Bidding among Friends and Enemies

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Summary

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Keywords: Auctions, revenue, allocation, externalities, toeholds, budget-constraints

JEL: D44, D62, G32

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Abstract

We consider an auction setting in which potential buyers, even if they fail to obtain the good, care about the price paid by the winner. We study the impact of these price-externalities on the first-price auction and the second-price auction in a symmetric information framework. First, we consider situations in which bidders care about the price paid independently from the identity of the winner. We prove that the first-price auction is not affected by this kind of price-externalities while the second-price auction is. In broader specifications, we observe though that the first-price auction can be affected by the presence of such price-externalities. In any case, in comparison with the first-price auction, the second-price auction exacerbates the effects of price-externalities whatever their types. Therefore, there is no revenue equivalence between the two auction formats.

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1. Introduction

In 1999, the Ligue Nationale de Football (LNF), the organism that represents the interests of the French professional soccer teams, auctioned the retransmission

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rights of the French Soccer Championship for the next four years. Canal+ was among the bidders. Canal+ is the leading French pay-TV channel. Moreover, it owns one of the most important French professional soccer teams, i.e. Paris Saint-Germain. In its capacity of TV channel, Canal+ wanted to buy these rights for the lowest possible price. However, the auction revenue was divided among the professional teams including the Paris Saint-Germain. Thus, in its capacity of owner of Paris Saint-Germain, Canal+ preferred the price to be high. As a result, Canal+, independently from the identity of the winner, was not indifferent to the price paid by the winner. More specifically, conditional on losing, it preferred the price to be high. Finally, Canal+ won the ascending auction organized by the LNF, for a total amount of more than a billion Euros. This specific interest in the price conditional on losing the auction is likely to have influenced the strategy of Canal+ during the auction, and indirectly these of the other bidders (TF1, TPS, M6). We may then wonder if Canal+ was more aggressive during the auction process because of this specific interest in the final price. We may also wonder whether the choice of an ascending auction by the LNF was optimal considering the specifity of the situation.

As a matter of fact, because of this specific situation of Canal+, we cannot apply the standard results of the auction theory literature. In fact, this non applicability remains true for any setting in which some bidders, even if they lose the auction, care about the price paid by the winner. Now, bidders may care about the price conditional on losing in many situations. Let us illustrate that point through a few examples.

Consider an auction with two bidders, A and B. Bidder A owns a fraction of bidder B's capital. Then, if bidder B wins the auction, bidder A prefers the price to be low. The reason is that through his shares, he receives a fraction of the profit of bidder B.

Consider another auction setting with 2 bidders, C and D. Suppose that outside the auction itself, bidder C and the seller form a duopoly on a market not related to the object for sale. Markets are imperfect and bidder C and the seller are budget-constrained.[1] Then, bidder C wants the seller to raise the lowest possible amount of money through the auction process. As a matter of fact, the less money the seller receives, the less he will be able to finance research, marketing or other competitive activities on their common market. Finally, whoever the winner is, bidder C prefers the price to be low.

A charity sale: A good is auctioned. All the bidders know that the auction

[1] The budget constraint may be strict or firms may face an increasing cost for money.

revenue will be used to finance a charitable organization. We may assume that many bidders want the charitable organization to raise as much money as possible. Then, independently from the identity of the buyer, bidders prefer the price to be high. Of course, for the winner, there is a trade-off between the interest he has in the funding the organization and his preference for keeping his money for other uses. In any case, even for the winner, the money given to the cause is not exactly lost as it would be in a standard auction.

In all these cases, at least one bidder, even if he fails to win the auction, cares about the price paid by the winner. We call this concern of losing bidders about the price a price-externality (PE).

This short series of examples highlights few different features of price-externalities (PE) which will play a key role in the analysis. First, a losing bidder may have a preference for a low or a high price. Price-externalities may be decreasing or increasing functions of the price. Second, the PE incurred by a bidder may depend on the identity of the winner (as in the toehold case) or it may be identical whoever the winner is, including the bidder himself (as for the charity sale). Thus, we build the following typology. When the identity of the buyer matters, we speak of winner-identity-dependent-price-externalities (WIDPE). When the identity of the winner does not matter, we speak of winner-identity-independent-price-externalities (WIIPE).

In this paper, we examine how both types of price-externalities affect the equilibria of the first-price auction and the second-price auction. Here, the two other standard auction formats, the descending and the ascending auction are equivalent to respectively the first-price auction and the second-price auction.

We choose to consider these auction formats for two reasons. First, most of the time, sellers actually use one of these auction formats. Second, they are extreme cases regarding the impact that a loser can have on the final price. In the first-price auction, losers' bids do not affect at all the price paid by the winner. In the second-price auction, this is quite the opposite. The price is completely determined by the bid of a losing bidder. These extreme specifications allows to better illustrate the points we are interested in.

For the sake of simplicity, we focus on the two-buyers case. This is sufficient for the illustration of the effects caused by the presence of price-externalities. Besides, with more than two bidders, we would have to distinguish between the specific effects of price-externalities and the effects of allocative externalities (cf. infra). We discuss the extension to the case with more than two bidders and the robustness of our results in the last section.

We observe the following results. First, WIIPE do not have any effect on the equilibrium of the first-price auction, while they generically have an effect in a second-price auction. The intuition is as follows. WIIPE, by definition, do not depend on the identity of the winner. Therefore, they do not affect the price for which bidders are indifferent between winning and losing. In a first-price auction, it turns out that equilibrium bids depend only on these indifference-prices. Thus, WIIPE do not have any impact on the equilibrium of the first-price auction. On the other hand, in a second-price auction, a losing bidder may fix the price through his bid. Then, if he strictly prefers the price to be the highest (resp: the lowest) possible, he will raise (resp: lower) his bid. As a result, in a second-price auction, the equilibrium is affected by WIIPE. Consequently, the first-price auction and the second-price auction are not equivalent and do not generate the same revenue.

With WIDPE, things are slightly different. By definition, WIDPE depend on the identity of the winner. Then, they do affect the price for which bidders are indifferent between losing and winning the auction. As we said before, this indifference-price is the only element that matters in a first-price auction. Therefore, WIDPE do affect the equilibrium of the first-price auction. However, even when there are only WIDPE, the two auction formats are not equivalent either. The second-price auction is more sensitive to WIDPE than the first-price auction. In other words, the second-price auction exacerbates the effects of WIDPE. Once again, this is due to the very structure of the second-price auction in which the loser, through his bid, determines the price paid by the winner.

To grasp some intuition as to why the first-price auction and the second-price auction are different in this context, suppose, for instance, that price externalities are decreasing functions of the price. Then, the losing bidder prefers to bid zero in a second-price auction, in order to minimize the price paid. As a result, the price is equal to zero. In a first-price auction, the loser cannot have a direct impact on the price. Bidding zero has no direct effect on the price.[2] Besides, bidding zero is not an optimal strategy if it turns out that the bid of the competitor is mistakenly low. Thus, at the equilibrium of the first-price auction, the loser does not bid zero and the price is not equal to zero.

