Allocation Mechanisms and Post-Allocation Interaction

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In many traditional auctions, the seller or auctioneer is only interested in the price she gets for the auctioned objects. That is, the sole objective is to raise revenue. But, whenever the government sells some rights, it is often the case that the government is also interested in *who* will get the rights, and *how* the rights will be used. Generally speaking, when a market arises after an allocation mechanism is implemented (as it is the case with mobile telephony frequencies, radio frequencies or with the right to exploit gas stations along highways) the government is also interested in welfare issues related to the functioning of industry. Hence, the seller may try to establish already at the allocation stage conditions that ensure a future competitive market. Thus, whenever an auction affects the way a market functions, the seller (government) may have multiple objectives instead of just maximising revenue. One of the questions that arise is: how should these multiple objectives be ranked?

For potential bidders there are also fundamental differences between participating in a traditional auction[1] and participating in an auction, which, in a sense, gives the winner(s) an entry ticket to the market that arises afterwards. When there is a market after the auction, bidders may care about who (else) wins the auction and with what rights. This implies that their valuations are endogenous: they depend on the entire partition of objects among potential bidders. As a consequence of the ensuing strategic aspects, some of the fundamental results of traditional auction theory may fail to hold. In particular, the reasons for favouring auctions over beauty contests are not so clear-cut anymore.

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[1] For accounts of the traditional theory see Börgers and Van Damme (2003) in this volume or, for a more elaborate overview Vajna ?? (2002).

The above issues are particularly relevant in privatisation exercises. Large privatisation exercises (such as license auctions and beauty contests) do not only allocate scarce goods, but also determine the nature of whole industries. The initial allocation is just the beginning of a prolonged interaction among firms, consumers and regulators. Potential acquirers of licenses, say, will try to anticipate their respective profits in the possible future scenarios as a function of the auction's outcome, i.e., as a function of who got licensed, who got what capacity, what prices were paid, etc. This means that the values of the acquired items cannot be exogenously determined, but rather depend themselves on the auction's outcome. This is a novel aspect that differentiates large privatisation exercises from other more standard allocation situations. A good recent example that involved huge monetary stakes was offered by the German UMTS auction where the number of licensed firms could vary between 4 and 6. Prior to the auction, a major investment bank (see Deutsche Bank, 2000) estimated per license values of Euro 14.75 Bn, 15.88 Bn and 17.6 Bn for a German symmetric market with 6, 5, or 4 firms, respectively. Whatever these numbers are worth, they nicely illustrate the perceived endogeneity of valuations, and suggested that firms should try to reduce the number of sold licenses in order to increase future profits. It is obvious that strategic behaviour directed at influencing the number of licenses may also affect various goals such as attaining an efficient allocation or maximising revenue (in fact firms paid at that auction collectively about 20 Bn Euro (!) in order to reduce the number of licenses from 6 to 5 or 4, but were ultimately unsuccessful).[2]

As suggested by the above example, during an allocation procedure with endogenous valuations, firms will condition their behaviour on their expectations about future scenarios, and will strategically act in order to achieve the best possible scenario from their point of view. But this may not always be in the interest of a government who also has preferences over the various scenarios that go beyond the raised monetary revenue. These preferences must also represent the interests of future consumers, other future

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[2] See, also Maasland and Moldovanu (2003) in this volume. In the German case, this number can be easily measured as follows. At the moment when only six bidders were left competing for six licenses, total bids amounted to 30 Bn Euro. But bidding continued as some bidders wanted to have bigger licences and fewer parties in the market. The auction ended with a revenue of almost 50 Bn Euro, but all those six bidders were licensed..

users of the scarce resources, other current users, etc. Hence, a government may want to be careful when designing allocation mechanisms where rights are privatised.

