‘Counter-Intuitive Price Effects in Auction Theory’

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I. Introduction

The first things an economist learns are the laws of supply and demand: increasing supply lowers the price and increasing demand raises it. These results are intuitive, and generally applied across the field of economics. This paper aims to show that caution is warranted in applying such ‘intuitions’ on price effects in general without reflection. The theory of auction mechanism design instructs us on how such intuitions may be false under fairly common conditions without making any special assumptions.

To show this, we consider the auction of an (almost) common value good, where bidders care about the signals of other bidders in determining their valuation of the good. In such a setting, winning the auction may be ‘bad news’, as it means that the winning bidder was the most optimistic about the valuation and that the signals of other bidders on the value of the good were lower. This is the winner’s curse. To avoid suffering from the winner’s curse, bidders shade down their bids, such that they are indifferent about paying the current price, conditional on winning. Clearly, this has a negative effect on the price the seller obtains for the good. In this situation, increasing supply creates additional winners, reducing the winner’s curse, and this may under certain conditions have a positive net effect on the price. Similarly, rationing creates more winners and reducing the number of bidders reduces the winner’s curse, so that either of these strategies may also increase the price, contrary to our standard intuitions.

II. Toolkit

To establish these results, we must first derive the Revenue equivalence theorem, which says that under some standard assumptions, the standard auction formats, namely the English ascending bid, Dutch descending bid, First price sealed bid, and (Vickrey) Second price sealed bid auctions, yield the same expected revenue. Combined with the Marginal Revenue approach to auctions, this will allow us to establish the benchmark 'intuitive' price effects in the auction theory context.

Revenue Equivalence Theorem[1]:

Standard assumptions in auction theory
(McAfee and McMillan, 2987:706):

A1: The bidders are risk neutral
A2: The bidders have independent-private values
A3: The bidders are symmetric
A4: Payment is a function of bids alone

Proposition 1:
Consider the case where each of a given number of risk-neutral potential buyers has a privately known signal drawn independently from a common, strictly increasing atomless distribution. Then any auction mechanism in which the object always goes to the bidder with the highest signal and any bidder with the lowest feasible signal expects a zero surplus yields the same revenue.

Proof:

[1] This representation is directly based on Klemperer (1999:41-44)

Based on the revelation principle, this proof will show that any auction mechanism which is equivalent to the direct revelation mechanism satisfying incentive compatibility described below must thus yield the same revenue.

Let n bidders compete for a single unit of a good, with bidder *i* valuing the good at v_i, which is private information. It is common knowledge that each v_i is independently drawn from the same continuous distribution F(*v*) on $[\underline{v}, \overline{v}]$ with density f(*v*). Let $S_i(v)$ be the expected surplus that bidder i will obtain, and $P_i(v)$ be the probability of receiving the object in equilibrium.

The incentive compatibility constraint to ensure equilibrium behaviour is:

(1) $$S_i(v) \geq Si(\tilde{v}) + (v - \tilde{v})P_i(\tilde{v})$$

Where strategy $\tilde{v}$ is a deviation from the equilibrium strategy for type *v* and the right-hand side described the possible pay-off from such a deviation. We can rewrite this into the following two IC constraints for types v and v+dv:

(2) $$S_i(v) \geq Si(v + dv) + (-dv)P_i(v + dv)$$ (IC for type v)

(3) $$S_i(v + dv) \geq Si(v) + (dv)P_i(v)$$ (IC for type v+dv)

Note that these constraints imply that P_i increases monotonically in v (add the constraints to see this). Reorganise (2) and (3) to yield:

$$P_i(v + dv) \geq \frac{S_i(v + dv) - Si(v)}{dv} \geq P_i(v)$$

Take the limit as dv → 0 to obtain:

(4) $$\frac{dS_i}{dv} = P_i(v)$$

Integrate up to yield:

(5) $$S_i(v) = S_i(\underline{v}) + \int_{x=\underline{v}}^{v} P_i(x)dx$$

Hence, once $S_i(\underline{v})$ and $P_i(v)$ are determined we know the starting point and the slope of the $S_i(v)$ function at all v, thus we know $S_i(v)$. To conclude, any two mechanisms satisfying the initial assumptions and having the same $S_i(\underline{v})$ and $P_i(v)$ functions for all v and for every player i have the same $S_i(v)$ function. Hence, given the bidder's risk neutrality, player i makes the same expected payment in each mechanism for any type v. As this holds for all bidders i, both mechanisms must yield the same expected revenue for the auctioneer.

