AUCTIONS AND BEAUTY CONTESTS

A POLICY PERSPECTIVE

AUCTIONS AND BEAUTY CONTESTS

A POLICY PERSPECTIVE

April 2002

Co-ordination: Prof. dr. M.C.W. Janssen
Department of Economics
Erasmus University Rotterdam
PO Box 1738
3000 DR Rotterdam
The Netherlands
phone: 31-10-4082341
fax: 31-10-4089149
e-mail: janssen@few.eur.nl

TABLE OF CONTENTS

SUMMARY AND CONCLUSIONS I

Maarten Janssen

PART I THEORY

1 BEAUTY CONTEST DESIGN 1

Maurice Dykstra and Nico van der Windt

2 CREATING A LEVEL PLAYING FIELD 19

Emiel Maasland, Yves Montangie and Roger Van den Bergh

3 PREVENTING COLLUSION BETWEEN FIRMS IN AUCTIONS 35

Tim Salmon and Emiel Maasland

4 INTERACTION BETWEEN ALLOCATION MECHANISMS AND FUTURE MARKET OUTCOMES 49

Maarten Janssen and Benny Moldovanu

PART II CASE STUDIES

5 AUCTIONS TO GAS TRANSMISSION ACCESS; THE BRITISH EXPERIENCE 63

Karsten Neuhoff and Tanga McDaniel

6 SPECTRUM AUCTIONS BY THE UNITED STATES FEDERAL COMMUNICATIONS COMMISSION 89

Tim Salmon

7 MOBILE TELEPHONY (3G) 111

Tilman Börgers, Emiel Maasland and Benny Moldovanu

8 MATCHING MARKETS FOR US MEDICAL INTERNS 137

Benny Moldovanu

9 SALE OF GOVERNMENT BONDS IN A VARIETY OF COUNTRIES 151

Tilman Börgers and Joseph Swierzbinski

10 COMPETITIVE PROCUREMENT OF REINTEGRATION SERVICES IN THE NETHERLANDS **177**

Maurice Dykstra and Jaap de Koning

11 ALLOCATION OF RAIL FRANCHISES **195**

Luisa Affuso and David Newbery

12 BEAUTY CONTEST OF FLEMISH COMMERCIAL RADIO **207**

Maurice Dykstra and Emiel Maasland

AUTHORS **231**

SUMMARY AND CONCLUSIONS

Maarten Janssen

TABLE OF CONTENTS

1 INTRODUCTION III

2 GOALS IV

3 WHAT AND HOW MANY LICENSES WILL BE ALLOCATED? V

4 WHICH MECHANISMS CAN BE CONSIDERED? VI

5 PROPERTIES OF THE MECHANISMS VIII

6 ASPECTS OF AUCTION DESIGN X

7 ASPECTS OF BEAUTY CONTEST DESIGN XII

1 INTRODUCTION

From October 2001 to March 2002 a research project was initiated by the MDW working group Auctions and Other Allocation Mechanisms. The research consisted of case studies and more theory oriented studies surveying the relevant literature. A team of Dutch and foreign experts was invited to execute the research. The research served as background material for the working group. The present document summarizes the main findings of the research project without discussing the case studies in detail. Also, some general lessons are drawn. The structure of this part of the report is chosen in such a way that the connections with the discussions in the MDW working group "Auctions and Other Allocation Mechanisms" come to the fore.

The working group was mainly concerned with issues related to the allocation of rights to operate on a market. The recent UMTS-auction may serve as an illustrative example. Market parties need to have the right to use certain frequencies to be able to provide consumers with UMTS-services such as mobile internet. In the auction, the available frequencies were clustered into lots and the highest bidder on a lot won the license to operate on the market using the frequencies of that lot. There are two central questions the working group has focussed on:

1. Which mechanisms could a government – in principle – use to allocate rights to operate on a market?
2. What are the important design issues once a particular allocation mechanism is chosen?

This document and the research project in general starts from the observation that answers to these questions crucially depend on the objectives the government wants to achieve. Section 2 therefore first discusses possible goals and the relationship between them. A government will typically aim, among other things, at a well-functioning product market. The working of the product market depends to a large extent, however, on how the government has chosen to shape the licenses (what is allocated?) and how many licenses are allocated. Section 3 therefore delves into these issues first before providing an overview of the different allocation mechanisms that could be chosen. The issues discussed in Section 3 (what and how many are allocated?) have indeed to be answered first before the how-to-allocate-question can be posed. Section 4 argues that there are many different forms of Beauty Contests and auctions and attempts at providing criteria that help to distinguish when to speak of a Beauty Contest and when to speak of an auction. Section 5 then provides a list of properties on which the two prototypes of different allocation mechanisms can be scored. Finally, section 6 and 7 discuss important design issues that are relevant to either auctions or Beauty Contests.

All references are to the authors of the articles that follow.

2 GOALS

There are different goals that a government may want to achieve when allocating the right to operate on a market:

1. Efficient operation of the market.
2. Market that provides publicly desirable goods..
3. Revenues.
4. Efficient allocation process.
5. Value maximizing allocation process.
6. Transparent selection process.

And there may be even other goals. A first important point to realize is that the first two objectives pertain to the way the market operates, while the latter four objectives are objectives concerning the allocation process (who gets the right to operate on the market). It is important to distinguish goals 1 and 4 and 5: Given a certain market design, firms individually try to figure out how much money they will make in the market. Based on these estimates, they determine their valuation for the license. *A value maximizing allocation process* is a mechanism in which the firms with the highest valuations win the licenses. One way to measure the *efficiency of the allocation process* is by looking at the total surplus of the seller (government) and the (winning) buyers of licenses. The difference with a value maximizing allocation process is that the objectives of the seller are also taken into account. The first objective, *efficiency of the market*, means that the market allocation is such that the sum of consumer and producer surplus (and government surplus) is maximized.

Janssen and Moldovanu illustrate by means of examples that the different goals can be contradicting. For example, an efficient (competitive) market implies that the profits by firms are negligible so that they are also not willing to pay very much for the license. As a result any allocation mechanism will lead to low revenues. Also, a value maximizing allocation mechanism may not lead to an efficient market and vice versa. This is, in a sense, easy to see as value maximization only looks at the valuation of firms, whereas the latter notion also takes consumer surplus into account. If differences in cost structures are the only difference between firms i.e, they would have the same market power, the same costumer base, etc, then the two objectives coincide: low cost firms will typically have the highest valuations and the market will be more efficient with low cost firms.

An important lesson of the above is that it is not enough just to state the different objectives governments may want to achieve. Rather, one should also consider the relations between the objectives and in case the objectives are contradicting each other, choices concerning objectives have to be made.

The extent to which revenues should be an important goal on its own is open to discussion. It is of course true that high revenue may be a good alternative to distortionary taxes (another way to raise government income). However, I haven't seen any country where tax rates have been lowered after high revenues have been obtained. It seems more likely that governments use (auction) revenues to provide

(more distortionary) subsidies or to lower the amount of government debt financed through the issuing of bonds (see on the latter Börgers and Swierzbinski). Also, higher revenues means lower producer surplus, a concept that also should be taken into account when determining the welfare impact of the revenues raised by using an allocation mechanism. In short, the welfare impact of high revenues may be positive, but the size of this effect may be quite small.

Above, I have argued that it is important to define the goals of a privatisation exercise properly. This is important in determining (in advance) how the operation should be carried out and organized. It is also important when it comes to evaluate the success of the operation afterwards. Defining goals also implies to understand the relation between the different goals one may want to pursue and the ranking of the goals in case of inconsistencies. Sometimes, in formulating the goals it may be important to pay some attention to the origin of the issues at hand. Usually, the question to allocate rights to operate on a market arises when (groups in) society feels uncomfortable with the existing situation. Publicly run firms may be inefficient or may not have the right incentives to innovate. New technologies may come about that need to be exploited. Sometimes, it may be easier to understand the goals of the exercise if the origin of the situation is taken into consideration.

3 WHAT AND HOW MANY WILL BE ALLOCATED?

The most important question to be answered when putting a certain task in the hands of the private sector, is how the market should be *designed*. Given technological and legal constraints, the government is in the position to think of a market that best guarantees that the desired goals are achieved. Quite often, the market is *not* there, but is constructed by the government itself!

Looking at some of the case studies, it is clear that most of the interesting questions arise here at the market design stage. For example, Affuso and Newbery look at the way rail services can be privatised. Roughly speaking, there are two models: the Swedish model where there is a vertical separation between infrastructure and rolling stock: the infrastructure is in public hands and a private firm is responsible for the trains and the train schedule. In the Argentinean model, the country is split up in regions and within a region one firm is responsible for both infrastructure and railway services. In principle, in both systems there is also an issue how many competitors there should be in the market: one, two or more? Of course, given the fixed costs of building infrastructure, it probably does not make much sense to have more than one local operator in the Argentinean system, whereas one may consider two or more operators in the Swedish nationwide system. Markets work in a quite different way in the two countries and it is important to consider the pros and cons of each system *before* an allocation mechanism is chosen that allocates the right(s) to operate a service within the already chosen system.

Another example in this context is the way reintegration services are privatised in The Netherlands (see Dykstra and de Koning). The right to reintegrate a certain "lot", consisting of a certain number of unemployed people, back into the labour market is allocated to private companies and the companies can "bid" how and

for how much money they are going to do this. The groups are very heterogeneous, consisting of both men and women, handicapped and non-handicapped, people of different age, and so on. The people themselves do not have a choice which company they prefer to have to reintegrate them. This means that the license is defined in such a way that it rules out the existence of a market where firms compete to get clients. Another way that could have been chosen is simply to have a certain number of reintegration firms in each region and unemployed people being free to choose the firm they prefer best[1], or to have sector-specific or age or handicap-specific reintegration firms. I don't want to argue here that necessarily one system would have been better than the other. What I do want to argue though is that it is important to consider the different possibilities how to design the market and to choose the market design that best guarantees that the aims of the privatisation process are reached.

Another case study that makes the point clear of what needs to be allocated and how many need to be allocated is the UMTS-case (by Börgers, Maasland and Moldovanu). This may seem a little strange at first sight as the issue what to allocate seems to be quite obvious: a certain amount of spectrum. Delving a little deeper makes it clear, however, that also in this case there are many (important) issues to be settled. A first issue is whether firms are obliged to serve a whole country or only the most profitable areas and if the whole country has to be served, what is the time frame in which this has to be done. A second issue concerns the question whether firms that get a license have to provide roaming conditions for firms that do not have a 2G network. A third issue concerns the length of the contract. Public goals (the whole country needs to be covered by a network) may be achieved by defining the objects that will be auctioned in a proper way. Also, the nature of competition in the market may depend on the roaming conditions, as it is more attractive for potential entrants to enter the market when they know that they can roam on existing network. Finally, it is of course, important to determine how many licenses are to be awarded as this determines the number of competitors in the market.

By using these three case studies, I have discussed several issues that determine how much *competition in the market* there will be. These issues have to be faced *prior to* the choice of an allocation mechanism. They are relevant no matter whether the allocation of the licenses is done via an auction or a Beauty Contest.

4 WHICH MECHANISMS CAN BE CONSIDERED?

It is important to see that auctions and beauty contests are merely ways to select the private parties that get a license to operate in the market. The efficiency of the market, one of the most important goals from an economic point of view, depends to a large extent only on the way the market is designed (how is the license defined and how many licenses are allocated). From the point of view of the *efficiency of the market*, the choice of allocation mechanism (and the subsequent design) is important as it co-determines whether low-cost firms will operate in the

[1] This may be achieved by given unemployed people "vouchers" that can be used to buy reintegration services.

market (see the discussion above) and whether newcomers have a chance in obtaining a license. That is, given any market design (see Section 3) and the associated efficiency of the market a government can choose between different allocation mechanisms to determine who will operate in the market. The choice of mechanism determines how the *competition for the market* will take place.

A first, maybe trivial, point is that it is important to see that the government can make a *choice which allocation mechanism to use*. Quite often in practice, however, not all options are put on the table. This is clear, for example, in the case of the Flemish commercial radio frequencies studied by Dykstra and Maasland. Already early on in the process, The Flemish government had determined that a type of Beauty Contest will be used without considering, for example, the option to auction.

What are the options?

If it is important to consider the different options, can we then determine and characterize what these options are? The main distinction is between auction on one hand and Beauty Contest on the other hand.[2] The main distinction between the two is that the latter always contains an element in them that cannot be easily quantified or otherwise made objective. Auctions, on the other hand, are allocation mechanisms where a pre-defined algorithm can determine who will have the best bid. What is certainly not the case is that prices do not play a role in Beauty Contests or that in a Beauty Contest prices have to be exogenously fixed. A Beauty Contest can very well have as an ingredient that bidders specify the amount they are willing to pay for the license. Accordingly, in a Beauty Contest "price offered" can be one of the items on which parties are scored.

Auctions can be further distinguished between single and multi-attribute auctions. Multi-attribute auctions are auctions where a bid consists of more than one dimension, i.e., bidders do not only bid on price, but also on (for example) quality dimensions. Traditional auctions, such as first and second price sealed-bid and open cry, are single dimensional as bidders only bid a price. The distinction between single and multi-attribute auctions is important in relation to Beauty Contests. The distinction makes clear that in auctions quality considerations (if they can be objectively measured) can play a role: either as an imposed minimum requirement on the bidder, and/or on the way the license that is auctioned will be used (that is before the bidding process during the auction takes place), and/or part of the bidding process.

Beauty Contests can be further distinguished between weighted and unweighted Contests. In an unweighted Beauty Contest, bidders do not know in advance how their bids will be evaluated. A weighted Beauty Contest is an allocation mechanism in which bidders know in advance on which criteria they will be assessed and what the weights of the different criteria will be. Even though the maximum score on a certain criteria is known, it remains (somewhat) ambiguous even in a weighted Beauty Contest, how to score different bidders on a certain criterion. Prices that are bid can play a role in both types of Beauty Contests. One

[2] We don't discuss here other types of allocation mechanisms such as grandfather rights, lotteries and first-come-first-serve. As there are no clearly defined considerations at the basis of these types of allocation mechanisms, it seems obvious that all of them are either dominated by a Beauty Contest or by an auction.

advantage of having bidders bidding prices, even in a Beauty Contest, is that it becomes clear how much money the government is willing to give up in case a license is not awarded to the bidder with the best price. One may, in a weighted Beauty Contest, try to give objective criteria for scoring on a certain item. We continue to call this a Beauty Contest as long as at least one item is scored in a subjective way.

Theoretically, one can think of different ways to combine auctions and Beauty Contests. One way is where bidders may come up with a proposal how they are going to use a certain license. The auctioneer determines the ranking of the proposals and this ranking is translated into a bidding handicap. After the bidding handicap is made public an auction is held. A second way is to have an auction first where the right to participate in a later Beauty Contest is auctioned off. Finally, one can think of the bidders in an auction being determined by a Beauty Contest.

5 PROPERTIES OF THE MECHANISMS

A comparative analysis of the two extreme forms of the two instruments has already been made on several occasions (see, e.g., Van Damme et al. (1997) and Janssen et al. (2001)). Criteria with respect to the design that are usually used in these reviews are:

- Value revelation and efficiency of the bidding instrument.
- Transparency and lobbying.
- Speed.
- Quality.
- Consumer interests, and
- Revenue.

In the literature comparing the two allocation mechanisms, an auction always comes out as the best allocating mechanism: it appears to be efficient, clear and fast and, in addition, if well designed, it raises a fair amount of revenue. In a world in which the parties in the market are much better informed than the government with respect to the economic value of the goods offered (in this instance, the lots), an auction compels the parties “to put their money where their mouths are”.

Although the choice for an auction can be easily rationalized in this way, it is necessary to make a number of important remarks. First of all, when evaluating the auction mechanism as being “efficient, clear and fast”, one must not ignore the fact that the auction also has to be designed. Much too soon, however, the evaluator has eye only for the couple of weeks during which the auction itself takes place and one easily forgets that a process of months or years has been spent in designing the auction. Speed is therefore a relative notion. The proclaimed transparency also loses much of its appeal if one considers the fact that the market parties, naturally, employ their know-how and relationships to try to adjust the auction model to their own advantage. The efficiency of an auction 77can be only warranted if its design is adequate, offering therefore to all potential parties more or less equal chances to secure a license. The setting-up of a good

plan requires a thorough knowledge of the relevant market and of the theory of industrial organization, as well as (perhaps to a lesser extent) knowledge of auction theory (see above on What and How Many will be allocated?).

Scoring the alternative mechanisms on the other objectives mentioned above, we also get a picture that tends to favour auctions. Apart from the case where bidding prices are an integral part of a Beauty Contest, it seems that auctions score better on the revenue objective as it is difficult to determine a fixed price for other types of Beauty Contests.[3] Also on the aspect of value maximisation and efficiency of the allocation mechanism, auctions score better. One important concern is, however, whether the European legal system allows asymmetric or coloured auctions to be organized as such auction mechanisms are sometimes necessary to reach the first two objectives concerning the efficient operation of the market. Asymmetric auctions (see Maasland, Montangie and Van den Bergh) are required to create a level playing field between entrants and incumbents. In situations where incumbents have more knowledge about the market than entrants and where they have already invested and this investment is a sunk cost, entrants typically have lower valuations than incumbents. On the other hand, it may be judged that entrants in the market are important as to have more incentives to actively compete in the market to acquire clients. *Coloured auctions* may be necessary to reach public interests when for example some cultural group may be easily out competed by others.[4] At the moment it remains unclear whether these types of auctions should be regarded as providing state support for economically weaker companies. It seems to be the case that these legal problems are less pronounced in case a Beauty Contest is held.[5]

Another potential disadvantage of an auction is that only minimum requirements are taken into account regarding the use of a license. An auction reduces the competition among companies to prices only, given certain minimum quality conditions. In contrast a beauty contest offers the possibility that business plans are also judged on quality aspects. Whether or not this quality issue is of importance depends to a large extent on the question whether or not the market itself is organized in such a way that a socially optimal set of prices and qualities will pertain. If the market can be expected to provide this optimal mix, then this potential disadvantage of auctions should not be taken too seriously. If the market cannot be expected to provide the optimal price/quality mix, then a Beauty Contest may be considered if the quality that is bid in the contest can be enforced by contract.

Concerning consumer interests, it is important to note that neither in auctions nor in beauty contests the interests of consumers are directly represented. In designing the allocation mechanism this problem has to be taken into account. One way of doing this is by the choice of the number of lots. Another way in which this problem can be tackled is by staging a contest in which firm bid in terms of the

---

3 There is the danger of fixing the price too high (as France did in the UMTS case) or too low. See also the document on asymmetric auctions.

4 In the digital TV case authorites thought that given prevailing law it was not possible to hold a colored auction and reserve the frequencies for TV rather than for some internet application.

5 Maybe this is a reason to suggest in the report that the legal system concerning auctions has to be re-evaluated.

price they set in the market. This mechanism has been used in for instance privatisation of gas, electricity and water utilities. Bidding on the price in a market could be applied if the concession sale relates to well established markets in which services and technologies evolve relatively slowly - such as in the examples given above. Obviously it is not possible in a market that does not even exist yet, such as the one for UMTS-services.

6 ASPECTS OF AUCTION DESIGN

There are many aspects of auction design that are important when auctioning the rights to operate in a market. One distinction between single and multiple attribute auctions has already been made above. Also, the distinction between open cry and sealed-bid auctions has been made as well as the distinction between first and second price auctions. Another distinction is between simultaneous multi-unit auctions and sequential auctions. In a simultaneous multi-unit auction multiple objects are for sale at the same moment in time and bidders can bid on any object they like. In contrast, in a sequential auction objects are sold off one after the other. An Anglo-Dutch auction combines sealed-bid and open cry elements. This auction has two stages. The first stage, which lasts as long as there is one more bidder than there are objects for sale, is a simultaneous multi-unit auction. In the second stage, which has $N+1$ bidders for N objects, bidders make a last sealed-bid.

What can be said about these different auction formats, and when should they be seriously considered? There are a few issues to be considered, namely:

- Collusion.
- Winner's curse.
- Level playing field/entry deterrence.

Collusion may be a real problem in auctions as it lowers the bids of individual bidders and, hence, revenues. As explained by Tim Salmon, collusion may occur when the same bidders appear in different auctions that are held one after the other. It may, however, also occur in a simultaneous multi-unit auction as these auctions allow bidders to form strategies that effectively imply that they share the licenses between them. Collusion can take the form of signalling when bidders indicate with, for example, the last numbers of their bids which license they would like to obtain. Salmon also describes the different mechanisms the FCC has used in order to try to prevent collusion from happening.

The winner's curse may arise in common value auctions where the bidders' valuations of the object are strongly correlated and uncertain. A famous example is the auctioning of the right to exploit a certain oil field. In this case firms use seismological research to estimate the amount of oil in a certain location. Depending on the outcome of this research, the firms can calculate what the field is worth. Some estimations are, of course, more optimistic than others. A bidder who wins an auction may infer from the fact that he made the winning bid that he was too optimistic about the value of the oil field. This is the winner's curse. Another application may be the market for UMTS-services as at the moment the auction was held, nobody had an idea about the way the market would develop.

The winner's curse arises especially in sealed-bid auctions as this type of auction does not allow bidders to make any inference about the information other bidders have. In case, there is a serious chance the winner's curse may arise, it is advisable to use some kind of ascending auction.

A last issue is whether all participants have equal chances in obtaining a license. In quite a few instances, the licenses that are to be allocated and the market that is to be designed is in one way or the other related to already existing markets. This is the case for UMTS where the existing 2G market offers somewhat comparable services and the network of 2G may be upgraded to make it suitable for UMTS-services. This is much cheaper than to start with a completely new network. Another example, is the high-speed train where the national train operator has the advantage of knowing the market potential much better, in addition of having cost advantages in maintenance. When incumbents have advantages over potential entrants, entrants are confronted with the question whether it makes sense to take part in the auction (as preparing for an auction is quite costly). If the number of licenses is (much) larger than the number of incumbents, then this issue does not arise. If this is not the case, it may very well be that almost no entrant shows up for the auction. One way to overcome this problem is to introduce asymmetries in the auction design. This issue is studied in Maasland, Montangie and Van den Bergh from an economic and a legal perspective. Different types of asymmetries can be introduced:

– Reserving a license for newcomers.
– Reserving a license for a specific purpose (coloured auction).
– Introducing bidding handicaps.

From an economic point of view there may be good reasons to introduce one of the above types of asymmetries. Reserving a license for entrants is advisable when an entrant can stimulate competition in the market. A similar argument can be made for bidding handicaps. A coloured auction can be defended when there is a clearly specified public goal and the firms that can provide services that lead to this goal are probably financially weaker than other competitors. One problem with bidding handicaps is that it is difficult to determine how small or large the handicap should be. It can be shown that introducing bidding handicaps may decrease or increase the revenue of the auction depending on the specific circumstances.

From a legal point of view, it is not clear whether given prevailing European legislation introducing asymmetries is allowed or whether they should be regarded as providing some kind of state support to weak firms. I would advise the working group to just state the unclarity at this point and that one has to wait for decisions at the European level. A few further observations can be made, however. First, is that from a legal point of view it seems that it is easier to introduce asymmetries in a Beauty Contest than in an auction. This seems to be undesirable and if this is so, it may be suggested that existing regulations have to be changed in this respect. Second, a Beauty Contest can also be judged as providing state support and it is interesting to study whether or not there are legal differences in this respect between auctions and Beauty Contests. Finally, it has to be the case that the same legal issues arise when holding a coloured auction as compared to holding an auction where a license is reserved for an entrant. This should also be further investigated.

7 ASPECTS OF BEAUTY CONTEST DESIGN

An important issue in Beauty Contest design is how to overcome the ambiguity that is inherently associated with evaluating the proposals. One potential solution is to make a very detailed list of how proposals will be scored well in advance, but not to make this public to the applying organizations. One way to do this is to give the set of rules to a notary before the proposals come in. Ideally, criteria are specified under what conditions every point that can be obtained will be awarded. One problem with this is, of course, that by proceeding in this way one gets very close to a multi-attribute auction. More importantly, however, is that in cases when a Beauty Contest is most desirable, i.e., when the seller wants to get information about innovative proposals out of the market, it is impossible to prepare such a precise evaluation scheme in advance.

There are a few other issues that are important when considering the design of beauty contests. A first issue is the degree in which scores on different criteria are substitutable for each other. In a standard weighted Beauty Contest, proposals are scored on different criteria and the scores on all these different criteria are summed up and the winner is the proposal with the highest score. Alternatively, one can think of a procedure in which on certain criteria a proposal have to get at least more than a minimum score to be considered acceptable.

A second issue is how to measure the different criteria. Sometimes, the quality of a proposal (firm) is judged on the basis of the quality of the people who work for the firm at a certain date. This was the case in the Flemish radio frequency case, but it also for example the case in the research assessment of different universities in the U.K. When it is easy for people to change jobs, it is questionable whether this measure really measures quality of a firm. The measure may also lead to all kind of side effects such as the hiring of people just before the relevant date.

A third issue regards the question whether the proposed “beauty” of a proposal is also fixed in a contract. There are two related points here. The first is that if a proposal wins because of certain aspects in the proposal, then these aspects have also to be fixed in a contract with the winning organization. In the Dutch reintegration case, this was only partly done, as most of the contracts with the reintegration firms were standard and not directly related to the bids that were made. The second point is that it is advisable not to score a proposal on “beautiful aspects” that cannot afterwards be verified (and hence cannot be contractible).

