Chapter 10: Spectrum Auctions

Introduction

It was a sunny summer morning as we sat in a conference room high above the Rue de Rivoli in central Paris. All the windows had been flung open, and I could see the Jardin des Tuileries a few hundred metres to the south. Distant murmurs of cars and tourist chatter filtered up from street level, all suggesting it was far too pleasant a day to be indoors. But I had no choice. Having arrived by Eurostar from London yesterday evening, I was now deep in discussions with my French colleague, Dromio on a proposal we were putting together. The European Union frequently announces research frameworks, and invites bids for projects. We were bidding for one which would assess likely developments in fixed-mobile convergence over the coming years and which would propose options for EU regulatory policy. One of the critical issues the tender had highlighted was the procedure for spectrum allocation, and we were invited to state our opinions. Dromio's view was plain and incisive. "The cost of the 3G licences crippled the entire mobile industry. This must never happen again! We must stress in our submission that other, fairer methods of spectrum allocation must be used in future."

As the hairs on the back of my neck began to bristle, I recalled that Dromio had used to work for a major European equipment vendor, which had undoubtedly seen a serious cutback in orders from the debt-laden mobile sector subsequent to the Internet boom. But nevertheless, I was sure he was wrong. The 3G auctions, and auctions in general, were not a bad thing but a good thing. While the vast sums bid for the mobile licences might or might not have had an adverse effect on the industry, my instincts were that from a public interest standpoint, they actually constituted a positive outcome. And specifically, I did not believe they had raised prices for the public.

The UK Auction of 3G spectrum

The debate about 3G spectrum auctions centres around the UK case, which started the European round. In the spring of 2000 the British government auctioned five 3G mobile licences on twenty-year leases. After 150 rounds of bidding over 7 weeks, the auction had raised £22.5 billion ($34 billion) for the government and the licences were in the hands of Orange (now France Telecom), Vodafone, BT (now O2, bought by Telefonica), 121 (now T-Mobile) and TIW (now 3). The winning bids ranged from £4 billion to almost £6 billion in the case of Vodafone. Similar auctions were subsequently held across Europe with mixed results.

Almost immediate, however, there was a backlash. A unanimous opinion was that the Mobile Network Operators (MNOs) had overpaid, that the result would be higher prices to consumers and a delayed 3G roll-out. It was demanded that the government should refund some of the money back to the industry (it refused). Economists were more laid back, [1], [2], claiming that the licences were a sunk cost having no relevance to forward pricing decisions. The worst that could happen was that if shareholders believed their companies had overpaid, then the lack of return on this investment would lower the share price (as the discounted sum of future earnings). I would add that there was an additional risk that the regulator would go easy with the MNOs to compensate for their debt-servicing charges and to help restore liquidity to the industry - a back-door subsidy,

Where does the truth lie? Many industry players continue to maintain that auctions place too heavy a burden on the industry, weakening operating companies and their suppliers, and harming the public. With new spectrum blocks becoming available on a regular basis, getting the allocation mechanism right is an important factor in smoothing the way to next-generation networks. To understand the impact of a significant spectrum costs to MNOs, we first need to look at how pricing works in the telecoms business.

Pricing in the telecoms business

The telecoms business is very far from being a perfectly competitive market. Until recently, it was assumed to be a natural monopoly due to the enormous fixed costs involved in building out a national network, and the consequent increasing returns to scale as more and more customers paid to use such an expensive network at very small marginal cost.

In most countries there are only a small number of facilities-based Mobile Network Operators. The high fixed costs of a network have to be spread over a sufficiently large number of paying customers. As the number of operators increases, each gets a smaller and smaller slice of the market cake, and at some point the business case for the subsequent market entrant collapses. Mobile *Virtual* Network Operators (MVNOs) are not so restricted, as they resell capacity on an already-existing mobile network infrastructure.

Four to six players, which is what we normally see, is still too small a number to foster unrestricted competition, although chapter 6 would predict that the long-term market would have only three. Instead, as noted there, we see a form of market called oligopoly. The operators desperately wish to operate as a kind of ‘collective monopoly’ to achieve maximal returns, but as there are market-share rewards for

cheating, an air of instability pervades the arrangements. This is accentuated by laws which normally exist to restrict collusion and the formation of any kind of price-fixing cartel.

Cost and Demand curves

A basic tool for thinking about the pricing options open to a Mobile Network Operator can be seen in figure 1.