Marginal Revenue approach[2]:

To establish the benchmark of what we call intuitive price effects in auction theory, we must first develop the Marginal Revenue approach to auctions. This will greatly aid the intuition behind the effects of basic changes to the auction set-up such as increases in supply.

From the above we know that bidder i's expected payment to the auctioneer equals the expected gross revenue (v $P_i(v)$) from the auction minus the expected surplus ($S_i(v)$), so the auctioneer's expected receipts from bidder i are:

(6) $$\int_{v=\underline{v}}^{\bar{v}} (vP_i(v) - S_i(v)) f(v)dv$$

Substituting in (5) for $S_i(v)$ and integrating by parts yields:

[2] This exposition of the Marginal Revenue approach is directly based on Klemperer (1999:47-51)

(7) $$\int_{v=\underline{v}}^{\bar{v}} P_i(v) f(v) \left[v - \frac{1-F(v)}{f(v)} \right] dv - S_i(\underline{v})$$

Now define bidder i's Marginal Revenue as:

(8) $$MR_i(v) = \left[v - \frac{1-F(v)}{f(v)} \right]$$

This is intuitive if you compare the auctioneer to a monopolist facing a demand curve (v, 1-F(v)), where v is the price and 1-F(v) the corresponding quantity; (8) is then simply the first derivative of revenue v(1-F(v)) w.r.t. quantity.

Now assume, as above, that $S_i(\underline{v})$=0 for the standard auction mechanisms Hence, the expected revenue of the auctioneer over all bidders equals:

(9) $$\sum_{i=1}^{n} \int_{v=\underline{v}}^{\bar{v}} P_i(v) f(v) MR_i(v) dv = \sum_{i=1}^{n} E_{v_i} \left[P_i(v) MR_i(v_i) \right]$$

This last expression equals the expected marginal revenue of the winning bidder. Hence, the conclusion that, given the assumptions above, the expected revenue of the auctioneer equals the marginal revenue of the winning bidder. Clearly, an auction that sells to the bidder with the highest marginal revenue, but does not sell if no marginal revenue exceeds zero, maximises revenues. For the case of the standard auction forms, which allocate the good to the bidder with the highest value (signal)[3], as long as a higher value implies a higher marginal revenue

[3] This is clear when considering a second-price sealed bid or 'Vickrey-auction', where the dominant equilibrium strategy is to bid the true valuation, and the good is thus awarded to the bidder with the highest valuation. Informal proof: If the bidder were to bid higher than his valuation he has a positive probability that there is someone who bids between his valuation and his bid, such that he wins the auction with a negative expected pay-off.

III. The benchmark of intuitive price effects:

For the standard private value case we can directly derive some intuitive price effects from the Revenue Equivalence theorem and the Marginal Revenue approach to auctions. The following propositions are all considered for the standard auction formats with private values satisfying the assumptions of the revenue equivalence theorem.

Proposition 2:

Increasing supply reduces prices.

Proof:

Consider the case of increasing supply, that is auctioning off a second good. Clearly, in the standard auction formats, the second good would go to the second highest valuation bidder, who under weak assumptions on the distribution of v would have the second highest marginal revenue. This revenue is, however, lower than that of the highest valuation bidder. Consequently, by the marginal revenue approach, the average revenue of the auctioneer must fall, hence the price falls.

Proposition 3:

Increasing the number of bidders (competition) increases the price.