A last point concerning Beauty Contest Design is that in some cases it may make sense to have a first qualification phase in which a limited number of firms are selected, before the full contest takes place. This two-phase procedure may have advantages over a one-stage procedure if organizations are requested to provide a very detailed plan. Knowing that there are a limited number of competitors, firms have higher chances winning the contest and therefore better incentives to put in a lot of effort to come up with a nice proposal, i.e., limiting the number of competitors may increase the quality of the proposals. Second, a two-stage procedure may also restrict the effort the government authorities has to make in order to check the different proposals. A two-stage procedure was followed in

some of the Dutch reintegration firms contests, but not in all of them. It was also not chosen in the Flemish radio frequency case.

1 BEAUTY CONTEST DESIGN

Maurice Dykstra and Nico van der Windt

TABLE OF CONTENTS

1 INTRODUCTION 3

2 CRITERIA 3

3 PROCESS 4

3.1 NOTIFICATION 4

3.2 PRE-QUALIFICATION 5

3.3 ADJUDICATION 7

4 BEAUTY CONTEST DESIGN 10

4.1 QUALITY 11

4.2 PRICE 12

4.3 DECISION RULES 13

4.4 SCORE FUNCTION 13

5 CONCLUSION 17

REFERENCES

1 INTRODUCTION

It is often argued that auctions are best suited when the product or service required is fairly standard, the technical parameters can be defined with reasonable certainty in the bidding documents, and there is limited scope for innovation and creativity on the part of the operator. On the other hand it is argued that beauty contests are better suited for projects where there is scope for innovation and different approaches by developers, and authorities hope to elicit imaginative proposals for projects. Since the terms are not fixed, it permits developers to be more creative and tailor projects to the particular needs of government.

Once it is decided to use a beauty contest, the issue arises how such a beauty contest has to be designed. There are two main issues. The first is the process of the beauty contest: what are all the steps involved, starting from the definition of the objectives up to the drawing up of the contract. The other issue is the content of the beauty contest. In a beauty contest winners are determined on two accounts: the quality they offer in their bid and the price they offer. We then have to deal with questions such as: What is meant by quality? How is quality measured? How is quality weighted? How is the trade-off determined between quality and price?

This section describes design issues concerning both the process and the content of a beauty contest. It is among others based on information from organisations that frequently use tender procedures such as the European Commission and the World Bank.

2 CRITERIA

The proper design of a beauty contest hinges on the criteria used for judging the beauty of bids. In order to design these criteria properly goals have to be defined beforehand by government. Although this point is (or should be) more than obvious in practice, clear objectives tend to be disregarded.

Requirements for criteria are:

- The criteria have to be derived from the policy objectives identified.
- The criteria have to be in accordance with the relevant national and international laws and regulations and with accepted principles of good government conduct.
- The criteria may not lead to pre-conceived results. The procedure has to be non-discriminatory.
- The criteria have to be formulated carefully. Proper attention should be given to the juridical meaning of the criteria, and to the consequences the formulation has for the content of the criteria.
- The fashion in which the criteria will be weighted relative to one another will have to be considered carefully.

All these points require meticulous and detailed deliberation. Consultation with market parties might be helpful, as is advise from the relevant regulators.

3 PROCESS

In a beauty contest, generally the following stages are involved.[1]

- Notification of government's intent to award a concession, generally including a request for expressions of interest.
- Distribution of information memoranda, bidding documents, and related draft contracts to potential bidders.
- A formal pre-qualification round for selecting the bidders, who are allowed to make final bids
- A formal adjudication round for presenting proposals, evaluating proposals, and selecting a winner.

3.1 NOTIFICATION

Competition is central to getting good bids. One of the key conditions for successful competition is that a sufficient number of firms is willing to bid. These numbers cannot be expected to emerge by itself. A procuring organisation needs actively to stimulate interest in the beauty contest, to publicise the beauty contest in accordance with the relevant law and regulations, and to give guidance to potential bidders on how to submit good bids.

It may even be taken under consideration for the awarding authority to offer assistance in the process through which firms can become aware of each other's interest and come together into consortia. Coming together in consortia may lead to high quality bids, but on the other hand may be detrimental to the number of bidders, and thus lead to less competition. All of this must, of course, be done in accordance with the relevant legal framework.

In the notification it has to be made clear whether the contest is open or restricted. In an open beauty contest any interested party can participate in the contest, while in a restricted beauty contest a limited number of parties are invited to bid. In dealing with beauty contests for concessions the open procedure seems to be most appropriate.

An open procedure limits the possibilities for accusations of trying to favour certain parties. Often government will simply not know who the potentially interested parties are. Quite often new consortia of firms are especially set up to participate in the bidding competition, and if the competition is won to run the concession. In the Uniform Tender Regulation (Uniform Aanbestedingsreglement) of the Dutch government four tender processes are distinguished:

- Open tender (openbare aanbesteding).
- Open tender with pre-qualification (Aanbesteding met voorafgaande selectie).
- Restricted tender (Onderhandse aanbesteding).

[1] This is a similar process as in an auction or multi-attribute auction.

- Restricted tender with pre-qualification (Onderhandse aanbesteding na selectie).

In both public and restricted tenders a pre-qualification stage can be introduced.

Generally, the notification of the requests for bids have to contain at least:

- The address data of the awarding authority.
- A description of the lot(s).
- Date before which the bid must be received.
- The number of bidders which will be invited to make definitive offers in the case of a procedure with a pre-qualification round.
- The criteria by which the bids will be judged in the pre-qualification round.[2]
- The criteria by which the bids will be judged in the adjudication round.

It is common practice to insert a meeting in which interested bidders can ask for clarification regarding the beauty contest design. In order to ascertain a level playing field – with regards to the information on the beauty contest design – all bidders should have access to identical information. Detailed minutes of the meeting should therefore be made and passed on to all bidders.

Meetings between one bidder and the awarding authority should therefore be dissuaded. This not only opens the possibility for firms to lobby for their bid, but also holds the danger that the awarding authority is accused of favouring certain parties. In case bilateral meetings do take place, the information provided to the bidder should also be made available to the other bidders.

Emergency break

In the notification a clause should be included, that opens the possibility not to proceed with the contest, or to proceed in a different manner, if the number of bidders is too small. This procedure offers the awarding authority the possibility to adapt the rules, depending on developments with regard to bidders. In procurement by the European Commission for research proposals, it regularly happens that in the adjudication it turns out that no bid is considered acceptable. In that case no research proposal is approved, and the project gets shelved. It then is either cancelled entirely or the terms of reference are amended and the procedure commences again.

In the beauty contest regulation a clause should be included, that opens the possibility not to appoint a winner in the case that no bids are considered acceptable.

3.2 PRE-QUALIFICATION

When awarding concessions government wants to ensure that the winning firm has the capacity to operate the concession successfully. It does not want to award it to a firm that offers the best on paper, but later fails to deliver what is promised. It is therefore desirable that beforehand it can be determined whether a firm can

[2] One of these criteria may be that the bidder asserts that he is aware of the fact that in the case of winning the beauty competition, he will have to pay a once-for-all or annual fee for operating th concession.

make a credible bid. Pre-qualification can help weed out unsuitable firms.[3] Implementation of a pre-qualification stage is of course not particular to beauty contests. All bidding mechanisms face the same problem whether or not a firm can make a credible bid.

In addition, to pre-qualification, holding out the prospect that the concession contract imposes severe penalties for poor performance can discourage non-credible bids.

Pre-qualification criteria generally refer to such aspects as:[4]

- Experience, for example by showing that the bidder has operated in one or more comparable markets in terms of product or service, or operated in one or more comparably sized markets (generally expressed in terms of the customer base in those markets).
- Sufficient qualified personnel with relevant expertise, or that it has access to such personnel.
- Financial strength of the bidder.
- Minimum operating revenues from a comparable service run by the bidder.
- Minimum required equity of companies in the consortium.
- Quality of service provision in comparable operations.
- Paying a non-refundable fixed fee, which – when set high enough – performs as a kind of an entry fee.

Notice that most of these criteria simply relate to the size of operations of potential bidders. The implicit assumption is that size is a proxy for proven success. The use of such criteria can thus strongly favour incumbents, although they need not be the most efficient operators of the concession. Performance criteria that demonstrate the level of efficiency of operations elsewhere are then called for. These are sadly enough also much harder to identify, make operational and verify.

In order to make an assessment of the quality of a bid, quality measures and operational quality standards have to be defined. Not setting explicit standards for the criteria gives government more flexibility in the review of the submissions, but lacks transparency. This can give rise to complaints from bidders who do not pass the pre-qualification stage.

---

[3] If there are reasons to believe that substantial re-negotiations may become necessary during the life of a concession the original bidding may be rendered close to meaningless. In that case it becomes most important to chose a trustworthy, reputable concessionaire and to negotiate well. In a way, the process of choosing a concessionaire would then look more like that of choosing an important employee. Competence, character and chemistry would be crucial. “Interviews” would be the method of choice for awarding the contract.

[4] e.g. World Bank (1999).

3.3 ADJUDICATION

The most important stage in the beauty contest is the adjudication stage. At this point in the process it must be stressed that:

- Government does not always know exactly what it wants.
- Government and the awarding authority do not exactly know what the value is of different quality levels.
- The awarding authority cannot obtain perfect information on the quality achieved.
- Preferences may vary between government bodies.
- It is doubtful whether government is able to describe its preference function fully.

3.3.1 PROCESS DESIGN

Careful attention has to be given to the proper design of the process in which the bids are judged. It must be clearly acknowledged that decision-making is subjective. There is nothing wrong with making subjective judgments. In a beauty contest however the judgments made have to be accounted for. The process involves considerable discretion and judgment on the part of the awarding authority. In a beauty contest there will always be some scope for misusing discretion. It is, therefore, important to bind the hands of awarding authorities by imposing clear rules - laid down in guidelines, laws or regulations - on the award process. By limiting discretion some flexibility may be sacrificed in the interest of sustainable deals.

Objectivity

In a beauty contest the decisions made are by definition judgmental and subjective. They are therefore prone to being contested. In order to diminish the probability of decisions being disputed, it is requisite that judgments are well informed, subjectivity is well argued, and the process by which decisions are made is crystal clear.

The criteria have to be made operational. It must be ensured that the specified criteria represent precisely what is needed. The criteria should be neither esoteric nor weak. Strong, detailed ex ante specification of (sub-)criteria – as an explication of the general criteria – substantially reduces possible changes in judgments throughout the judgment process.

The exercise of this judgment should be within the context of an evaluation framework, which ensures that the method of evaluation is consistent with the objectives of the awarding authorities for the beauty contest and with what bidders had been told about their requirements. To be effective the awarding authority should set up this framework early in the process.

As an instrument to achieve objectivity one can also consider whether a standard form/questionnaire should be developed that bidders are obliged to use for making their bids.[5]

Using a standard form:

- Facilitates the assessment of the information offered.
- Makes inter-bid comparisons easier.
- Will speed up the evaluation procedure.
- Increases the transparency of the procedure.
- May lessen the risk of judgements being contested outside or inside court.

Making such a form is however no easy task. It will take a considerable effort, be costly and time-consuming.

Filtering out biased or erroneous judgments can be achieved by introducing sufficient checks and balances such as:

- Cross checking each other judgements.
- Make underlying arguments explicit.
- Communicating information fairly and objectively internally.
- Disclosing fully all relevant information within the awarding authority.

Proper procedures will have to be specified to ensure that these actions come in effect. Furthermore, impartiality in the consideration of the bids can be raised by evaluating different aspects separately and by the use of evaluation models. In addition, computer software can be used to automate the assessment of the technical aspects of each bid.

Finally, as a point of another order than the ones above, it is requisite to refuse any gift, favour, or hospitality that would influence or would appear to influence actions of the awarding authority.

Transparency

Careful attention must be paid to the overall transparency of the award process. By no means does transparency come by itself. Transparency is important for two reasons. The first is that transparency facilitates competition to come about. Bidders can make better bids when it is clear on what grounds a winning bid is chosen. Transparency also forces the awarding authority to make clear-cut accountable decisions. This reduces possible challenging of decisions.

Transparency can be achieved by:

- Clearly specifying the awarding authority's requirements. Bidders cannot submit good bids unless they know clearly what is that the awarding authority wants. The lack of a clear specification may result in the submission of only a very limited number of bids that adequately meet the requirements, thus effectively reducing the extent of competition.[6]

---

5 In tenders, the use of the Logical Frameworks Matrix has become quite popular.

6 However clarity in itself is insufficient to ensure high quality bids. A clear specification may still result in poor bids if it does not state the procuring organisation's real needs or if it contains excessive detail,

- Making weights known beforehand makes it clear to bidders what the priorities of the awarding authority are. This greatly facilitates bidders in making their bids. They can more easily assess whether they are capable of offering a winning bid.
- Offering the opportunity for bidders to offer additional exposé, in the form of a hearing in which the bidders can elucidate their bids.
- Communicating information fairly and objectively internally and externally.
- Preparing complete and clear reports and recommendations after appropriate analyses of bids have taken place.
- Disclosing fully all relevant information ex ante and ex post to bidders.

There also is quite another side to transparency. The bids themselves must be transparent. Proposals cannot always be taken at face value. The beauty of a proposal has to be more than skin-deep. This may require asking supplementary evidence from bidders.

3.3.2 AWARDING AUTHORITY

Role

When designing a beauty contest careful deliberation must be given to the role of the awarding authority. This role is especially important in relation to the objectivity of the process.

The awarding authority can be within the political arena of government (ministry) or an outside organisation such as an independent government agency, a regulator or an organisation that specialises in bid evaluation, or an independent commission or advisory commission. The members of an independent commission or advisory commission usually hail from a wide range of society and should be well-informed of relevant laws and regulations. The independence of the awarding authorities is rarely discussed as much as the evaluation principles and the rules of the bidding mechanism. However, in the case of concessions this is shortsighted, given the degree of discretion involved and the political prominence of many of the businesses involved. Particularly, those who argue that reputation and character matter a lot and that therefore tightly defined contracts and bidding mechanisms are not the answer should advocate the institution of "independent awarding authorities" to avoid conflicts of interest.[7]

Clear-cut procedures and rules have to be set up who (government or the outside awarding authority) is responsible for each task that has to be conducted in a beauty contest.

These stages are:

- General formulation of criteria.
- Weighing of the criteria.
- Specific formulation of criteria.

---

particularly detail focussed on inputs rather than desired outputs or outcomes. Specifying inputs or the methods of service delivery will limit innovation.

7 Klein (1998).

- Notification.
- Pre-selection of candidates.
- Adjudication of bids.
- Formulation of conclusions / formulation of advice.
- Issuance of license.

If a ministry conducts the entire procedure the question of independence plays no role. Transparency and bias can then however be an issue. If government has a stake as shareholder in one of the bidders, in each case government will have a tough time in appearing to be unbiased.

Expertise

Regardless of the method of award chosen, the solicitation and evaluation of bids and the negotiation of contracts involve complex legal, financial and technical issues. The awarding authority must have in-house knowledgeable and experienced experts or access to such people in technical, financial, legal, and accounting areas. Additionally the team should include experienced project managers and people steeped in policy issues.

It is necessary to stress the importance of qualified, professional advisers to the success of concession design and implementation. The issues involved typically lie outside the scope of traditional civil service work, and the use of specialised external advisers to government is advocated, especially given that private investors will generally employ their own team of experienced advisers on such projects.

Project management

Conditions for making credible judgments with low probability of being challenged from a project management point of view are among others:

- Provide a realistic and detailed time schedule containing milestones against which progress of the adjudication can be measured.
- Identify and get commitment for all needed resources; provide sufficient time for the evaluation of bids.

4 BEAUTY CONTEST DESIGN

In all allocation mechanisms there are always two attributes which matter: price and quality. In an auction quality is exogenous in the bidding stage, only price is endogenous. In a beauty contest quality is endogenous and price can (and should) be endogenous.

It is important to make a clear distinction between two types of quality: on the one hand the quality of the firm and on the other hand the quality of the product

[8] Various decision analysis techniques such as MAUT (Multi-Attribute Utility Theory) (Keeny and Raiffa (1993)), AHP (Analytic Hierarchy Process) (Saaty (1980)) can be used to determine the utility function of a buyer.

or service. In the pre-qualification stage the quality focus is on the quality of the firm. In the adjudication stage, focus is on the quality of the product or service.

In the adjudication stage besides quality also the price offered for the concession is taken into account.

4.1 QUALITY

An often used definition of quality is "the totality of features and characteristics of a product, process or service that bear on its ability to satisfy stated or implied needs" (ISO 9000). While this is not a particularly operational definition, it does point to the fact that quality is not just any one characteristic, nor the sum of many, but involves the entirety of many different aspects. Quality has been characterised from alls sorts of angles. In the context of auctions and beauty contests, a useful characterisation of quality is along the lines of structure, process and performance.

Structural features: This refers primarily to characteristics of the bidder itself. In how far can he/she guarantee that the bid made is upheld? Characteristics are for instance proven track record in a certain line of business, experience and expertise of work force, certification, company finances *etc.* One can even question in how far quality is at stake here. These characteristics are rather signals of quality than actual quality.

Process: This refers primarily to characteristics of the implementation phase of the project for which is bid. Bidders submit detailed business plans with information proposed investment plan, promised additional investments, organisational plan, roll out plans, speed of deployment, delivery time *etc.*[9]

Outcome: This refers primarily to characteristics of the product or service as such. Characteristics are for instance types of services, technology used to supply services, reliability of service, speed of services *etc.*

The attribute quality is usually sub-divided in say four or five different general attributes matching the defined criteria. In order to make the attributes operational they in turn each consist of a number of sub-attributes. This leads to a hierarchy of criteria. In order to make an assessment of the quality of a bid, quality dimensions and criteria must be verifiable. Quality measures and *operational* quality standards therefore have to be defined. Quality measures are the quantitative or qualitative indicators of the degree to which the bid meets the quality standards. The quality standards are the specific, measurable levels of quality *desired* by government. The measurability of the attributes themselves can also range widely. They can be nominal (e.g. yes/no), ordinal (e.g. high/low) or cardinal (e.g. Euro, MHz, km).

Although the awarding authority should have clearly expressed in the specification what they required to be delivered, bidders may have been able to add value by suggesting alternative deliverables. These alternatives could include, for example,

[9] Changing market conditions after contract award often require operators to make significant (and justifiable) modifications in their business plans and investment programs. These changes reduce the meaningfulness of the evaluation process to the extent that it relied heavily on the assessment of the proposed business plans.

the delivery of different requirements, different bases for measuring the aspect of performance required. It has to be decided on in advance whether the awarding authority should be open to such alternatives and so far as may be legally permissible should conduct the beauty contest in such a way that alternative proposals from bidders can be considered.

4.2 PRICE

Careful consideration must be given about exactly what is understood by the attribute "price" in a beauty contest. In general two kinds of prices can be discerned. The first relates to lump-sum payments for the right to operate the concession. The second relates to the price per unit for the good or service to be supplied in the market that arises after the beauty contest.

Awarding the concession right to the bidder who pays the largest lump-sum fee for the right to operate the market capitalizes the monopoly profits, which thereafter accrue. But the product or service for which the concession is granted will be priced monopolistically.

The deliberation is not an easy one. Full treatment of the pros, cons and pitfalls go well beyond the context of this paper. Careful attention must be paid to for instance the number of suppliers in the market, whether practicable and contractible price-quality packages can be made, whether a proper quality level will be delivered by the market itself (without ex-ante obligations imposed), the contract length of the concession, if the market is characterised by uncertainty with respect to technology etc.

In an article in El Pais[10] and in the Symposium "To Auction or Not to Auction" Klemperer criticises Nicolas Negremonte who suggests that winners should be chosen according to who would guarantee the lowest price to consumers, invest the most in infrastructure, stimulate most creativity, etc. Klemperer is of course right when he ridicules "creativity" as an attribute in a bidding mechanism. He also has a point when he questions the use of "price" in a market that does not even exist yet, such as the services in UMTS frequencies. His point is less valid when the concession sale relates to well established markets in which services and technologies evolve relatively slowly - such as electricity, gas or water distribution.

In practice both types of prices i.e. lump sum payments or price per unit are used in bidding contests. Some of the more common options are:

- The highest concession fee (one-time or annual) paid to the government.
- The lowest cost to the government for constructing or operating facilities or services.
- The lowest subsidy that the government must provide to the winning bidder to operate a loss- making service.
- The lowest tariff to be charged to consumers. The lowest net present value of the future revenue stream to the developer from the service or project.

[10] Klemperer (2000).

4.3 DECISION RULES

In a perfect world of government knowing exactly what it wants, exactly what it is willing to pay for different quality levels and in which perfect information on the quality can be obtained, then including quality considerations is relatively straightforward. Government states its preferences over price p and quality q as $U(p,q)$ and it invites bids (p,q). The bid achieving the highest utility level for government wins. Unfortunately government usually does not always know exactly what it wants, what it exactly is willing to pay for different quality levels and cannot obtain perfect information on the quality achieved. Additionally, preferences may vary between government bodies and it is doubtful whether government is able to describe its preference function fully. The final choice of bid is likely to hinge on the trade-offs between price and quality proposed by the bidders. In such circumstances, the judgements on the various attributes of the bids received, need to be brought together into a comprehensive ranking. In doing this the awarding authority will then have to address these trade-offs explicitly in their final evaluation of bids by taking account of both quality and price attributes and seeking to identify the bid that offered the best combination of these.

Weighted or unweighted

It can be argued that when putting together the comprehensive ranking of bids, awarding authorities should avoid uncritically following some arithmetical scheme of weighting. Separate attribute are already hard to judge and put a figure on. Such an evaluation scheme simply cannot accurately represent the value of differing bids in a beauty contest, and should therefore not be used as a substitute for the necessary exercise of informed judgement when attempting to address the necessary trade-off between price and quality. Organisations should be prepared to be flexible and open to proposals. This is especially the case when the awarding authority is interested in alternative innovative ideas for the product or service to be delivered.

Not weighing attributes can also lead to biased outcomes. The danger exists that only the attributes that can be adequately quantified are taken fully into account. This would then in fact lead to the outcome virtually only being based on price. A weighted scheme can then provide a useful discipline in helping ensure that a contract is not awarded solely on the grounds of price, but went to the bidder offering the highest utility, that is the combination of price and quality which best met the objectives. Weighting also disciplines the awarding authority. It makes it much more difficult to favour a certain bidder on ground of say one single attribute – which happens to be the hobby horse of one of the evaluators – on which the bidder has a high score.

4.4 SCORE FUNCTION

In a weighted beauty contest the score function brings the price and quality elements together into a comprehensive ranking. The score function $S=S(Q,p)$ is one or another form of a utility index. It gives an exact representation of the relationships between the attributes. The bidders know the algorithm (functional form and parameter values). They do not however know the value of the

attributes they have included in their bid. The functional form of the score function is usually linear.

We first turn our attention to how quality is brought together into a total quality score and from there proceed to how quality and price can be brought together in an overall score.

Quality

Before the awarding authority can fix the total quality score the various quality attributes of the bids have to be judged and scores attached to the quality attributes of the bids. We assume here that this scoring has taken place.

The functional form of the score function is usually linear, thus

$Q = Sw Q_i$.

To give an example, in the case of a beauty contest with two quality attributes (Q_1 and Q_2):

$Q = aQ_1 + (1\text{-}a)Q_2$.

Notice that in this case all attributes can be substituted for one another. A very low score on one attribute can be compensated for by a very high score on another. If for instance Q_1 stands for experience of the bidder and Q_2 for the quality of the product, it could be possible that a bidder who offers a low quality product, but is very experienced can win the competition. One way to remedy this is by putting a low value on experience. Another way is by defining thresholds for each attribute; say a minimum of 60 out of 100 points. If a bid fails on one of these attributes the bid is disqualified, no matter how well the bid is on other attributes.

The general functional form of the score function of this type is thus

$Q = \text{S}\, w_i Q_i$ if $Q_i > Q_{i\,\min}$, else Q=0.

The question of substitutability also again brings to mind the perhaps even more important question: which quality dimensions should be included in the adjudication phase? These quality characteristics which are rather signals of quality than actual quality, such as proven track record in a certain line of business, experience and expertise of work force, certification, and company finances don't belong in the adjudication stage but in the pre-qualification stage.

If one does wish to include such an attribute in the adjudication stage, as an extra check on credibility of bids, it is possible to do so simply in the form of a threshold, without including it in the final score.[11] An example: if experience is subject to a quality threshold, only bids that pass the threshold qualify. The score on experience is not included in the final score. Thus:

$Q = Sw_i Q_{i?\,e}$ if $Q_e > Q_{e\,\min}$.

Above we have presented a few alternatives for the scoring rule. Obviously different scoring rules can lead to different winners. For instance in the case of the Flemish Radio Frequencies (see Report 12 in this bundle), if a threshold was set for the financial aspect of the bid Radio 4FM would not have qualified. Careful attention should therefore be paid to the functional form.

---

[11] This rule thus functions as a second pre-qualification.

Examples of scoring rules.