This chapter focuses on the many ways in which allocation mechanisms and post-allocation events interact. The chapter is organised as follows. In Section 1 we look more closely at several common seller objectives. In Section 2 we briefly look at strategic bidding behaviour in auctions with "external effects" - these effects allow us to describe situations in which bidders care not only about their own allocation, but also about the entire distribution of rights among the relevant agents, i.e., they care about who (else) wins what.[3] Next, in Section 3 we describe the main features of allocation procedures that are followed by interactions among the agents. We point out that these strategic effects may completely blur the relations between some standard and well-known design goals. The main new strategic effects are illustrated via several simple examples. In Section 4, we summarise the resulting main lessons for the design of allocation procedures that influence future market outcomes.

Before proceeding, we want to mention that the influence of future interaction on competitive "bidding" situations is quite ubiquitous, and it is not confined to privatisation exercises. Here are a few other interesting examples (see also Jehiel and Moldovanu, 1996, and Jehiel, Moldovanu and Stacchetti, 1996):

- In take-over or mergers deals, the structure of the industry may dramatically change and even firms that are not part of the transaction are positively or negatively affected. We often see prolonged waves of restructuring in the same industry, as firms react to a merger of some competitors by merging themselves, exiting, etc.

- Any acquisition of an "input" that is crucial for future competition (e.g., a license to operate, a new major customer, a project that leads to the creation of an industry standard, etc.) will affect competitors in a significant way. This means that there are externalities between competitors that go beyond the competition for the object at stake.

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[3] We want to mention here that we focus here on physical external effects (agents care about the entire distribution of physical goods), and not on informational external effects arising when valuations also depend on the distribution of information available to other agents (see, in this context Jehiel and Moldovanu (2000b, 2001a) and also Maskin, (1992).

- A large firm locating in a certain community may create new jobs also in nearby areas, and/or environmental damage to a larger region. Note that the location of large firms can be seen as a competitive bidding situation in cases where communities compete with tax-rebates and other infrastructure sweeteners in order to attract large employers.

- The sales of weapon systems have clear adverse effects on countries or groups that have a serious conflict with the acquirer.

1. Auctions and Future Interaction: The Seller's Objectives

Competitive markets in which the most efficient firms are operating generally enhance economic efficiency. Thus, in addition to revenue, a government may be interested in other objectives such as (*i*) allocating scarce items efficiently and (*ii*) creating sufficient competition in the market, which appears after the auction. In a "traditional" auction for one object there need not be a conflict between these different objectives: the competitive market criterion is not relevant since there is no market after the auction, while efficiency requires that the firm with the lowest cost (or best business plan) wins the auction. Since this firm will also be willing to pay most for the object, selling efficiently also maximises revenue.

This picture changes if there is a market after the auction. For example, it may be possible to raise high revenue by creating a privatised monopoly (since monopolistic profits tend to be higher than total oligopoly profits), but such an outcome is undesirable if it means that, due to the absence of competition, consumers will have to pay high prices in the future.[4] That is, revenue maximisation is at odds with the objective of achieving a competitive market. We argue below that the relations between goals such as "market efficiency" (which includes government's and consumers' preferences), "value maximisation" or "efficiency of the auction allocation" (which focuses on the efficiency of the acquiring firms) and "revenue maximisation", become complex and

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[4] This is the case when the bidders are quite similar and expect identical profits in monopoly and oligopoly settings. When there is one strong bidder and many weak bidders, the strong bidder has to bid slightly more than the value of one of the weaker bidders in order to obtain the monopoly right. In this case revenue may be increased by creating an oligopoly.

less transparent. Failing to take into account the effect of future interaction may have harsh consequences for governments and/or consumers.