For these reasons, WIDPE affect in different ways the two auction formats. Downwards or upwards, the second-price auction amplifies the consequences of WIDPE. Moreover, given what we already said regarding WIIPE, this amplification remains true with any type of price-externalities.

[2] In a first-price auction, only a commitment to bid zero would have an effect. However, we will see that such a commitment is not credible.

While the literature on auction theory is flourishing, few papers have been published so far on topics related to price-externalities considerations. The idea of auctions with externalities was only recently introduced. Articles such as Jehiel and Moldovanu (1996) or Jehiel and Moldovanu (2000) first present the possible consequences of allocative externalities in an auction framework. In this literature, the key element is not the price but rather the identity of the winner. They assume that a losing bidder may have preferences regarding the identity of the winner. As a result, they observe equilibrium multiplicity and strategic non-participation. In our setting, the main issue is not that bidders care about who wins but rather that they care about how much money is spent by the winner. Then, we observe qualitatively different results that derive from other motivations. Contrary to what they observe in their original setting (see Jehiel and Moldovanu (1996)) without reserve price or entry fees,[3] here, the standard auction formats are not equivalent. Hence, we observe clear-cut differences between auction formats that could not appear in their framework.

Apart from this literature that focus on allocative externalities, there is no systematic study of auctions with externalities. However, other papers consider specific situations with price-externalities.

In a symmetric information framework, Pitchik and Schotter (1988) study sequential auctions with budget-constrained bidders. They observe that the standard auction formats are not revenue equivalent. In fact, this can be reinterpreted as a specific application of our more general results. Benoit and Krishna (2000) also analyze sequential auctions with budget-constrained bidders but with a different perspective. The paper emphasizes matters such as the best sequencing to sell goods. We are more focused on the situation of a seller who has a unique good to sell. We take the environment as given and recommend an adequate format to sell his good

In an asymmetric information framework, Bulow, Huang and Klemperer (1999) consider a setting in which bidders own a fraction of the good for sale. They assume that the value of the good is common and derive that small asymmetries among bidders -in terms of fraction of the good they own- may have dramatic effects. In fact, their point is more related to the impact of asymmetries in a common value environment than specifically to price-externalities.[4] Finally,

[3] For an analysis of the impact of reserve prices and entry fees in the context of auctions with externalities, see Jehiel and Moldovanu (2000).

[4] See, on this topic, their other papers such as Klemperer (1998) or Bulow and Klemperer (1999).

Burkart (1995), Singh (1998), Engelbrecht-Wiggans (1994) Maasland and Onderstal (2001) and Ettinger (2001) study the impact of some types of toeholds in an asymmetric information framework. Our results are generally consistent with theirs. Our choice to consider a symmetric information framework allows us to study a broader range of situations and to emphasize the result that are solely due to price-externalities rather than a mix of asymmetric information and price-externalities.

The remainder of the paper is organized as follows. Section 2 introduces the model. Section 3 shows how a wide range of applications fits into the model. Section 4 studies the first-price auction. Section 5 considers the second-price auction and compares the result of both auction types. Section 6 suggests recommendations and presents possible extensions.

2. The model

One good is sold through an auction process to two bidders, 1 and 2. Bidders' preferences may depend on the identity of the winner and the price paid by the winner whoever the winner is. For $i = 1, 2$, bidder i's preference is represented by a Von Neuman-Morgenstern utility function U_i. $U_i(k, p)$ stands for the utility of bidder i if the good is bought for a price p by bidder k, with $k = 1, 2$.

Without lost of generality, we can normalize utilities so that if $i \neq j$, $U_i(j, 0) = 0$. If a bidder buys the good for sale for the price zero, the other bidder derives a utility zero. Besides, we assume that utilities functions are common knowledge among bidders and that utilities are non transferable.

For convenience, we introduce v_i, $f_i(p)$ and $g_i(p)$ defined by:

$$\begin{aligned} v_i &= U_i(i, 0) \\ g_i(p) &= U_i(i, p) - (v_i - p) \\ f_i(p) &= U_i(j, p) - g_i(p) \end{aligned}$$

Utility functions can then be written:

$$U_i(i, p) = v_i - p + g_i(p) \tag{2.1}$$

$$U_i(j, p) = f_i(p) + g_i(p) \tag{2.2}$$

The functions $g_i(p)$ and $f_i(p)$ are to be interpreted as follows. $g_i(p)$ is the winner-identity-independent-price-externality (WIIPE) incurred by bidder i if the good is sold for the price p, whoever the buyer is. $f_i(p)$ is the winner-identity-dependent-price-externality (WIDPE) incurred by bidder i if the good is sold for the price p specifically to bidder j. As a matter of fact, whoever the winner is, if the price paid is p, $g_i(p)$ appears in the utility function of bidder i. Besides, if bidder j buys the good for the price p, the utility of bidder i is $g_i(p) + f_i(p)$. $g_i(p)$ is the WIIPE incurred by bidder i if the price paid is p. Then, $f_i(p)$ must be the WIDPE, the residual price-externality that bidder i incurs specifically because this is bidder j who pays p. Everything else corresponds to the standard representation of bidders' utilities in an auction setting, v_i playing the role of bidder i's valuation for the good. Therefore, whatever the shapes of $U_i(i,p)$ and $U_i(j,p)$ are, we do not lose any generality by representing the different types of price-externalities in an additively separable fashion. We also remark that in the case without price-externalities i.e. $f_1 = f_2 = g_1 = g_2 = 0$, $U_i(i,p) = v_i - p$ and $U_i(j,p) = 0$ as in the standard case.

We consider two auction formats, the first-price auction and the second-price auction. In both auction formats, each bidder submits simultaneously a bid $b \geq 0$ and the one who submits the highest bid obtains the good. In the first-price auction, the winner pays the amount of his bid. In the second-price auction, he pays the second highest bid which reduces here to the bid of his opponent.

Whatever the auction format is, if both bidders submit the same bid, b, the price paid is b and the following tie-breaking rule is applied. Bidder i obtains the good if $v_i - f_i(b) > v_j - f_j(b)$.[5] If $v_1 - f_1(b) = v_2 - f_2(b)$, the seller flips a fair coin to choose the winner.

We make the following Assumptions. For $i = 1, 2$:

- A1. $U_i(i, 0) > 0$.
- A2. $U_i(i,p)$ and $U_i(j,p)$ are continuous and differentiable functions of p.
- A3. for $p \geq 0$, $\frac{\partial U_i(i,p)}{\partial p} < 0$.
- A4. for $p \geq 0$, $\frac{\partial U_i(i,p)}{\partial p} < \frac{\partial U_i(j,p)}{\partial p}$.