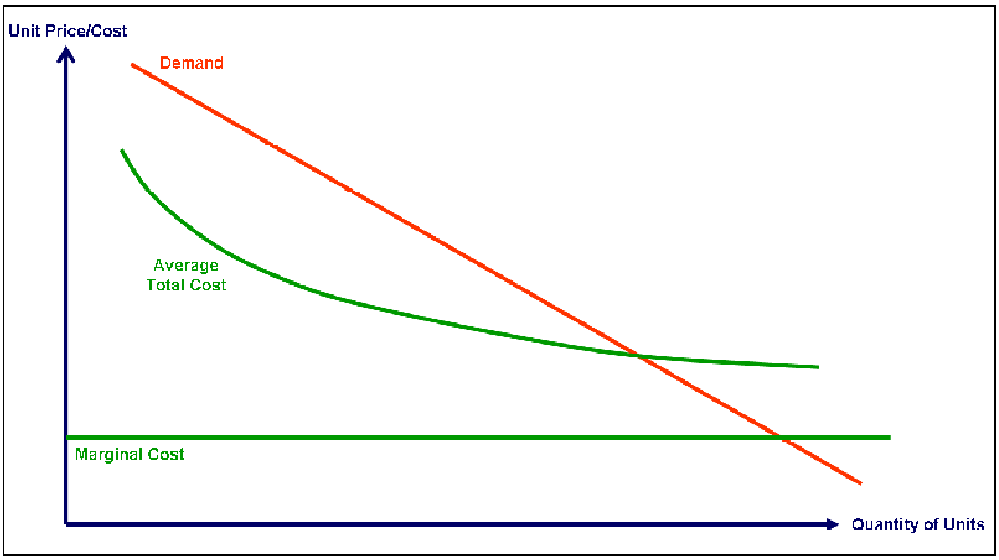

Figure 1. Short Run MNO Cost and Demand curves

In figure 1, unit prices and costs are on the vertical axis, and the number of units sold are on the horizontal axis. A unit of service is whatever you are buying per month: call minutes, handset or line rental, Megabytes downloaded.

The short-run marginal cost to the operator is whatever it immediately costs to supply you with that service: perhaps some fraction of the cost of a subsidised handset plus customer service plus fractional operating costs. Note that to a first approximation, and in the short run, this cost is constant - independent of how many other subscribers are already on the network. The marginal cost is shown by the horizontal line.

The operator's fixed costs (rents, debt repayments, out-payments for leased lines, permanent staff salaries) also have to be covered of course, and from the point of view of business survival, what matters is the total cost (fixed + variable) and how it is averaged over an increasing number of customers units sold.

The *average total cost* line on the graph shows how the sum of fixed and variable costs goes down on a per-unit basis as the quantity of units sold increases - more customers are paying for the fixed cost of the network and staff.

If the price is set high, then only a few very keen customers will buy. If the price is very low, assuming the service offered is genuinely popular, then many people will spend their money.

This basic truth is shown by a demand curve sloping from top left to bottom right. When the price is high, few units are sold. When the price is low, many units are sold. So how should the operator set the price?

The profit-maximising price

By sliding down the demand curve from left to right, the operator adjusts the price and therefore the number of units sold. Assuming everyone gets to see the same price, the profits after costs of sales is the area of the shaded rectangle:

(price - marginal cost) * quantity-sold

since the marginal cost is taken to be constant. This is true for *any point* on the demand curve. The gross profit rectangle starts tall and thin, then becomes rather square looking, then becomes short and wide. The area is the maximum somewhere in the middle - marked in figure 2 as the monopoly price. Here the operating profits are highest.