For another prominent example, consider several of the questions related to the incumbent-entrant asymmetry in the UMTS licensing exercise: Should the government create a level playing field? Should licenses be reserved for newcomers? Should handicaps be imposed on some bidders? Newcomers usually have lower valuations than incumbents and this is what we assume in what follows. An immediate observation is that if the government wants to "put the licenses in the hands of those who value them the most",[5] i.e., if it wants to *maximise the value generated by the auction*, it should not reserve a license for a newcomer. On the other hand, reserving a license for a newcomer may or may not increase *the revenue* that is raised through the auction, depending on how much competition is there for the remaining licenses and how fierce these same firms would compete if no license were reserved.[6] Finally, in terms of *after-market efficiency*, reserving licenses for entrants usually increases market competition, as the newcomers have to fight for obtaining market share. This increase in has to be weighed against the potential duplication of fixed costs.

Given that the three goals may diverge or even be inconsistent with each other, it is important to ask the question whether these objectives can be ranked from an economic point of view. Using the notion of total surplus, several interesting observations can be made.[7] First, the auction's revenue should not be a (very) important objective for the government, as total surplus is independent of the revenue raised through an auction: whatever amount the government raises through the auction comes at the expense of the winning firms (i.e., their shareholders). To be fair, one could take into account the possibility that the government will decrease taxes since auction revenues can substitute

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[5] This phrase is used often to explain the benefits of auctions to laymen. See Milgrom (2001)

[6] An important issue in this context is whether newcomers will bother to participate in the auction if no license is reserved for them and if number of license equals the number of incumbents (see Klemperer, 2002 and Jehiel and Moldovanu, 2001).

[7] When considering welfare implications of policy proposal economists work either with the notion of Pareto efficiency or with the notion of total surplus. An allocation is Pareto efficient if there does not exist another allocation in which some agents are better off, while nobody is worse off. Pareto efficiency does not compare the surplus of different agents with each other. The measure of total surplus simply adds all the surplus (welfare) of all agents in society. For our purposes Pareto efficiency is too weak a notion since many outcomes are Pareto efficient.

for tax revenues. Since taxes are usually collected in such a way that they distort the economic process while auctions impose non-distortionary lump-sum taxes, revenue rising through auction may enhance welfare. Unlike revenue maximisation (whose welfare effect depends on the magnitude of the tax-substitution), value maximisation and market efficiency always influence total surplus to a great extent.

2. Auctions and Future Interaction: Buyers' Strategies

We often think about traditional auctions as being populated by people who demand the good solely for their own consumption purposes. In particular, the agents do not care about the allocation of goods among the rest of society. As we explained above, such traditional thinking about auctions cannot accurately encompass situations arising in instances where agents interact after the allocation procedure in a way that is influenced by the allocation procedure itself. Therefore, we need to consider extended models that allow us to capture the various ways in which agents care about how goods are allocated to others. It is common to call such effects "externalities", and to differentiate among "positive" and "negative" externalities.[8] In our context, the externalities represent the individual effects of each future scenario resulting from a particular allocation of goods among the agents.

The presence of externalities creates a multitude of new and surprising strategic effects. We illustrate a few important ones through some simple examples. The first example illustrates how externalities can strongly affect the identity of the winner and the resulting price. In particular, with negative externalities, agents are willing to pay more than their intrinsic valuations in order to avoid that the good falls in the hands of another, i.e., there is a value attached to pre-emption. The opposite phenomenon occurs when there are positive externalities - agents are willing to pay less than their intrinsic valuations if they can expect a positive payoff in case another one wins. This is usually called "the free rider problem" and often plagues the private provision of public goods.

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[8] Positive externalities are present when the payoff of one agent goes up when another agents consumes an item or bundle, while negative externalities are present when the payoff goes down.