Proof:

Define the hazard rate as:

$$h_i(v) = \frac{f(v_i)}{1 - F(v_i)}$$

An increase in the number of bidders increases the expected marginal revenue of the winning bidder (given that the hazard rate h_i is increasing).The intuition being that the more often you pick a signal from the distribution the higher the probability that one of these signals will be 'high'. Or alternatively, as the number of bidders increases, the distribution of their signals will be more dense, that is, the second highest signal will be closer to the highest signal, which means that (in a first price auction) the highest signal bidder shades down his bid by less. Consequently, the auctioneer's revenue rises, which means the price has increased (see McAfee and McMillan 1987:711 for a different proof and further references).

Proposition 4:
Rationing a good cannot yield a higher price than under competitive bidding

Proof:
Suppose the auctioneer decides to allow bids only on half of the original good, such that two halves are sold. Then, by the increasing supply argument above, the average price of the good must be lower than if he were to auction off the good in its entirety. Alternatively, suppose the auctioneer decided to ration the good at a fixed price, which guarantees excess demand in expectation (another definition of rationing). This requires that at least the bidder with the second highest valuation would, in expectation, be willing to buy at that price. The second highest valuation is exactly the expected revenue of the auctioneer if a single unit is sold under one of the standard mechanisms, hence rationing could not yield a higher price.

IV. Counter-intuitive price effects[4]:

In this section will show that three counter-intuitive price effects may occur under quite realistic circumstances. Particularly, it will show that increasing supply may raise the price; that it may be profitable to ration a good; and that excluding potential buyers may raise prices.

The reason is that in common value auctions buyers may wish to exit an ascending auction at more or less than their pre-auction estimate of the value. This is a consequence of the winner's curse (see appendix), which ensures that buyers must bid more conservatively as their number increases, because winning then implies a relatively greater optimism (i.e. winner's curse). This effect may well dominate the effect of increasing bidding competition, such that increasing the number of bidders can decrease prices. Conversely, increasing supply and rationing can increase the number of winners and reducing the conservatism caused by the winner's curse, thus increasing prices.
These results are most likely in the asymmetric almost common value case, where one bidder has a slight advantage over the other bidders (e.g. a toehold in a take-over battle) because the other bidders then face an exacerbated winner's curse. The intuition behind this is that a disadvantaged bidder knows that when he wins he had a higher signal than the advantaged bidder, implying even larger optimism than under the pure common value case, which is bad news. Hence, disadvantaged bidders bid more conservatively and the advantaged bidder more aggressively. Consequently, for the disadvantaged bidder winning implies even more optimism, yielding yet more conservatism etc. Thus, even with slight asymmetries between the bidders, the advantaged bidder will

[4] The exposition and arguments in this section are directly based on Bulow and Klemperer (2000)

almost always win in an almost common value setting. Therefore, the exacerbated winner's curse effect is more likely to outweigh for instance the competition effect from increasing the number of bidders.

The model:

Here, a simple model by Bulow and Klemperer (2000:6-8) is briefly set out to show how counter-intuitive price effects may occur. Consider three risk-neutral bidders observing a private signal t_i independently and identically distributed according to the distribution $F(t_i)$, for i=1,2,3. Assume $F(\cdot)$ has a strictly positive continuous finite derivative $f(\cdot)$ everywhere on its range, and that the lowest possible signal is $\underline{t}>0$, such that $F(\underline{t})=0$. Conditional on all the signals, the expected value, v_i, of a unit to i is:

(10) $v_i = (1+\beta_i)t_i + t_j + t_k$

Hence, the unit has a common and a private value element. Now note that for $\beta_1 = \beta_2 = \beta_3 = \beta > 0$ the auction is 'symmetric' and for $\beta_1 > \beta_2 = \beta_3 = \beta > 0$ the auction is 'asymmetric' with bidder 1 being 'advantaged' and much more likely to have a higher valuation if we assume $(\beta/\beta_1)\approx 0$. It is assumed throughout that β_i are small and results are stated for the limits where β_i goes to zero. Assume no bidder wants more than one unit and that the unit is auctioned by the standard ascending bid 'English' auction. Attention is restricted to the Perfect Bayesian equilibrium, where bidders exit at the price at which they would be happy to win conditional on the assumption that other players have played the equilibrium strategy.