EC procurement tender on research

Number; qualitative award criteria; weighting (maximum points):

1; overall quality, methodology and exhaustive nature of the analysis proposed for performance of the study; 20 points;

2; proven track record in relation to the distribution sector and quality of human resources to be made available for the conduct of the study (studies, publications); 20 points;

3; expertise in the field of statistical analysis; 20 points;

4; level of knowledge of the legal framework and functioning of the internal market; 20 points;

5; ability to cover the Member States of the European Union in a uniform and consistent manner; 20 points.

A bid with less than 10 points on any one of criteria is disqualified. In addition the bidder has to offer a price, for which he is prepared to conduct the research. The winning bid is the one with the highest number of points per Euro.

Demonstration project wind park in the North Sea

In the field of procurement an interesting project is that of a demonstration project for a wind park. The principal was the Netherlands Ministry of Economic Affairs. Criteria related to the quality of the bidder, quality of the project plan, financial underpinning of the project and the demonstration value of the project. There is no limit to the price that may be offered, but if the bid sum exceeds 9.1 million Euros this results in a reduction of the points available.

Beauty contest for second GSM licence in Morocco

In this beauty contest an explicit weight was set between quality on the one hand (the technical rating) and price on the other. Total score was sum of score for the total technical rating and the score for the price offered. The maximum number of points for the technical rating was 40. The highest price bid was set at 60 points. The valuations of the lower price bids were proportionately lower. So a bid 25 percent lower than the highest price bid received 45 points ((100-25%)*60). The winner is the one with the highest number of points. Given the heavy weight placed on the price element, this beauty contest comes close to being a sealed first bid auction.

Quality and Price

The functional form of the score function is usually linear, thus

$S = aQ + (1-a)p$.

For both quality and price a maximum of 100 points can be scored. The highest price bid equates 100 points irrespective of the height of the bid. The total maximum score is then also hundred.

Setting an explicit weight on quality versus price as is done above is very arbitrary and rather difficult. By using a two-step procedure this explicit choice can be circumvented.

First quality, then price. In the first step the bids are evaluated on a pass/no pass basis. Only the bids that offer the highest quality, say the top 40 percent pass on to step two.[12] In step two the winning bidder is then strictly selected on price. The highest price bid is then winner, irrespective of the quality offered.

The incentive in the bidding mechanism involves the trade-off between the chance of failing the uncertain quality threshold and the need to keep the price up to outbid other bidders whose bids pass the quality threshold. Competition is thus by price against other bidders and by quality against the quality threshold. Additional quality above the unknown threshold holds no value to the bidders.

The subjective choice that has to be made in this method is the cut-off percentage: should it be 50%, 40% or? The percentage may not be too high, or else the quality test will lose its value. If it is however set too low, say 15%, the price test holds no value. It may well be that only one bidder remains.

First price, then quality. A similar procedure can be followed, but in this case the pass/no pass test is on price. Only the bids that offer the highest price, say the top 40 percent pass on to step two. In step two the winning bidder is then strictly selected on quality. The highest quality bid is then winner, irrespective of the price offered.

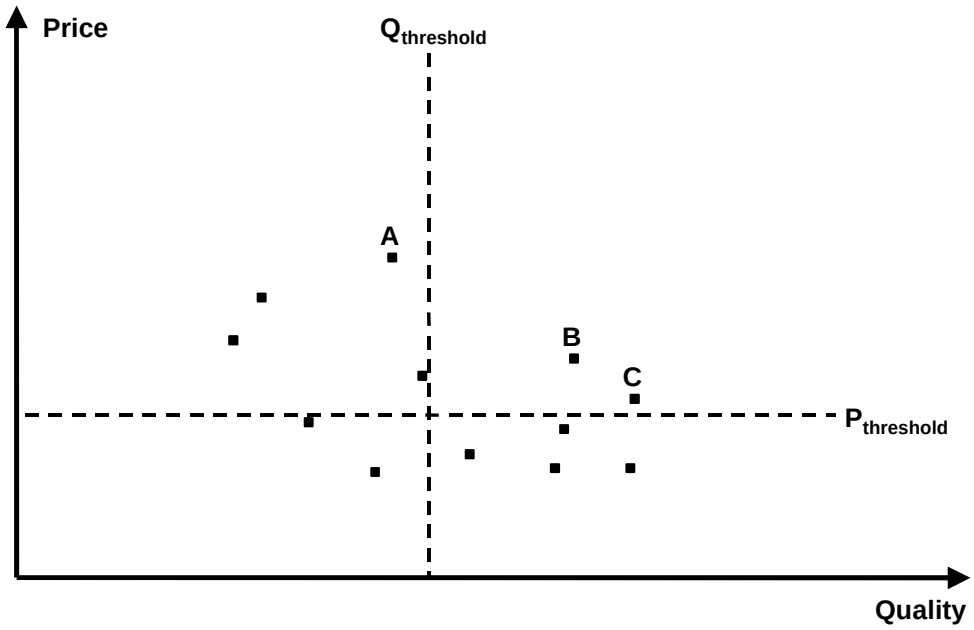
This procedure could be applied in case there is – for whatever reason – a very large time pressure on the process. Not having to judge the bids, which did not pass the price test can save precious time.

Obviously the different rules will lead to different outcomes. The figure shows an example of a number of imaginary bids, where for illustration purposes it is assumed that the bids do not change depended on the procedure followed. Following the first decision rule bid A would be the winner, in the case a relatively high weight was placed on price relative to quality. Using the “first quality, then price” procedure bid B is winner. If the “first price, then quality” procedure was followed, bid C would be the winner.

What the optimal bid is, cannot be determined either ex ante or ex post. A subjective element is implicit in the concept of a beauty contest. The way towards the outcome can nevertheless be determined in a non-arbitrary fashion.

[12] An alternative is to set an absolute quality threshold.

Figure 1 Different procedures lead to different outcomes.



5 CONCLUSION

It is generally accepted that beauty contests fit better to cases where quality forms an essential element in the selection process, where quality is endogenous. Beauty contests offer bidders the opportunity to submit imaginative proposals tailoring the projects to the particular needs of the authorities. Although beauty contests take quality explicitly into account it should at the same time be recognised that it is often very difficult to define quality objectively. For that reason it is required that the way the awarding party defines quality with all its attributes is as clear as possible to the bidders beforehand.

Quality is not just any one characteristic, nor the sum of many, but involves the entirety of many different aspects. These can be summarised as follows. Structural features refer to the characteristics of the bidder itself. Although it does not guarantee the quality of the product offered it is generally seen as an indication of to what extent the bidder is able to upheld its bid. Since reputation of the bidder plays an important role it often benefits the incumbents. Process features refer to the characteristics of the implementation phase of the project for which is bid. It includes the way the bidder is planning the implementation of the project, and it should convince the awarding authority of the feasibility of the plans. Outcome features refer to the product or services to be delivered. Since different bidders score differently regarding these features a weighting scheme is necessary.

The several attributes that together define quality can be brought together in a score function giving different weights to the different aspects. This function can be continuous or discrete. In a continuous function the different aspects are given different weights and the total score gives an indication of the total quality of the offer. Another approach often applied is that for several (important) quality aspects a minimum score is required. On this basis the number of bids can be reduced and the remaining bids can be compared, again with a scoring function.

In a beauty contest the price is one of the attributes on the basis of which a bid is awarded. It is one of the elements in the scoring function. In practice (a combination of) two types of prices are used in bidding contests: lump sum payments for the right to operate a concession and the price per unit for the good or service to be supplied in the market that arises after the beauty contest. Whatever the choice in a beauty contest the price should be weighted against the quality offered. The final choice of bid therefore hinges on the trade-offs between price and quality proposed by the (remaining) bidders. In such circumstances, the judgements on the various attributes of the bids need to be brought together into a comprehensive ranking. In doing this these trade-offs should be addressed explicitly in the final evaluations by taking account of both quality and price attributes and seeking to identify the bid that offers the best combination of these.

Although the beauty contests can be characterised by common features, in practice they are virtually all very specific in terms of how the process is organised as well as how the various aspects are treated. This need not be a problem as long as the rules of the game are specified beforehand and as long as the selection procedures are transparent. There will always be subjective elements included in the judgment of the various quality attributes. But the contestability of the contest can be limited by organising the beauty contest in a non-arbitrary fashion providing a level playing field to as many as possible potential bidders.

REFERENCES

International Telecommunication Union (2001) *Effective regulation; Case study: Morocco*, www.itu.int/itudoc/itu-d/publicat/ma_ca_st.html.

Klein, M. (1998) Bidding for concessions, Working Paper 1957, World Bank.

Klemperer, P.D. (2000) Are Auctions Always Best? www.nuff.ox.ac.uk/economics/people/klemperer.htm

Ministerie van Economische Zaken (1999) *Europees Aanbesteden: Haal pegels uit de regels!*, Den Haag.

Ministerie van OC&W (2001) *Onderzoek naar de juridische en technische merites van een vergelijkende toets, (motie Wagenaar c.s. II, 2000-2001, 24095, nr. 75)* Zoetermeer.

Uniform Aanbestedingsreglement (2001) [Uniform Tender Regulation; in Dutch], Staatscourant, 15 juni 2001, nr. 113.

World Bank (1999) *Guidelines Procurement under IBRD Loans and IDA Credits*, The World Bank, Washington D.C.

2 CREATING A LEVEL PLAYING FIELD

Emiel Maasland, Yves Montangie and Roger Van den Bergh

TABLE OF CONTENTS

1 INTRODUCTION 21

2 OVERVIEW OF WAYS TO LEVEL THE PLAYING FIELD BEFORE THE AUCTION 22

3 CASE STUDY I: UK UMTS AUCTION 23

4 CASE STUDY II: FCC SPECTRUM AUCTIONS 25

5 AFFIRMATIVE ACTION MAY INCREASE REVENUE 27

6 ASYMMETRIC AUCTIONS UNDER THE EC STATE AID RULES 29

6.1 OVERVIEW OF STATE AID RULES 29

6.2 NO CLEAR GUIDELINES ON THE APPLICABILITY OF ARTICLE 87 TO ASYMMETRIC AUCTIONS 30

6.3 ASSESSMENT OF THE IMPACT OF STATE AID RULES ON ASYMMETRIC AUCTIONS REQUIRES A CASE-BY-CASE APPROACH 31

REFERENCES

1 INTRODUCTION

This report deals with the question "How to create a level playing field?" We wish to stress here that the title of this report should not be interpreted in such a way that under all circumstances a level playing field should be created. However, there are many circumstances under which it should be done. A detailed analysis of the arguments lies outside the scope of this report. However, the essence is nicely formulated in McMillan (1994).

> "*Theory says that auctions usually produce efficient outcomes: in most cases the winner is the bidder with the highest use-value for the license. This argues for laissez-faire. Favouring certain bidders is justified, on the other hand, if bidders' willingness to pay does not reflect social value, because of externalities or capital market imperfections, or for distributional reasons.*"

Usually, favouring certain bidders is justified in case it would prove helpful to economic efficiency, i.e. the sum of consumer and producer surplus.[1] However, in general, whether or not a level playing field should be created is dependent on the precise description of the goal of the auction.

The structure of this report is as follows. Section 2 summarizes a number of ways to level the playing field before the auction.[2] In Sections 3 and 4, we describe two case studies, the UK UMTS-auction and the FCC spectrum auctions respectively, and focus on the asymmetric elements in these auctions. For the first case study, the UK UMTS auction, we have held a short questionnaire. In Section 5, we show that affirmative action may increase revenue, in other words affirmative action does not need to cost money and may even yield extra money. In Section 6, we argue that affirmative action does not necessarily imply state support, and therefore might be allowed by Dutch / European law. However, we will also argue that due to:

- The difficulty of setting the right types and levels of asymmetries which would guarantee such a positive result;
- The fact that there are no precedents in the Commission's decision practice supporting such an argument.

It may be very difficult to build up a solid *ex ante* argument justifying the conclusion that an asymmetric auction falls outside the scope of the provisions on State aid.

---

1 Consumer surplus is the value that all consumers together assign to the market outcome. Economists define this notion as the difference between what consumers are prepared to pay and what they really have to pay. The producer surplus corresponds to the profits producers together make.

2 An analysis of the ways to create a level playing field after the auction lies outside the scope of this report.

2 OVERVIEW OF WAYS TO LEVEL THE PLAYING FIELD BEFORE THE AUCTION

There are many ways to level the playing field before the auction. Broadly speaking, there are three ways how to do it:

1. Changing the rules of a particular auction.
2. Changing the auction type (e.g. simultaneous multiple round auction, sealed-bid auction).
3. Taking corrective measures before the auction starts.

We now comment briefly on each category.

Ad 1. There are at least five forms of asymmetry which can be introduced in the auction design (a combination of these forms is of course possible too):

- (Partial) exclusion, i.e. forbidding certain bidders to bid on certain (all) licenses; in the Dutch DCS-1800 auction the two incumbents (KPN and Libertel) were not allowed to bid on the large lots, and in the UK UMTS auction the incumbents were not allowed to bid on the largest lot; this form of asymmetry will be dealt with in more detail in Section 5.
- Restriction on the maximal number of licenses which may be acquired by certain bidders. In the Dutch DCS-1800 auction the potential newcomers were not allowed to bid on the two large (nation-wide) lots simultaneously.
- Geographical restriction on the maximal number of licenses, which may be, acquired by certain bidders; in the US spectrum auctions each bidder was not allowed to acquire more than a certain number of frequencies in each of the 493 “basic trading areas”.
- Allowing certain bidders to withdraw their bids (or to make package bids); the rationale behind this form of asymmetry is to prevent that a newcomer acquires an inefficient number of licenses.
- Directly favouring certain bidders financially, e.g. by giving certain bidders bidding credits; this form of asymmetry will be dealt with in more detail in Section 5.

These instruments may be desirable in special situations. The typical situation is one where the government is attempting to encourage competition in the auction and the post-auction market. By levelling the playing field between incumbents and new entrants, competition may be enhanced. Still, these instruments have serious potential problems. For example, gauging the right level of set-asides or bidding credits is extremely difficult. Also, it is nearly impossible to target the favour only to the desired group.

Ad 2. Suppose, for example, that raising (maximum) revenue for the government is the goal (an important sub-goal) of the auction. In case there are ex ante asymmetries among the bidders a sealed-bid design may be favoured over an ascending-bid design as an ascending auction may discourage participation by lower-valued bidders. Weak competition may have detrimental effects on the auction revenue. If a bidder knows that it will ultimately lose to the bidder with the highest value, then it has no incentive

to participate. At the extreme, if all parties know which potential bidder has the highest value, then only this highest bidder is likely to bid in an ascending auction, and the auction ends at a price near zero. The advantage of a first-price sealed-bid auction in this setting is that it may eliminate this zero-price equilibrium. The low-valued bidders have an incentive to participate, since in equilibrium they win with positive probability at favourable terms. The possibility of an inefficient assignment is precisely what attracts the bidders that will discipline the highest-valued bidder. These (*potential*) revenue benefits of first-price sealed-bid auctions are studied in Klemperer (1998) and Bulow et al. (1999) in an "almost" common value context[3] and in Maskin and Riley (2000) in a private value context. Maskin and Riley give conditions under which the first-price sealed-bid auction is superior to the ascending bid auction.[4]

Ad 3. Incumbents may have two important advantages over potential entrants. Firstly, incumbents might be better informed as they know already existing market conditions. This informational advantage of the incumbent can be (partly) counteracted by the government by providing as much information as possible (provided the government has information the entrant does not have). Another option is to choose for an auction form in which the better-informed firm should bid first. From the auction literature we know that in the pure common value setting a bidder with private information has a large advantage over a bidder with no private information. Both in the ascending auction and in the first-price sealed-bid auction the latter does not make any profits in equilibrium. Secondly, incumbents might have an investment lead over potential entrants. In the UMTS auction context, the adoption of mandatory roaming and mandatory site sharing has the effect of decreasing the infrastructure costs, with a stronger relative effect on entrants. These rules can have an important role in levelling the playing field between entrants and incumbents.

3 CASE STUDY I: UK UMTS AUCTION

For this case study we have sent a short questionnaire to the Radio communications Agency, which was responsible for the UMTS-auction in the UK.

The UK Government used a simultaneous ascending auction to auction five 3G licenses, A-E. The bandwidth for each license was as follows:

---

[3] In an (almost) common value context bidders have the same, or close to the same, actual value for an object, but they have different information about that actual value.

[4] The revenue comparison is dependent on the value distributions of the bidders. A detailed analysis of the conditions lies outside the scope of this report.

	A	B	C	D	E
Paired Spectrum	2 x 15	2 x 15	2 x 10	2 x 10	2 x 10
Unpaired Spectrum	5	0	5	5	5
Total	35	30	25	25	25

License A was set aside for a new entrant. Only potential new entrants could bid on this license. All bidders (4 incumbents and 9 potential new entrants) could bid on any of the remaining licenses (B to E). Furthermore, measures were taken to ensure a new entrant or entrants had access to roaming on 2G networks. The auction rules were similar to the ones in the Dutch UMTS auction. Basically, the only difference was that the UK auction was more transparent than the Dutch auction: at the end of each round all bids were revealed. The UK Government defined their objectives for the auction as, to:

1. Utilize the available spectrum with optimum efficiency ("efficiency of the auction").
2. Promote effective and sustainable competition for the provision of 3G-services ("efficiency of the market").
3. Subject to the overall objectives above, design an auction that is best judged to realize the full economic value to customers, industry and the taxpayer of the spectrum ("revenue maximization").

In the National Audit Report (2001), one can read that the UK Government / Radio communications Agency reserved lot A (the largest one) for a new entrant, basically because of sub-goal ii), in spite of the fact that reserving more spectrum for an entrant would be at the expense of sub-goal i):

> *"The Government recognized that the incumbent companies' existing networks and customer base are major barriers to new entrants, who would have to build their own networks over several years during which their service could be inferior and unattractive to consumers. The Agency allocated more spectrum for the new entrant in order to strengthen its business. Extra spectrum allows operators to reduce their investment in infrastructure, and to sell surplus capacity to other companies who wish to offer telephone services under their own brands. This is inefficient in technical terms because the new entrant, Hutchison 3G UK (TIW), starts with no existing base of customers, and the extent to which its spectrum will remain under-utilised depends on how quickly the company attracts customers and gets them using advanced, non-voice services. The Agency and OFTEL however, saw efficiency in wider terms, considering that a new entrant would roll out 3G services quickly and exert competitive pressure on the four incumbent companies to do likewise. This reduced the risk that the incumbents might otherwise defer their investment in 3G services while exploiting their spectrum only for less intensive voice telephony".*

Cramton (2001) argues that, on balance, setting aside the largest license for a new entrant probably was a desirable trade-off between competition and efficiency. His argument is as follows:

> *"The only potential source of inefficiency was setting aside a large 15 MHz license for a new entrant. The bidding revealed that BT valued the extra 5 MHz more than the new entrant TIW. However, guaranteeing that the entrant would win a 15 MHz license and not be forced to pay BT's incremental value for 5 extra MHz likely was pro-competitive, both in the auction and in the post-auction market. The set-aside surely stimulated participation by potential entrants. Post auction competition was also stimulated, since the new entrant (TIW) will be stronger and less capacity constrained as a result of the extra 5 MHz block".*

As can be read above, incumbents and entrants were treated asymmetrically in the auction. First of all, the incumbents were not allowed to bid on the large license (lot A). The European Licensing Directive rather than the Telecommunications Act applies here. The Licensing Directive requires open, non-discriminatory, and transparent procedures unless there is a reason for "objective differentiation". With respect to this issue, the Radio communications Agency filled out our questionnaire as follows:

> *"We believe that the decision to reserve a license was justified in this case. However, as with any licensing decision this could have been subject to a legal challenge, and the courts may not have agreed with us. In the event none of the operators challenged the decision. Should we have had five incumbents and decided to reserve a license, a legal challenge would have been more likely. It would have been more difficult for us to convince the courts that it was a proportionate measure because it would mean that one of the incumbents could not get a license".*

Also a measure was used to ensure a new entrant or entrants had access to roaming on 2G networks. This was by means of a roaming condition inserted in an incumbent's Telecoms Act which was triggered if the incumbent won a 3G spectrum license. The condition requires the incumbent to negotiate a roaming agreement if requested to do so by a new entrant. If the new entrant and incumbent are unable to reach agreement on roaming through commercial negotiation then the Director General of Telecommunications could have determined an agreement. Initially all the incumbents resisted this roaming condition, wanting to negotiate their own terms with the new entrant. Vodafone and BT Cellnet agreed to the condition but One2One and Orange mounted a legal challenge on the way the condition was imposed, which the government won on appeal, following an initial ruling against her. The government decided to let One2One and Orange participate in the auction and take up their license without the obligation, considering that the new entrant would have sufficient rights to roam without them, and that further delay to the auction would be unwarranted (the start of the auction was delayed by three months already).

4 CASE STUDY II: FCC SPECTRUM AUCTIONS[5]

In the FCC spectrum auctions in the US bidders were also treated differently. One of the auction objectives that the US Congress gave the FCC is to have a diversity of auction winners. The FCC was instructed to encourage participation by small

[5] For a more detailed analysis of the FCC spectrum auctions case, we refer to Report 6 in this bundle by Tim Salmon: FCC experience on the design for auctioning spectrum.

businesses and women- or minority-owned firms, so called "designated entities," in order to foster innovation and intensify competition. (47 U.S.C. §309(j)(4)(D)).

Section 309(j)(4) identifies a number of means by which the FCC can carry out this mandate, such as "the use of tax certificates, bidding preferences, and other procedures." The FCC has adopted a variety of such measures for different auctioned services. It has employed instalment payments, bidding credits, and, for the auctions of the broadband PCS service, "entrepreneurs' blocks" (i.e., set-aside of spectrum for bidders not exceeding certain financial thresholds), to facilitate designated entity participation in the provision of spectrum-based services. A bidding credit of x% means that if a designated entity would win a license, he only has to pay (100-x)% of his bid. These credits, ranging from 10% to 40%, were intended to offset any disadvantage these firms faced in raising capital and providing services. The specific rules that the FCC has adopted in regard to implementing bidding credits is found in: 47 Code of Federal Regulations Section 1.2110.[6]

In 1994, the FCC adopted provisions for women- and minority-owned businesses. Since 1995, The FCC has largely focused its efforts upon small businesses because, subsequent to the 1993 Budget Act, Congress eliminated the tax certificate program, and the Supreme Court issued two landmark decisions, *Adarand Constructors, Inc. vs. Peña*, *United States vs. Virginia.*[7] These decisions raised legal uncertainty as to whether the special auction provisions for minorities and women (as initially adopted) could withstand an equal protection constitutional challenge.

Cramton (2001a) and Salmon (Report 6 in this bundle) argue that governments must be cautious when using favors for designated entities. A vivid example is the FCC's major setback, the C-block broadband PCS auction. The auction failed largely because of overly attractive installment payments (10% down and 6-year interest-only at the risk-free 10-year Treasury rate). This encouraged speculative bidding, which led to all the major bidders defaulting and declaring bankruptcy. Even now, years after the auction, much of this C-block spectrum lies unused, tied up in bankruptcy litigation. Installment payments were a bad idea, because they advantaged the bidders with the most speculative business plans. In addition, installment payments put the FCC in the role of banker, an activity for which the FCC has no advantage. Since the C-block experience, the FCC no longer offers installment payments. The other two instruments (bidding credits, set-asides) have fared better. Ayres and Cramton (1996) argue that in the 1994 FCC auction, in which licenses for narrow bands of the radio spectrum were awarded for advanced paging services networks, subsidized bids by a minority-controlled company substantially increased the price a concern paid. The extra revenue the

---

6 These rules can be found online: http://wireless.fcc.gov/auctions/21/releases/lmsbp_g.pdf. This pdf-document contains a bidder information package from an auction and includes some selected parts of the legal code that forms the basis for the auction rules (see p. 309).

7 See *Adarand Constructors, Inc. vs. Peña*, 115 S. Ct. 2097 (1995) (constitutionality of all government imposed racial classifications determined under a "strict scrutiny" standard of review; under strict scrutiny, measures must serve a compelling governmental interest and must be narrowly tailored to serve that interest); *United States vs. Virginia*, 116 S. Ct. 2264 (1996) (state-imposed gender classification violated constitution because state failed to show "exceedingly persuasive justification" for the program).

government got from the strong bidders more than offset the subsidy to the weaker bidders.

5 AFFIRMATIVE ACTION MAY INCREASE REVENUE

In this section, we illustrate, through three examples, that affirmative action (e.g. set-asides, bidding credits) does not need to cost money and may even increase revenue. This observation is crucial to argue that affirmative action does not necessarily imply state support (see Section 6). We like to stress here again that, gauging the right level of set-asides or bidding credits is extremely difficult, and if the level of set-asides or bidding credits is chosen falsely, it would probably have a revenue decreasing

Set-Asides

Auction revenue can be increased by setting aside certain licenses for weaker parties (e.g. potential entrants). The argument is simple, by setting aside licenses for potential entrants the number of licenses on which incumbents are allowed to bid is restricted, which will intensify the competition. The intensified competition will lead to a higher price. This higher price can compensate the lower price on the set-aside licenses, so that in total a higher revenue arises.

A simple example may illustrate the argument.