Example 1: There are two buyers. Buyer A values the object at 10 (Euro, say), while buyer B values the object at 8. In a standard auction, buyer A will get the object and pay approximately 8. But consider now the situation where buyer A suffers a loss of -4 if buyer B gets the object, while buyer B suffers a loss of -7 if buyer A gets the object. Now buyer A will be willing to pay as high as 14 (10+4) in order to avoid that the good goes to buyer B. Similarly, buyer B will be prepared to pay as high as 15 (8+7). Hence, at a standard auction, buyer B will win the object at a price of approximately 14. Note that, relative to the status quo before the auction, B is actually incurring a loss of -6. But this is better than the alternative where A gets the object, in which case B incurs a loss of -7. Note that valuations are here endogenous since, for example, if A publicly commits to not buy the object (say, by not filling the auction registration forms), the valuation of B immediately drops from 15 to 8. ///

The example shows that winning players may consciously take a loss. If taking such a loss seems curious, consider the following citation from *The Economist*, June 28, 1997 that describes a bidding war among producers of aircraft engines:

> The good sales at Rolls-Royce began 18 months ago when it snatched a huge order to supply Singapore Airlines...Its hard nosed American rivals, Pratt&Whitney and General Electric, were prepared to take a loss to land such a prestigious deal. So they assumed Rolls-Royce won the bid by taking an even greater loss.

The idea behind this quote is that failing to get the Singapore deal puts a firm in a disadvantageous position when bidding for later deals. The need to avoid this disadvantage in future market interactions drove firms to sacrifice current profits.

Example 1 provides some insight about one of the reasons that have been put forward in order to explain why telecom companies have paid such enormous sums of money for acquiring UMTS frequencies in some European countries: if incumbents feared that their current GSM frequencies would become worthless without the new UMTS-

services, they should be willing to pay more than their respective intrinsic valuations for the UMTS-frequencies.

When there are more than two buyers it can also be shown, with either positive or negative externalities, that some agents may prefer not to participate at the auction if they perceive that their mere presence (via the externalities) influences the identity of the winner or the price to be paid (like in Example 1). For example, the French food conglomerate BSN quit a bidding war over Perrier in order to allow Nestle to take over. It simply feared Nestle less than other bidders.

3. Buyers' Strategies and Sellers' Objectives

We have qualitatively discussed how the seller's possible objectives are related to each other, and how bidders may adapt their bidding behaviour in environments where externalities are important. We will now discuss the seller's objectives and the bidders' strategies simultaneously via several simple examples.

The first example in this Section shows that value maximisation (for buyers) and efficiency (which takes into account also the seller's utility) may diverge when there are externalities. In particular, this implies that a government interested in market efficiency may want to handicap some bidders, while favouring others.

Example 2: Consider the same setting with externalities as in Example 1, but imagine that the seller also incurs externalities: assume that, besides getting the revenue from the auction, the seller incurs a loss of - 2 if buyer A gets the object, and a loss of -4 if buyer B gets the object (for example, imagine that the buyers are taking over a public firm which is being privatised, and that they both have restructuring plans which include firing different amounts of workers; the government would *ceteris paribus* like to see as little firing as possible). In a standard auction (see above) the object is sold to buyer B, yielding a payoff of 10 (revenue of 14 minus loss of 4) for the government. But the government prefers to sell to buyer A: he is also willing to pay up to 14, but creates a

smaller loss of 2 (i.e., by committing to fire less workers). This yields a payoff of 12 for the government.

The following straightforward calculations show that value maximisation and "market efficiency" may diverge. The value created for buyers is 3 when buyer A gets the object (this is obtained by subtracting from A' s valuation of 10, B's loss of 7), while the value created for buyers is 4 when B gets the object (subtract from B's valuation of 8 the loss of 4 incurred by A). Hence, buyers' values are maximised by selling to B, and this outcome will be indeed achieved by a standard auction. Consider now the entire society which includes the seller, and which regards revenue as zero-sum transfer.[9] Total welfare is 1 when A gets the object (buyers' value of 3 minus seller's loss of 2), and 0 when B gets the object (buyers' value of 4 minus seller's loss of 4). Hence, if the seller is interested in "market efficiency" he should sell to A, which also agrees in this particular case to his own preferences.