Now bidder i's Marginal Revenue is defined as:

(11) $MR_i = \left[v_i - \frac{1}{h_i}\frac{\partial v_i}{\partial t_i} \right]$ for hazard rate: $h_i(v) = \frac{f(v_i)}{1-F(v_i)}$

As the β_i are small, $MR_i \approx v - 1/h_i$.

Proposition 5:

Increasing supply can increase prices

Proof:

<u>Symmetric case:</u>

By the appendix, the player with the second highest signal quits at $p=t_3+(2+\beta)t_2$, which for $\beta\approx0$ implies $E(p) \approx E(v)-E(t-t_2|t\geq t_2)$. If a second good is being sold (recall that each bidder wants only one unit), the lowest value bidder, would be just indifferent about winning were he tied with the second highest signal, thus he quits at $p=(2+\beta)t_3 + E(t|t\geq t_3)$ (as the highest signal would obtain the other unit). But $E(v) = E(t_3) + 2E(t|t\geq t_3)$, hence, $E(p) \approx E(v)-E(t-t_3|t\geq t_3)$. Hence, the per unit price increases with supply if $E(t-t_2|t\geq t_2) > E(t-t_3|t\geq t_3)$. This depends on the hazard rate h_i, which tells us how probable it is that a signal will arrive given that it has not yet arrived. If it is increasing, the expected time of the signal arriving, given that it has not yet arrived decreases, i.e. $E(t-z|t\geq z)$ falls (for formal proof see Bulow and Klemperer 2000:29). By this argument, per unit prices increase in supply when the hazard rate is decreasing. This can also be seen directly from the Marginal Revenue equation (11), as MR increases in the hazard rate, selling a unit to the bidder with the second highest signal (with a higher hazard rate than the bidder with the highest valuation), must increase per unit price. The intuition is that with common values a higher signal of one bidder raises the values of the other bidders and thus their marginal revenues, which means that it need no longer be true that the bidder with the highest signal also has the highest marginal revenue. When marginal revenues decrease in signals, but the auction awards the good to the bidder with the highest signal, increasing supply awards goods to lower signal bidders, with higher marginal revenues, and thus yields an increase in per unit price.

Asymmetric case:

First we show that the advantaged bidder tends to win (almost) always in the one unit auction to establish the benchmark against which to evaluate the price change. Note that bidder i would like to quit at the point where he would find himself indifferent about being a winner. Thus his marginal type $\underline{t}_i$ quits where $p = (1+\beta_i)\underline{t}_i+\underline{t}_j+\underline{t}_k$, where $\underline{t}_j$ and $\underline{t}_k$ are his expectations of j and k's signals conditional on winning. Now bidder i and j quit simultaneously iff $(1+\beta_i)\underline{t}_i+\underline{t}_j+\underline{t}_k=\underline{t}_i+(1+\beta_j)\underline{t}_j+\underline{t}_k$, i.e. when $\beta_i\underline{t}_i=\beta_j\underline{t}_j$, implying that bidder i quits before bidder j when $\beta_i\underline{t}_i<\beta_j\underline{t}_j$. Now note that for a sufficiently small (β/β_1) $\beta_i\underline{t}<\beta_j\underline{t}_j$ for j=1,2. Then, the bidder with the second highest signal will quit at $p = (1+\beta_2)t_2+t_3+\underline{t} = v-(t_1-\underline{t})$, i.e. $E(p) = E(v) - E(t-\underline{t})$. This implies that the advantaged winner almost always (for most actual signals) wins. The intuition is that because the advantaged bidder values the asset most in expectation, the others face an exacerbated winner's curse when bidder 1 exits, and therefore assume $t_1\approx\underline{t}$.