[5] In this kind of situation, the standard hypothesis is that the limit of the discrete case is to allocate the good to bidder i if $v_i > v_j$. In our model, what is important for a bidder is not his v_i but his utility difference for his obtaining the good or not $U_i(i,p) - U_i(j,p) = v_i - p - f_i(p)$. Comparing the values of this formula between the two bidders is equivalent to a comparison between $v_1 - f_1(p)$ and $v_2 - f_2(p)$. Hence, our tie-breaking rule.

- A5. $\nexists p$ such that $U_i(i,p) = U_i(j,p)$ and $U_j(j,p) = U_j(i,p)$ (genericity-Assumption).

With the notations that we introduced, this can be written:

- A1'. $v_i > 0$.
- A2'. f_i, g_i are continuous and differentiable.
- A3'. for $p \geq 0$, $g_i' < 1$.
- A4'. for $p \geq 0$, $f_i' > -1$.
- A5'. $\nexists p$ such that $v_i - p = f_i(p)$ and $v_j - p = f_j(p)$.

Assumption A1 is equivalent to a strict preference for buying the good rather than leaving it to the other bidder when the price is zero. Assumptions A3 and A4 suggest some form of limited altruism. They can be interpreted as follows. A3: All the bidders have a strict preference for paying the lowest possible price, a limit to the altruism in the direction of the seller. A4: In the neighborhood of any price, for both bidders, the marginal disutility of paying ε more is always strictly higher than the marginal disutility of the other bidder's paying ε more. This is a limit now to the altruism in the direction of the other bidder. Assumptions A2 and A5 are purely technical.

Notation: $v = (v_1, v_2)$, $f = (f_1, f_2)$ and $g = (g_1, g_2)$.

A strategy for a bidder is a bid $b \geq 0$ and an equilibrium is a couple (b_1, b_2). We only consider equilibria with pure and non-dominated strategies.

Eventually, let us define (i,p), with $i \in \{1,2\}$ and $p \in R^+$, as an outcome of the auction. An outcome (i,p) is enforceable if and only if there exists an equilibrium of the auction such that the good is allocated with probability 1 to bidder i for the price p. By extension, the price p is enforceable if and only if, there exist an i such that (i,p) is an enforceable outcome. The allocation i is enforceable if and only if there exists a p such that (i,p) is an enforceable outcome.

3. Illustrations

In this section, we provide some motivations for looking at price-externalities. We develop two examples, one with increasing WIIPE and the other with increasing WIDPE. Through these examples, we also show how we derive our representation from situations with price-externalities and that, in standard cases, Assumptions A1-A5 are satisfied.

Example 3.1. Increasing WIIPE. *A good is auctioned by a charitable organization to either bidder 1 or 2. The value of the good for bidder i is V_i with $V_1 < V_2$. Bidder i derives a specific extra utility $u_i(p)$ when the organization receives an amount of money p with u_i continuously differentiable. For $i = 1, 2$, we have $u_i(0) = 0$ and $0 < u_i' < 1$. We can represent agents as if they were maximizing the following utility functions:*

$$U_1(1, p) = V_1 - p + u_1(p) \quad and \quad U_1(2, p) = u_1(p)$$
$$U_2(1, p) = u_2(p) \quad and \quad U_2(2, p) = V_2 - p + u_2(p).$$

With our formalism, this can also be represented by:

$$v = (V_1, V_2), \quad f_1(p) = f_2(p) = 0, \; g_1(p) = u_1(p) \text{ and } g_2(p) = u_2(p).$$

Both bidders, conditional on losing, prefer the price to be high since $0 < u_1', u_2'$. We observe that Assumptions A1-A5 are verified. More specifically, Assumption 3 is verified because $u_1', u_2' < 1$.

Example 3.2. Increasing WIDPE. *Two risk-neutral bidders, bidder 1 and 2, are competing in two sequential auctions, first for good A and then for good B. The valuations for both goods are: $V_A^1 = 70$, $V_B^1 = 100$, $V_A^2 = 80$, $V_B^2 = 100$. Bidder 2 has a strict budget constraint of 100 and bidder 1 has no budget constraint. Good A is sold at date $t = 1$ and good B is sold at date $t = 2$, with a probability β. After the first auction, before knowing if the second auction will take place or not, the utility that bidder 1 expects to derive from the second auction[6] is βq, q being the money spent by bidder 2, in the first auction. By backward induction, we can apply our model here to the auction of good A. At date $t = 1$, expected utilities depending on the allocation of good A can be written as follows:*

$$U_1(1, p) = 70 - p \quad , \; U_1(2, p) = \beta \min(p, 100)$$
$$U_2(1, p) = 0 \quad and \quad U_2(2, p) = 80 - p$$

With our formalism, this can also be represented by:

$$v = (70, 80), \; f_2(p) = g_1(p) = g_2(p) = 0 \text{ and } f_1(p) = \beta \min(p, 100)$$

[6] Whether it is a second-price auction or a first-price auction has strictly no incidence.

Bidder 1 prefers that bidder 2 pays a high price, then f_1 is increasing in p. Assumptions A1-A5 are verified. More specifically, Assumption 4 and 5 are verified because $\beta \geq 0$.

Through these examples, we showed in which way our model represents price externalities. We will also refer to them across the paper to illustrate our results.

4. The first-price auction

This section studies how the presence of price-externalities affects the outcome of the first-price auction. We compute the equilibrium and observe that g (WIIPE) do not have any impact on the determination of the equilibrium. It is uniquely defined by v and f (WIDPE).

First, let us remark that, in our model, v_i is not the price for which bidder i is indifferent between obtaining or not the good for sale. It represents the difference in utility for bidder i between obtaining the good at a price zero and leaving it to the other bidder for a price zero. With the addition of price-externalities, v_i is no longer the value for which bidder i is indifferent between his buying or the other bidder's buying the good. Then, let us define e_i, bidder i's indifference-price as:

$$U_i(i, e_i) = U_i(j, e_i)$$

Bidder i is indifferent between the two events: "Bidder i buys the good for a price e_i" and "Bidder j buys the good for a price e_i".[7] The existence and uniqueness of a strictly positive e_i follows from Assumption A1, A2, and A4. Furthermore, our genericity Assumption (A5) implies that $e_1 \neq e_2$.[8] Then, without loss of generality, from now on, we will assume that $e_1 < e_2$. Besides, it follows from A4 that for $p < e_i$, bidder i prefers buying the good and for $p > e_i$, he prefers leaving it to bidder j.

[7] In the standard case, without price-externalities, this gives us $e_i = v_i$.

[8] This result allows us to rule out the possibility of equilibrium with both bidders obtaining the good with a probability $\frac{1}{2}$. As a matter of fact, suppose that (b, b) is an equilibrium such that both bidders obtain the good with probability $\frac{1}{2}$. As $e_1 \neq e_2$, then $\exists i$ such that $e_i \neq b$.