Example 1: Consider six bidders competing for four identical licenses. Each bidder desires a single license. Four of the bidders (who are strong) are willing to pay up to 25 for either license; and two of the bidders (who are weak) are only willing to pay up to 5. Without any preferential treatment, each of the strong companies would only need to bid slightly more than 5 to outbid the weaker rivals for each license. The government collects 20. But if the government gave preference by setting aside one license for the weaker bidders, the four strong bidders competing for one of the three remaining licenses would bid close to 25. And the weaker bidders would bid close to 5 for the set-aside license. This asymmetric auction format lifts the government's expected revenue by 400 percent, to 80.

Setting aside licenses for weaker bidders can also increase revenue in another way, namely when this increases the number of bidders. In the example above, the number of bidders was exogenously given. If the auction would have been symmetric, it is questionable whether bidders with a lower value would like to participate in the auction anyhow: they do not have a chance to acquire a license. If they do not participate, the symmetric auction revenue in this example would have been zero. The weaker bidders only have a chance if the auction is asymmetrically designed, like in the example above. As we have seen, this auction format generates a revenue of 80.

Bidding credits

Likewise, auction revenues could be increased by handicapping the stronger bidders or equivalently giving bidder subsidies ("bidding credits") to weaker bidders. A strong bidder might be willing to bid more because it must now

compete with subsidized bids. The extra revenue the government gets from the strong bidders can more than offset the subsidy to the weaker bidders.[8]

Essentially this system is a generalization of the above mentioned system of "set-asides", which corresponds roughly with the case in which the fraction to be paid by the weaker bidders is close to zero. The system with bidding credits has more degrees of freedom and therefore its revenue, by choosing the fraction ("bidding credit") appropriately, can be higher in general than a system with set-asides.

Example 2: Consider two bidders competing for one license. One of the bidders is willing to pay up to 10, the other bidder to 20. In an ordinary ascending auction the second bidder will acquire the license for a price of 10. If however the rule would be that the second bidder only wins the auction if he bids at least twice the price as the first bidder, he will be forced to bid up to 20 and the revenue will be 20. The factor 2 in this example is optimal from a revenue perspective. With a factor x smaller than 2, the second bidder will acquire the license for a price of 10x. In this case the revenue is not maximal. With a factor x larger than 2 the first bidder will acquire the license for a price of $20/x$. In this case the revenue is not maximal either and moreover the auction outcome is not efficient (i.e., that the bidder which is willing to pay most, actually acquires the license).

The above example illustrates the importance to choose the correct "bidding credit". A factor, which is too high, favors one party too much and can lead to an inefficient outcome; a factor, which is too low, stimulates the competition insufficiently and is to the advantage of the party with the highest value. The factor should be chosen in such a way that a "level playing field" arises; the factor should compensate the ex-ante difference between the values of the bidders exactly: when one bidder assigns on average a twice as high value to a license than the other, then the latter should be given a "bidding credit" of 100%, i.e., he only needs to pay 50 percent of his bid.

In the example above the optimal "bidding credit" was easy to determine since the values were known. In general, this will not be the case. Myerson (1981) has shown that also in case that the values are not known a revenue maximizing seller does want to make use of an asymmetric auction where a corresponding advantage will be given to the underlying parties. This result is illustrated with the following example.

Example 3: Suppose that there are two bidders for one license. The first assigns a low value to the license, which is not known exactly but can be estimated at somewhere between 0 and 10.[9] Bidder two assigns a higher value to the license, estimated at somewhere between 10 and 30, again assuming the uniform distribution.

---

[8] This happened e.g. fall 1994 when licenses for narrow bands of the radio spectrum were awarded for advanced paging services networks. Subsidized bids by a minority-controlled company substantially increased the price a concern paid.

[9] Formally we assume that all outcomes are all equally likely, so we assume the uniform distribution.

In an ascending auction the second bidder will always acquire the license for an expected price equal to 5. This bidder realizes a big surplus (15 on average) and the revenue of the auction is low.[10]

Myerson (1981) shows that a revenue maximizing seller can realize an expected revenue of 13,3 with the following procedure, which contains asymmetric elements:

1. both bidders are asked to give a bid (sealed bid), say b is the bid of bidder i;
2. if $b_1 + 10 > b_2$, then the license will not be sold to bidder 2, bidder 1 gets the license for the price $b_2 - 10$ if $b_1 > 5$; if the bid of bidder 1 is less than 5, the license remains unsold;
3. if $b_2 > b_1 + 10$ (bidder 2 bids at least 10 more than bidder 1), then the license will be sold to bidder 2 for the price $b_1 + 10$, provided that the bid of bidder 2 is at least 15; if this bid is below 15, then the license remains unsold.

Thus the optimal auction (expected revenue maximizing auction) favors bidder 1 with a view to induce more aggressive bidding by bidder 2. Note that, if bidder 1 is not favored, bidder 2 would never bid more than 10, resulting in an auction revenue of at most 10, while in the optimal auction the payment of bidder 2 to the seller can be up to 20.

The example also shows that in an optimal auction the object will sometimes not be assigned to the highest bidder; to maximize the revenue it is sometimes necessary not to accept the highest bid (i.e., inefficiency).

In conclusion, if the potential buyers are in asymmetric positions, then the revenue maximizing seller should use an asymmetric auction format, because of the following two reasons:

1. he creates a "level playing field", he corrects for the ex ante given asymmetry and this leads to higher bids;
2. he gives the weaker bidders an incentive to participate in the auction, increasing herewith the potential demand which leads to a higher price.

6 ASYMMETRIC AUCTIONS UNDER EC STATE AID RULES

6.1 OVERVIEW OF STATE AID RULES

Article 87 (1) of the EC Treaty prohibits, save as otherwise provided, any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain

[10] An easy way to increase the revenue is by requiring a minimum bid. With a minimum bid of 10, he always sells the license and the revenue is 10. A required minimum bid of 15 gives him an even higher expected revenue. It's true that the license remains sometimes (with probability ¼) unsold, however in all other cases the revenue is 15, the expected revenue is thus 11¼. With an asymmetric auction a seller can realize an even higher expected revenue.

undertakings or the production of certain goods, insofar as it affects trade between Member States.

Article 87(2) enumerates certain categories of State aids that are deemed compatible with the EC and will automatically be exempted from this prohibition by the Commission. Article 87(3) mentions some categories of State aids, which are not automatically exempted but can be exempted by the European Commission following a discretionary decision of the latter.

Article 88(3) requires any State aid measure a Member State plans to adopt, to be notified to the Commission. Member States may not put their proposed aid measures into effect until the Commission has approved them. The Commission examines the compatibility of the aid with the EC Treaty not in terms of the form which it may take, but in terms of its effect. It may decide that the Member State must amend or abolish aid which it finds to be incompatible with the common market. The primacy of EC law over the national law of the Member States, as laid down in established case law of the European Court of Justice, implies that the State aid rules will apply regardless of whether the measure is allowed by national law.

Where aid has been implemented in breach of the procedural rules, i.e. without a formal notification to the Commission having been made, the aid is illegal and the Member State must in principle recover it from the recipient. Third parties may have this aid declared void before a national court of law and, when they have suffered damages from the aid having been granted to other parties, claim damages.

Article 89 of the Treaty allows the Council of Ministers of the EU to adopt any appropriate regulations for the application of Articles 87 and 88 and in particular to determine the conditions in which Article 88(3) shall apply and the categories of aid exempted from this procedure. To this end, the Council has adopted a Regulation in which empowers the Commission to exempt certain categories of aids from the prohibition by a regulation.

6.2 NO CLEAR GUIDELINES ON THE APPLICABILITY OF ARTICLE 87 TO ASYMMETRIC AUCTIONS

The Commission's decision practice does not offer clear guidelines on the applicability of the State aid regime to asymmetric auctions.

The Commission's decisions on the granting of licenses for GSM radiotelephony in Italy and Spain[11] stated that a Member State breaches Article 86 (public enterprises) in conjunction Article 82 (abuse of dominant position) of the EC Treaty when it discriminates between the incumbent dominant provider and the new second operator. However, these decisions did not shed light on the applicability of the State aid rules to auctions that would have the opposite effect of granting certain advantages to newcomers.

From the Commission's practice on related subjects, it would seem that asymmetric auctions are likely to fall under the scope of the State aid rules.

---

[11] Commission's Decision of 4 October 1995, OJ L 280, of 23 November 1995 & Commission's Decision of 18 December 1996, OJ L 076 of 18 March 1997.

Transactions leading to the sale of land and buildings owned by public authorities are considered to contain elements of State aid when the sale is not concluded on the basis of an *open and unconditional bidding procedure*, accepting the best or only bid, or when, in the absence of such procedure, it is made at less than market value as established by independent values.[12]

In privatisation operations, the Commission only considers those operations to fall outside the scope of the State aid rules when the terms and conditions of the sale are *non-discriminatory and transparent* and State property is sold to the highest bidder.

To obtain some clarification on this issue of asymmetric auctions and State aids in general, one will have to wait until the Commission has examined "whether additional measures are required to further clarify the Community rules and principles applicable to the selection of the provider of services of general interest".[13]

6.3 ASSESSMENT OF THE IMPACT OF STATE AID RULES ON ASYMMETRIC AUCTIONS REQUIRES A CASE-BY-CASE APPROACH

Until then, to assess the possible impact of the State aid regime on a particular (type of) asymmetric auction, one will have to assess on a case-by-case basis

- Whether the asymmetries introduced in the auction in question can be regarded as State aid, taking into account the definition of this notion and its composing elements (a)
- When the asymmetric auction falls under the scope of the State aid regime, whether it would qualify for one of the exceptions in Article 87(2)-(3) or belongs to one of the categories of aid the Commission has exempted by regulation (b)

a. Does a specific asymmetric auction qualify as State aid?

A State measure will be qualified as a form of State aid within the meaning of Article 87, when it meets the following criteria:

1. The measure confers on certain undertakings an advantage they would not enjoy from their own commercial endeavours or relieve them of charges that are normally borne from their budgets.
2. The measure is specific or selective in that it favours only certain undertakings or the production of certain goods or services.

Asymmetric auctions will probably, by their very own nature, meet these two criteria.

3. The advantage is granted by the State or through State resources.

---

[12] Commission's Communication on State aid elements in sales of land and buildings by public authorities, Official Journal OJ C 209 of 10 July 1997.

[13] Commission, Report to the Laeken European Council - Services of General Interest, *COM(2001) 598 final of 17 October 2001, 39.*

This may take the form of any transfer of State resources to private undertakings, be it under the form of an actual payment by the State (e.g. through grants or subsidies) or under the form of a loss of revenue by the State.

In the case of asymmetric auctions which are intended to increase State revenue, it may be argued that these "escape" the definition of State aid in as far as there is no transfer from the State's resources towards private undertakings. In as far as the introduction of asymmetries in the auction would lead to a loss of revenue to the State, ex ante proof would be required of the fact that the auction will eventually lead to a higher revenue for the State, compensating for this loss. However, due to

- The difficulty of setting the right types and levels of asymmetries which would guarantee such a positive result.
- The fact that there are no precedents in the Commission's decision practice supporting such an argument.

It may be very difficult to build up a solid *ex ante* argument justifying the conclusion that an asymmetric auction falls outside the scope of the provisions on State aid.

4. The measure must affect competition and trade between Member States.

Under settled case-law, for the purposes of this provision, this criterion is usually met if the aid strengthens a firm's position compared to that of other firms which are competitors in intra-Community trade and, *a fortiori*, when the recipient firm carries on an economic activity involving/connected to any trade between the Member States.

In the case of asymmetric auctions, it may be argued that the distortion of competition during the auction is offset by the enhanced competition after the auction. This would lead to the conclusion that the State measure has a pro-competitive effect on balance, which may justify excluding it from the scope of Article 87(1). Here again, due to the uncertainties in predicting the outcome of the auctions and the lack of precedents supporting such an argument, the validity of such argument remains most uncertain.

b. Does the auction qualify for one of the exceptions to the State aid prohibition?

If a State measure such as an asymmetric auction would be regarded as a form of State aid, it might apply for one of the exceptions, three of which may be of relevance here:

1. The exception of Article 87(3)b EC-Treaty for aid intended to promote the execution of a project of common European interest (or to remedy a serious disturbance in the economy).

To benefit from this exception, one would first have to demonstrate that the aid is in the interest of a project of common European interest. There is no clear definition of this notion. While it is clear from the Commission's decision practice that this exception is not limited to projects in which all Member States are involved, it will otherwise be required to demonstrate that the aid would lead to the achievement of a community objective and is not limited to benefiting the interests of one particular Member State. It is also doubtful that aid directed at

specific firms in one specific sector would be considered to be justified on the basis of this exception.[14]

Secondly, it would have to be demonstrated that the State aid measure is necessary to achieve this result and that it could not have been obtained otherwise (f.i. through the market process).

Furthermore, one would have to demonstrate in advance that the duration, intensity and scope of the aid are proportional to the importance of the intended result.

One has to bear in mind that aid qualifying for an exception under this provision would in any case still have to be notified to the Commission: the latter will ultimately decide whether the exception applies.

2. The exception of Article 87 (3) c for aid intended to facilitate the development of certain economic activities (…) where such aid does not adversely affect trading conditions to an extent contrary to the common interest.

To benefit from this exception, it would have to be demonstrated that the aid is directed at the development of an economic activity in general and not just the development of specific undertakings. It is unlikely that aid to weaker undertakings in a market that is overall considered as "healthy" would be allowed under this exception.

Here too, it would have to be shown in advance that the State aid measure is necessary to achieve this result and that its duration, intensity and scope are proportional to the intended result.

Aid qualifying for an exception under this provision would also still have to be notified to the Commission who will ultimately decide whether the exception applies.

3. The exception for *de minimis* aid.

On the basis of the powers granted to it by the Council, the Commission has issued a regulation in which it defines the so-called *de minimis* aid.[15] This is aid of which the amount is that limited that an appreciable effect on trade and competition between the Member States is thought to be absent.

To be qualified as *de minimis* aid, the aid granted by a State measure to a particular undertaking must not exceed 100 000 Euro over a three-year period beginning when the first *de minimis* aid is granted. This limit is expressed as a cash grant of 100 000 Euro. In cases where assistance is provided under another form than as a grant, it has to be converted into its cash grant equivalent value for the purposes of applying the *de minimis* limit.

For an asymmetric auction to escape the prohibition on State aid, it would have to be shown that the value of the benefit attributed to the participating undertakings does not exceed the 100.000 Euro limit when converted to a cash equivalent.

---

[14] Commission's Decision 89/254/EEC of 15 November 1988 (Ottignies/Louvain-la-Neuve), OJ L 106 of 18 April 1989.

[15] Commission Regulation (EC) No 69/2001 of 12 January 2001 on the application of Articles 87 and 88 of the EC Treaty to *de minimis* aid, OJ L10 of 13 January 2001.

State measures that can be qualified as *de minimis* aid are thought not to fall under the scope of article 87(1) and do not have to be notified to the Commission under Article 88(3).

REFERENCES

Ayres, I. and Cramton, P. (1995) The Case for Affirmative Action: From Conscience to Coffers, *New York Times*, 21 May 1995, F13.

Ayres, I. and Cramton, P. (1996) Deficit Reduction Through Diversity: How Affirmative Action at the FCC Increased Auction Competition, *Stanford Law Review* 48, 761-815.

Bulow, J.I., Huang, M. and Klemperer, P.D. (1999) Toeholds and Takeovers, *Journal of Political Economy* 107, 427-454.

Cramton, P. (1998) Ascending Auctions, *European Economic Review* 42, 745-756.

Cramton, P. (2001a) Spectrum Auctions, in Martin Cave, Sumit Majumdar, and Ingo Vogelsang, eds., *Handbook of Telecommunications Economics*, Amsterdam: Elsevier Science B.V., forthcoming.

Cramton, P. (2001b) *Lessons Learned from the UK 3G Spectrum Auction*, University of Maryland, Report commissioned by the National Audit Office of the United Kingdom.

Federal Communications Commission (1997) *The FCC Report to Congress on Spectrum Auction*, FCC 97-353.

Janssen, M.C.W. et al. (2001) *De draad kwijt? Onderzoek naar de gang van zaken rond de Nederlandse UMTS-veiling*, Erasmus Universiteit Rotterdam.

Jehiel, P. and Moldovanu, B. (2001) *The European UMTS/IMT-2000 License Auctions*, mimeograph, Mannheim University.

Klemperer, P.D. (1998) Auctions with Almost Common Values: The "Wallet Game" and its Applications. *European Economic Review* 42, 757-769.

Klemperer, P.D. (1999a) Auction Theory: A Guide to the Literature, *Journal of Economic Surveys* 13, 227-286.

Maskin, E.S. and Riley, J.G. (2000) Asymmetric Auctions, *Review of Economic Studies* 67, 413-438.

McMillan, J. (1994) Selling Spectrum Rights, *Journal of Economic Perspectives* 8, 145-162.

Myerson, R.B. (1981) Optimal Auction Design, *Mathematics of Operations Research* 6, 58-73.

National Audit Office (2001) *The Auction of Radio Spectrum for the Third Generation of Mobile Telephones*, Report by the comptroller and auditor general, HC 233 Session 2001-2002: 19 October 2001.

Van Damme, E., Maasland, E. (1998) *Asymmetrisch veilen: waarom?* Ministry of Finance.

Van Damme, E., Maasland, E. (1998) *Asymmetrie: De Amerikaanse Spectrumveilingen*, Ministry of Finance.

Van Damme, E., Maasland, E. and Onderstal, S. (2000) *Veiling MBVP's langs Rijkswegen*, Ministry of Finance.

Wilson, R. B. (1967). Competitive Bidding with Asymmetric Information, *Management Science* 13, A816-A820.

3 PREVENTING COLLUSION BETWEEN FIRMS IN AUCTIONS

Tim Salmon and Emiel Maasland

TABLE OF CONTENTS

1 INTRODUCTION 37

2 GENERAL THEORETICAL MODEL OF COLLUSION PROBLEM IN AUCTIONS 37

3 CASE STUDY OF FCC EXPERIENCE WITH COMBATING COLLUSION IN SPECTRUM AUCTIONS 39

3.1 TYPES OF COLLUSION IN FCC AUCTIONS 40

3.2 FCC ATTEMPTS TO DEAL WITH COLLUSION 42

3.3 ALTERNATIVE RULES THAT HAVE BEEN CONSIDERED BY THE FCC 44

4 CONCLUSIONS 47

REFERENCE

1 INTRODUCTION

One of the most important issues in auction design is preventing collusive behaviour. Collusion among bidders may take many forms. It may entail explicit agreements before the auction (*bidding rings*) on how to bid during the auction. It may also take the form of *tacit collusion*. In this case bidders do not directly communicate but they have an implicit mutual understanding on how to keep prices down. In this report, we primarily focus on tacit collusion, as explicit agreements before an auction are usually not allowed by law.

The report is structured as follows. In Section 2, we describe a general theoretical framework that explains the idea behind the most common form of collusion in auctions. Section 3 analyses the FCC experience with combating collusion in spectrum auctions. Section 4 concludes.

2 GENERAL THEORETICAL MODEL OF COLLUSION PROBLEM IN AUCTIONS

Before examining the FCC case study, it will be useful to briefly describe a general theoretical framework that explains the idea behind the most common form of collusion in auctions. Virtually all of the examples and types of collusion that will be discussed below can be related to a fairly simple framework. Most of the attempts to limit collusion are also based on eliminating the collusive strategies of the form described here.

Consider a simple auction environment in which there are 2 bidders and 2 items. Both bidders are interested in winning both items such that their values for the items are as in the following table.

	Bidder 1	Bidder 2
Item A	100	80
Item B	100	80

To begin to analyse this example we need to develop two concepts that will be used several times in the report. The first is the idea of an equilibrium outcome of an auction. We will use the game theoretic concept of Nash equilibrium, which refers to a set of strategies such that no bidder would prefer to deviate from them. We will also use the term efficiency, which refers to the amount of the possible value to society that has been achieved. If the bidders who value the items most win the items, then the most efficient or 100% efficient outcome has been achieved. If the items end up being assigned to other bidders then a less efficient outcome will be achieved.

If we think of these bidders as participating in a simultaneous ascending auction, the efficient equilibrium allocation is for bidder 1 to win both items paying 80 for each item resulting in total revenue to the seller of 160 and total surplus of 40 to bidder 1 and 0 for bidder 2. The strategies that support this outcome involve each

bidder intending to bid on any item so long as the asking price is less than their value.

There are, however, many other equilibria of this game that result from collusive strategies. One such collusive equilibrium outcome would involve bidder 1 winning item A for a price of 1 and bidder 2 winning B for a price of 1. Both bidders prefer this outcome, as bidder 1 would have a surplus of 99 and bidder 2 a surplus of 79. The seller, consequently, receives significantly less revenue and the allocation is inefficient. This is an example of what is commonly referred to as **strategic demand reduction** in which bidders reduce their demand for items in order to decrease the price they pay on the items they win.

The important detail to see is how this outcome can be supported as an equilibrium. To verify that it is an equilibrium we need to define strategies for each bidder and show that neither bidder would prefer to deviate from them. The strategy for bidder 1 in this case would involve placing a bid of 1 on item A and then, if bidder 2 ever places a bid on A, they bid according to their non-collusive equilibrium strategy of bidding until they pass their value. If bidder 2 adopts a similar strategy in regard to item B, then neither bidder would choose to deviate. Deviation from these strategies would involve something like bidder 1 choosing to bid on item B. If he did that, bidder 2 would punish him by bidding up to his value of 80 on both items. The outcome would be the non-collusive outcome in which bidder 1's surplus is 40. This is significantly lower than his surplus from not deviating, 99. The same can be verified for bidder 2. Thus these strategies constitute a Nash equilibrium of the game. The key element that allows this collusive outcome to be supported as an equilibrium is the ability for one bidder to punish the other bidder if they try to cheat from their collusive agreement. A more detailed discussion of this type of equilibria in large auctions can be found in Engelbrecht-Wiggans and Kahn (1999) and Brusco and Lopomo (1999).

If we think instead of a first price sealed bid auction for both of these items simultaneously, then this demand reduction equilibrium disappears. If the bidders strike an agreement before the auction to only bid 1 on their respective items, this agreement will be unenforceable during the auction as both have an incentive to deviate from it. If bidder 2 goes ahead and bids a price of 1 on item B, then bidder 1 can bid 1 on A and 2 on B and significantly improve the outcome for himself. Once bidder 2 realizes that 1 has cheated, however, he has no recourse to punishment as he would in the ascending auction. Without this punishment capability to enforce the collusive agreement it should be expected to disappear.

This example should not, however, be taken as an indication that collusion is not possible in a sealed bid environment. If the bidders expect to be competing in a series of auctions or even in a repeated interaction outside of the auction environment, they can adopt strategies to punish a deviator in future auctions or business dealings. The key, then, to supporting collusive equilibria as possible outcomes of an auction is the ability of the bidders to punish someone who deviates from a collusive agreement. This is an application of what is known as the **"folk theorem"** in game theoretic terms. This is a general theorem which states that collusion can occur in games which are repeated an infinite or unknown number of times assuming players possess sufficient patience. The strategies that support collusion in these cases will take the form of a collusive

agreement with punishment strategies used to enforce the agreement should anyone deviate from the agreed upon bids.

Most of the standard approaches to combating collusion in auctions will take the form of finding ways to limit the ability of bidders in an auction to punish a deviator. There is one obvious and certain way to break up collusive equilibria of this sort: a third bidder. If the auctioneer has attracted a third bidder to this auction, there is no longer a way that the bidders can agree to split the items up that is mutually agreeable without using side payments, which are assumed to be illegal. In the ascending version of the auction, bidders will bid competitively until the values of one bidder have been surpassed on both items. The remaining two bidders could still find a demand reduction equilibrium after that point, but the position of the auctioneer has been made significantly stronger by the addition of the third bidder. In the repeated sealed bid auction, if a third bidder outside of the bidding ring is introduced, this will again break up the collusive equilibria.

Many methods will be discussed below that attempt to limit collusion in auctions. The performance of all of them will be further enhanced by the incorporation of more competitors into an auction. One issue to note with this though is that this third bidder must be a willing an active participant. Some have suggested that problems in some of the European UMTS auctions have occurred as a result of some bidders assuming they would be likely to lose the auction given the other participants and choosing to bow out of the auction. The existence of such bidders is certainly not helpful. What is helpful is the existence of additional bidders who believe they have a legitimate chance of winning the auction even against a competitor deemed stronger. This suggests that pro-competitive measures such as giving smaller bidders bidding credits which allow them to compete against larger firms may also work against collusion.

3 CASE STUDY OF FCC EXPERIENCE WITH COMBATING COLLUSION IN SPECTRUM AUCTIONS

There are two facts about the history of collusion in the FCC's spectrum auctions that explain why this is an important case study to consider. First, there have been a large number of different instances of bidders attempting to collude in FCC auctions. Second, these attempts have been largely unsuccessful and to date no one has been able to identify more than a negligible loss in revenue in these auctions resulting from collusion.[1] The reason for this lack of success is due in part to the FCC's attempts to minimize collusion, but these attempts have been made far more successful by the large number of competitors that are usually involved in each auction. We will begin this case study by cataloging some of the more common or well known types of collusion that have been attempted in FCC

[1] The possible exception to this is the DEF block PCS auction. This auction saw the highest level of collusive activity in any auction and there is reason to believe that this lead to lower than optimal prices. This issue is discussed in more detail in the general FCC case study.

auctions and then go on to explain how the rules of the auctions have evolved to deal with these issues.