Suppose a second unit is offered for auction. Now, the expected value for bidder i at the moment one of the other bidders quits is $v= (1+\beta_i)\underline{t}_i+\underline{t}_k$ $E(t_j|t_j\geq\underline{t}_j)$ if j quits now (similar for when k quits now). Hence, bidder i quits when $p= (1+\beta_i)\underline{t}_i+\underline{t}_j+\underline{t}_k+x_j$Prob(j quits now|j or k quits now) + x_kProb(k quits now|j or k quits now), where $x_j = E(t_j-\underline{t}_j|t_j\geq\underline{t}_j)$. Note that for small enough β_i, the difference between β_1t_1 and $\beta_2t_2=\beta_3t_3$ is going to be relatively small compared to the difference between x_1 and x_2. Consequently, when hazard rates are increasing, such that x_i decreases in t_i, that means that when $\underline{t}_1$ is lower than $\underline{t}_2$ for example the price at which bidder $\underline{t}_2$ quits is higher than that of $\underline{t}_1$ because x_1 (entering into the valuation of $\underline{t}_2$) is larger than x_2, this forces $\underline{t}_1$ to quit until $\underline{t}_1$ roughly catches up with the value of $\underline{t}_2$, that is increasing hazard rates require: $\underline{t}_1\approx\underline{t}_2=\underline{t}_3$. Consequently, bidder i quits approximately at (1+

$\beta_i)t_i+t_i+E(t_k|t_k \geq t_j=t_i)$ as in the symmetric equilibrium. This yields $E(p) \approx E(v)-E(t-t_3|t \geq t_3)$, which is higher than our benchmark $E(p) = E(v) - E(t-\underline{t})$ when hazard rates are increasing. The intuition is that the disadvantaged bidders can compete symmetrically for the extra unit without facing the exacerbated winner's curse, as the price of the two units must be the same (by virtue of the auction set-up), this forces the advantaged bidder to bid more aggressively and may cause him to exit if the signal is too low. As hazard rates are increasing, the disadvantaged bidder with the highest marginal revenue gets the good. For this reason, when hazard rates are decreasing, prices decrease in supply, because the advantaged bidder almost always wins one of the goods, and then the lower marginal revenue disadvantaged bidder obtains the second good.

To conclude, prices increase in supply when hazard rates are decreasing in a symmetric (almost) common value auction, or when hazard rates are increasing in an asymmetric almost common value auction. This latter conclusion, must, however, be qualified. Consider a model with more than three bidders, in which one bidder is advantaged. In this case, the price indeed increases when supply is increased from one to two units when hazard rates are increasing. Nevertheless, this conclusion does not obtain when supply is increased from two to three goods and thereafter. The intuition is that the initial price increase came from forcing the advantaged bidder to bid aggressively and thus reducing the winner's curse for the other bidders. However, when increasing supply from two to three goods, the third good is allocated to the bidder with the third highest signal, who will have a lower marginal revenue than the second highest signal bidder when hazard rates are increasing. Hence, this increase in supply must decrease the price again.

Proposition 6:

Reducing the number of bidders can increase the price

Proof:

Symmetric case:

As shown above, with three bidders $E(p) \approx E(v)-E(t-t_2|t \geq t_2)$. With only two bidders, by the appendix, the bidder with the second highest signal quits when indifferent about winning conditional being tied with the other bidder, i.e. at $p=(2+\beta)t_i+E(t_k)$, which yields $E(p) \approx E(v)-E(t-t_{(2,2)}|t \geq t_{(2,2)})$. Given that t_2 is the second highest of three signals and $t_{(2,2)}$ is the lowest of two signals then for any set of three signals $t_2 \geq t_{(2,2)}$, hence with decreasing hazard rates, the expected price increases when excluding one bidder at random from the three bidders. The intuition is that this may eliminate the otherwise winning highest signal bidder, who has the lowest marginal revenue. This result is caused by the problem that with decreasing hazard rates the increase in the winner's curse due to increasing the number of bidders outweighs the effect from the resulting increase in bidding competition.

Asymmetric case:

As show above, with three bidders $E(p) \approx E(v)-E(t-\underline{t})$. This will be the same for the cases where the disadvantaged bidders are excluded, but when the advantaged bidder is excluded we have by the argument above $E(p) \approx E(v)-E(t-t_{(2,2)}|t \geq t_{(2,2)})$, which, if hazard rates are increasing, is higher than $E(p) \approx E(v)-E(t-\underline{t})$.