In a first-price auction, if $b < e_i$ then $v_i - b + g_i(b) > f_i(b) + g_i(b)$ and, by continuity, $\exists \varepsilon > 0$ small enough such that bidder i is better off bidding $b + \varepsilon$. If $b > e_i$ as $v_i - b + g_i(b) < f_i(b) + g_i(b)$, bidder i is better off bidding e_i.

In a second price auction, if $b < e_i$ then $v_i - b + g_i(b) > f_i(b) + g_i(b)$ and bidder i is better off bidding e_i. If $b > e_i$ as $v_i - b + g_i(b) < f_i(b) + g_i(b)$, by continuity, $\exists \varepsilon > 0$ and small enough such that bidder i is better off bidding $b - \varepsilon$.

The equilibrium of the first-price auction derives directly from the status of e_1 and e_2.

Proposition 4.1. *Suppose $e_1 < e_2$, then there is a unique equilibrium of the first-price auction: both bidders submit e_1 and bidder 2 buys the good for a price e_1.*

Proof: see the Appendix.

In a first-price auction, only the prices for which bidders are indifferent between winning and losing the auction matter. The bidder with the highest indifference-price wins the auction and pays the indifference-price of his opponent.[9]. This equilibrium derives from the two following constraints. First, it is a dominated strategy for bidders to submit more than their indifference prices. Second, the winning bid cannot be lower than the indifference price of the loser. Otherwise, the loser could profitably overbid it.

Corollary 4.2. *WIIPE (g) do not affect the equilibrium of the first-price auction.*

Proof: $U_i(i, e_i) = U_i(j, e_i)$ can be rewritten $v_i - e_i + g_i(e_i) = f_i(e_i) + g_i(e_i)$. We derive: $v_i - e_i = f_i(e_i)$. Thus, e_i does not depend on g_i. It follows that the equilibrium of the first-price auction is independent from WIIPE. Q.E.D.

The equilibrium price is equal to the second highest indifference-price. Indifference-prices are independent from WIIPE. Thus, the equilibrium is also independent from WIIPE.

To illustrate that result, we can consider example 3.1 (the charity sale). There, $e_1 = V_1$ and $e_2 = V_2$. Then, in a first-price auction, at the equilibrium, bidder 2 wins the good and pays a price V_1. This result is equivalent to what would have happened without price-externalities. In fact, both bidders would like the charity organization to receive the highest possible amount of money. However each bidder always prefers a dollar in his pocket than a dollar given to the charity organization (in accordance with Assumption A4). As a result, bidders are indifferent between winning and losing the auction when the price is equal to their valuations for the good. Finally, the bidder with the highest valuation buys the good for a price equal to the second highest valuation as in the standard case. WIIPE have no impact on the outcome of the auction.

In contrast, WIDPE affect the equilibrium as stated in the following corollary.

[9] Here, indifference-prices play the part that valuations play in a standard setting.

Corollary 4.3. *Suppose that $\overline{f}_1, \underline{f}_1$ are such that for $p > 0$, $\overline{f}_1(p) > \underline{f}_1(p)$. Then, whatever v, g, f_2*[10] *are, the equilibrium price of $< v, (\overline{f}_1, f_2), g >$ is lower than the equilibrium price of $< v, (\underline{f}_1, f_2), g >$.*

Proof: Let us define $\overline{e}_1$ (resp: $\underline{e}_1$) as the indifference for $U_1(1,0) = v_1$ and $f_1 = \overline{f}_1$ (resp: $\underline{f}_1$). From proposition 4.1, we derive that $\overline{e}_1$ is the equilibrium price of $< v, (\overline{f}_1, f_2), g >$. Suppose that $\underline{e}_1 \leq e_2$, then the equilibrium price of $< v, (\underline{f}_1, f_2), g >$ is $\underline{e}_1$. However, as for $p > 0$ $\overline{f}_1(p) > \underline{f}_1(p)$ and $v_1 - \underline{e}_1 = \underline{f}_1(\underline{e}_1)$, we derive $v_1 - \underline{e}_1 < \overline{f}_1(\underline{e}_1)$ then $\overline{e}_1 < \underline{e}_1$. Now, suppose that $\underline{e}_1 > e_2$, the equilibrium prices are e_2 and $\overline{e}_1$ and by definition $\overline{e}_1 < e_2$. Q.E.D.

If for any $p > 0$, $f_1(p)$ increases, it means that the utility bidder 1 derives if bidder 2 buys the good for a price p is higher. Therefore, he is less eager to win the auction since his utility is higher if he loses the auction. His indifference-price is lower and he submits a lower bid. Bidder 2 takes these elements into account and submits a lower winning bid. This result is reminiscent of what was observed with fixed allocative externalities (see Jehiel and Moldovanu (1996)). In that case also, with two bidders, the larger the externality that the loser derives conditional on losing, the lower the final price.

To illustrate this result, let us reconsider example 3.2. We had $v = (70, 80)$, $f_2(p) = g_1(p) = g_2(p) = 0$, $f_1(p) = \beta \min(100, \beta)$, therefore $e_1 = \frac{70}{1+\beta}$ and $e_2 = 80$.

At the equilibrium (see proposition 4.1), the price paid is $\frac{70}{1+\beta}$ which is indeed a decreasing function of β. If β increases, it is more important for bidder 1 that bidder 2 buys good A for a high price as it becomes more and more likely that the second auction will take place. However, the equilibrium price goes in the opposite direction. The larger β is, the smaller is the price paid by bidder 2 for good A. At the extreme, if β goes to 1, bidder 2 pays 35 for good A while if β goes to 0, bidder 2 pays 70 for good A.

As β increases, it is indeed more important for bidder 1 that bidder 2 spends a higher fraction of his budget on the first auction. For any additional dollar spent by bidder 2 in the first auction, the expected gain of bidder 1 in the second-auction increases by β dollar. However, this gain exists also if the price is low. Even for a relatively small bid submitted by bidder 2, bidder 1 prefers that bidder 2 obtains the good and spends this amount of money. This second effect dominates, all the more so since bidder 1 cannot have a direct impact on the price paid by bidder

[10] As we do not want to lose any generality, we keep $\overline{e}_1 < e_2$ but we do not impose that $\underline{e}_1 < e_2$.

2. The larger β is, the less credible is bidder 1 if he threatens bidder 2 with submitting a high bid. Bidder 1 submits a small bid and bidder 2 submits the smallest necessary bid to overbid him and win the auction. Finally, the equilibrium price of the first auction is decreasing in β.

5. The second-price auction

In this section, we study the impact of price-externalities on the equilibria of the second-price auction. Both WIIPE and WIDPE affect equilibria of the second-price auction. As a result, there is no revenue equivalence between the second-price auction and the first-price auction. Besides, this non equivalence remains true even if there are only WIDPE. The second-price auction accentuates the effects of any type of price-externalities. At last, we study with more details the equilibria for different structures of price-externalities.