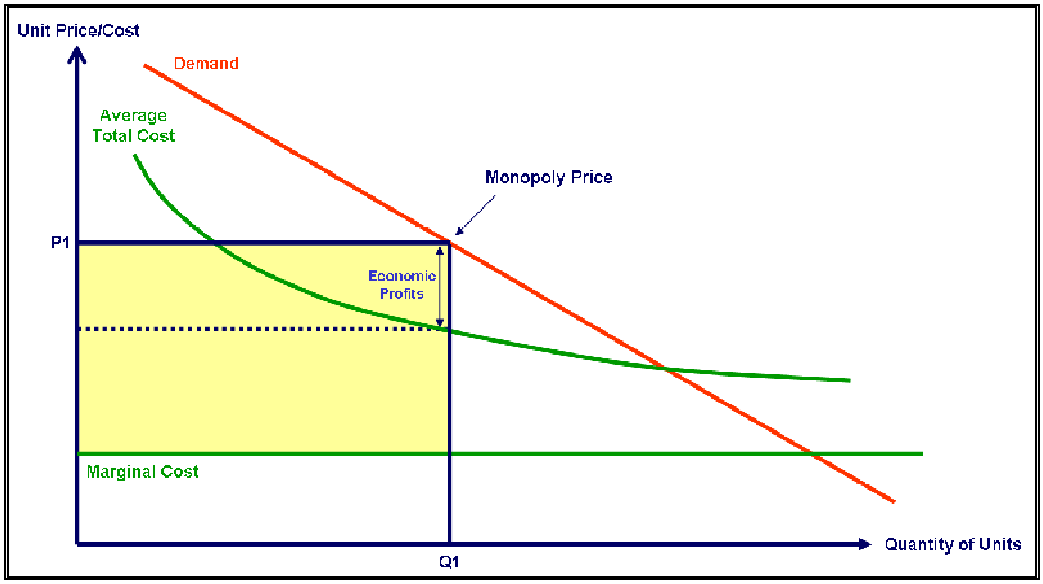

Figure 2. Profit-maximising price

Any sane company would want to sell at the monopoly price, so what stops them? The answer is *competition*, and in its absence, regulation. If you are selling at the monopoly price and I am competing with you, then I only have to set my price a little lower, and customers will desert you and flock to me (other things being equal). Sure, I make less money than if I was able to sell at the monopoly price, but I am still more than covering my operating costs.

It is not difficult to see that in this simple model you get a race to the bottom - a price war. And how low is the bottom? If I am determined to take business away from you, I am prepared to sell an additional unit at *any price down to my short-term marginal cost* - I will still make incremental revenue on the deal. In telecoms, as in many high-tech industries, the cost structure is high fixed-costs and low marginal costs. Typically the marginal cost of producing the extra CD, piece of software or delivering one more telephone subscription is very low, and specifically below the average total cost. If you price at short-run marginal cost, then you cannot pay your overheads and you will go bust. But not necessarily straight away.

In fact there are a number of marginal costs over increasing periods of time. The shortest time period is the extra cost to allow, for example, one more copy of a software product to be downloaded by a customer over the Internet. This cost must be close to zero. Over a longer time period, a marginal cost can include that fraction of costs such as salaries, rents, utility bills which on a shorter time frame are taken as fixed. And on a longer time period again, several years, marginal costs include those capital costs involved in growing and modernising the company's plant and equipment.

To stay in business, prices have to be sufficient to cover the latter costs, which is why regulators talk about LRIC as their regulated price target - Long Run Incremental Cost (figure 3). Notice that this is not quite the same as average total costs, since these are backward looking [3]. Average (unit) total costs do not necessarily have to be covered by the regulated unit price - it is not the job of the regulator to allow pricing levels which insure against poor business decisions. To stay in business, prices have to be sufficient to cover all current costs and projected forward investment, and that is what LRIC is measuring (and one reason why it is so hard to determine).

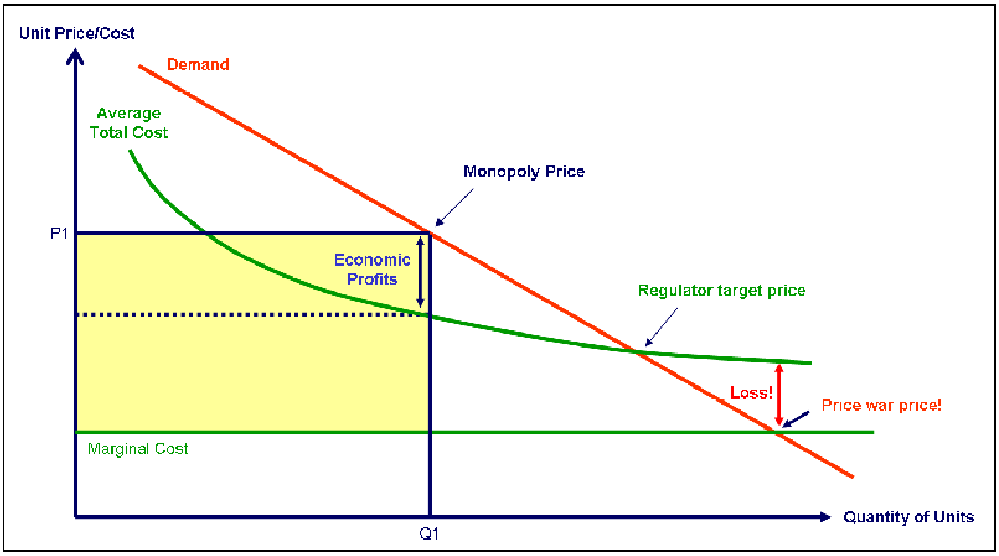

Figure 3. Regulated Price

However, business is carried out day-to-day, and in a short-run competitive situation my fixed costs are indeed fixed. So it still pays me to price down to short run marginal cost to take business away from you. Yes, neither of us will recover our fixed costs, and in the end, one or both of us could go out of business, but maybe it will be you. There is, after all, a reason why the most frequent adjective applied to price wars is 'ruinous'.