Thus, excluding bidders can increase the price when hazard rates are decreasing in a symmetric (almost) common value auction or when hazard rates are increasing in an asymmetric almost common value auction.

Proposition 7:

Rationing the good can increase the price

Proof:

First note that for the symmetric case selling two half units should fetch the same per unit price as selling two whole units, given that bidders want at most one unit. Now, by the price increases in supply argument given above, selling two half units yields an expected price $E(p) \approx E(v)-E(t-t_3|t\geq t_3)$, which for decreasing hazard rates is larger than the price for a whole unit $E(p) \approx E(v)-E(t-t_2|t\geq t_2)$. The intuition is that rationing increases the number of winners, which reduces the winner's curse, and thus elicits more aggressive bidding.

In fact, under decreasing hazard rates, the maximum expected price the auctioneer could ever receive is $E(p) \approx E(v)-E(t-\underline{t})$. Hence, the optimal policy for the auctioneer under decreasing hazard rates is to ration the good with certainty to all three buyers at price $p=\underline{t}+2E(t)$. Note that this policy is consistent with individual rationality, as $S_i(t_i)\geq 0$ for all i, including type $\underline{t}$, who receives $S(\underline{t})=0$ and performs better than any of the auction mechanisms in the symmetric case and equally well as the auction mechanisms in the asymmetric case[5].

V. Application:

How increasing supply can affect the prices is well illustrated by the British 3G Telecom auction (Klemperer 2001:10-14) contrasted to the Dutch 3G Telecom auction (Klemperer 2001:20). The former raised $34bn, which was partly due to the technical possibility of increasing the number of licenses from four to five. The problem in Britain was that there were four incumbents, which made it clearly an asymmetric auction. The fifth license, which was reserved to a new entrant, allowed profitable entry into the auction and reduced the winner's curse faced by prospective entrants. Subsequent competitive bidding by entrants forced up the prices of the licenses acquired by the incumbents. The Dutch case can function as a benchmark. Here also, there were four incumbents, but only four licenses

[5] In fact, for the one good asymmetric case independently of whether the hazard rates are increasing or decreasing

on sale. The result was that only one weak entrant showed up and that, instead of the $8.5bn the Dutch government had forecast based on the British experience, the auction raised a mere $2.5bn.

As for the proposition that reducing bidders could increase the price, this may well be the explanation for why we regularly see merger-targets opening negotiations with a limited number of potential acquirers (Bulow and Klemperer, 2000:23). The reduction in bidders surely decreases competition, but the simultaneous effect that the reduction in the winners curse allows more aggressive bidding might well dominate.

Finally, with the proposition on rationing, we may be able to explain why in Initial Public Offerings we often observe excess demand that the offer price. If signals are distributed log-normally, as is often assumed in this context, hazard rates are first increasing and then decreasing. Given symmetric bidders, the seller would maximise revenue by first increasing the price gradually to eliminate the buyers with the lowest signals, and then ration once a high enough price is reached. This process corresponds closely to the practice of Initial Public Offerings. Here, generally a range of prices are explored but often the final price is fixed at level that makes excess demand likely. (Bulow and Klemperer, 2000:21).

VI. Counter-intuitive price effects in other contexts:

One might well be tempted to conclude that such counter-intuitive price effects as described only occur in this specific common value case. On the contrary, these effects are not an artefact of highly specific assumptions in the particular context of auctions (see also section V). For instance, optimal rationing results can also be established for private value auctions with endogenous entry or in general for monopoly pricing for products which require supplier specific sunk-cost investments by the consumer (Gilbert and Klemperer, 2000). Here, the idea is that the seller must compensate the *marginal* customer for this sunk-cost, such that prices must accomplish the dual goal of allocating output and providing incentives for investment. When these goals are in conflict, the seller may compromise allocative efficiency to promote investment through rationing. This case may correspond to an asymmetric auction with a cost of entry. Here, the seller may wish to commit to an inefficient auction (rationing) to induce entry of low signal types, for whom it would otherwise be more costly to induce entry.