5.1. The general case

In the first-price auction, at the equilibrium, the losing bid is important uniquely because it deters the winner from bidding less. That is why it is equal to the price for which the loser is indifferent between winning and losing. In the second-price auction, with two bidders, by definition, the losing bid determines the price. Suppose that, for instance, at the equilibrium, bidder i is the loser and $b_j > 0$.[11] Then b_i must be such that $b_i \in \arg\max_{x \in [0, b_j]} (f_i(x) + g_i(x))$. Through this formula, we see that,contrary to what we observed in the first-price auction, in a second-price auction, g_i (WIIPE) may determine the losing bid i.e. the price.

In order to illustrate that point and give some intuitions about the differences between the first-price auction and the second-price auction, we introduce the following example.

Example 5.1. *$v = (10, 15)$ and for $p \geq 0$, $f_1(p) = f_2(p) = g_2(p) = 0$. Then $(e_1, e_2) = (10, 15)$ and whatever g_1 is, the equilibrium in a first-price auction is $(10, 10)$ with bidder 2 obtaining the good.*

Now, let us define g_1 as follows: $g_1(p) = \min(\frac{p}{k}, 2 - \frac{p}{k})$ with $k \in (1, 15)$.

Then, there is a unique equilibrium of the second-price auction: $(k, 15)$.

[11] Which must always be the case since, for a price zero, both bidders strictly prefer obtaining the good (Assumption A1).

Corollary 5.2. *WIIPE (g) have an impact on the equilibrium of the second-price auction.*

Example 5.1 points out the possible impact of WIIPE on the equilibrium of the second-price auction. f_2 and g_2 are null-functions, then it is a dominant strategy for bidder 2 to submit his valuation. In any case, the price for which bidder 1 is indifferent between winning and losing is strictly lower than the bid of his opponent. Thus, he never overbids bidder 2. Since bidder 1 loses the auction, his bid will determine the price. Then, he submits a bid equal to the price he prefers his opponent to pay in the interval $[0, 15]$. This price that he prefers depends on both f_1 and g_1. In fact, these results can be extended to a more general framework.

Proposition 5.3. *For v, f such that $e_1 < e_2$ and for any $p^* \in [0, e_2]$, there always exist a g such that p^* is an enforceable price of the second-price auction. Reciprocally, for any v, f, g satisfying Assumptions A1-A5 and such that $e_1 < e_2$, any enforceable price of the second-price auction must be in the interval $[0, e_2]$.*

Proof: For any v, f and for any $p^* \in [0, e_2]$, we can always build a g such that p^* is an enforceable price. For instance, let us define g as follows.

$g_2(p) = -f_2(p)$ and $g_1(p) = -f_1(p) + \varepsilon(p^* - \mid p^* - p \mid)$ with $\varepsilon > 0$ such that $g_1' < 1$ which always exists as $f_1' < -1$ (Assumption A4').

Then (p^*, e_2) is an equilibrium and p^* is an enforceable price.

Now suppose that for a given $< v, f, g >$ there exists an equilibrium (b_i, b_j) such that bidder i obtains the good for a price $p > e_2$. In that case, we would have $e_1 < e_2 < b_j = p \leq b_i$. However, as $g_i' < 1$, we have $U_i(i, p) = v_i - p + g_i(p) < v_i - e_i + g_i(e_i) = g_i(e_i) + f_i(e_i)$. Then bidder i can profitably deviate bidding e_i. (b_i, b_j) is not an equilibrium. Q.E.D.

Corollary 5.4. *There is no equivalence between the first-price auction and the second-price auction.*

Contrary to what happens with a first-price auction, in a second-price auction, the equilibrium price is not always the lowest indifference-price. Depending on the shapes of both types of price-externalities, the equilibrium price may have any value in the interval $[0, e_2]$, e_2 being the highest of the two indifference-prices. For more precise results regarding the price and the allocation, we must put more constraints on the structure of price externalities.

Hence, we make the following Assumptions for the remaining part of the paper:

- B. For $i = 1, 2$, $U_i(j, p)$ is strictly monotonic.

Equivalent to

- B'. For $i = 1, 2$, $h_i = f_i + g_i$ strictly monotonic.

The utility of a bidder, conditional on losing, is always a strictly monotonic function of the price paid by the winner. If he loses the auction, a bidder has a strict preference over his opponent paying the lowest or the highest possible price. In the following sub-sections, we study in details the equilibria of the second-price auction when this Assumption is verified and for the different specifications.

5.2. $U_1(2, p)$ and $U_2(1, p)$ are co-monotonic

Here, we suppose that conditional on losing the auction, both bidders prefer their opponent to pay the highest possible price or both bidders prefer their opponent to pay the lowest possible price. We could say that they are mutual friends or mutual enemies. Results are clear-cut, in that case.

Proposition 5.5. *If h_1 and h_2 are strictly increasing, there is a unique equilibrium: (e_2, e_2) and the good is allocated to bidder 2.*

Proposition 5.6. *If h_1 and h_2 are strictly decreasing, the only enforceable price is 0. $(2, 0)$ is always an enforceable outcome and $(1, 0)$ is an enforceable outcome if an only if $v_2 - e_1 + g_2(e_1) \leq 0$.*

Proofs: see the Appendix.

Let us compare proposition 5.5 and proposition 5.6 to what we have obtained in the first-price auction case. As we already said, WIIPE are a key-element in the second-price auction while they have strictly no incidence in a first-price auction. However, even if we neutralize WIIPE (i.e. for $p \geq 0$, $g_1(p) = g_2(p) = 0$), we still observe many differences. In the first-price-auction, the equilibrium price is a smooth function of the losing bidder's WIDPE. The result is more extreme with the second-price-auction. If bidders are mutually benevolent (h_i are decreasing), the price is at its minimum, zero. If they are mutually malevolent (h_i are increasing), the winner pays the highest price such that he does not strictly prefer leaving the good to his opponent. The second-price-auction exacerbates the effect of price-externalities, leading to these extremum prices.

Furthermore, unlike in the first-price auction case, if the loser prefers that the winner pays a high (resp: low) price, the winner j does not pay a lower (resp: higher) price, quite the reverse. If the loser prefers the price to be high (resp: low), the price is actually at its maximum (resp: minimum). This is the complete reversed as compared to what we observed with the first-price auction in corollary 4.3.

We can interpret this difference in terms of credibility. In both auction formats, one of the two bidders would like to commit but cannot. For instance, if h_1 is increasing, in the first-price auction, bidder 1, the losing bidder, would like to commit to a bid of e_2. That way, he would force bidder 2 to bid e_2 and to pay e_2. In the same case, with a second-price auction, bidder 2 would like to commit to a bid of e_1. That way, he would force bidder 1 to bid e_1 which would allow bidder 2 to obtain the good for the price e_1. However, none of these commitments are credible. They require bidders playing dominated strategies. Thus, the ruling out of dominated strategies constrains the losing bidder more in the first-price auction and the winning bidder more in the second-price auction. That is why, even in the absence of WIIPE, we do not observe the same equilibria in the first-price and the second-price auctions. The burden of the credibility is on a different bidder in each auction format.