Strictly speaking, if I have deep pockets, I could price down to zero and definitely bankrupt you if you have less financial resources than I have. This is called predatory pricing and is usually illegal (although it can be hard to prove). My incentive to do it is that I destroy competition and can recoup all my losses later by monopoly pricing. Well, we all think we know this is bad, but what exactly is wrong with monopolistic behaviour?

The standard critique of monopoly is that the monopolist under-produces. There are customers who would be delighted to buy the product (e.g. a mobile phone service) at a price which would certainly cover the operator's costs, but the operator declines to serve them at that price. However, monopoly pricing may be the rewards accruing to innovation, prices will come down as the premium returns attract competitors. And sometimes, as in the pharmaceutical industry, apparent monopoly prices are covering the cost base of all the drugs which didn't make through to production. Here marginal costs are far, far, lower than total costs.

As we observed in chapter 6, a level of premium pricing in high-tech industries is essential to give some headroom to the company to innovate. Yes, capital for innovation could always be raised from the capital market, but lacking in-house expertise, the costs would be higher. It's similar to the discussion about the correct limits of the firm, the point where administrative overhead outweighs market transaction costs.

Did the 3G Auction lead to higher prices?

Peter Cramton [2] spoke for many economists when he argued that the licence payment was a one-time fixed fee and that it was a sunk cost which could not affect subsequent pricing decisions (which would be made in the profit-maximising way as just described). He did suggest that the debt burden on the operators could well inhibit them from acquiring further debt to finance network build-out, and that this might inhibit service roll-out, or even lead to bankruptcy.

It might be argued that debt also has to be paid for. Regular interest payments (and repayments of the principal) are another fixed cost for a company. Increasing debt pushes up the Average Total Cost curve, and therefore the pricing point where the company makes a normal, competitive rate of return. If you like, it raises the price floor for sustainable business for operators in the sector. This is all true but beside the point. When the auction contenders put in their bids for the spectrum licences, they were proposing an investment just as if they were considering funding any other capital programme. All investments by definition incur costs, and the usual criterion as to whether one should make them is positive NPV (net present value). To make an investment rationally, you must believe that the NPV of the investment is positive, which means you will more than recover your debt-servicing charges.

Each bidder would have put together a financial model, where cost items included 3G licence fees, network build-out costs, service development and marketing charges and so on. If the anticipated (discounted) revenues covered the summation of all the (discounted) costs in the model, then it was rational to bid. Every serious bidder had constructed such models, and in reality, few were surprised by the size of the winning bids. This last remark is, of course, tautologous: no-one would have bid past a point where they still considered they would (eventually) make a profit, the auction design successfully forced companies to bid (very close) to that limit. No doubt the auction winners would have liked to have bought a portion of their input goods at bargain-basement prices (that is, via a public subsidy), but it was not to be (at least in the UK). And note that debt servicing costs are fixed costs - they make no contribution to marginal costs, and therefore do not affect the *monopoly* price point at all (or pricing decisions in general except to raise the long-term total cost floor - not a price-point where oligopolists like to operate). This was Cramton's point..

However, the mobile phone industry is not heavily regulated as regards consumer price. And as good oligopolists, the MNOs make every effort to avoid a price war with each other. Instead they indulge in endless efforts to develop market segmentation through which they can practice price discrimination, charging more to customers prepared to pay more. So there is little evidence that the debt-driven elevation of the price floor is actually visible in customer pricing - the observed prices based on market strategy are simply higher than that. The oligopoly is simply making less economic profits than it otherwise would have done. Note that if the government had run a less-effective auction (or had capitulated to the demands for a refund), then it would simply have been pricing spectrum at a lower value than the assessment of the operators themselves. This would have constituted a subsidy to the industry.

Maybe the mobile phone sector should be regulated more stringently? Perhaps, but it is not very likely. The market is quite competitive already, particularly since the arrival of Mobile Virtual Network Operators. Since these can get quite low wholesale rates (which could in principle even be below long run incremental costs for the facilities-based Mobile Network Operators) they can compete quite aggressively on price, as we have seen in a number of European countries. Other technologies such as voice over IP over competing radio technologies (WiFi, WiMAX) should also increase price competition in the longer term. A surfeit of regulation should be avoided, it tends to create 'rent-seeking behaviour' - costly activities aimed at influencing the regulator rather than on increasing value for the customer. More competition is a considerably better motivator for innovation and lower prices.