3.1 TYPES OF COLLUSION IN FCC AUCTIONS

There have been many forms of collusive strategies that have been attempted over the history of the 30+ spectrum auctions conducted by the FCC. All have shared the same basic structure discussed in section 2. That is, they have involved attempts to settle upon demand reduction equilibria supported by punishment strategies. The interesting part of these attempts is the varied approaches bidders have used to communicate such intentions to other bidders.

The most basic attempts at collusion observed have taken the form of simple punishment strategies. These involve situations such as bidder 1 who is interested in license A, bidding on license B, one they may well not be interested in, in an attempt to convince bidder 2, who does want B, to cease bidding on license A. Instances of such behavior are quite common throughout the FCC's auctions. The difficult part of using a strategy such as this to signal another bidder to coordinate on the collusive outcome is finding a way to make the other bidder aware of what the signal means.

Perhaps the most creative and well-known approach to this has come to be known as **bid signaling with trailing digits**, which took place most notably in the FCC's early PCS auctions. At that time, bidders were allowed to enter in their own bid amounts. Since the prices of these licenses were in the millions and hundreds of millions of dollars, the last three digits in the bids were of no real consequence. The licenses themselves in these auctions were identified by a two or three digit code identifying the geographic location of the license. Imagine a situation in which bidder 1 is interested in license 242 while bidder 2 is interested in licenses 105 and 242. If bidder 1 wants to signal bidder 2 to stay away from license 242, he might submit a bid on license 105 of $5,000,242. The last three or "trailing digits" are then used to refer back to the license bidder 1 wants 2 to cease bidding on. Using such trailing digits, bidders could effectively send coded messages back and forth to try to settle upon a collusive outcome.

One problem with even the trailing digits approach is that some bidders might not look closely enough at a rival's bid to notice them. This prompted some bidders to make their intentions even more obvious using **strategic withdrawals.** In an attempt to alleviate the exposure problem in their auctions[2] the FCC allows bidders to withdraw standing high bids in the auction. When a bidder withdraws their standing high bid on a license, the new minimum accepted bid becomes the amount of the previous high bid on the object. In the early auctions, withdrawals were submitted after a round of bidding had concluded and standing high bidders

---

[2] See "Spectrum Auctions by the United States Federal Communications Commission" in this bundle, the general FCC case study, for more information on the exposure problem. The general idea of the exposure problem refers to a problem that can occur when a bidder needs a group of say five licenses for their business plan such that if they only win four they are worth little or nothing to the firm. In that case, the bidder can be "exposed" to a significant loss if they bid on the package intending to win the entire group and then another bidder bids more on one of the licenses than this bidder is willing to pay. The bidder could end the auction having promised to pay a large sum of money for four licenses that are now of little value to him.

declared. In the same scenario as above, assume that bidder 2 has a bid of $4,500,000 on license 105. Bidder 1 could submit a bid of $5,000,242 for license 105 and then withdraw it in the same round. Such a sequence would not only call attention to the bid but also constitutes a more explicit offer to bidder 2 since they can simply resubmit their previous bid of $4,500,000 to regain the standing high bid on license 105. Such a withdrawal serves as a very clear signal of bidder 1's intent.

Without these two mechanisms, signalling collusive intent can be more difficult but it can still be done using a strategy generally called **retaliatory bidding**. The general idea of retaliatory bidding involves bidding on a license of another bidder whenever they bid on one you have an interest in to convince that bidder to stop bidding on your license. This is fundamentally the same behaviour as bid signalling but without using trailing digits. Consequently, communicating intent requires a little more effort.

As an example, in one auction, there were 3 nationwide licenses, A, B and C, in addition to a large number of smaller regional ones. It was well known that one particular bidder, we will refer to as bidder 1, had to win one of these three licenses but only wanted one. There were three other bidders interested in these licenses as well with two of those being interested in more than one license. Bidder 1 tried on repeated occasions to signal a collusive equilibrium by following a set pattern of bidding. They bid on license A in one period and then in the subsequent period they would bid on all three licenses, A, B and C. Then in the next period, they would re-bid on license A again, regardless of whether or not they already held the high bid on that license. They continued this pattern so long as one of the other bidders bid on license A. This was a very clear retaliatory signal being sent that bidder 1 would refrain from bidding on the other two licenses if the other bidders stopped bidding on license A. The outcome of this auction is that the auction progressed with bidder 1 bidding according to the described strategy while the other three bidders bid more or less evenly across the three nationwide licenses for many rounds, apparently ignoring the collusive offer being made, until two of the three dropped out of the competition in one round simultaneously. At that point bidder 1 stopped further bidding as did the remaining nationwide bidder. Bidder 1 ended up winning the license they had claimed for themselves and the remaining bidder won the other two.

It seems quite clear that this was an attempt by bidder 1 to collude with other bidders. The interesting question is whether or not the outcome that emerged was a collusive outcome or a competitive outcome. Based upon the evidence, it seems more likely to have been a competitive rather than a collusive outcome. Since two bidders dropped out of the auction at the eventual price level, it seems likely that the prices were more than they were willing to pay rather than that they were agreeing to demand reduce for collusive reasons. The remaining bidder could have demand reduced for collusive reasons from three licenses to two, but that seems unlikely as well. One thing about the outcome is certain though; by following this strategy, bidder 1 was driving up the price on license A faster than the prices of the other two items. Consequently, they ended up paying approximately 20-27% more for the license they won above the price the other

two bidders paid for identical items.[3] This example serves both as an example of a rather clever signalling approach that can be used even in the absence of trailing digits and strategic withdrawals and it shows why such collusion attempts are not necessarily effective. Competing bidders are not always willing to go along with the collusive offer being made by another. Also, pursuing a collusive strategy and failing can be quite costly.

3.2 FCC ATTEMPTS TO DEAL WITH COLLUSION

The FCC has had some fairly simple anti-collusion rules in place since the auctions began. Their basic requirement is found in Section 1.2105(c)(1) of the Commission's rules and says:

> *"After the short-form application filing deadline, all applicants are prohibited from cooperating, collaborating, discussing or disclosing in any manner the substance of their bids or bidding strategies, or discussing or negotiating settlement agreements, with other applicants until after the down payment deadline, unless such applicants are members of a bidding consortium or other joint bidding arrangement identified on the bidder's short-form application pursuant to § 1.2105(a)(2)(viii)."*

The interpretation of this is that bidders can talk among themselves, and form whatever cooperative arrangements they choose to prior to the start of the auction process, which is considered to be when the bidders submit their applications to be bidders. These pre-auction discussions, however, have two conditions on them, which are that any cooperative agreements formed must be disclosed in the application stage and that the bidders are still subject to any relevant anti-trust laws dealing with collusion between firms and any agreements must not violate those laws. So long as these conditions are satisfied, bidders can talk as much as they want before the applications are submitted, but once that occurs bidders are not allowed to communicate about the auction.

This was one of the reasons bidders have reverted to sending signals through their bidding behaviour since they are not allowed to talk directly. These signals are also technically violations of the anti-collusion rules, but the violation is perhaps not as clear. There have been two cases in which the Justice Department has prosecuted bidders for violating the anti-collusion rule. One violation was based upon bid signalling while the other was based on direct communication between two bidders.

In the course of the DEF block PCS auction, High Plains Wireless accused a competitor, Mercury PCS, of using trailing digits to try to signal a warning for High Plains to cease bidding on a particular license. Mercury's main initial defence was that they believed that this was a common practice and therefore did not violate the FCC's anti-collusion rules. After an extensive investigation by the FCC and the Justice Department, this case was resolved when Mercury agreed to settle with a consent decree. In general terms, the company had to agree to little more than that they would agree not to collude in a similar manner in future auctions. Unfortunately, this was not a strong message sent to future bidders about the consequences of such behaviour. The reasons the Justice Department settled the

[3] $3.9 million compared to $3.2 and 3.0 million.

case in this manner were never made public, but it appears to be due to the perceived difficulties in convincing a jury that such signalling was collusive in nature and to the likely low level of damage of the incident.

Parallel to the Department of Justice investigation, High Plains had filed a lawsuit against the FCC protesting the award of licenses to Mercury. This lawsuit lead to a very long series of appeals with the most recent decision (January 11, 2002) coming from the US District of Columbia Circuit, Court of Appeals. High Plains was challenging the award on several grounds, all of which the court dismissed. On the specific charge that the award of licenses should be rescinded due to Mercury's violation of the anti-collusion rule, the court ruled that since the language of the rule had not specifically mentioned and forbidden this sort of bid signalling and retaliatory bidding in general, the FCC was not violating its authority to award the licenses to Mercury.

The second case occurred in the same auction and involved one bidder, US West, actually calling another bidder on the telephone, Western PCS, during the auction. The purported intent of the call was to "apologize" for a mistakenly placed bid on a license Western had the high bid on. Even if the intent was benign, this still constituted a direct breach of the auction anti-collusion rules. The communication was reported by Western PCS and the outcome was a fine in the amount of $1.2 million levied against US West, although they were able to reduce the fine down to $800,000 through subsequent negotiations. Western PCS also ended up paying a smaller fine due to the fact that they waited until well after the auction concluded to report the incident.

Beyond this standard rule that simply prohibits collusion, when the FCC's auction format was originally designed, they had not incorporated many design features to attempt to mitigate the problem. Since those first auctions, many rule changes have been proposed but only two have been implemented while a third is in the final stages of implementation. As a means of eliminating the possibility of bid signalling, the FCC has changed over to a system of *increment bidding.* In this system, instead of bidders typing in the specific amounts they wish to bid, they can simply choose to bid some multiple of the minimum increment over the previous standing high bid. If the standing high bid is $5000 and the minimum increment is $500, then bidders are allowed to bid by choosing an integer x in the range 1-9 and their new bid will be $5000+x*$500. This makes it impossible for someone to use trailing digits to signal which license the bidder wants someone else to stop bidding on.

Similarly, the FCC has limited the number of withdrawals bidders can place. In the PCS auctions, DEF block in particular, bidders were submitting a large number of withdrawals throughout the auction as signalling devices. Not long after this auction, bidders were reduced to only being able to submit withdrawals in only two rounds during the auction. That is, any bidder can choose two rounds in the auction for themselves and during those two rounds they can submit withdrawals. This makes withdrawals relatively more expensive to use as signalling devices and has virtually eliminated their use in such strategies.

3.3 ALTERNATIVE RULES THAT HAVE BEEN CONSIDERED BY THE FCC

The FCC has considered a number of other possible rule changes to further reduce the possibility of collusion in their auctions. Most have been rejected. It is useful though to go through some of the more common proposals and explain why they have been rejected here. It is important to keep in mind that just because these proposals were rejected for the FCC's case does not mean that they are necessarily bad ideas, just that in the FCC's determination they do not fit in this context.

Perhaps the most common rule change suggested is to move to anonymous bidding and/or reduce the amount of information published during each round of the auction. The standard approach in the FCC's auctions right now is to publish every bid submitted at the end of every round with the identity of the bidder. Some propose just publishing the highest bid with the associated bidder while others go so far as to suggest that the high bid only should be published without reference to the bidder that submitted it. The idea behind this is that if the identity of a bidder cannot be ascertained then this weakens the enforceability of the collusive equilibria described earlier. They rely on one bidder being able to see that the other deviated from the collusive agreement. With anonymous bidding, this is difficult to verify so bidders would be more tempted to cheat from any collusive agreements. It also makes sending signals about coordinating which licenses someone does or does not want others to bid on virtually impossible.

There are two main reasons this proposal has not been adopted by the FCC. One is something of a philosophical commitment to making the auctions as transparent as possible. This is thought to increase the trust among the bidders that the FCC is conducting the auction in a fair and legitimate manner. If bidders believe the auctioneer to be untrustworthy, this can adversely affect the outcome. Full publication of all information represents an attempt to foster that trust. A related point is that making the information public also minimizes any possibility of corruption on the part of the auctioneer. When the information is free and easily available, there is little reason for a bidder to try to bribe an employee to obtain it. If information becomes scarce, then its value rises.

In many of the FCC's auctions there is a solid economic reason for publishing the information as well. For many of the services, the value a bidder has for a license may legitimately depend on what other bidders are bidding on the adjacent licenses. This might be for reasons of technological compatibility such as the ability to settle upon roaming agreements later on. Publishing bidder identities can then be very important to obtaining an efficient outcome from the auction. The FCC believes that the efficiency enhancing aspects of the information outweigh its potential to be used for collusive purposes. Further, the general hypothesis of the nature of values the bidders possess for the licenses is that they are affiliated. This means that if bidder 1 has a high value for a license, then it is more likely that bidder 2 also has a high value for the license rather than a low value. A well-known result from standard single unit auction theory is that in such situations, publishing information increases auction revenue. For other situations in which such value affiliation considerations are unimportant, these economic reasons for

publishing information will not be applicable and may indicate that anonymous bidding is an applicable rule to counter possible collusion.

Another proposal that has been made on many occasions and in many different forms is to end the auction with a final sealed bid round. The idea behind this is that if there is a definitive final round then these collusive equilibria are destroyed. Each bidder would be able to deviate from a collusive agreement without the chance that their partners could punish them for it.

While theoretically this sounds like an easy fix, there are a very large number of problems with it for this case. An immediate problem comes from the incentive this gives bidders to engage in parking behaviour. Parking refers to a bidder bidding on licenses they have little or no interest in to draw attention away from the licenses they are interested in. Such behaviour already occurs in the FCC's auctions but the uncertain end point gives the bidders an increasing incentive to move away from this strategy as the auction moves on. If they know there is a defined endpoint, there is no reason to stop parking until then. If that occurs, then all of the information revelation that is the reason behind the ascending format is eliminated as no useful information is revealed until the sealed bid round and by then it can not be taken advantage of. A final sealed bid round then is quite likely to have a significantly negative effect on efficiency and perhaps revenue although it would break-up the collusive equilibria.

In Ausubel and Milgrom (2001) there is a recently proposed alternative version of this idea, which is the use of proxy bidding. Under their proposal, instead of submitting bids, the bidders would send in a value function to the FCC and bidding would be done by a proxy bidding agent that would place bids by finding the collection of items that would maximize the bidders surplus given the current prices and the value function sent in by the bidders. In their paper they prove that if bidders were to bid in this manner themselves the result would be an almost efficient outcome. This design is an attempt to force such behaviour.

Unfortunately, this proposal runs into a host of implementation problems. One of the most significant is constructing an interface through which bidders could send in such a value function. Since values in these auctions are very complex and interdependent constructs, for this to have a chance at reaching an efficient outcome, such interdependencies must be accounted for in the system. More problematic still, bidders would have to actually be able to quantify such tradeoffs and be able to figure out how to program them into the system. These are all very difficult tasks and there is little reason to suspect the problems could be overcome for complex auctions. Unless these problems are solved, this approach again is likely to lead to inefficient outcomes and to bidders being faced with very serious exposure problems. In much simpler scenarios such as when values are not affiliated across bidders and interdependent across items as well as when the number of items is small, such an approach might work.[4] In the FCC's case and other complex environments, this should not be expected to be a workable solution.

The final standard proposal that attempts to deal with collusive behaviour is to adopt a combinatorial auction design. In such a design, bidders would be able to

[4] For example, this is the basic methodology used by e-Bay in single unit auctions and there is no reason to believe this causes any efficiency or revenue problems for such auctions.

send in a single bid that would be an "all or nothing" bid on a group or package of items. This is in contrast to the FCC's current system in which bidders must send in one bid per item and they could well end up getting only a few out of the group the package they are interested in. The primary motivation behind switching to such a design is discussed in Report 6 in this bundle of the general FCC case study, which is to reduce the exposure problem bidders face. A side benefit is that it can also reduce the incentive to demand reduce.

Imagine a situation in which there are two bidders bidding on two items for which their values are those in the following table:

	Bidder 1	Bidder 2
Item A	100	80
Item B	100	80
Both	200	80

These values indicate that bidder 2 wants either A or B but not both while bidder 1 wants both. The equilibrium of a standard ascending auction would involve bidder 2 always being willing to place a bid on either A or B so long as the price were less than 80. This would result in bidder 1 winning both items for a price of 80 each, resulting in a total cost of 160 and surplus of 40. If, however, he were to reduce his demand to only a single item he could end up with a much large surplus, 99, with both bidders just bidding a price of one on alternate items. This is essentially the same example discussed earlier.

In a combinatorial auction, this demand reduction strategy is no longer an equilibrium. Winner determination in a combinatorial auction is performed by finding the set of mutually exclusive bids that yield the highest revenue. For example, if bidder 1 submitted a package bid on A and B of 20, in order for bidder 2 to submit a bid for A that would win, it would have to be at least 21. What this means is that in order for bidder 1 to win both items, he only has to submit a package bid for both that is higher than bidder 2 would be willing to bid for either item individually.

Since the highest bid 2 is willing to submit for either A or B individually is 80, the equilibrium in this case would involve bidder 1 placing a package bid of 80+epsilon on both items. Bidder 2 would not be willing to bid more and bidder 1 would end up with a surplus of 120. Since bidder 1's surplus of 120 is greater in this outcome than under the collusive outcome, the collusive outcome will no longer be an equilibrium of this game. This shows an example of a general phenomenon which is that the cases in which demand reduction equilibria exist are significantly fewer in combinatorial auctions. We should note that this does lead to less revenue than the competitive equilibrium in the non-combinatorial design but it seems unlikely that the competitive outcome is the one that would emerge in the non-combinatorial case.

We can note further that if bidder 2 possessed additive values for both items, that is, if his value for the package were 160 instead of 80, there would now be a demand reduction equilibrium. So combinatorial bidding does have some advantages in removing certain types of collusive equilibria but it will not remove all of them and may make those easier for the bidders to settle on. As a collusion

fighting device, a combinatorial mechanism alone is insufficient. It does have enough other benefits that in certain circumstances it is still desirable. The FCC is currently in the process of attempting to adopt a combinatorial mechanism, although as mentioned elsewhere, it seems unlikely that their current proposed design is the best one possible or even an effective one.

4 CONCLUSION

In this report, we have seen that all forms of collusive strategies that have been attempted in the FCC auctions (bid signaling with trailing digits, strategic withdrawals, retaliatory bidding) shared the same structure: they all have involved attempts to settle upon demand reduction equilibria supported by punishment strategies. Most of the attempts by the FCC to limit collusion were based on eliminating the collusive strategies. We have also seen that the performance of all of the attempts to limit collusion can be enhanced by the incorporation of more competitors into the auction and/or by measures that level the playing field between the bidders. Another possibility is changing the auction type. A collusive agreement is for example much easier to sustain in open auction formats than in sealed-bid auction formats. The reason is that in a sealed-bid auction format bidders have neither the opportunity to signal, nor the ability to retaliate against a bidder who fails to cooperate.

REFERENCES

Ausubel, L. and Milgrom, P. (2001) *Ascending Auctions with Package Bidding*, Working Paper, Stanford University.

Brusco, S. and Lopomo, G. (1999) *Collusion via Signalling in Open Ascending Auctions with Multiple Objects and Complementarities*, Working Paper, Stern School of Business, New York University.

Cramton, P. (2000) *Lessons from the United States Spectrum Auctions*, Prepared Testimony before the United States Senate Budget Committee.

Cramton, P. and Schwartz, J. (1999) *Collusive Bidding in the FCC Spectrum Auctions*, Working Paper, University of Maryland.

Cramton, P. and Schwartz, J. (2000) Collusive Bidding: Lessons from the FCC Spectrum Auctions, *Journal of Regulatory Economics*, 17, 229-252.

Engelbrecht-Wiggans, R. and Kahn, C. M. (1999) *Low Revenue Equilibria in Simultaneous Auctions*, Working Paper, University of Illinois.

Graham, D. A. and Marshall, R. C. (1987) Collusive Bidder Behavior at Single-Object Second-Price and English Auctions, *Journal of Political Economy*, 95, 1217-1239.

Marshall, R. C. and Meurer, M. J. (2001) The Economics of Bidder Collusion, in *Game Theory and Business Applications*, Kalyan Chatterjee (ed.), Kluwer Academic Publishers.

Robinson, M. S. (1985) Collusion and the Choice of Auction, *Rand Journal of Economics*, 16, 141-145.

4 INTERACTION BETWEEN ALLOCATION MECHANISMS AND FUTURE MARKET OUTCOMES

Maarten Janssen and Benny Moldovanu

TABLE OF CONTENTS

1 INTRODUCTION 51

2 AUCTIONS AND FUTURE INTERACTION: THE SELLERS' OBJECTIVES 52

3 AUCTIONS AND FUTURE INTERACTION: BUYERS' STRATEGIES 54

4 BUYERS' STRATEGIES AND SELLERS' OBJECTIVES 55

5 MAIN LESSONS FOR AUCTION DESIGN 58

REFERENCES

1 INTRODUCTION

In many traditional auctions, the seller or auctioneer is only interested in the price she gets for the object that is to be auctioned off. The sole objective is to raise revenue. In many procurement situations, however, the government as the seller of some right is also interested in what the winner of the auction will do with the right that is obtained. That is, revenue is no longer the sole objective of the auction, but the seller may also be interested in *who* will get the right and *how* the right will be used. When a market arises after an auction is held, as is the case with auctioning off mobile telephony frequencies, radio frequencies or the right to exploit gas stations along highways, the seller (government) may also be interested in obtaining a competitive market after the auction and having the most efficient parties winning the auction. 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 question that arises is how these multiple objectives should be ranked?

For the bidders there are also fundamental differences between participating in a traditional auction or participating in an auction which, in a sense, gives the winner(s) an entry ticket to the market that arises afterwards. In a traditional auction (and in traditional auction theory) bidders come to the auction with a fixed valuation and, roughly speaking, bid up to the moment where the auction price gets larger than the individual valuation. When there is a market after the auction, bidders may care about who (else) wins the auction so that their valuation does not depend only on the object itself and is, therefore, not exogeneously given. This implies that some of the fundamental results of traditional auction theory may fail to hold and that the reasons for favouring auctions over beauty contests are not so clear-cut anymore. Below we will argue why this is so and what are the important consequences.

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).[1]

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 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.

The report is organised as follows. In Section 2 we look more closely at the multiple objectives that a seller may aim at in the type of auctions we have in mind. In Section 3 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).[2] 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. Sections 3 and 4 illustrate some of the main new strategic effects via several examples. In Section 5, we summarise the resulting main lessons for the design of allocation procedures that influence future market outcomes.

2 AUCTIONS AND FUTURE INTERACTION: THE SELLERS' OBJECTIVES

In traditional auctions sellers are mainly (or only) interested in the revenue raised by the auction. A government, however, may in addition to be interested in other objectives such as (*i*) allocating a scarce item (such as the limited number of frequencies available for UMTS-services) in an efficient manner and (*ii*) creating sufficient competition on the market which appears after the auction. It is clear why the government may want to aim at reaching these objectives: economic efficiency is generally enhanced by more competitive markets in which the most efficient firms are operating. In traditional auctions, there is no conflict between these different objectives. First of all, the criterion of a competitive market is not relevant as there is no market after the auction. Secondly, allocating an item in an efficient manner requires that the firm with the lowest cost (or best business plan)

---

[1] 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.

[2] 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).

wins the auction. Competing behaviour of bidders in an auction generally leads to the highest possible revenue and at an efficient allocation (as the firm with the lowest cost will be the firm with the highest valuation).

When there is a market after the auction, however, this whole picture starts to change. For example, it may well be possible to raise a very high revenue by creating a privatised monopoly (since monopolistic profits will tend to be higher than the sum of profits achieved in an oligopoly), but such an outcome seems nevertheless undesirable if it means that, due to the absence of competition, consumers will have to pay high prices in the future. That is, the objective of the highest possible revenue is at odds with the objective of achieving a competitive market. Unfortunately, it is true more generally that the different objectives that the government may have are inconsistent with each other: Below we will argue that standard relations between general goals such as "market efficiency" (which includes the 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 more complex and non-transparent. Failing to take into account the effect of future interaction may have harsh consequences for governments and/or consumers.

So, if the number of licences to operate can be chosen by the government and the degree of competition in the market after the auction can be chosen, the government may very well face a trade-off between market efficiency and revenue maximisation. This trade-off may become more severe if in addition there are asymmetries between parties: incumbents and entrants. To see this, consider the questions whether a level playing field should be created, whether bidding handicaps should be introduced, and whether licences should be reserved for newcomers. 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 whomever values them the most", i.e., 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 there is for the remaining licenses and how fierce these same firms would compete for the licenses if no license were reserved.[3] Finally, in terms of market efficiency after the auction, reserving a license for an entrant usually increases market competition as the newcomer has to fight for obtaining market share. This increase in competitiveness of the market has to be weighed against the potential loss of possibly duplicating fixed costs that some of the incumbents have made already.

Given that the three goals may diverge or even be inconsistent with each other, it is important to ask the question whether from an economic point of view these objectives can be ranked. When considering welfare implications of policy proposal economists work either with the notion of Pareto efficiency or with the notion of total surplus. A allocation is Pareto efficient if there does not exist another allocation in which some agents are better off, while nobody is worse off.