In the example it is possible to achieve "market efficiency" through a non-anonymous auction. One way to do this is by tilting the auction in A's favour or by handicapping B, e.g., by stipulating that A gets the object unless B bids at least 2 more than A.[10] But in practice many of the relevant valuations are not known ex-ante and it will be often difficult to precisely set efficient handicaps. Thus, such non-anonymous allocation auction procedures may be inefficient due to incomplete information, or because the handicaps and favours are set via a process that is subject to lobbying activity.   ///

We can learn from the above example that if a seller does not only care about revenue, but also cares about who wins the auction (because the seller believes that after the auction one bidder behaves in a way that better serves society's interest than another bidder) a standard auction may not produce an efficient outcome even though buyers' valuations are maximised.

In the next example we want to show that the goal of efficiency may be in conflict with the goal of revenue maximisation. In Section 1, we already illustrated this issue with an

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[9] Compare the discussion in Section 1.
[10] For a discussion on asymmetric auctions, compare the chapter by Maasland, Montagnie and Van den Bergh in this volume.

example where the issue was how many licenses to auction. In the example below we assume the number of licences cannot be chosen (and is here fixed at 1) and show that revenue maximisation in the presence of negative externalises may call for letting agents pay even if the object is not sold (bidders pay for the avoided losses). The same logic, applied to the case of positive externalities, implies that some agents should be compensated in order to induce them to provide a public good.

Example 3: Consider the same setting with externalities as in Example 1, but assume now that there is another buyer C. The seller prefers to sell to C. C values the object at 31 and does not perceive a loss or gain if someone else gets the object. Both A and B suffer a loss of 20 each if C gets the object. One instance in which this may be realistic is when A and B are incumbents that can also operate with their old licenses, while C is a very efficient new entrant, able to steal existing customers from A and B. The seller can be a government who thinks that the prices for consumers will be significantly lower after the entry of the efficient firm C and therefore prefers to sell to C.

A standard auction will award the object to C (who is willing to pay up to 31) at a price of about 30 (this is what A is maximally willing to pay, taking into account the need to pre-empt C). Is such auction revenue maximising? The answer is "No"! The seller can get a higher revenue by committing not to sell the object at all, and by requiring payments of 19, say, from both A and B (who should be induced to be believe that refusing to pay leads to a sale to C). This yields total revenue of 38. Note that A and B are indeed willing to pay each 19 in order to avoid a sale to C, which would cause losses of 20 for each of them.

Is this outcome where the object is not sold also efficient? If the seller actually sells to C the buyers valuations sum up to –9 (C's valuation of 31 minus two times 20, the distillate of buyers A and B when C gets the object). So, if the seller gets a pay-off of more than 9 by selling to C instead of not selling at all, we obtain that the goal of efficiency (which calls to sell to C) is in conflict with the goal of revenue maximisation (which calls for not selling the additional license, while extorting payments, say a tax, from both incumbents).   ////

A Machiavellian scheme similar to the one illustrated above was in fact implicit in the German UMTS design. In that design the number of licences was endogenous, with 4 as a lower limit and 6 as an upper limit (there were 4 incumbents). The trade-off was between having a competitive market with more than 4 firms and obtaining high revenue from bidders that pay in order to restrict the number of winners and thereby future competition. In fact the winning firms got trapped and paid a lot without being able to reduce the number of licenses.[11]

The last example will show that in auctions where each buyer can buy more than one unit even value-maximisation for buyers and revenue maximisation are not correlated (as is usually the case in one-object auctions without externalities). For this illustration we do not need external effects (see Jehiel and Moldovanu, 2001b).

Example 4: Consider an auction for two objects, *p* and *r*, and two bidders *A* and *B*. For both agents, the valuation of the entire bundle {*p,r*} is given by the sum of their valuations for the individual objects in the bundle. These are given as follows: *A* values object *p* at 10 and object *q* at 7, while *B* values object *p* at 8, and object *q* at 12. The valuations are given in the table below.