So we should conclude that the 3G bidders paid the correct market price for spectrum, namely what they thought it was worth. If they had paid less, by poor auction design or via a 'beauty contest', the government would have been granting them an input factor of production at less than market price. This is called a subsidy. Given the oligopolistic structure of the market, where the players have market power, pricing is not even that of competitive markets, i.e. priced at long-run incremental cost. Even if the government *were* so ill-advised as to 'return some of the money', there is no reason to believe that prices would come down, although shareholders would be pleased. It is possible to imagine a mobile industry which is heavily subsidised by the government (i.e. the public) and is very competitive or very tightly regulated. Under these conditions, prices could indeed be made very low. But this is not a sustainable economic venture as we understand it. It is preferable to rely upon technological advances, economies of scale and vigorous competition via MVNOs to address pricing issues. This seems to be working its magic as the experience since 2000 bears out. If anything, the regulators have been too soft on the industry, particularly in European roaming, where the price-cost ratio has been particularly wide. Over the last few years, we have seen an increasingly diversified and structured market, with service packages and price

points at every level. The industry lobbyists have moved their attention to other matters, and there has been very little debate about the alleged 3G auction cost overhang.

I did not put these arguments to Dromio. We didn't have time, and he would not have been convinced. The issue was one of corporate loyalty to him, not economic logic. What is in the public interest is not always in the interests of operators or their equipment vendors. We put something more anodyne in the proposal and moved on.

Appendix 1: Auctions in more detail

Introduction

Until comparatively recently, radio spectrum was allocated to broadcasters and mobile operators through a form of beauty contest. Applicants had to submit business plans and were assessed by Government committees against numerous criteria such as who would guarantee the lowest consumer prices, the most extensive coverage, stimulate the most creative usage etc. Of course, such plans cannot credibly predict the market conditions some years hence, so such contests were, in reality, opaque public subsidies to the industry, prone to lawsuits from losing contenders, and the ever-present possibility of favouritism and corruption. By contrast, an auction process, if well-designed, can identify the honest valuations which businesses put on assets such as spectrum, and can also raise revenues to pay for government without the distortions and disincentives causes by taxation.

In this appendix, I will first look at the different kinds of auction and discuss optimal bidding strategies. I will then look again at the experiences of mobile phone spectrum auctions in Europe and show how poor design can permit bidder tactics such as collusion and predation which can wreck the auction as a means to develop competitive markets as well as a generator of revenues. Organisations which take part in large public auctions put together high-powered bidding teams to advise them on strategy and tactics. Neither this appendix, nor even its references, e.g. [4], can substitute for those. But understanding something about the principles and pitfalls of the auction process can be valuable to managers in the context of the next-generation network. This is not just about radio spectrum, although there are numerous spectrum auctions planned, such as those for further 3G, the sale of WiMAX frequency band licences and the disposal of analogue TV spectrum following digital switch-over. With Internet trading, many commodity items - some high-value such as IP routers - are being auctioned. And the standard RFQ purchasing process is also an auction, albeit one where the objective is to buy at the lowest price (other things being

equal) rather than sell at the highest. Auctions have been around for a long time, and as prologue, let us consider one of the strangest.

The Auction of the Empire

The Praetorian Guard had been set up by the first emperor, Augustus, in 27 BC as an instrument of his personal power [5]. Comprising ten cohorts of 1,000 men each, they were stationed in and around Rome. The next emperor, Tiberius, moved the whole Guard to a specially-built citadel within Rome itself, in the early years of the first century. Around the time of Vespasian, mid 1st century, they were increased to around 16,000 elite troops.

The Praetorians soon realised their power, not simply to support emperors but also to dispose of them. In AD 193 they had murdered the emperor Pertinax [6]. The reasons are not entirely clear: Pertinax had been in office for only three months, and had himself been implicated in the murder of the previous emperor, Commodus, who had proved himself singularly ineffectual. However, with Pertinax's demise, there were no obvious successors.

Sulpicianus, the father-in-law of Pertinax and a leading public official, was endeavoring to calm the roman masses after the assassination when the Praetorian Guard marched up bearing his son-in-law's head on a lance. Astonishingly, Sulpicianus attempted at this point to claim the mantle of emperor himself, but the Praetorian leadership, sensing a better deal, ran to a nearby vantage point and proclaimed to the waiting crowd that the empire would be disposed of by public auction!

This offer eventually reached the ears of a wealthy senator, Didius Julianus who was sumptuously dining at the time, and he made his way to the Praetorian camp and began to bid against Sulpicianus from the foot of the ramparts. Sulpicianus had already bid a $25,000 *donative* for each soldier in today's money, when Julianus submitted a '*jump bid*' of $32,000 per Guard. The purpose of a jump bid is to intimidate other bidders by indicating that you have a high valuation of the product being auctioned, so encouraging them to withdraw early, thus closing the auction and securing a lower price. In any event, the tactic worked. The offer was enough to win the auction and buy the empire.