[3] Important questions in this context are whether newcomers are expected to participate in the auction if no license is reserved for them and the ratio of licences to be auctioned off and the number of incumbent parties.

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. Using the notion of total surplus, some interesting observations can be made, however. First, the auction's revenue should not be a (very) important objective for the seller, as total surplus is independent of the revenue raised through an auction: what the seller gains is what the buyers pay.[4] Value maximisation and market efficiency are, however, important.

3 AUCTIONS AND FUTURE INTERACTION: BUYERS' STRATEGIES

We often think about traditional auctions as being populated by demanders of goods that derive utility solely from the bundle they themselves consume. In particular, the agents do not care about the allocation of goods among the rest of society. As we explained above, such traditional thinking cannot accurately encompass situations arising in instances where the 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. In other parts of Economics, it is common to call such effects "externalities", and to differentiate among "positive" and "negative" externalities. Positive externalities are present when the payoff of one agent goes up when some other agents consumes an item or bundle, while negative externalities are present when the payoff goes down. 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.

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

[4] This argument can be somewhat qualified when taking into account the possibility that the government can decrease tax rates as auction revenues can substitute for tax revenues. Taxes are usually collected in such a way that they distort the economic process; auction revenues are a kind of lump-sum tax, which is non-distortionary. This argument pre-supposes, however, that the government is in need of a fixed amount of money and that tax substitution does take place.

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 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.

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.

4 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. By doing so, we want to emphasise again that revenue maximisation, value maximisation and market efficiency can be inconsistent with each other. To make the points in a clear way, we adhere to some simple examples.

The first example in this Section shows that value maximisation (for buyers) and efficiency (which takes into account also the seller's payoff) may diverge when there are externalities. In particular, this may call for handicapping 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 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 commits to fire less workers). This yields a payoff of 12 for the government.

To see that value maximisation and "market efficiency" may diverge, follow the following straightforward calculations. 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 – this includes the seller, and regards revenue as zero-sum transfer.[5] 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.

It is possible in this example to achieve "market efficiency" through an asymmetric 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.[6]

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. This results stems from the fact that buyers' and sellers' interests may diverge after the auction. Asymmetric auctions where some bidders are handicapped and others are favoured may produce an efficient outcome of the auction, but for this to happen the seller must have a good idea about the size of the handicaps to be introduced (cf., the article on asymmetries by Maasland *et al.*).

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 2, we already have argued that this may be so by appealing to the issue of how many licences to auction: auctioning a monopoly may be revenue maximising, but may not be efficient. 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 externalities 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

---

5 Compare the discussion in Section 2.

6 For a discussion on asymmetric auctions, compare the article by Maasland et al. in the bundle.

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 which can operate also 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 an 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.[7] This yields total revenue of 38. Note that A and B are willing to pay each 19 in order to avoid a sale to C (which would cause losses of 20 each).

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 disutility 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).

Such a scheme was in fact implicit in the German UMTS design. In that design the number of licences to be awarded was endogenous to the auction itself, with 4 as a lower limit and 6 as an upper limit. The above trade-off between an efficient market (which is more easily established with more licensed firms including newcomers) and a high revenue (which is promoted by having bidders trying to restrict the number of winning bidders and thereby restricting competition in the after-market) was also present in that auction. The difference of course is that, in the example, the question is whether to auction one license (the upper limit) or not to auction at all (the lower limit of 0) whereas the lower and upper limits were different in the German case. In fact the winning firms got trapped and paid a lot without reducing the number of licenses.[8]

The last example will show that in auctions where each buyer can buy more than one unit there is no correlation even among value-maximisation for buyers and revenue maximisation (as is usually the case in one-object auctions without externalities. For this illustration we do not even 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

---

[7] The seller could get this by using the auction as a threat: "if I will auction the object, everyone knows that C will get it, so A and B how much are you willing to pay me by not auctioning the object".

[8] 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, and Ukraine agreed to destroy its nuclear arsenal (thus preventing proliferation) after it got hefty payments from the US, Russia and the EU.

follows: A values object p at 10 and object r at 7, while B values object p at 8, and object r 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 r	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 r 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.

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 a 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.

5 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. Taking these effects into account, we have shown above that 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' behaviour will be driven by aspects other than the intrinsic value of the auctioned objects. 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 be nonsense (see Example 2) if the auction's goal is economic efficiency - a criterion that takes into account the preferences of all economic actors (such as government, various consumer groups, other potential users, etc...). In an auction, firms take only their own interests into account, and it is only possible to incorporate the preferences of other groups at the design stage. In particular, allowing too much flexibility to bidders (in order to facilitate value maximisation) may run contrary to the designer's true goal, especially if he has objectives in addition to revenue maximisation.

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 will be possible to extract more revenue; 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 efficiency 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 Example 4 and Jehiel and Moldovanu, 2001b). 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 Newbery, 1982). When new scarce goods are allocated, these firms 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, a proposal for the auction of 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 allows more flexibility and it avoids 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 strategic motives are irrelevant in this example (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 (in addition to the standard motive of keeping prices down). On one hand, this collusion motive is partly alleviated if there is no obvious method of sharing the cost of pre-emption (without illegal side payments). One the other hand, perfectly legal collusion-like behaviour 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 (see also other reports on the FCC case by Salmon and on asymmetries by Maasland et al.). 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.

At the end of this report, 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 and auctions in this context. 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.
- 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 sale of weapon systems have clear adverse effects on countries or groups that have a serious conflict with the acquirer.

REFERENCES

Caillaud, B. and P. Jehiel (1998) Collusion in auctions with externalities, *Rand Journal of Economics* 29, 680-702.

Deutsche Bank (2000) *UMTS, The Third Generation Game*, Deutsche Bank Equity Research.

Gilbert, R., and D. Newbery (1982) Preemptive Patenting and the Persistence of Monopoly, *American Economic Review* 72, 514-526.

Jehiel, P., and B. Moldovanu (1996) Strategic Non-Participation, *RAND Journal of Economics* 27(1), 84-98

Jehiel, P., and B. Moldovanu (1999) Resale Markets and the Assignment of Property Rights, *Review of Economic Studies* 66, 971-991.

Jehiel, P., and B. Moldovanu (2000a) *License Auctions and Market Structure*, discussion paper, Mannheim University and CEPR.

Jehiel, P., and B. Moldovanu (2000b) Auctions with Downstream Interaction among Buyers, *RAND Journal of Economics* 31(4) 768-791.

Jehiel, P., and B. Moldovanu (2001a) Efficient Design with Interdependent Valuations, *Econometrica* 69 (5), 1237-1259.

Jehiel, P., and B. Moldovanu,. (2001b) A Note on Efficiency and Revenue Maximisation in Multi-Object Auctions, *Economic Bulletin* 3(2), 2-5

Jehiel, P., B. Moldovanu, and E. Stacchetti (1996) How (not) to Sell Nuclear Weapons, American Economic Review 86, 814-829.

Jehiel, P., B. Moldovanu and E. Stacchetti (1999) Multidimensional Mechanism Design for Auctions with Externalities, Journal of Economic Theory 85, 258-293.

Maskin, E. (1992) Auctions and Privatizations, in H. Siebert (ed), Privatization, Kiel 1992

5 AUCTIONS TO GAS TRANSMISSION ACCESS: THE BRITISH EXPERIENCE

Tanga McDaniel and Karsten Neuhoff

TABLE OF CONTENTS

1 INTRODUCTION 65

2 PRIVATISATION AND LIBERALIZATION 66

3 EVOLUTION OF ACCESS RIGHTS REGIME 70

4 CURRENT AUCTION DESIGN 75

5 EVALUATION 80

6 SUMMARY 87

REFERENCES

1 INTRODUCTION

Within Great Britain, the movement towards auctions of entry capacity to the National Transmission System (NTS) has evolved along with changes in the national gas industry and accompanying regulation. In this report we will use the natural experiment offered by Great Britain to test the hypothesis that: auctioning of well defined access rights is the most efficient way to deal with significant transmission constraints in the presence of competition in production and supply whilst also allowing for non-discriminatory access and entry.[1]

Auctioning transmission access is only appropriate if the network constraints are significant, such that the transaction costs incurred by all parties for setting up a mechanism of property rights are below the costs incurred for constraint resolution by capacity expansion or constraint resolution by spot market interventions of the transmission operator.

Well-defined property rights are required to deal with significant transmission constraints. Property rights to transmission access when there is monopoly ownership of the network can be allocated in one of the following ways: (i) by leaving the access rights with the existing monopolist; (ii) by allowing existing shippers to continue their transmissions at traditional volumes (grandfathering); (iii) by auctioning the rights. The UK experience from 1982 to 1990 shows that existing monopolists do not want to create competition and are therefore reluctant to grant access to their network. Grandfathering of rights discriminates against entrants and thereby reduces competitive pressure. In contrast, when there are well-defined property rights, the transmission operator issues transmission access corresponding to the available transmission capacity in the system; appropriately designed auctions accompanied by secondary trading markets can apportion these property rights efficiently.

Whereas up to now the time-horizon of auctions was only half a year, the regulator Ofgem suggests to introduce long-term auctions and sell 80% of entry rights five years ahead of time (Ofgem 2001/2). The expectation of Ofgem is that the transmission operator Transco can use information provided by such an auction to guide its capacity expansion decisions. In a separate study we argue, that in the presence of market power of shippers, long-term auctions will provide distorted signals, which are likely to result in under-investment (McDaniel and Neuhoff, 2001). However, if the link between auction results and investment is altered after closure of the auction to correct for the distortion, then shippers will incorporate the information in their future bidding strategy requiring even stronger future corrections.

In section two we provide a brief introduction to privatisation and liberalisation of the gas industry in Great Britain. In section three we analyse the steps that led towards the current system. In section four we describe the current transmission access design and changes to the design that have occurred since the first auctions

[1] Because of the nature of these auctions (sequential, concurrent, multi-unit demands, common values) the auction itself is unlikely to provide a perfectly efficient allocation of access rights. Thus secondary trading institutions are essential as is a well-functioning spot market.

of entry rights in September 1999. Finally, in section five we conclude with a brief evaluation of the auctions.

In this report we do not separately address the question of gas storage and auctions for storage as we believe that the additional complexity does not alter the basic economic arguments that we address here.

2 PRIVATISATION AND LIBERALISATION

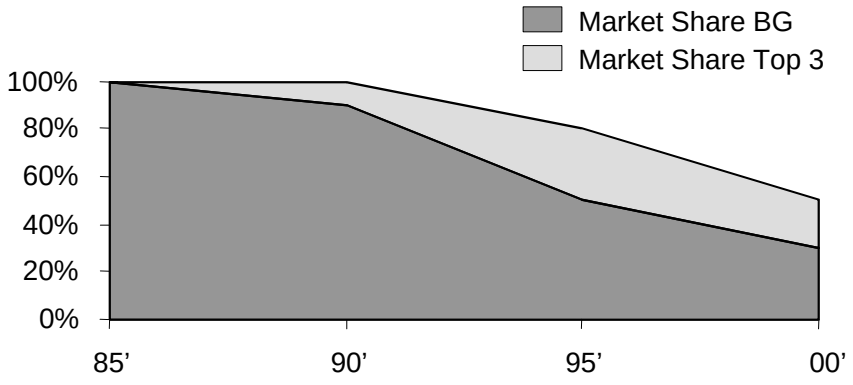
Background

Feasible transmission access designs depend on the existing industry structure and concentration. Therefore we start with a report of the industry development. We then discuss the transmission network and describe the evolution of the transmission access regime and the currently applied auction mechanism.

The British gas industry was nationalised in 1949 with the creation of 12 area supply boards which then were united to become the British Gas Corporation in 1972. In the nationalised framework an integrated high pressure network was built to directly deliver natural gas from the North Sea instead of coal and oil based town gas and liquefied gas delivery.

The Oil and Gas Act of 1982 was the first step towards liberalisation and allowed for access to the transmission network for competing gas suppliers to supply industrial customers with demand above 25,000 therms. The Gas Act of 1986 transformed British Gas Corporation into British Gas (BG) and in the same year shares were offered for sale. Figure 1 shows that BG had at that time 100% of the supply market share, which it retained throughout the eighties.

Figure 1: Competition in Gas Supply Sector, GB [source: Oxera 2000]



Following the 1986 Gas Act large industrial customers were legally allowed to contract with independent shippers, and BG was required to provide transmission facilities. However only after an inquiry by the Monopolies and Merger Commission (MMC) in 1988 and 1993 and several interventions of the Office of Fair Trading would competition occur. BG used its monopoly position to discriminate against independent shippers by applying non-transparent, high

transmission tariffs for the use of the transmission system and for the use of back up gas. Moreover, BG discriminated against shippers other than BG in the provision of system reinforcements and connection services.

In 1988 the MMC forced BG to publish information about tariffs it charged to customers and not to contract more than 90% of any new gas field. The Office of Fair Trading ruled in 1991 that BG's gas market share should not exceed 40%; therefore, the monopoly tariff threshold was lowered in 1992 from 25,000 therms to 2,500 therms, allowing small business to freely contract.

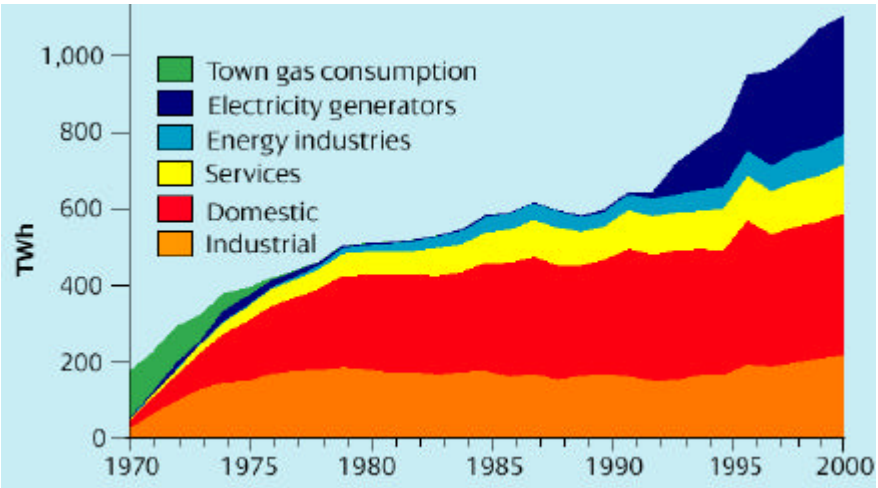
Traditionally, transportation and storage formed part of BG's integrated gas supply business. The 1993 MMC report concluded that the lack of effective neutrality of the transportation and storage business "may be expected to inhibit choice, restrict innovation, and lead to higher levels of gas prices to users" (paragraph 2.104). Based on the MMC recommendation the Secretary of State required BG to establish a separate business unit for transportation and storage with full physical separation of people, property and computer systems and information barriers.[2] Transco was established as a business unit of BG in 1994 and has been subject to a separate (RPI-X) price control since 1 October 1994.

The Gas Act of 1996 laid down the framework to open the market even for small consumers, with full domestic liberalisation to be implemented by May 1998. However, already during the 1997 MMC inquiry it became apparent that gas sales and trading, services and retail business had to be de-merged. All companies remained in the same group, Centrica plc, and separation of ownership was only achieved in October 2000, when Transco became part of Lattice Group plc. By 2000 25% of domestic and 72% of industrial customers had switched gas suppliers (Oxera 2000).

The major contribution towards a lower level of concentration in supply was the expansion of gas demand in the UK of 85% between 1990 and 2000 (Figure 2). 60% of demand growth was due to new combined cycle gas turbines, which were previously prohibited under EU energy law (UK Energy in Brief, July 2001, DTI).

[2] To ensure that trading business would not have access to information provided by its competitors to the transportation business. (MMC 1997).

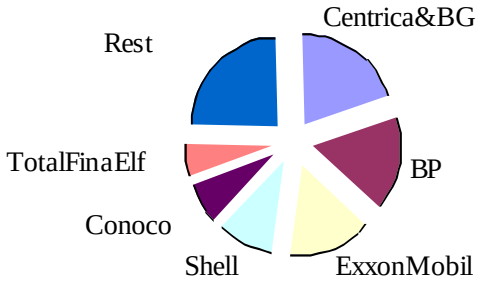
Figure 2: UK gas consumption.



Source: UK Energy in Brief, July 2001, DTI and national statistics.

The concentration of upstream gas drilling and transport to landing pipelines was and is rather low. Oxera 2000 suggested that in 1985 British Gas produced 22% of total UK gas production, a share that has dropped insignificantly to 21% for the combined output of BG and Centrica (See Figure 3).

Figure 3: Share of UK gas production



Source: Leading UK Gas Producers, Platts (1998).

A consultation process started by the regulator Ofgem in 2001 addressed questions raised by downstream suppliers, specifically, whether up-stream producers can and do exercise market power. Transmission constraints imply that producers can have regional market power. One of the reasons why significant constraint costs are incurred only at the St. Fergus terminal could be that competition among producers is stronger at this terminal and therefore producers cannot reduce output in order to retain transmission rents as they might be able to do at other terminals.

The gas pipeline network

The above description shows the difficulties of introducing competition if a vertically integrated monopolist is in private ownership. However there is now an independent owner and operator of the transmission network, and competition in gas production gas supply. How did the access regime to the transmission network evolve with that development?

Figure 4 illustrates the main gas pipeline network in Northern Europe. Most underwater pipelines start from gas fields and transport gas of different consistencies that has to be processed at the beach before it can be inserted to the National Transmission Network. The UK is responsible for 55% percent of North Sea gas production that can be roughly classified as wet and dry gas fields. Wet-gas is produced in the Northern fields that are interconnected to St. Fergus, and can be considered a by-product of crude oil production. Therefore producers do not appreciate adjusting the output to match demand. The other fields are dry-gas fields, which only produce natural gas, and can therefore be adjusted better to accommodate seasonal variations in gas demand.

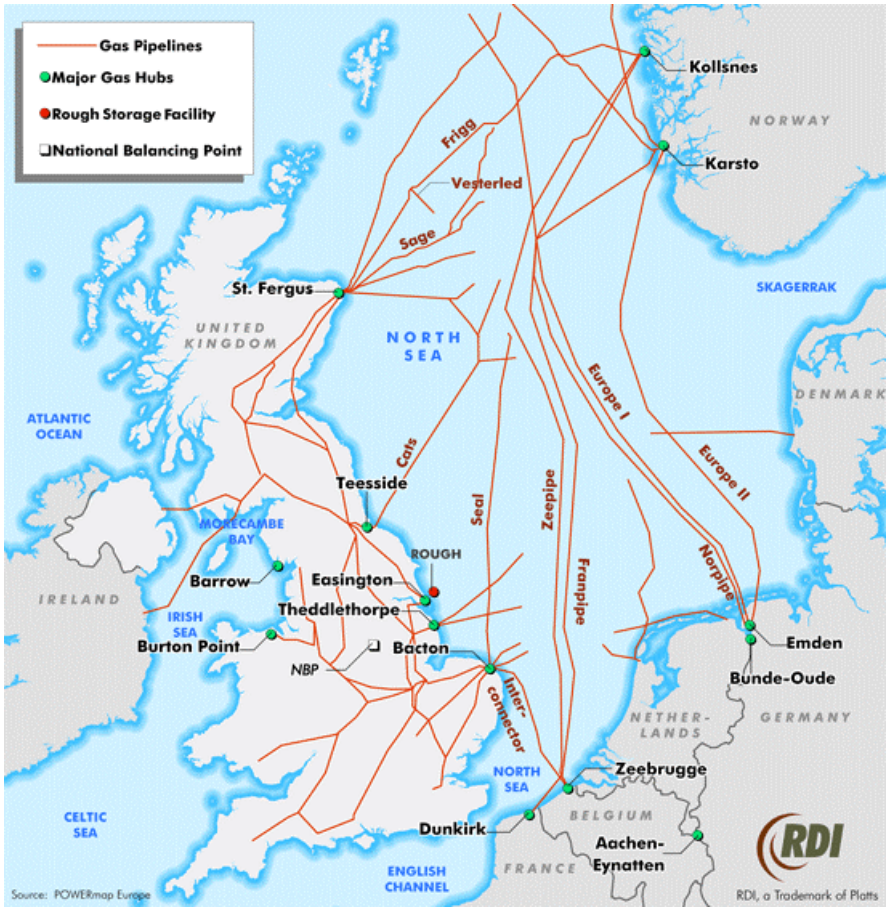
The Frigg pipeline was initially constructed to allow gas from the UK-Norwegian Frigg field to be transported to the UK. The Frigg Treaty of 1997 allowed the usage of the pipeline to import gas into the UK from additional Norwegian gas fields by interconnecting it with other pipelines and using it for new gas exploration.

The UK-Belgium interconnector, opened in October 1998, was initially planned to allow for exports of UK gas to the continent, but is also used on so-called reverse flows for imports into the UK during winter peak demand. Upgrades of compression facilities are planned for 2002 to increase the reverse flow capacity. Two further interconnectors are used for exports to Ireland. Given the level of abstraction of the current study, we simply classify them as additional demand on the National Transmission System (NTS).

The NTS in the UK connects the gas landing facilities and storage facilities to gas customers. Demand for transmission services is volatile over the year and capacity is capital intensive. Therefore it would be inefficient to provide for a network that can satisfy all transmission requests. Over the last years landing gas at the St. Fergus terminal in Scotland was most constrained, with currently binding constraints in Scotland at Aberdeen, Moffat & Woller and Kirriemiur.[3]

[3] MSEC Network Analysis, Rosemary Jones, System Operation, Transco.

Figure 4: Gas Pipelines Northern Europe



Source: copyright Platts (2001).

3 EVOLUTION OF ACCESS RIGHTS REGIME

Three general methods are available to resolve transmission constraints on the network: (i) by inserting gas in the NTS at a different landing usually from a different gas field; (ii) using storage facilities in import constrained areas to provide gas during high demand days; (iii) offering interruptible contracts to industrial consumers and electricity generators. Interruptible contracts allow the transmission operator Transco to stop supplying gas for up to 45 days per year if system demand reaches 85% of peak demand and transmission constraints prevent delivery. In exchange industrial consumers pay lower capacity charges for access to the transmission network.

1986-1996

A vertically integrated monopolist with integrated operations controlling a complex transmission network cannot be assumed to provide correct information about binding transmission constraints. Therefore the initial regime did not address transmission constraints during operation. Only if industrial customers required an increase in the capacity at which they would acquire gas, then BG

could claim that insufficient capacity was available to ship gas towards the region or to the plant. "[BG] acknowledged, for example, that problems had occurred in some cases in estimating the capacity available for its competitors when they have sought to supply customers previously supplied by BG." (MMC, 1993) Subsequently it was decided that shippers could only be charged for costs of capacity expansion of the direct interconnection of the plant (shallow connection charges), but not for system wide reinforcements (deep connection charges).

During this period, shippers were only required to match gas consumption of their customers with the gas shippers inserted at the beach terminals on a monthly basis. BG would balance the system on a daily basis and resolve transmission constraints using the above described three methods of storage, managing the volume and terminals at which BG inserted gas in the network and via the interruptible contracts.

Leaving British Gas with the sole responsibility for system balancing and resolution of transmission constraints was feasible at a time when independent shippers only supplied large industrial customers, which usually have low variance of energy demand during the year. As the monopoly threshold is lowered customers with more seasonally varying demand are included, which require more balancing and account for more constraints on system capacity. This aspect goes hand in hand with the big market share of British gas. Only because British gas had a market share of more than 50% could it provide for balancing and transmission constraint resolution by rescheduling its beach deliveries. At the same time it would have been difficult at that time to introduce the later described market based approach to system balancing, since BG as a dominant player could have distorted the prices and created inefficiencies.

The former access regime was presumably appropriate given the existing industry structure. However, the combination of industry structure and access regime was seen as an intermediary stage. The monopolies and mergers commission concludes in 1993. "In the longer term, however, we would regard the ability of competitors to access the transportation network and other facilities such as storage on non-discriminatory terms (including, for example, the balancing regime adopted by BG to ensure adequate availability of gas in the system to meet demands) as essential if competition is to be sustained."

New Network Code, March 1996

The opening of the domestic market (with volatile demand profiles); falling market share and therefore balancing capabilities of BG; increased pressure for non-discriminatory pricing of transmission services and the request of independent shippers to profit from provision of balancing services resulted in the New Network Code in 1996 (the Code). The Code required shippers to balance gas inserted at terminals and storage facilities with the gas delivered to their contracted customers. Transco would balance the system if deviations occurred and subsequently charge shippers the resulting costs.