	Valuation of bidder *A*	Valuation of bidder *B*
For object *p*	10	8
For object *q*	7	12
For both objects	17	20

The *value-maximising* auction (which puts the objects in the hand of those who value them most) is simply given by two separate standard auctions, one for each object. Then object *p* goes to *A* for a price of 8, while object *q* goes to *B* for a price of 7. Total revenue is therefore 15 and total value of the winners that is generated through this auction for both objects is 22.

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[11] Other examples of such schemes abound in the world of weapon deals: China got the US to lift its embargo on satellite exports by agreeing not to sell missiles to some countries in the Near East; Ukraine agreed to destroy its nuclear arsenal (thus preventing proliferation) after it got hefty payments from the US, Russia and the EU.

Consider now a single auction for the entire bundle {*p,r*}. Note that B is willing to pay up to 20 for the bundle, while A is willing to pay up to 17. Hence, the bundle will go to *B* for a price of 17 and total value that is generated through this auction is 20. Thus, auctioning the bundle yields higher revenue than the two separate auctions, but generates a lower total value. The *revenue-maximising* auction misallocates object *p* to *B*, although *A* values it higher. If we add externalities to the example, the wedge between allocative value maximisation and revenue-maximisation becomes even larger.

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The above Example shows in a simple way that the precise definition of the sold objects matters quite a bit for the auction outcome.

4. Main Lessons for Auction Design

When there is future interaction after the auction, bidders may not have a fixed valuation for the objects to be auctioned, and the seller may have preference over *who* wins the auction with *what* rights. Taking these effects into account, we have shown that several relations among objectives that do hold in standard auctions may not hold in auctions with externalities. We state below the main implications of our analysis.

1) In auctions followed by future interaction, bidders are driven by aspects other than the intrinsic value of the auctioned objects. It may even be that the intrinsic value of the object is not well defined.[12] This behaviour can significantly affect the outcome (see Examples 1-3), and therefore, in order to avoid unpleasant surprises, must be well-understood and taken into account already at the design stage. This insight also applies to the lobbying activity that accompanies beauty contests.

2) "Put the licenses in the hands of those who value them most" may not be a sensible goal (see Example 2) in view of overall economic efficiency - a criterion that takes into account the preferences of all economic actors (such as government, various consumer

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[12] Janssen (2003) considers the case where winning an auction gives the right to play a coordination game with two Pareto-ranked equilibria. The intrinsic value of winning the auction is not well-defined in such a case as the value critically depends on how the coordination game is played.

groups, other potential users, etc.). In an auction, firms take only their own interests into account. In particular, allowing too much flexibility to bidders (in order to facilitate value maximisation) may run contrary to the designer's. For example, consider auctions of radio spectrum to commercial operators. If the government cares about the aired content, it may need to give up some revenue in order to reach the desired programme variety.

3) Another widespread idea is that "Value maximisation for buyers and revenue maximisation go hand in hand". The intuition is as follows: if a large pie is created (by maximising value for the bidders), it may be possible to extract more revenue as bidders are willing to pay up to their valuation; conversely, a large willingness to pay (reflected in high bids and revenue) means that a large value has been created. Based on this belief, it seems possible to use revenue maximisation as a handy proxy for the more fickle value maximisation. Moreover, revenue maximisation seems a legitimate goal, particularly in the cases where it is believed that this form of taxing firms is less distorting than other, more traditional taxation schemes.

But, the above belief is based on intuitions from one-object auction theory with exogenous valuations. There is no general relation between value maximisation and revenue in auctions where the valuations are endogenous due to external effects caused by market structure considerations, or in multi-object auctions with either exogenous or endogenous valuations (see Examples 3-4). This means that multi-object auctions that maximise revenue will not necessarily put the objects in the hands of those that value them most, and auctions that maximise value may not maximise revenue. It is important to be aware of these conflicts, and to choose the appropriate weights for the various goals in each particular application.