Note that if all the troopers were to receive this amount, the total bill would have been around half a billion dollars (the rich in Rome were *very* rich). The annual tax revenues of the roman empire at this time were around $7 billion [7]. Given the discretionary revenues available to the emperor, Julianus could have expected to recoup this investment in under a year. Alas, it was not to be. His political support did not

extend beyond those he had bribed and three field generals rose against him from opposite corners of the empire. In the end, Septimius Severus, at the head of three eastern legions won, and Julianus was out of office and executed within 66 days, a victim of the *winner's curse*. The Praetorians were also out of luck. Severus ordered them to parade unarmed outside the city, where his Danubian legions disbanded them. Severus subsequently ruled as emperor for the next eighteen years.

Four types of auction

The Praetorians ran the most common type of Auction, known as the English auction, or ascending bid auction. In this model, the price is successively raised by the auctioneer until only one bidder is left, who wins the object at the final price.

In the Dutch auction (used to sell flowers in the Netherlands), the auction starts at a high price which is successively reduced until a bidder commits to buy. The object is then sold to that bidder at the price they committed at.

In a first-price sealed-bid auction, the contenders each separately and privately submit their bids to the auctioneer and the highest bidder wins, and pays the price they bid. This method can be used for procurement, where vendors submit price quotes and the lowest offer wins. Note that this is functionally identical to the Dutch auction - imagine each bidder in a first-price sealed-bid auction taking their envelope to the auction room. As the auctioneer counts down, eventually the bidder with the highest valuation in their envelope will bid and the auction will end - the Dutch auction.

In a second-price sealed-bid auction, contenders also separately and privately submit their bids to the auctioneer and the highest bidder wins. However, the winner pays the price bid by the second-highest bidder. This is known as a Vickrey auction. Paying the second-highest amount probably sounds mysterious, here is the reason for it (we first have to take a detour via the English, ascending bid auction model).

Suppose Alice and Bob are each bidding for a telecoms licence. Alice's valuation of the worth of the licence to her is $5 million and Bob's personal valuation is $6 million. Both these valuations are kept secret of course for commercial reasons. What does the term 'valuation' mean? Simply that Alice would buy the licence at any value up to $5 million, and if she paid less she would consider she had had a bargain. At exactly $5 million and at any price higher we assume she would just walk away. Bob exhibits the same behaviour, this time around the figure of $6 million.

We run an English auction and unsurprisingly, as we pass $4,999,999 Alice stops bidding. Bob puts in a bid of $5m and wins the licence. But wait, Bob's valuation was $6 million. So although Bob would have been prepared to bid up to $6 million, the price he had to pay was set by Alice's valuation of $5 million (the second price).

Notice that if Alice had known Bob's valuation, she might have bid past $5 million, pushing the eventual price to Bob up closer to his own valuation, to the profit of the auctioneer and the detriment of Bob's business case. There is a competitive motivation to do this.

Still, if you were the auctioneer, perhaps you would have preferred the Dutch auction? Surely by starting the bidding at, say, $10 million and reducing slowly, then as soon as you reached a touch below $6 million, Bob would have bid and you would receive essentially $6 million, rather than the $5 million you in fact received in the English case. Not so fast, it is very unlikely that Bob would have bid his full valuation. In fact if he had clearly understood Alice's valuation, then it would have been sufficient just to bid at $5 million and come in ahead of Alice by a whisker. After all, Alice would not have wished to bid her complete valuation either - she, too, would have been looking for a bargain.

In a competitive bidding situation, neither method gives a clear-cut advantage. In the English case, Alice's knowledge about Bob can force Bob to raise his bids nearer his own valuation. In the Dutch case, Bob's knowledge about Alice can permit him to lower his bid.

Notice that the fourth model we looked at, the second-price sealed-bid, the outcome is essentially the same as in the English auction. The winner pays a price set by the highest loser. This is not an accident. It turns out that the second-price sealed-bid auction and the ascending-bid auction are equivalent under many conditions ([4] p. 14).

Another important distinction is between private-value auctions, where each bidder has their own, invariant valuation of the object(s) being auctioned, and common-value auctions, where bidders might alter their valuations depending on signals (i.e. observed bids) made by other participants.

One of the advantages of the second-price sealed-bid private-value auction (= the private-value English auction) is that the optimal strategy is for the bidder to bid their true valuation (rather than bluff above or below it).