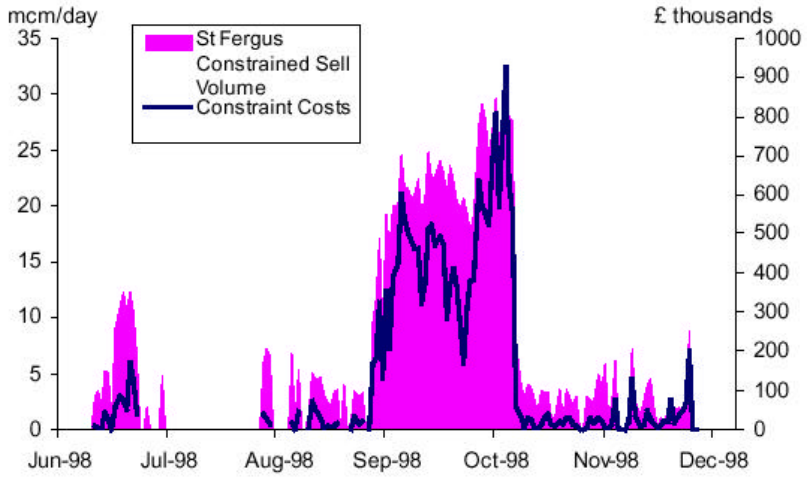
The Code contained a twofold approach towards resolution of transmission constraints: Transco continued to offer interruptible contracts to large customers at a discounted connection fee; additionally, a new market mechanism was created at the entry terminals. In a three-step process shippers had to book and pay for annual entry capacity for a specific terminal at a price related to Transco's capacity

costs. One day ahead shippers would then nominate how much gas they would flow during the following day in order to finally insert the gas at the day in question.

This system did not *ex ante* incorporate transmission constraints. Shippers could book unlimited amounts of entry capacity, could nominate above their booked capacity at a charge of 73/183 of the annual entry capacity, and could insert gas above the nominated level at the risk of the "overrun charges". However, it provided Transco with day ahead information as to how much gas would be inserted at any terminal. Transco would then use information about large consumers' demand and estimate domestic users' demand based on weather forecast to simulate next days gas flows. If constraints were anticipated, then Transco would use the "flexibility mechanism" to resolve the constraints; e.g., if gas insertion at St. Fergus would exceed transmission capacity in Scotland, then Transco would sell gas at St. Fergus and buy gas at southern beach terminals. Uncertainty about the functioning of the flexible mechanism implied that Transco retained additional storage at the beginning to allow for balancing, but initial success of the Code allowed most of the storage facilities to be made available to shippers on an annual basis.

This system worked well during the initial two years, until in summer 1998 significant capacity shortages occurred for entry at St. Fergus due to delayed commissioning of additional capacity and constructing on existing capacity. As a result "The level of nominations was far in excess of the available capacity, or indeed the level of [additional] capacity originally projected by Transco to be available at St. Fergus" (Ofgem, 1999). Transco had to sell significant amounts of gas at St. Fergus and acquire replacement at other Terminals, resulting in total balancing costs of £23.1 million during the period from late August to 8 October 1998 (see Figure 5). In this situation shippers faced perverse incentives. Even if they had otherwise not planned to ship gas, they could nominate gas insertions and subsequently submit bids in the flexibility mechanism to reduce the insertion. Such behaviour is individually rational, because the shipper profits and is only exposed to a fraction of the costs he creates since balancing costs are smeared among all shippers.

Figure 5: St. Fergus and Bacton Constraint Costs



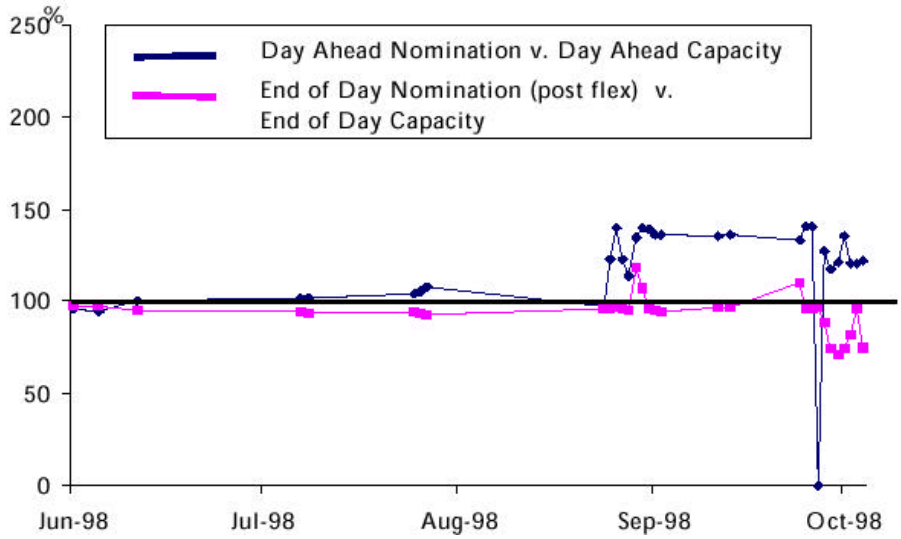
Source: Ofgem (1999).

The design of shipper licences defined in the Gas Act 1986 tries to equip the regulatory body with authority beyond usual competition law to intervene in the case of non-competitive behaviour. Specifically, condition 2(2) prohibits a shipper knowingly or recklessly pursuing a course of conduct that is likely to prejudice the efficient balancing by the transporter of its system. Condition 2(3) requires that the licensee shall not knowingly or recklessly act in a manner likely to give a false impression to a relevant transporter as to the amount of gas to be delivered by the licensee on a particular day to that transporter's pipeline.

Standard condition 9 furthermore requires the shippers to furnish to the Director General information as he may reasonably require, even if they are subject to confidentiality provisions. Only information is excluded that a court in civil proceedings would not be able to compel the shippers to produce.

Ofgem concluded in its 1999 inquiry that excessive nominations for gas to be flowed day ahead constituted a breach of the standard conditions 2(2) and/or 2(3). The most impressive part of the evidence was against Elf Exploration. Figure 6 illustrates how Elf nominated excessive capacity once it became apparent in September that Transco would have to use the flexibility mechanism to resolve anticipated constraints[4]. It would be an interesting question to see, whether the evidence available to Ofgem would suffice for the conclusion to stand up to judicial review. Shippers did not have to challenge the Ofgem's conclusion, because due to subsequent change of trading arrangements in September 1999, Ofgem did not take enforcement action.

Figure 6: Elf Exploration's excess nominations



Source: Ofgem (1999).

[4] Traders of Shell gas were similarly ignorant of the capabilities of regulatory offices, whereas most other shippers behaved according to the spirit of the Network Code.

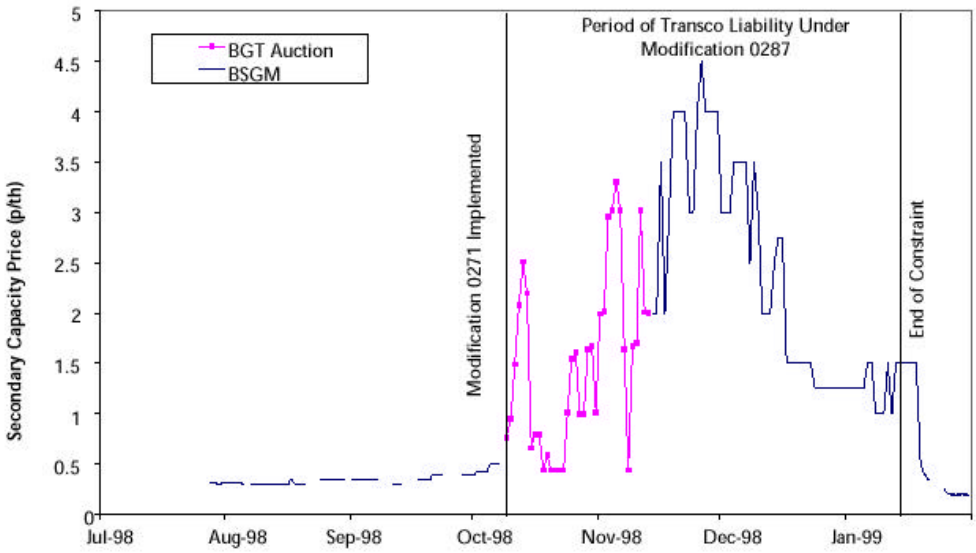
Scaling Back

As a reaction to the increasing costs of constraint resolution with the flexibility mechanism, as illustrated by Figure 5, Ofgem modified Transco's network code on 9 October 1998. Modification 271 required Transco to "scale back bookings to ensure that booked capacity equalled the amount of gas that could be physically evacuated from St. Fergus entry terminal". Obviously the result was that some shippers did not receive the capacity they required for their contractual requirements, whilst other shippers, at that time in particular BG, still retained unused booked capacity.

BG made it's excess capacity available in a day ahead auction until on 11 November 1998 Modification 273 introduced a day ahead auction at entry terminals which allowed unsold or unused physically available capacity to be made available to shippers.

The value of entry rights in the day ahead auction is given in Figure 7, and it can be seen that the prices match the price differences in the day ahead spot market for gas at St. Fergus and gas at the National Balancing Point (as shown in Figure 11). This was a first indication that auctioning of entry rights might be a successful approach. Scaling back of booked capacity rights was considered to be only a temporary solution, mainly because of complaints about the uncertainty shippers face up to day ahead whether they will have sufficient capacity available. The Ofgem inquiry from December 1999 had concluded that during the scaling back regime some shippers had breached their licence conditions by nominating gas flows above the capacity which they had been available after their initially booked capacity had been scaled back. The defence brought forward by shippers was, that they did face significant uncertainty about available capacity and felt that they had to honour commercial commitments to ship the gas. Even so these shippers could certainly have resolved the conflict between commercial commitments and obligations following from the licence conditions by interacting in the spot market, such a solution requires significant interactions. The corresponding transaction costs can be considered to be a major disadvantage of the scaling back approach.

Figure 7: Price in secondary capacity auction.



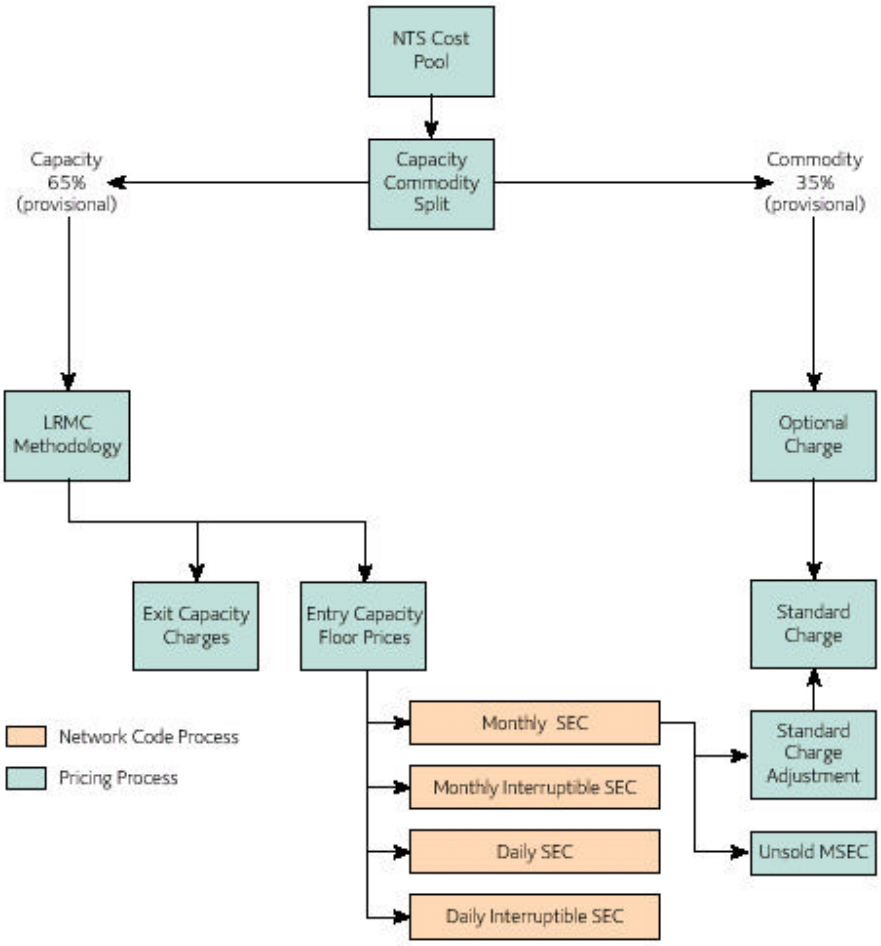
Source: Ofgem (1999).

4 CURRENT AUCTION DESIGN

Charges to use the gas transmission system are split between use of the National Transmission System (NTS) and the Local Distribution System. Only the NTS is relevant for our purposes. Fees to use the NTS are split between capacity (65%) and commodity charges (35%). Capacity charges included both an entry fee (charged at the auction price) and an exit fee (determined on the basis of LRMC for each exit zone on the network). The commodity charge is a flat fee per unit of gas transported and is independent of the entry and exit zones. This description is shown schematically in Figure 8.

Transco is a monopolist with regulated revenues. The MSEC auctions account for approximately 5 percent of its annual revenue target. Provisions are made for the events of over and under recovery of auction revenues and generally entail revisions to other regulated network charges. Day-ahead and daily auctions form part of an incentive scheme whereby Transco is awarded for increasing available capacity. These auctions do not contribute to the company's revenue target.

Figure 8: NTS charges and Floor prices



Source: Transco(2000), Table 3.2.1.
SEC= system entry capacity

Description of the current auction approach

As can be seen in Figure 4 there are six major beach terminals in Great Britain where gas is put into the National Transmission System (NTS). Five of these terminals are on the east-coast: St. Fergus, Teeside, Easington, Theddlethorpe and Bacton; the last, Barrow is on the west-coast. St. Fergus in Scotland and Bacton in the south-east are the most used entry terminals on the network. The importance of St. Fergus is understood by observing the number of gas pipelines flowing from there into the North Sea. Bacton is likewise connected to a number of major pipelines, but more importantly, it is the closest terminal to the interconnector linking Great Britain to the continent via Zeebrugge in Belgium. The auctions for rights to enter gas onto the NTS began in September 1999 and originally only included these six beach terminals. The subsequent auctions also included a number of onshore fields, storage and constrained LGN facilities. The important characteristics of the auction design and product, the auction rules, and the evolution of the auction design since 1999 are outlined below.

Important auction features

Product definition. The product sold in the auctions is the right to enter a volume of gas at a given entry point for one month (referred to subsequently as monthly system entry capacity or MSEC). Auctions of MSEC are for six month tranches; the auction dates and the period covered by the auction are shown below.

Auction Date	Auction Period
September 1999	October 1999 – April 2000
March 2000	April 2000 – Sept. 2000
September 2000	October 2000 – March 2001
March 2001	April 2001 – Sept. 2001
September 2001	October 2001 – March 2002

In June 1999 Transco published a document expressing views on the auction features including the time period and the objectives to be achieved from the process.[5] Transco discussed selling either twelve, six, or one month capacity rights at each auction; it considered that the monthly option would be best in principle since it would provide the most flexibility to shippers, but this option could not be realized in time for the September 1999 auctions. Six months were preferred to twelve since this would reduce shippers' risk from bidding mistakes and would take account of the different demand profiles of winter and summer.

The document further considers the types of auctions that would "achieve an efficient allocation of capacity and to identify the value of information that may be generated by the auction process" (p.34) and meet criteria with respect to: allocative efficiency, accommodating substitutes, accommodating complements, ease of use, familiarity, and system readiness. The accommodation of complements and substitutes would be important features of any design of gas network auctions for periods of more than one month since shippers will value the ability to adjust their demands depending on maintenance, for example, or their need to have rights for consecutive periods.

MSEC auctions are accompanied by daily auctions of firm and interruptible capacity rights. We first describe the monthly auctions and follow this with a description of the daily auctions for both firm and interruptible capacity.

Auction rounds. The total capacity available at each terminal is divided equally and sold over four rounds separated by one business day. Beginning with the March 2000 auctions, these four rounds were supplemented by a fifth "flexible" round in which any unsold (aggregate) capacity could be auctioned and subsequently nominated at any entry terminal on the network. As the fifth round is a "residual" round, the volumes sold are rather low. There is one proviso, however: Transco sets a maximum amount that can be allocated to each terminal in the MSEC auctions. Thus, if a shipper bought gas in the fifth round and wanted to nominate at St. Fergus, she would only be able to do so if that

[5] Transco, "Option for the Mechanism to Allocate Terminal Capacity in October 1999," 1999-06-30.

maximum were not binding. In the March 2000 auctions a very small amount of the aggregate residual capacity remained unsold because bids to nominate fifth round capacity to St. Fergus were rejected on the grounds that the maximum allowed MSEC for that terminal had been reached.

Reserve prices. Reserve prices are important for capacity auctions when there is market power and when there is excess capacity available in order to reduce the risk that the network owner is unable to meet its revenue requirement. Prior to October 1999, entry rights were booked on the basis of regulated prices that were estimates of the long run marginal cost (LRMC) at each entry point. Reserve prices equal to LRMC would reduce the efficiency of the auction if these were above the marginal valuation of shippers. In determining appropriate reserve prices, the estimated LRMC has been used as a benchmark with proportional discounts depending on the concentration of bidders at each entry point. At Barrow where there is essentially one bidder the reserve price equals the LRMC and the auctions always clear at this price.

Auction quantities. The amount offered for sale in the monthly auction will affect the amount of secondary trading and the amount of rights that Transco must repurchase in the event of network constraints. This implies that the amount offered for sale in the auction will not necessarily correspond to the amount of physical capacity available either in total or at each entry point. Initially, the total amount of capacity auctioned at all terminals each month was determined by a forecasted estimate of demand for that month. The baseline level of demand that determines the total capacity offered for MSEC is system normal demand or SND. The SND is derived using historical data of demand and weather patterns.

If excess capacity is auctioned relative to actual downstream demand then Transco must buy back those rights from shippers, possibly at higher prices (see Table 1 in Section V for a discussion of the high buyback costs in October 2000).

Auction Rules

We following the Network Code published by Transco in the discussion of the auction rules and procedures.[6] Capacity rights for six months are sold at each auction. The auctions are sealed-bid, pay-bid, and concurrent by terminal and month.

Bids

Each bid includes the following items:

- The shipper's identity.
- The entry terminal (more specifically, the Aggregate System Entry Point).
- The month for which capacity is sought.
- A minimum volume.
- A bid price.

Shippers' bid prices are given in pence/kWh/day, specified to four decimal places, and must not be below the reserve price. The minimum volume for which a

---

6 Transco, *The Network Code: version 2.26*, October 2001 can be found online at http://www.transco.uk.com/default.htm?netcode/nethome.htm~home.

shipper can bid is 100,000 kWh/day. Shippers can submit as many as 20 bids for each terminal and each month in each round.

Allocation

- Bids are ranked (ignoring the entry point) high to low.
- Capacity is allocated based on bids and associated volumes until all available capacity (= minimum eligible amount) is allocated.
- If amount bid for is > than the remaining unallocated capacity, the bidder receives amount remaining.

Information

Between auction rounds (before 09:00 the next business day) bidders are told:

- Teir winning volumes.
- Highest/lowest bid price of capacity that was allocated.
- The weighted average price of accepted bids.

Monthly interruptible capacity

Like the monthly firm auctions, interruptible capacity is make available each month and is sold in 6 monthly tranches. These auctions are also pay-bid, but occur over two rounds instead of five. The monthly capacity available on an interruptible basis:

C^I_m= Maximum physical demand – available monthly firm capacity.

Capacity in each round equals ½ C^I_m. The reserve price is 0.9*LRMC estimate, and any unsold capacity is made available in the daily auctions.

Short term auctions: daily and within day

Day-ahead auctions are held for firm and interruptible capacity rights. Reserve prices for the daily firm auctions equal 0.5*LRMC estimates at each terminal; for daily interrupt reserve prices are zero. Daily interruptible capacity:

C^I_D = unsold monthly interrupt + use it or lose it capacity.

"Use it or lose it capacity" consists of capacity bought by a shipper that has not yet been nominated for use on the day. The original owner of the rights can *ex post* decide to nominate or to resell the rights herself. In this case the new owner would be interrupted. In June 2000 Transco began to hold with-in the day auctions for firm capacity rights. Reserve prices in these auctions are 0.5*LRMC estimates.

Evolution

While the essential auction design has remained the same, a number of changes have occurred in the auction process since September 1999. The most significant of these changes has been the increase in the total MSEC made available. The total MSEC available in the September 1999 auction was the SND for each month in the October 1999 to March 2000 period. For the March 2000 auctions available capacity was increased from SND to SND + 10%. Because in England there is less total downstream gas demand in the summer than in the winter, the total MSEC in September 1999 (equal to SND) was still greater than the total in the March auctions. The available monthly capacity was increased still further in

the September 2001 auctions. The total volume of capacity sold in these last auctions approximates the maximum system entry capacity. As the MSEC has increased, the availability of daily and within day capacity has declined. In particular, the result has been a substantial reduction in the amount of interruptible capacity. Reduced short run capacity availability increases shippers' incentive to secure MSEC. Total capacity available at St. Fergus between October 1999 and February 2002 is shown in Figure 9 of Section V.

There is a trade-off between capacity increases and increasing the probability of system constraints. Thus, accompanying the increases in MSEC has been a change in Transco's incentives and buy-back targets as well as new methods for handling over-recovery of auction revenues.

Incentives for Transco: The company is incentivised to make available as much capacity as possible. As such it is allowed to retain a proportion of revenues received above the monthly auctions. Additional capacity sales increase the likelihood of constraints thus there is an additional incentive to reduce constraint costs. Transco is responsible for 20 percent of the cost of buy-backs necessary to alleviate any constraints on the network due to over-booking of capacity. The total amount of Transco's responsibility is capped annually and monthly. Shippers are responsible for the remainder of these costs.

Over-recovery: To deal with the over-recovery of auction revenue, Transco proposed introducing a buy-back fund that would reduce the amount that shippers are responsible for paying to alleviate constraints. Under this scheme total revenue is divided by six to reduce shippers share of buy-back costs in each of the six auction months. If there is still surplus remaining it is used to adjust transport charges more generally. The need to deal sensibly with over-recovery became apparent only after the second series of auctions in March 2000 when Transco over-recovered 160% relative to its target.

5 EVALUATION

From a theoretical perspective a comprehensive analysis of this auction design and the efficiency of the outcomes is problematic for a number of reasons. Most importantly, these are concurrent, sequential auctions with multi-unit demands and common values. As such one does not *a priori* expect to achieve full efficiency.[7] However, any misallocation of property rights should be resolved on secondary markets among shippers.[8]

When bidders in an auction have common values (e.g., the value to any one bidder is correlated to the values of other bidders), then bidding is expected to be more conservative relative to the case in which bidders have private values. This is because participants fear the winner's curse; i.e., paying too much for the object. From auction theory we know that open auctions are generally preferable to sealed-bid auctions when there are common values, because the outcry process

---

[7] Dasgupta and Maskin (1998) show conditions under which multi-unit auctions with common values can result in efficient allocations. Bids are contingent on others' values in their model, however.

[8] At this time we do not have full data on the extent of shippers' secondary trades.

leads to more aggressive bidding (Milgrom and Weber, 1982). The intuition behind this result is that the observation of when others drop out of the auction (and hence the information this reveals about their values) reduces the possibility that the winner will pay too much for the object. Conversely, the open outcry process may make collusive strategies feasible.

Also contrary to private value auctions, increasing the number of buyers in common value auctions can decrease instead of increase the expected revenue for that seller. That is, increasing the number of bidders can lead to more conservative bidding when values are correlated. The fact that you win an object in common value auctions suggests to you that you likely paid too much since you beat everyone else. The more bidders competing against you, the more likely you are to be cursed if you win.[9] These results suggest a trade off between increasing competition on the own hand, and preventing the winners curse on the other.

We believe that the sealed-bid sequential auction where bidders are given feedback between rounds mimics the properties of the open outcry auction. Specifically, the information obtained between rounds allows shippers to learn about the values of other bidders and therefore decreases the chance that they will be subject to the winner's curse. However, if there is market power at an entry point, multiple rounds can serve to maintain collusion.

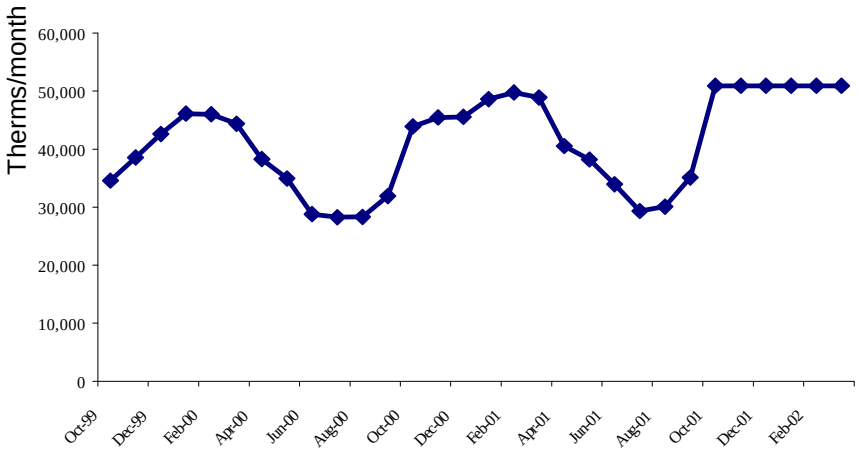
In Figure 10 we present empirical results of the auctions. The squares give the price paid for entry rights in the monthly auctions. One notes the strong correlation between simultaneously auctioned months, which is based on the similar information available. Even more obvious in the data is the sharp difference between winter and summer months. Figure 9 shows that during summer months less entry capacity is available, because higher outside temperatures reduce transmission and compression capacity and mainly because lower gas demand in the downstream market reduces the off-take of gas in the Northern UK, thereby making constraints in Scotland and Northern England binding.[10] Most fields delivering gas towards St. Fergus terminal are wet-fields, producing oil and gas as 'by-product'. To reduce the gas-output of such fields because of less available entry capacity at St. Fergus in summer times would imply for oil companies, that they reduce oil production accordingly, which they are reluctant to do. Most companies are therefore willing to sell gas, even at a lower price, and are therefore prepared to pay higher prices for entry rights at St. Fergus.