5.3. $U_1(2,p)$ and $U_2(1,p)$ are non co-monotonic

Now, we suppose that bidders have opposite preferences concerning the price paid, conditional on losing the auction. One prefers it to be the highest possible and the other prefers it to be the lowest possible. Then, in most cases, the equilibrium price is 0. The aggressive bidder takes advantage of the benevolence of the other bidder.

Proposition 5.7. *If h_1 strictly increasing and h_2 strictly decreasing then*

- $(1,0)$ *is an enforceable outcome and there is no other enforceable outcome in which bidder 1 wins the auction.*

- (b,b) *is an equilibrium with bidder 2 obtaining the good if and only if $b \in [e_1,e_2]$ and $v_2 - b + g_2(b) \geq 0$. There are no other possible equilibria with bidder 2 obtaining the good.*

Proposition 5.8. *If h_1 strictly decreasing and h_2 strictly increasing then $(2,0)$ is the only enforceable outcome.*

Proofs: see the Appendix.

As in the co-monotonic case, equilibrium prices are more often than not extreme. Still, we observe the following phenomenon that could not appear in the former setting.

Suppose bidder i prefers that bidder j pays a low price in case bidder j obtains the good and bidder j has the opposite preferences concerning bidder i. Then, whatever v is, there are equilibria in which bidder i obtains the good for a price zero. We illustrate this point with the following example.

Example 5.9. *We consider a second-price auction with two bidders. Bidder 1 owns 5% of the seller's capital, bidder 2 owns 10% of bidder 1's capital. The valuations for the good for sale are* $V_1 = 5$ *and* $V_2 = 20$. *With our representation, this is equivalent to* $v = (5, 19.5)$, *for* $p \geq 0$ $f_1(p) = g_2(p) = 0$, $f_2(p) = -\frac{p}{10}$ *and* $g_1(p) = \frac{p}{20}$. *Then* $e_1 = 5$ *and* $e_2 = \frac{65}{3}$. $v_1 \lll v_2$ *and* $e_1 \lll e_2$. *Nevertheless,* $(20, 0)$ *is an equilibrium.*

If bidder 1 loses the auction, he strictly prefers bidder 2 to pay a high price. Thus, submitting an extremely high bid is not a dominated strategy for bidder 1. Bidder 1 can credibly threaten bidder 2 with submitting a high bid. At the equilibrium, bidder 2 knows that bidder 1 does indeed submit a high bid. His best-response is to bid zero as he strictly prefers bidder 1 to pay the lowest possible price. Therefore, we obtain equilibria as the one we have exhibited.

When a bidder is benevolent towards another bidder and this second bidder, on the contrary, is malevolent towards the first bidder, the second bidder can always turn the situation to his advantage. He can benefit from the benevolence of the first bidder and obtain the good for the lowest possible price, here zero.

6. Summary and possible extensions

In this final section, we summarize our results, suggest some recommendations and propose natural extensions to our work.

6.1. Summary

Auction format	Specifications	Enforceable price
First-price	-	e_1
Second-price	-	$[0, e_2]$
Second-price	h_1 and h_2 strictly increasing	e_2
Second-price	h_1 and h_2 strictly decreasing	0
Second-price	h_1 stric. decreasing, h_2 stric. increasing	0
Second-price	h_1 stric. increasing, h_2 stric. decreasing	$0 \cup [e_1, e_2]$

Table 1. Enforceable prices depending on the auction formats and for different specifications of h.

Table 1 presents the enforceable prices with both auction formats and for different specifications of h. It is particularly flagrant that in the second-price auction, in most cases, the price is at an extremum, 0 or e_2 while, in the first-price auction, it is always around some kind of an intermediate value, e_1. However, let us be more precise and summarize our results with the four following points:

- There is no revenue equivalence between the two auction formats. The difference between equilibrium prices can be large.
- The equilibrium of the first-price auction does not depend on WIIPE while WIIPE do affect the equilibrium of the second-price auction.
- The burden of credibility is on a different bidder for each auction format. On the loser in the first-price auction, on the winner in the second-price auction. Consequence: in a first-price auction, a losing bidder, if he prefers the price to be the lowest possible, cannot credibly commit to bid less than his indifference price, e_1. Therefore, the price is e_1. In a second-price auction, he will bid 0 which will be the final price (we have presented in a former section the symmetric case: when the loser prefers the price to be high. With a second-price auction, the price is e_2 and with a first-price auction, the price is e_1.)
- Consequence of the former point: the second-price auction magnifies the effect of price-externalities while the first-price auction tempers them. The second-price auction which was designed partly in view of his robustness properties (it relies on dominant strategies) is more sensitive than the first-price auction to the introduction of price-externalities.

6.2. Recommendations

Across the paper we made the underlying assumption that the seller does not know the exact value of $< v, f, g >$. Nevertheless, in general, the seller has a qualitative perception of the kind of price-externalities bidders are facing. The seller may perceive two polar cases. From our results, we derive the following. In the first case, the most favorable to the seller, price-externalities are increasing in the price. In the second case, the most unfavorable to the seller, price externalities are decreasing in the price. In the first case, in order to take advantage of price-externalities, the seller should choose the second-price auction. In the second case, in order to protect himself from undesirable effects of price-externalities, he should choose the first-price auction. There is no auction format which the seller should choose in general when facing price externalities. The better choice crucially depends on the type of price externalities at stake.

To illustrate these results, let us apply them to the situations we have exhibited in the introduction. We can interpret them in terms of WIIPE and WIDPE. The Canal+ case and the charity sale are two examples of increasing WIIPE. The bidder owning a fraction of another bidder is a case of decreasing WIDPE. At last, a bidder who prefers that the seller raises the lowest amount of money is a case of decreasing WIIPE. Thus, we derive the following recommendations. In both the charity sale and the Canal+ case, the seller should use a second-price auction. In the two other cases, he would be better off using a first-price auction.

6.3. Possible extensions

A natural extension of our model would consist in studying a setting with $n > 2$ bidders. A first step would be to consider situations in which the utility of a losing bidder depends on the price paid by the winner but not on which other bidder obtains the good. In such a case, the utility of a bidder i could be defined just the same as we did by a 3-uplet (v_i, f_i, g_i).[12] We should also assume that Assumptions A1'-A5' are verified for any $i \in \{1, 2, ..., n\}$.[13] e_i defined by $v_i - e_i + g_i(e_i) = f_i(e_i) + g_i(e_i)$ is still the price for which bidder i is indifferent between losing and winning the auction. We can also rearrange bidders so that if $i < j$ if and only if $e_i < e_j$. Then, we derive results close to what we obtained with two bidders.