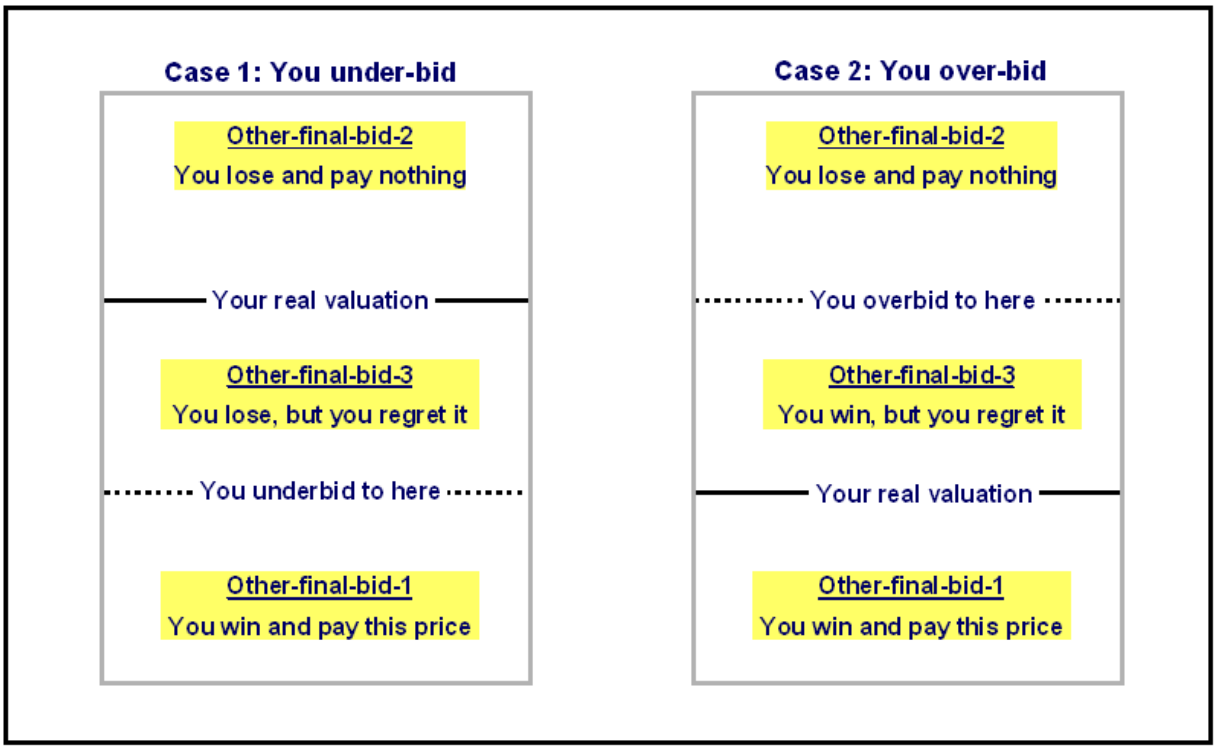

Figure 4. Why you should bid at your valuation.

To see this, take a look at figure 4. Case 1 is on the left, where you bid below your real valuation, and case 2, on the right, is where you bid above your true valuation. The various 'other-bid-n' indicate the possible final bid from anyone else in the auction. A final bid from someone else could be below your bid, in which you pay what they bid (plus the tiniest increment) and win, or it could be a bid which beats anything you bid, in which case you lose and pay nothing.

Take case 1 where you decide to under-bid: if you can win at 'other-bid-1' then that is the price you pay, and it is irrelevant that you were proposing to underbid your own true valuation. If the auction is won by someone else at 'other-bid-2', then you lost and you pay nothing. Irrelevant again that your own private valuation was higher than the point where you stopped bidding. The final case is 'other-bid-3. Here, someone else won the auction by trumping your under-bid. But you regret it, because really, you would have been prepared to bid higher yourself. So underbidding as a strategy is a poor idea.

Overbidding is equally poor. Take case 2. The first two instances are the same as before, so consider when the other person dropped out at 'other-bid-3'. You won at this price, but now you wish you didn't, because it is in excess of your real valuation.

To reiterate, the moral of the story is that in a second-price sealed-bid private-value auction (= the private-value English auction), you should bid to the valuation you privately hold.

If we relax the private-value condition, so that each bidder's valuation can be affected by signals they are getting from other bidders as the auction progresses, the equivalence is broken. Now bidders can learn something from the English auction which they cannot in the sealed-bid model. Clearly anyone who eventually wins would have had to have had a higher valuation than everyone else. The question they should ask themselves is whether they were right to do so, in the presence of so much pessimism amongst the drop-outs. If ignoring the weight of opinion represented by the losers is not a sound policy, we talk about the *winner's curse*, the over-payment to win engendered by excessive optimism about the value of the object being auctioned. This was the situation which faced Didius Julianus when he omitted to ask himself whether the Praetorians could actually deliver what they were auctioning.