4) With endogenous valuations due to future interactions, standard auctions loose many of their appealing properties (see Examples 1-3). Even post-auction bilateral re-trading may not be able to restore efficiency (see Jehiel and Moldovanu, 1999). More complex mechanisms (such as the so called "Vickrey auctions", where agents pay proportionally to the external effect they impose on society) are in some cases able to achieve efficient

allocations. Revenue-maximising mechanisms are not generally known. For multi-object auctions with exogenous valuations a main idea is the need to bundle some of the auctioned objects (see Jehiel, Meyer-ter-Vehn, 2002). With endogenous valuations, revenue maximisation may require that the auction rules incorporate some "threats" to induce unpleasant outcomes if bidders do not pay enough (see Example 3, Jehiel, Moldovanu and Stacchetti, 1999, and recall the German UMTS design).

But "Vickrey auctions" or revenue maximising auctions do not take the form of simple bidding procedures, and may be cumbersome to implement in practice. Hence, for practical purposes one has often to make a trade-off between a simpler auction format that may not be optimal, and a more complex optimal format whose practical implementation may be problematic.

5) A particularly important application of the above points concerns the behaviour of incumbents (see also Gilbert and Newberry, 1982). When new scarce goods are allocated, incumbents will be driven both by their valuations for the resources and by the need "to protect their turf". Understanding the interplay between these pre-emptive motives and the standard demand motives is essential in order to achieve a good, balanced design (the same applies of course to beauty contests that are often accompanied by intense partisan lobbying).

For example, at one stage (Summer 2001) the design for allocating spectrum for national radio services in The Netherlands stipulated that some "designated" frequencies (for stations broadcasting classical music, news, etc.) could be allocated to regular commercial stations if nobody bids on them during the first few stages of the auction. This was thought to allow more flexibility and to avoid the creation of money-loosing enterprises. But it may also drive some incumbent stations to buy these designated frequencies in addition to their main one (this is allowed by the rules) precisely in order to avoid the entry of new commercial national stations. It is possible that such considerations were irrelevant (since the achieved value of such a strategy may be low) but it is necessary to consider them carefully at the design stage in order to assess the probability of their occurrence.

6) Since all incumbents are partially driven by a common pre-emptive goal (see Example 3), there is a strong motive for collusion among them (in addition to the standard motive of keeping prices down). Perfectly legal collusion-like behaviour (without illegal money transfers) becomes feasible if there is a symmetric method to share the cost of pre-emption (see Jehiel and Moldovanu, 2000a).

For example, consider a bidding event for one new license between two incumbents and several potential entrants. Each incumbent prefers to preserve the cosy duopoly, but also prefers that the cost be borne by the other incumbent (this is a "free-rider" problem). If the new license is not very valuable per-se to incumbents, there is a reasonable probability that an entrant will acquire it, since each incumbent hopes that the other will buy it (we abstract here from illegal side payments among incumbents). But consider now the same situation with two licenses: it appears that entry should be even more likely. But entry may not occur at all since the two incumbents can now easily and legally share the cost of pre-emption by buying one license each. This last example shows why a design such as the one for Dutch UMTS auction (with 5 license and 5 incumbents) was problematic, and why it was possible for us to anticipate its outcome.

7) We have seen that in asymmetric situations efficiency may be achieved by handicapping some firms while favouring others (see Example 2). The feasibility of such operations depends on the particular legal system in place. For example, the US Federal Communication Commission favoured certain small or minority owned firms, the UK design for the UMTS auction did not allow incumbents to bid on the largest available license, etc.[13] An asymmetric design must be based on transparent and well-defined, "hard" criteria (this applies also to beauty contests). Such a designed asymmetry will create new strategic incentives, and it is necessary to assess whether these new effects will indeed combat the ones they meant to alleviate.

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[13] See also other chapters by Salmon on the FCC case and by Maasland, Montagnie and Van den Bergh on asymmetries in this volume.

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