	1253	1131	34	918	1019	1044	1069	1095	0													
7	8	66	A	1253	1427	-38	1111	1111	1111	1111	1111	1155													
7	8	67	B	1253	1093	-47	918	0	0	0	0	0													
7	8	68	B	1253	1271	-20	918	1018	1043	1070	1100	1121													
7	9	65	A	1216	1123	96	1030	1200	1153	1178	1204	1230													
7	9	66	A	1216	1046	15	1027	1127	1152	1178	1204	0													
7	9	67	B	1216	1067	99	1028	0	0	0	0	0													
7	9	68	B	1216	1270	-12	1028	1127	1200	1200	1204	1229													
7	10	65	A	1045	1208	90	1100	1100	1100	1126	1226														
7	10	66	A	1045	1122	80	999	999	1111	1158	1225														
7	10	67	B	1045	1032	28	820	921	1022	1126	0														
7	10	68	B	1045	1155	-8	816	920	1025	1125	0														
7	11	65	A	1285	1321	92	1200	1200	1200	1282															
7	11	66	A	1285	1208	95	999	1111	1181	1281															
7	11	67	B	1285	1372	-61	980	1081	1185	0															
7	11	68	B	1285	1260	-80	974	1080	1181	0															
7	12	65	A	1256	1063	26	1078	1179	0	0															
7	12	66	A	1256	1206	61	1111	1222	1279	1304															
7	12	67	B	1256	1371	-53	1080	1180	1283	1305															
7	12	68	B	1256	1259	-18	1077	1178	1279	0															
7	13	65	A	1428	1322	96	1087	1188	1288	1388	1488	0													
7	13	66	A	1428	1617	96	1222	1187	1287	1387	1487	1587													
7	13	67	B	1428	1576	45	1100	1200	1290	1390	1490	0													
7	13	68	B	1428	1603	-35	1086	1188	1287	1387	1487	1588													
7	14	65	A	1238	1428	75	905	1600	1200	1212	1237	1262	1300	1312											
7	14	66	A	1238	1327	57	1111	1111	1111	1255	1255	1261	1286	1312											
7	14	67	B	1238	1077	-56	910	1010	1111	0	0	0	0	0											
7	14	68	B	1238	1398	-53	904	1005	1111	1211	1236	1261	1286	0											
7	15	65	A	1115	1186	50	870	971	1072	1200	1280														
7	15	66	A	1115	1257	12	1200	1200	1200	1177	1277														
7	15	67	B	1115	1249	-27	880	980	1080	1175	0														
7	15	68	B	1115	1285	-39	880	970	1080	1172	0														