Auctions in real-life

Auction theory is about mathematical models and their properties. Auctions in the real world are competitions where real money is at stake and any and all tactics will be employed to win. Critical tactics to 'game' auctions include *collusion* between bidders to avoid bidding against each other therefore lowering prices for everyone, and *predatory behavior*, where weaker bidders are frightened off either before or during the auction, thereby clearing the field and closing the auction early.

Predatory Behaviour

We have already discussed the UK 3G auction during February-April, which attracted 13 serious entrants for five licences. Four of these were the existing UK GSM operators, who were each expected to go after one of the 3G licences, while the fifth licence was reserved for a newcomer. The format of the auction was ascending bid (i.e. an 'English' auction) and after 150 rounds the auction terminated on 27th April, 2000 having raised $34 billion. This was around 650 euros per head of the UK population ([4] p. 187).

In July 2000, the auction road show rolled around to the Netherlands. The Dutch authorities decided to adopt the UK's auction design, expecting to net around 10 billion euros or 560 euros per head (opinion was already turning against the prospects for 3G revenues, as the Internet bubble began to burst). But the auction designers missed some significant differences with the UK experience. In the first instance, the Dutch happened to have exactly the same number of licences to auction as they had incumbent 2G operators, namely five. Existing operators have an enormous advantage over any new entrant as they have operational experience, an existing brand and the opportunity to reuse parts of their GSM infrastructure to

lower costs for 3G deployment. It would clearly be difficult for any new entrant to put together a plausible business case which would deliver a valuation above that of the incumbents, or even close to it. That consequent difficulties of displacing an incumbent provided a strong disincentive to participate in the first place. Most of the entrants who had bid independently in the UK auction therefore decided to cut deals with one or other of the incumbents in the Dutch market, with the regulator taking no action to stop this. In the event, there was only one further bidder when the auction started, a weak alternate operator called Versatel.

The auction therefore started with six bidders for five licences. One of the incumbents, Telfort, promptly sent a letter to Versatel stating its perception that Versatel must believe that its bids would always be surpassed by stronger players in the auction, and that therefore its participation must be motivated by attempts either to raise its competitors' costs or to force access to their GSM or future 3G networks. Telfort stated that it would hold Versatel legally liable for all damages as a result of this.

This extraordinarily intimidating and predatory behaviour put the Dutch Government in a dilemma, as to take action against Telfort would end the auction early and reduce revenues to a derisory amount. In the event, Versatel buckled under the pressure and withdrew. The result was that the auction was a disaster, raising less than 3 billion euros (170 euros per head). The incumbents were delighted at their bargain ([4] p. 155).

Collusion

In 1999, Germany sold ten blocks of GSM spectrum with a rule that any bid had to exceed a previous bid by 10%. The bidders were the four incumbents, but the two weaker players, Viag Interkom and E-Plus soon dropped out. The remaining two bidders were Mannesmann and T-Mobil. In the first round, T-Mobil bid low, and Mannesmann bid DM 18.18 million per MHz on blocks 1-5 and DM 20 million on blocks 6-10.

The significance of the peculiar value of 18.18 is that increased by 10%, it comes to 20. T-Mobil deduced that this was a signal that Mannesmann would not mind if T-Mobil bid DM 20 million for blocks 1-5 and let Mannesmann win the remaining blocks at DM 20 million. This result duly occurred and the auction closed at this very low price ([4] p.105).

Conclusions

Auctions can be an effective method of both creating a competitive market (e.g. by allowing new entrants) and of raising revenues, but neither of these objectives is likely to be in the interests of the proposed bidders. Even a good auction design is subjected to intense lobbying to weaken it, and to permit collusive and/or predatory behaviour on the part of the stronger bidders. If the auction design is sophisticated, lobbyists can often force apparently technical changes past non-specialist decision makers with the result that the auction fails spectacularly (from the public interest point of view - the successful bidders are only too delighted). Paul Klemperer has a number of notable examples in [4], the 'recommended reading' for this chapter.

Knowing your way around auctions, both in theory and practice, is part of the competency set underpinning business strategies for next-generation networks.

References

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Recommended Reading

Paul Klemperer was the principal auction theorist advising the UK Government on the design of the 3G spectrum auction in 2000, which raised $34 billion. This was the biggest auction in history, comfortable beating the prior auction of the roman empire. In [4] he reviews auction design both *theoretically* and in *practice* - the two perspectives turn out to be very different. This book succeeds in creating in the non-economist reader a sense that they understand the basic terrain of auctions - what they are about - although there is clearly a much deeper set of theoretical results underpinning this map of the territory.