[12] In that case, we define v, f and g by $v = \{v_1, v_2, ..., v_n\}$, $f = \{f_1, f_2, ..., f_n\}$ and $g = \{g_1, g_2, ..., g_n\}$.

[13] The only modification would concern A5' which should be written now: $@p, \{i, j\}$ with $i \neq j$ such that $v_i - p = f_i(p)$ and $v_j - p = f_j(p)$.

- There is a unique enforceable outcome of the first-price auction: (n, e_{n-1}).
- In a second-price auction
  - Any enforceable price must be in the interval $[0, e_n]$ and reciprocally for any (v, f) and for any $p^* \in [0, e_n]$, there always exist a g such that p^* is an enforceable price.
  - If h_n is not decreasing and if there exists an $i \in \{1, 2, ..., n-1\}$ such that h_i is strictly increasing, there is a unique enforceable outcome, (n, e_n).
  - If all the h_i are strictly decreasing, the only enforceable price is zero.
  - If there exists a couple $(i, j) \in \{1, 2, ..., n\}^2$ with $i < j$ such that h_i and h_j are strictly increasing, then any enforceable price p must satisfy $p \geq e_j$.

In the first-price auction, at the equilibrium, the good is always allocated to the bidder with the highest indifference-price for a price equal to the second highest indifference-price. Thus, as in the two-bidders case, in a first-price auction, with price-externalities, indifference-prices have the same role as valuations in a context without price-externalities. As a result, WIIPE have still no impact on the equilibrium.

We remark that these results are clearly different from what happens with allocative externalities that depend on the identity of the winner but not on the price. In that case, with more than two bidders, there may be more than one enforceable outcome (see Jehiel and Moldovanu (1996)). Here, there is a unique enforceable outcome. In their case, there may be several enforceable outcomes because bidders conditional on losing may prefer that a bidder obtains the good rather than another. We assumed here that it is not the case, hence the uniqueness of the enforceable outcome.

In the second-price auction, as in the two-bidders case, the situation is slightly more complex. The equilibrium depends on both types of price-externalities and the equilibrium price lies between zero and the highest indifference price. If at least one bidder has a strict preference for the price to be high conditional on losing, then he can force bidder n to pay e_n, as long as h_n is not decreasing. In contrast, the equilibrium price is zero if all the bidders, conditional on losing, prefer the price to be low. Without entering more into the details of the second-price auction case, we observe that these results also are not qualitatively different from what we observed in the two-bidders case. In the second-price auction also, our results are relatively robust to an increase of the number of bidders.

Finally, another extension of our model that would be worthwhile is to consider a setting with $n > 2$ bidders whose utilities conditional on losing may depend on both the price paid and the identity of the winner. The study of this broader framework awaits future research.

A. Proof of proposition 4.1

Suppose that at the equilibrium $\exists i$ such that $b_i > b_j$. Bidder i's utility is $v_i - b_i + g_i(b_i)$. However, as bidder j bids b_j, if bidder i bids $\frac{b_i+b_j}{2}$, his utility is $v_i - \frac{b_i+b_j}{2} + g_i(\frac{b_i+b_j}{2})$. Because of Assumption A3'($g_i' < 1$), we must have $v_i - \frac{b_i+b_j}{2} + g_i(\frac{b_i+b_j}{2}) > v_i - b_i + g_i(b_i)$. Therefore b_i is not a best answer to b_j. Then at the equilibrium $b_1 \neq b_2$ impossible.

As $U_i(i, e_i) = U_i(j, e_i)$, it is a dominated strategy[14] for bidder i to bid more than e_i. Let us prove it by comparing the utility of bidder i if he bids e_i or $b^* > e_i$, $U_i(b)$ being the utility of bidder i if he bids b.

- If $b_j \leq e_i$, we have $U_i(e_i) = v_i - e_i + g_i(e_i)$ and $U_i(b^*) = v_i - b^* + g_i(b^*)$ then $U_i(e_i) > U_i(b^*)$ (as $g_i' < 1$).
- If $b_j \in (e_i, b^*)$, then $U_i(e_i) = f_i(b_j) + g_i(b_j)$ and $U_i(b^*) = v_i - b^* + g_i(b^*)$. Because of Assumption A4', we have $v_i - p - f_i(p)$ strictly decreasing function of p. As by definition $v_i - e_i - f_i(e_i) = 0$, then $\forall b_j \in (e_i, b^*)$: $v_i - b_j - f_i(b_j) < 0$ and consequently $v_i - b_j + g_i(b_j) < f_i(b_j) + g_i(b_j)$. Besides, from Assumption A3', we derive that $\forall b_j \in (e_i, b^*)$, $v_i - b^* + g_i(b^*) < v_i - b_j + g_i(b_j)$. The union of this two inequations gives us $U_i(e_i) > U_i(b^*)$.
- If $b_j = b^*$, there are two possibilities. If $v_i - f_i(b^*) < v_j - f_j(b^*)$, bidder j obtains the good for a price b^* and $U_i(e_i) = U_i(b^*)$. If $v_i - f_i(b^*) > v_j - f_j(b^*)$, then $U_i(e_i) = f_i(b^*) + g_i(b^*)$ and $U_i(b^*) = v_i - b^* + g_i(b^*)$. For any $p > e_i$, bidder i prefers leaving the good to bidder j for the price p rather than paying it p. Then $U_i(e_i) > U_i(b^*)$.

Therefore, any equilibrium must be of the following form, (b, b) with $b \leq e_1$. Now suppose that $b < e_1$ and bidder i does not obtain the good. As $b < e_1 < e_2$, $\forall i = 1, 2$, we have $v_i - b > f_i(b)$. Then by continuity of f and g, $\exists \varepsilon$ such that $v_i - (b + \varepsilon) + (g_i(b + \varepsilon) - g_i(b)) > f_i(b)$. Bidder i is strictly better off bidding $b + \varepsilon$. (b, b) with $b < e_i$ is not an equilibrium. The only possible equilibrium is (e_1, e_1).

Because of our genericity Assumption, we cannot have $v_2 - f_2(e_1) = v_1 - f_1(e_1) = e_1$. Suppose that $v_2 - f_2(e_1) < v_1 - f_1(e_1) = e_1$. Then $v_2 - f_2(e_1) - e_1 < 0$.

[14] Here, we give all the details of the proof that a strategy is dominated. This kind of demonstration is repetitive and we give here the general scheme of the proof. In the other demonstration, we only say that a strategy is dominated or dominant and give the main argument justifying it.

this is impossible since $e_2 > e_1$, $v_2 - f_2(e_2) - e_2 = 0$ and $f(p) + p$ is an increasing function of p (direct consequence of Assumption A4'). $v_2 - f_2(e_1) > v_1 - f_1(e_1)$ and if both bidders bid e_1, the good is allocated to bidder 2. Then, there are no profitable deviation, (e_1, e_1) is an equilibrium. Q.E.D.