Supplement

Treatment TEAMS – Set 8

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)																
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14			
8	1	69	A	1462	1341	87	1200	0	0	0	0	0	0										
8	1	70	A	1462	1278	89	1194	1294	1319	1344	1369	0											
8	1	71	B	1462	1400	-56	1244	1344	1344	1344	1369	0											
8	1	72	B	1462	1337	-7	1194	1294	1319	1344	1369	1394											
8	2	69	A	1380	1215	21	1100	1190	0	0	0	0	0										
8	2	70	A	1380	1360	3	1100	1187	1287	1312	1337	1362	0										
8	2	71	B	1380	1390	34	1424	1200	1300	1320	1340	1390	1390										
8	2	72	B	1380	1415	28	1087	1187	1287	1312	1337	1362	1387										
8	3	69	A	1201	1303	-44	1333	1250	1250														
8	3	70	A	1201	1220	-99	1050	0	0														
8	3	71	B	1201	1147	-86	1100	1200	0														
8	3	72	B	1201	1191	-4	1191	1200	1225														
8	4	69	A	1408	1478	47	1300	1200	1255	1355	1455	0											
8	4	70	A	1408	1271	95	1150	1154	1254	1354	1454	0											
8	4	71	B	1408	1563	-58	1300	1160	1300	1400	1460	1554											
8	4	72	B	1408	1507	-25	1054	1154	1254	1354	1454	0											
8	5	69	A	1321	1281	18	1150	1174	1274	0	0												
8	5	70	A	1321	1343	1	1100	1173	1273	1373	1398												
8	5	71	B	1321	1367	-35	1100	1180	1280	1380	0												
8	5	72	B	1321	1404	80	1073	1173	1273	1373	1398												
8	6	69	A	1040	1225	51	900	920	1020	1045	1100	1095	1120										
8	6	70	A	1040	968	6	820	968	0	0	0	0	0										
8	6	71	B	1040	1083	28	900	950	1020	1045	1070	1095	1120										
8	6	72	B	1040	1174	-91	820	920	1020	1045	1070	1095	0										
8	7	69	A	1466	1502	43	1273	1374	1399	1424	1449	0											
8	7	70	A	1466	1423	52	1300	1373	1398	1423	1448	1473											
8	7	71	B	1466	1387	-74	1280	0	0	0	0	0											
8	7	72	B	1466	1522	-75	1272	1373	1398	1423	1448	1473											
8	8	69	A	1176	1179	58	950	1050	1150	0													
8	8	70	A	1176	1066	92	1000	1049	1149	1249													
8	8	71	B	1176	1135	-33	1000	1049	1149	2000													
8	8	72	B	1176	1177	-2	949	1049	1149	0													
8	9	69	A	1327	1271	93	1084	1184	1284	0													
8	9	70	A	1327	1338	5	1100	1184	1284	1309													
8	9	71	B	1327	1165	-53	2000	2000	0	0													
8	9	72	B	1327	1146	-4	1084	1184	1284	0													
8	10	69	A	1247	1075	7	974	0	0	0													
8	10	70	A	1247	1382	-58	973	1073	1098	1123													
8	10	71	B	1247	1116	-85	2000	2000	2000	0													
8	10	72	B	1247	1229	-8	973	1073	1098	1123													
8	11	69	A	1238	1322	52	981	1082	1181	1281													
8	11	70	A	1238	1376	68	1000	1081	1181	1281													
8	11	71	B	1238	1079	-88	2000	1081	1181	0													
8	11	72	B	1238	1049	-12	981	1081	1181	0													
8	12	69	A	1318	1157	-51	1062	0	0	0													
8	12	70	A	1318	1314	28	1062	1162	1262	0													
8	12	71	B	1318	1344	31	2000	1162	1262	1287													
8	12	72	B	1318	1352	83	1062	1162	1262	1287													
8	13	69	A	1437	1499	61	1233	1333	1434	1458													
8	13	70	A	1437	1447	5	1233	1333	1433	0													
8	13	71	B	1437	1304	-78	2000	1333	0	0													
8	13	72	B	1437	1549	-86	1233	1333	1433	1458													
8	14	69	A	1445	1255	47	1096	1196	0	0	0	0											
8	14	70	A	1445	1269	78	1100	1196	1296	1321	1346	1371	1396										
8	14	71	B	1445	1502	-61	1096	1196	1296	1321	1346	1371	0										
8	14	72	B	1445	1524	-39	1096	1196	1296	1321	1346	1371	1396										
8	15	69	A	1397	1413	-79	1022	1122	1222	1322	0												
8	15	70	A	1397	1592	27	1022	1122	1222	1322	1422												
8	15	71	B	1397	1370	-22	1022	1122	1222	1322	1422												
8	15	72	B	1397	1290	-37	1022	1122	1222	1322	0												