Alternatively, many examples of other counter-intuitive price effects may be found in cases where the Revenue Equivalence theorem does not obtain. Take for instance, the example of car sales moving from dealers to the internet (see Klemperer, 2001:13-18). From the consumer's point of view this means more transparency and seemingly more open competition. Now consider that dealers make offers independently of their competitors and without knowing exactly what prices the competition is charging, much like the first price sealed bid auction. The properties of Internet sales are more like the English ascending bid auction, except for that they are descending because they involve sale offers. For the case where market demand is downward sloping, not inelastic, Hansen (1988, as cited in Klemperer 2001:15) showed consumers prefer sealed bid auctions to the ascending bid auctions. The intuition is that the price in the ascending auction reflects the runner's up cost's, whereas in the sealed bid auction, the price reflects the costs of the winner, which allows more aggressive bidding. Moreover, ascending auctions tend to be more sensitive to collusion (Klemperer 2001:15). Additionally, the bidders may be asymmetric. Then, as in the model described above, the advantaged bidders may bid less aggressively in an English auction, yielding higher consumer prices. The sealed bid auction alleviates this problem, by allowing more aggressive bidding by disadvantaged bidders, thus yielding lower consumer prices. Finally, as the sealed bid auction is not efficient, like the English auction, this gives 'weaker' disadvantaged competitors a shot at winning the auction, and thus promotes entry, increasing competition and thus reducing consumer prices. Concluding, contrary to the intuition that increased transparency would reduce prices, auction theory indicates that it might increase consumer prices[6].

VII. Conclusion:

This paper has shown how the theory of (auction) mechanism design and the application of the principle of incentive compatibility can explain some striking counter-intuitive price effects. Notably, when agents compete to obtain a (almost) common value good, the standard intuitions only obtain under rather stringent assumptions on the distribution of signals. When these assumptions do not obtain we found that increasing supply, reducing the number of bidders, or rationing may increase the price of the good.

[6] Clearly, reduced search costs and gains from 'cutting out the middle-man' could reverse this conclusion in practice.

Appendix:

The winner's Curse

Let bidders have signals t_i and $v_i = (1+\beta)t_i + \sum_{i \neq j} t_j$ then β_i is the pure common value case. When bidding in the symmetric ascending auction equilibrium, the first quit would be at $\beta t_n + nt_n$, since if all remaining bidders had this signal this would be the value of the object to this bidder and waiting longer would make this bidder unhappy about finding himself a winner. The next bidder would quit at $t_n + \beta t_{n-1} + (n-1)t_{n-1}$ by the same logic, having inferred the signal of bidder n. The final quit would be at

(B1) $p = (1+\beta)t_2 + \sum_{j=2}^{n} t_j$

Note that this bidder knows that the expected value of the object is weakly higher than her bid by virtue of the other bidder not having quit. Thus, the bidder quits before the price has attained the expected value of the object. If the bidder did not have this strategy, she would suffer from the winner's curse, finding that the value of the object was lower than the price each time she won. This would happen because winning the auction in a common value setting is bad news about the signals of the other bidders (i.e. the winner was the most optimistic and the other bidders all had lower signals which are part of the valuation function of the winning bidder). Therefore, the winner computes the expected value of the object conditional on winning, which entails shading down the bid to avoid the winner's curse.

References:

Binmore K. and Klemperer P. (2001), "The Biggest Auction Ever: the Sale of the British 3G Telecom Licences.", http://www.paulklemperer.org/index.htm, pp1-25.

Bulow J. and Klemperer P. (2000), "Prices and the Winner's Curse", http://www.paulklemperer.org/index.htm, pp1-39.

Gilbert R. and Klemperer P. (2000), "An Equilibrium Theory of Rationing", Rand Journal of Economics, Vol. 31(1), pp1-21.

Klemperer, P. (1999), "Auction Theory: a Guide to the Literature", http://www.paulklemperer.org/index.htm, pp1-88.

Klemperer, P. (2001), "Why Every Economist Should Learn Some Auction Theory", http://www.paulklemperer.org/index.htm, pp1-50

McAfee R. and McMillan, J. (1987), "Auctions and Bidding", *Journal of Economic Literature*, Vol. 25 pp699-738.