B. Proof of proposition 5.5

First, suppose that $b_i < b_j$, as h_i is strictly increasing, bidder i can strictly increase his utility by bidding $\frac{b_i+b_j}{2}$. Then, at the equilibrium, we must have $b_1 = b_2$. Furthermore, as h_2 is increasing, it is a dominated strategy for bidder 2 to bid less than e_2. Any equilibrium must then be of the form (b, b) with $b \geq e_2$. Then, from proposition 5.3, we derive that the only possible equilibrium is (e_2, e_2). As $e_1 < e_2$, bidder 2 obtains the good. And, (e_2, e_2) is indeed an equilibrium since no bidder can improve his utility by deviating from his bid. Q.E.D.

C. Proof of proposition 5.6

Suppose that, at the equilibrium, bidder i obtains the good. As bidder j's utility, equivalent in that case to $h_j(p)$, is strictly decreasing in the price paid by bidder i and b_j is the price paid by bidder i, it must be the case that $b_j = 0$. As a result, the only enforceable price is 0.

$(0, e_2)$ is always an equilibrium because as h_1 is decreasing, bidder 1 cannot profitably deviate and bidder 2 obviously cannot profitably deviate since $U_2(2, 0) > U_2(1, 0)$. Besides, none of these strategies are dominated.

Now, for bidder 1, bidding more than e_1 is dominated by bidding e_1 because for any price over e_1, bidder 1 prefers not to obtain the good and h_1 is decreasing. Then, if bidder 1 obtains the good at the equilibrium, he must bid $b_1 \leq e_1$. However, for $(b_1, 0)$ to be an equilibrium, it must be verified that bidder 2 cannot profitably deviate. As h_2 is decreasing, bidder 2 can only profitably deviate if his deviation increases his probability of obtaining the good. There are no profitable deviation if and only if $v_2 - b_1 + g_2(b_1) \leq 0$.[15] Because of Assumption A3', $-x + g_2(x)$ is strictly decreasing. Besides, we must have $b_1 \leq e_1$. $v_2 - b_1 + g_2(b_1) \leq 0$ for $b_1 \leq e_1$ induces $v_2 - e_1 + g_2(e_1) \leq 0$. Then $v_2 - e_1 + g_2(e_1) \leq 0$ is a necessary condition. Now suppose that $v_2 - e_1 + g_2(e_1) \leq 0$, in that case, $(e_1, 0)$ is an

[15] We normalized our utility functions so that bidder 2 derives a utility zero if bidder 1 obtains the good for a price of zero.

equilibrium as bidder 1 cannot profitably deviate and as $v_2 - e_1 + g_2(e_1) \leq 0$ and h_2 decreasing, bidder 2 cannot profitably deviate either. Q.E.D.

D. Proof of proposition 5.7:

$(e_2 + 1, 0)$ is an equilibrium. Besides $b_1 = e_2 + 1$ is not a dominated strategies because h_1 strictly increasing. Then, $(1, 0)$ is an enforceable outcome. Suppose now that $(1, p)$ with $p > 0$ is an enforceable outcome. This means that there is an equilibrium (b_1, b_2) with $0 < p = b_2 \leq b_1$ and bidder 1 obtaining the good. However, as h_2 strictly decreasing, bidder 2 can profitably deviate bidding 0. Then, such a (b_1, b_2) cannot be an equilibrium and $(1, p)$ with $p > 0$ cannot be an enforceable outcome.

Now suppose that (b_1, b_2) is an equilibrium such that bidder 2 obtains the good. As h_1 strictly increasing, we must have $b_1 = b_2$, otherwise bidder 1 could strictly increase his utility raising his bid. Besides, if $b_2 < e_1$, bidder 1 can profitably deviate by bidding $b_2 + \varepsilon$ then $e_1 \leq b_1 = b_2$. It must also be the case that bidder 2 cannot profitably deviate. As he yet obtains the good, bidding more would not change his pay-off. A profitable deviation could only consist in bidding less than b_1. As h_2 strictly decreasing, there exists a profitable deviation if and only if, bidder 2 can profitably deviate bidding 0, condition which is equivalent to $v_2 - b_1 + g_1(b_1) < 0$. Then (b, b) is an equilibrium if and only if $e_1 \leq b \leq e_2$ and $v_2 - b + g_2(b) \geq 0$. Q.E.D.

E. Proof of proposition 5.8

As h_2 is strictly increasing, it is a dominated strategy for bidder 2 to bid less than e_2. At the equilibrium, $b_2 \geq e_2$. For bidder 1, as h_1 is strictly decreasing and $e_1 < e_2$, the unique best response to any bid $b_2 \geq e_2$ is 0. Then the unique enforceable outcome is $(2, 0)$. Q.E.D.

References

[1] Benoit, J-P and Krishna, V, "Multiple-Object Auctions with Budget Constrained Bidders", Review of Economic Studies, 2001, 68 (1), pp155-179.

[2] Bulow, J, Huang, M and Klemperer, P, "Toeholds and Takeovers", Journal of Political Economy, 1999, 107 (3), pp427-454.

[3] Bulow, J, Klemperer, P, "Prices and the winner's curse", working paper, 1999.

[4] Burkart, M, "Initial Shareholding and Overbidding in Takeover Contests", Journal of Finance, 1995, 50 (5), pp1491-1515.

[5] Che, Y K and Gale, I, "Standard Auctions with Financially Constrained Bidders", Review of Economic Studies, 1998, 65 (1), pp1-21

[6] Engelbrecht-Wiggans, Richard, "Auctions with Price-Proportional Benefits to Bidders", Games and Economic Behavior, 1994, 6 (3), pp339-346.

[7] Ettinger, D, "Auctions and shareholdings", mimeo Ceras, 2001.

[8] Jehiel, P and Moldovanu, B, "Strategic Non-Participation", Rand Journal of Economics, 1996, 27 (1), pp84-98.

[9] Jehiel, P and Moldovanu, B, "Auctions with downstream interaction among buyers", Rand Journal of Economics, 2000, 31 (4), pp768-791.

[10] Klemperer, P, "Auction with Almost Common Values: "The Wallet Game" and its Applications", European Economic Review, 1998 42 (3-5), pp757-69.

[11] Maasland, E and Onderstal, S, "Auctions with Financial Externalities", 2001, Mimeo Tilburg University.

[12] Pitchik, C and Schotter, A, "Perfect Equilibria in Budget-Constrained Sequential Auctions: an Experimental Study", RAND Journal of Economics, 1988, 19 (3), pp363-388.

[13] Singh, R, "Takeover Bidding with Toeholds: the Case of the Owner's Curse", Review of Financial Studies, 1998, 11 (4), pp679-704.

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