Supplement

Treatment TEAMS – Set 10

Set	Auction	Bidder	Type	cvc	ecvc	pvc	Bidding round (R)																	
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14				
10	1	77	A	1250	1382	78	1150	1200	1253	1353	0													
10	1	78	A	1250	1374	39	1200	1200	1374	1353	1453													
10	1	79	B	1250	1423	-3	1050	1200	1253	1353	0													
10	1	80	B	1250	1182	78	953	1153	1257	1355	0													
10	2	77	A	1458	1414	-99	1252	0																
10	2	78	A	1458	1640	78	1252	1277																
10	2	79	B	1458	1282	-68	0	0																
10	2	80	B	1458	1284	-51	1253	1278																
10	3	77	A	1080	1238	37	800	876	976	1020	1031	1051												
10	3	78	A	1080	1128	50	775	875	0	0	0	0												
10	3	79	B	1080	1010	23	800	900	975	1000	1025	0												
10	3	80	B	1080	1097	-9	776	876	976	1001	1026	1051												
10	4	77	A	1363	1292	11	1103	0	0	0	0													
10	4	78	A	1363	1464	-85	1102	1202	1227	1252	0													
10	4	79	B	1363	1531	34	1200	1300	1250	1280	1300													
10	4	80	B	1363	1384	42	1103	1203	1228	1253	1278													
10	5	77	A	1304	1301	66	1137	1167	0															
10	5	78	A	1304	1234	25	1063	1163	1263															
10	5	79	B	1304	1330	-75	1065	1200	1265															
10	5	80	B	1304	1201	-12	1063	1163	0															
10	6	77	A	1327	1215	30	1003	1028	1054	1080	1106	1132	1158	0										
10	6	78	A	1327	1501	96	1003	1028	1100	1100	1150	1150	1157	1182										
10	6	79	B	1327	1201	-75	0	0	0	0	0	0	0	0										
10	6	80	B	1327	1390	95	1004	1029	1054	1080	1106	1132	1158	1183										
10	7	77	A	1140	1307	-69	968	1068	1093	0														
10	7	78	A	1140	1069	60	968	0	0	0														
10	7	79	B	1140	1174	38	968	1068	1093	1118														
10	7	80	B	1140	1210	-16	968	1069	1094	1118														
10	8	77	A	1374	1193	52	1084	1109	1134	1159	1184	1209	1244	0										
10	8	78	A	1374	1377	76	1084	1109	1134	1159	1184	1209	1234	1259										
10	8	79	B	1374	1227	-99	0	0	0	0	0	0	0	0										
10	8	80	B	1374	1294	-89	1084	1109	1134	1160	1184	1209	1234	0										
10	9	77	A	1498	1394	4	1177	1277	1377	0														
10	9	78	A	1498	1437	7	1177	1277	0	0														
10	9	79	B	1498	1642	83	1177	1277	1378	1403														
10	9	80	B	1498	1510	-88	1177	1277	1377	1402														
10	10	77	A	1244	1128	54	915	1015	1114	1139	1164	1190	1214	1240										
10	10	78	A	1244	1129	24	914	1014	0	0	0	0	0	0										
10	10	79	B	1244	1271	-22	914	1014	1114	1139	1164	1189	1214	0										
10	10	80	B	1244	1344	60	914	1014	1114	1139	1164	1189	1214	1239										
10	11	77	A	1219	1347	81	897	1000	1097	1122														
10	11	78	A	1219	1021	-42	897	997	0	0														
10	11	79	B	1219	1379	-37	900	1000	1097	1122														
10	11	80	B	1219	1029	-47	897	997	1097	0														
10	12	77	A	1333	1446	60	1052	1152	1252															
10	12	78	A	1333	1144	29	1052	1152	0															
10	12	79	B	1333	1362	-62	1052	1152	0															
10	12	80	B	1333	1411	-72	1052	1152	1252															
10	13	77	A	1355	1418	-37	1067	1167	1267	0														
10	13	78	A	1355	1181	98	1067	1167	1267	0														
10	13	79	B	1355	1316	64	1067	1167	1267	1367														
10	13	80	B	1355	1299	-22	1067	1167	1267	1367														
10	14	77	A	1419	1499	70	1200	1230	1330	1418	1443	1468	1493	1520	1543									
10	14	78	A	1419	1487	78	1118	1218	1318	1418	1443	1468	1493	1518	1543									
10	14	79	B	1419	1570	-32	1118	1218	1318	1418	1443	1468	1493	1518	0									
10	14	80	B	1419	1270	-75	1118	1218	1318	0	0	0	0	0	0									
10	15	77	A	1005	974	36	836	950	961	986	1012													
10	15	78	A	1005	1051	20	836	936	961	986	1011													
10	15	79	B	1005	1094	-92	838	0	0	0	0													
10	15	80	B	1005	921	-12	836	936	961	986	0													