---

9 See Bulow and Klemperer (2000) for a broader discussion. Bulow and Klemperer also suggest, however, that increases in supply can mitigate the winner's curse by increasing the number of winners and thereby removing or lessening the curse of being among the winners.

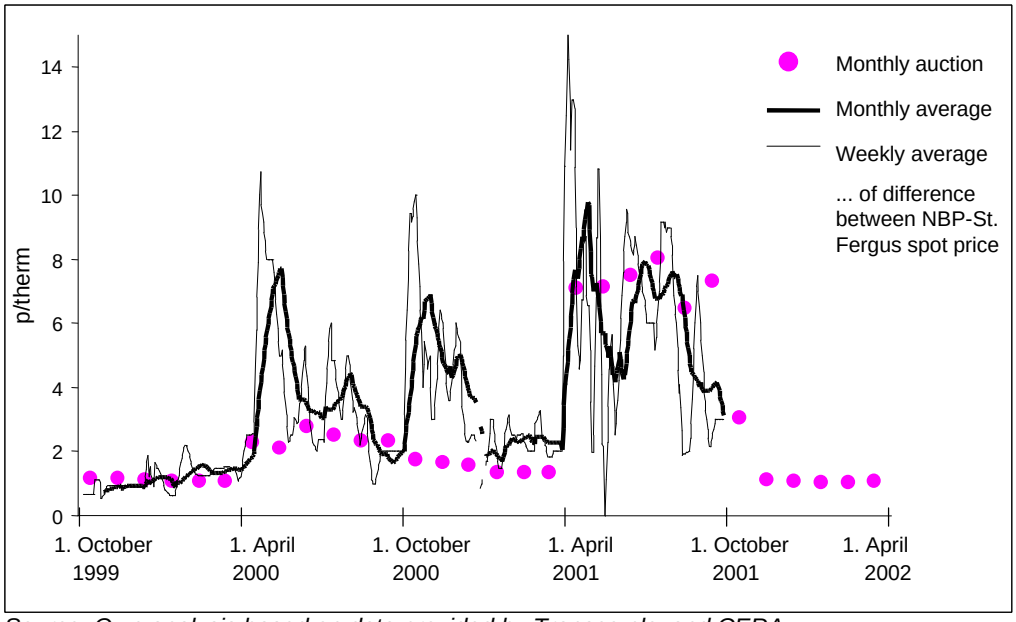
10 Network analysis of Jones (2001) shows that the relevant (binding) constraints in winter 2001/2002 areexpected in diverse locations as Aberdeen, Moffat & Wooler and Kirriemuir.

Figure 9: Available entry capacity in monthly auctions for St. Fergus



The black line in Figure 10 gives the 30-day average of the value attributed to entry rights in the day-ahead spot market. Unfortunately results of the daily capacity auctions were not available, and would in any case only cover days with excess capacity. Therefore we had to calculate the daily value attributed to entry rights by comparing the day ahead spot market prices for St. Fergus (before entering the NBP) with the spot market prices at the NBP -implying that the gas is in the NTS (See Figure 11). The resulting price differences are very volatile; therefore we present the 30-day average to allow comparison with the results from the monthly auctions. The graph shows that anticipated entry prices in the monthly auctions are roughly matched by the subsequent realisations of spot prices.

Figure 10: *Price difference between day-ahead spot market for gas at St. Fergus and National Balancing Point and weighted average prices paid in auction for monthly entry rights*



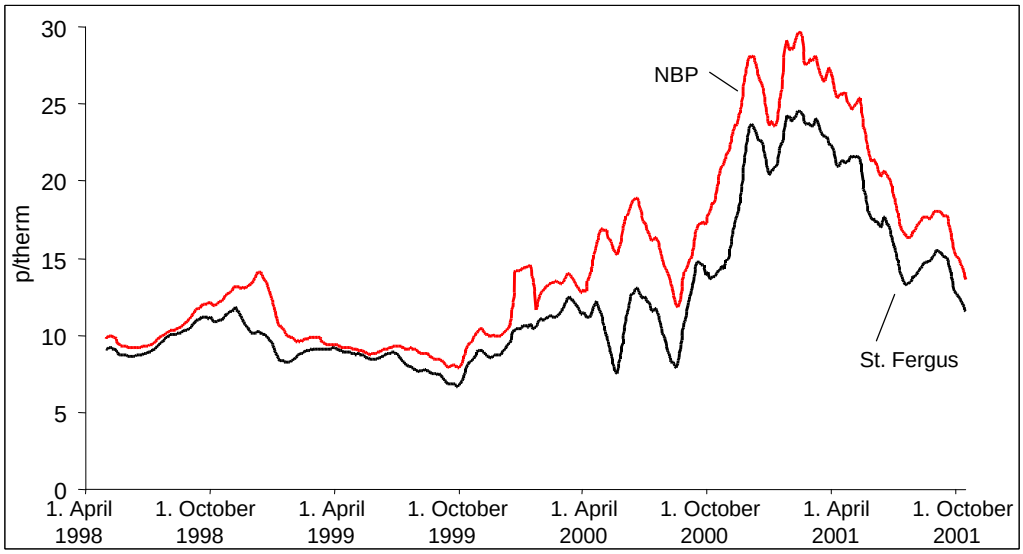
Source: Own analysis based on data provided by Transco plc. and CERA.

However, starting from April 2000 the day-ahead evaluation of entry capacity was frequently above the price paid in the entry auction. This can only be explained by unexpected events that occurred after the auctions for monthly entry rights in March, otherwise it should already have been reflected in the prices paid in the monthly auctions. Indeed, the unexpected oil price spikes of 2000 had a twofold effect on the value of entry capacity. First higher oil-prices during the fuel crisis induced producers in the Northern fields to increase oil-production and accordingly their gas production. Constraints on entry capacity implied that the gas sales could not be likewise increased. Increasing supply while maintaining demand reduces prices, as the drop at St. Fergus spot price in summer 2000 proofs (as shown in Figure 11). At the same time gas prices on the continent rise because they are coupled to the oil prices. In Britain gas contracts are not directly linked to oil prices; therefore, shippers want to sell additional gas on the continent via the interconnection from Bacton to Zeebrugge, pushing up UK gas prices (once again observable in Figure 11). As access to the network was constrained, higher continental and UK gas prices could not feed through to St. Fergus spot prices, and lower St. Fergus spot prices could not balance higher NBP prices. The result is a wedge between prices at St. Fergus and the NBP - and a high value attributed to entry rights.

The next spike for entry rights occurred starting in October 2000. Ofgem claims because of warmer than expected weather demand for gas in Scotland and Northern England was lower, reducing the available entry capacity below the volume of firm rights sold in the monthly auction. Transco had to buy back capacity rights in a significant volume, and was paying prices of on average 18p/therm. This price is again above the wedge of spot price differences between St. Fergus and the NBP. The “premium” paid in the buy back market above the spot market can possibly be explained by the additional costs incurred by gas

producers when they have to change their production on short notice during the day. Furthermore shippers might have used their market power to obtain higher prices from Transco when selling back entry rights. In a subsequent investigation Ofgem however concluded, that no further action was required, as "shippers and Transco [had] to learn about the dynamics and operation of the capacity buy back market." (Ofgem 2001/2).

Figure 11: Monthly averages of spot prices at the National Balancing Point and St Fergus



However, the main reason for the unexpected price spike for entry rights in Fall 2000 can be seen in Figure 11. The wholesale gas prices in the UK market almost doubled, but constrained entry capacity at St. Fergus did not allow producers at St. Fergus to react to higher demand at the NBP. Therefore the prices of the NBP did not feed through to prices at St. Fergus where spot prices stayed constant. The resulting wedge in prices was reflected in a spike of the value attributed to entry rights.

Since 2001 the monthly auctions returned to be a good predictor for the average value attributed to entry rights. How necessary the auctioning of entry rights is can be seen by comparing the scarcity of entry rights during the constraint in September 1999, when the average difference between spot price in St. Fergus and NBP was 0.7 p/therm and October 2000, when the average difference between the spot prices was 6.7 p/therm. Even though the scarcity of transmission capacity increased tenfold, the costs for buy-backs have fallen. Since the auctions began in September 1999, there has been one instance of seemingly substantial buy-backs by Transco to reduce network constraints. Table 1 shows the costs of buy-backs for the auctions through February 2001. For the five months period, October 2000 to February 2001 these costs reached £11.6 million. This was high enough to prompt an investigation into shipper behaviour by Ofgem,[11] yet it is still below the £23.1 million for the five months period August-

[11] Ofgem (2001).

December 1998 shown in Figure 5. This provides just one example, but more generally, the advantage of the auction approach is the added transparency. Because Transco typically waits until the gas-day to buy-back entry rights, these cost are higher than the prices at which the rights were bought at auction.

Table 1: Capacity buy-backs April 2000-February 2001

	Number of days requiring buybacks	Average Daily Buy-back vol [GWh]	Weighted average price [p/kWh]	Total cost of Buybacks [£]
April	0	0	-	0
May	0	0	-	0
June	5	11.93	0.21	126,717
July	7	28.2	0.40	783,041
August	10	12.57	0.07	87,259
September	6	18.08	0.19	203,349
Total	28	17.54	0.24	1,200,366
October	20	76.71	0.55	8,514,192
November	8	47.78	0.45	1,723,850
December	5	28.63	0.61	869,433
January	0	0	-	0
February	1	128.53	0.37	475,158
Total		64.35	0.53	11,582,633

Source: Ofgem (2000).

Another issue, which arises in these auctions, is Transco's revenue requirement. Deciding how to distribute over-recovery of auction revenues is a problem not normally confronted in private-sector auctions, yet, it is important where there the auctioneer is a regulated firm. The fact that over-recovery occurs should not be a problem, *per se*, but a well-defined auction should address this issue at the beginning so that participants know the game they are playing. How to distribute "surplus" revenues is not a trivial problem since reimbursements can impact shippers' bidding decisions in the monthly auctions. As such, participants should have recourse to a credible dispute resolution in the event, for example, that well-founded assumptions regarding the use of extra-revenue do not materialize. Transco's auction revenues for the period October 1999-March 2000 were £85.62 million (within 3 percent of its revenue target). A similar situation was anticipated for the March auctions. In the event, auction revenues were £86 million or 160 percent greater than target revenues (See Table 2 for the actual and target revenues for the second auctions and the average number of bidders at the six main entry terminals).

The auction rules made allowances for over/under-recovery. Specifically, it was anticipated that adjustments would be made to the generic correction factor in Transco's price control; i.e., the price control contains a revenue under/over recovery adjustment factor such that if the company over-recovers relative to it's

revenue target in a given year, the target is scaled downward the following year. This would imply a general reduction in transportation charges for shippers in the following year.

Table 2: Revenues for the March 2000 auctions [£million]

		Bacton	Barrow	Easington	StFergus	Teeside	Theddle.	Total
Apr-00	actual	0.62	0.84	0.34	21.91	1.61	0.54	25.85
	target	0.26	0.74	0.6	9.6	0.79	0.21	12.19
May-00	actual	0.66	0.53	0.3	18.82	1.4	0.45	22.15
	target	0.2	0.4	0.41	7.89	0.76	0.16	9.82
Jun-00	actual	0.63	0.14	0.49	19.72	2.83	0.7	24.51
	target	0.15	0.16	0.28	7.08	0.67	0.13	8.48
Jul-00	actual	1.52	0.07	0.39	18.16	2.72	0.5	23.35
	target	0.1	0.01	0.26	6.89	0.64	0.1	8.01
Aug-00	actual	1.8	0.08	0.35	16.77	2.77	0.45	22.22
	target	0.1	0.03	0.24	6.75	0.67	0.13	7.91
Sep-00	actual	1.71	0.15	0.46	18.51	2.79	0.61	24.23
	target	0.15	0.18	0.32	7.58	0.74	0.15	9.11
Total	target	8.68	7.89	4.9	181.86	19.18	5.45	227.96
	actual	2.81	11.55	6.42	111.84	8.89	2.12	143.63
Average number of bidders (round1-round4)		17.1	1	7.4	19.8	13.9	10.3	
Avg. number of successful bidders (round1-round4)		5.6	1	2.9	9.3	5.8	5.8	

Source: Ofgem (2000) and Transco data.

Following the large over-recovery from the second auctions, Transco decided to make a one-off adjustment whereby commodity, capacity and transport charges were proportionately reduced. Fifteen percent of the over-recovery went to reductions in transport charges while the remainder reduced NTS capacity and commodity charges (Ofgem, 2000). It seems obvious that such a rebate mechanism would alter bidding behaviour if this type of surplus redistribution became the rule. If a portion of entry capacity charges are refunded to shippers they will not incur the full cost of their bids and therefore have skewed bidding incentives. This would bias estimates of the demand for capacity and lead to erroneous investment decisions if long-run capacity auctions were pursued. In the future over and under recoveries will be assigned to a "buy-back" fund that will reduce shippers' share constraint costs.

Finally, in the international environment the auction mechanism seems to prevail as well. In October 2001 additional pipelines in the North Sea was taken into service to allow the export of gas from Norwegian fields towards the UK, using

the St. Fergus terminal. Even so Norway complained that the constraint costs would reduce the Norwegian revenues in the project, it finally supported a project that retains the bottleneck and therefore the capture of scarcity revenues on British soil.

6 SUMMARY

We began with the hypothesis that the auctioning of well defined access rights is the most efficient way to deal with significant transmission constraints in the presence of monopoly ownership of the network with competition in production and supply whilst also allowing for non-discriminatory access and entry. We have supported this view by describing the evolution of the liberalisation of the gas industry in Great Britain; discussing the shortcomings of the previous methods of allocating network access; and illustrating the correspondence between auction and spot prices.

We provide a description though not a thorough evaluation of the specific auction design as a full theoretical model is outside the scope of this report, and the five available auction data points do not make a full quantitative analysis feasible. Also a number of events occurred outside of the auction mechanism which influenced the auction results. Most notably, higher gas prices in continental Europe, the oil price spikes with impacts on wet-gas fields and changes in the allocation of excess revenues from auctions. Comparison between the auction and previous models is limited. First, because the opening of the UK-Belgium interconnector in October 1998 changed trade patterns. Secondly a continuous increase in gas demand in the UK in parallel with falling production at existing fields, resulted in an increase of scarcity of entry capacity at St. Fergus by up to the factor of ten. However, the costs of resolving constraints have nevertheless fallen significantly - implying that the definition and auctioning of property rights for entry capacity was successful.

We conclude that the current auction improves upon the previous methods historically used in Great Britain to allocate entry rights. We add, however, that this might not be the case if there were not a reasonable amount of competition in the production and supply markets. Also, if there were no significant transmission constraints, then the assignment of access rights via auction would be unnecessary.

Finally, although we are enthusiastic about the use of auctions to allocate entry rights when the network is fixed we have reservations about the appropriateness of using auctions to signal the need for and to fund network investments.

REFERENCES

Armstrong M., Cowan S. and Vickers J. (1994) *Regulatory Reform, Economic Analysis and British Experience*, Cambridge Massachusetts, 1994.

Bulow, J. and Klemperer, P. (2000) *Prices and the winner's curse*, Working Paper.

http://www.nuff.ox.ac.uk/users/klemperer/papers.html.

Dasgupta, P. and E. Maskin (1998) *Efficient Auctions*, mimeo.

Jones, R. (2001) *MSEC Network Analysis*, System Operation, Transco.

Milgrom, P and Weber, R. (1982) A theory of auctions and competitive bidding, *Econometrica*, 50, 1089-1122.

McDaniel, T. and Neuhoff, K. (2001) *Entry capacity auctions and investment signals*, mimeo, Department of Applied Economics, Cambridge.

Monopolies and Mergers Commission (1997) BG plc., *A report under the Gas Act 1986 on the restriction of prices for gas transportation and storage services*.

Monopolies and Mergers Commission (1993) *Reports under the Gas Act 1986 on the conveyance and storage of gas and the fixing of tariffs for the supply of gas by British Gas plc.*

Newbery, D. (1999) *Deriving Long-Run Marginal Cost Tariffs using Transcost*, mimeo, Department of Applied Economics, Cambridge.

Ofgem (1999) *St. Fergus and Bacton Investigation, A Report under Section 39(4) of the Gas Act 1986.*

Ofgem (2000/1) *The new gas trading arrangements: a review of the new arrangements and further development of the regime*, July: http://www.ofgem.gov.uk.

Ofgem (2001/1) Ofgem's investigation into shipper conduct in the capacity market in October 2000, *Conclusions*, November: http://www.ofgem.gov.uk.

Ofgem (2001/2) *Transco's National Transmission System, System Operator incentives* 2002-7, Final Proposals, December 2001.

Oxera (2000/2) *Energy Liberalization Indicators in Europe*, A consultation document based on a study carried out by Oxera for the Governments of the UK and the Netherlands, October 2000.

Platts (2001) *Guide to UK Gas Prices*, Platts

Transco (2000) *Transport charges from 1 Oct 2000*, http://www.transco.uk.com

6 SPECTRUM AUCTIONS BY THE UNITED STATES FEDERAL COMMUNICATIONS COMMISSION

Tim Salmon

TABLE OF CONTENTS

1 INTRODUCTION 91

2 REGULATORY HISTORY OF SPECTRUM ALLOCATION 91

3 OVERVIEW OF THE SIMULTANEOUS ASCENDING AUCTION 95

4 LESSONS LEARNED FROM AUCTION RESULTS 100

4.1 IVDS AND C-BLOCK 100

4.2 WCS AND LMDS 102

4.3 DEF BLOCK 103

4.4 WITHDRAWALS AND THE NEED FOR COMBINATORIAL AUCTIONS 104

5 COMPETITIVE EFFECTS 106

6 CONCLUSION 109

REFERENCES

1 INTRODUCTION

In 1985 then Federal Communications Commission (FCC) Chairman, Mark Fowler, first asked for permission from the U.S. Congress to use auctions in the assignment of spectrum licenses. This request was denied. In fact, successive FCC Chairmen asked Congress for this authority every year until the authority was finally granted in 1993. In the Omnibus Reconciliation Act of 1993, Congress finally provided the FCC with the statutory authority to conduct spectrum auctions. This led to the FCC's first spectrum auctions being conducted in 1994. Since then the FCC has conducted 37 such auctions with total net high bids summing to over $40 billion.

Over the course of these 37 auctions there have been many successes but also a few failures. Unfortunately some of these failures have been colossal mistakes. In this report, we will detail the reasons both for the successes and the failures with the intention of trying to show how the FCC's experience with designing and running auctions can be used to show how auctions can be designed to solve highly complex allocation problems.

Section 2 will discuss the regulatory background of spectrum allocation methodologies in the US with intent to describe how the auctions program came to be. Section 3 will present the standard structure of a Simultaneous Ascending Auction including the specific version used by the FCC as well as the standard modifications to the design that might be used under different circumstances. Section 4 will discuss the successes and failures of specific FCC auctions to see what lessons can be learned from both.

2 REGULATORY HISTORY OF SPECTRUM ALLOCATION

As with most spectrum regulatory authorities, the FCC had a long tradition of assigning licenses through the use of comparative hearings or "beauty contests" as they are sometimes called. In the early 1980's the FCC tried a brief experiment with using lotteries to assign licenses before finally settling upon using auctions. It was a long and drawn out process to get to this point but it is useful to look into the problem both of why it took so long as well as why it was the right thing to do.

The problems with comparative hearings are in general quite well known but they were particularly problematic in the US. To understand why, it is useful to understand more clearly the fundamental nature of the allocation problem that needs to be solved. To illustrate this problem we will use a very simple example of three licenses needing to be allocated among a group of four potential operators. The goal of the government should be to make sure that those licenses end up in the hands of those operators who can use them in the most economically valuable manner for society. If this is accomplished, then we can say that the efficient outcome has been reached. As an illustrative example consider the following table. This table contains some hypothetical values that 4 different firms might have for three different items. We can think of these values as the economic value to

society the license would have if it were in the hands of that firm, or we can think of them as the value each firm places on owning the item. In effect, both ways of viewing these values are the same. This analysis is ignoring any "social" value that might be achieved by a particular firm obtaining a license. If the government believed that there were some social good that would be served by a small or minority owned firm getting the item then these economic values could be modified accordingly.

	Firm 1	Firm 2	Firm 3	Firm 4
Item A	100	40	95	25
Item B	45	85	120	65
Item C	10	95	35	60

The problem of the government is to figure out who among these four firms should be assigned each of these items. The efficient assignment, as stated before, would assign the items to the firms who have the highest value for them. In this case that would mean firm 1 should get item A, firm 3 item B and firm 2 should get item C. This results in a total value to society of 100+120+95=315. We can measure the level of efficiency of any other possible allocation according to this benchmark. Consider the value achieved by assigning firm 1 item B, firm 2 item A and firm 3 item C. The value achieved here is 45+40+30=115 and the ratio of value achieved to value possible is 115/315=0.365. If the government made this second assignment then, they would have achieved 36.5% of the possible value and we term this the efficiency level of the assignment.

This explains what the government wants to do. Now we need to figure out how it should go about it. In order to make the right decision, the government needs to know the values each firm has for each item. One possible way to extract this information is to simply ask each firm what their value is and then assign the objects to those stating the highest value. This is, to some degree of approximation, what the comparative hearing process is. The process involves each firm presenting a case to the regulator of why they are the most deserving candidate or why society is best served if they are awarded the item. If we frame the problem in this example context and simply ask each of these four firms what they value each license at, it is clear to see that they will all have an incentive to overstate their value. The problem of the regulator in the comparative hearing process then, is to try to uncover the true values from the potentially misleading signals being sent in by each firm. This is not likely to be an easy task. The one possible advantage of such hearings is that if there is thought to be some social value to awarding an item to a particular type of firm, then this can be explicitly taken into account during the hearing process.

In the US and in particular in the case of allocating licenses such as those to provide wireless telephony, this problem is significantly more difficult. The number of items is very large and the value structure of the firms over these licenses is much more complex than the simple one contained in the table above. These complexities will be explained in more detail later. Using a hearing process to uncover these values would be a long, difficult and likely inaccurate process. Such processes in the US have been known to take many years to allocate

relatively few licenses. During those years, the public is not receiving service and the firms are spending large sums of money in legal bills to have teams of lawyers argue their case in the administrative court. In the end, the likelihood of the court making the efficient assignment is quite low. If, however, the situation is less complex, involving only a few potential firms and a few licenses, then the problem may be of low enough dimensionality that these problems can be alleviated. Even in the simple example above, however, the task is already becoming difficult unless the regulator has very good information on the firms.

Due to these issues, the FCC decided to attempt to allocate cellular telephone licenses in the 1980's through the use of a lottery mechanism. This resulted in a vast number of applications being submitted and we can use our example above to get a gauge for the likely efficiency level. If we consider each of the bidders equally likely to win each license it is easy to compute the expected value realized by the lottery, 193.75, which is an efficiency level of $193.75/315=0.615$. This is the efficiency level that should be expected to be achieved on average although the actual level could be above or below. The level is obviously quite low, but these are just arbitrary values. If the values of the applicants were closer, then the randomly achieved efficiency would be higher. It is an open question as to what the differential would be in practice, but in the FCC's case, many were applying who had no value for the license themselves and wanted to win a license purely for resale. If the FCC had restricted the applicants to only "serious" applicants, we might look at the recent U.K. UMTS auction for an idea of the practical spread in values, which was revealed to be at least £2 billion since the first bidder dropped out of the auction when the prices the £2 billion level and the final sale prices were in the neighborhood of £4 billion.

Given the likely inefficient allocation that would result from a lottery, some argued that the efficiency of the initial assignment was unimportant as secondary resale markets could work out any mis-assignments. This is certainly possible, but as it happened and as is predictable from simple bargaining theory, it took many years after the lottery assignment for operators to obtain enough contiguous cellular licenses to form legitimate businesses. The fundamental problem is that if a business needs three licenses to operate, the third lottery winner they negotiate with for the last license has a very large amount of bargaining power which can result in significant hold-up problems. Solving a sequential bargaining problem like this, takes a large amount of time, money and patience.

Experience in the US showed that neither comparative hearings nor lotteries were effective means of assigning spectrum. The key to understanding why auctions are expected to be more effective requires us to go back to our simple example. In order for the government to make a good assignment they need to know the entries in that value table. This requires some mechanism to use in eliciting those values from the firms and it is important to elicit those values truthfully. This is precisely what auctions are designed to do and why they should be expected to allow the government to make more efficient assignments. Properly designed auctions effectively work by asking bidders to send in signals and then those signals are used to assign objects and generate payment levels. The payment schemes are generally designed in order to insure that bidders find it in their best

interest to send in their true value as their signal, which makes it significantly easier to make efficient assignments.[1]

This explains the economic reasons why auctions were adopted in the US for assigning spectrum. As with most cases, the political reasons they were adopted were not exactly identical. For a more detailed description of the political process that led to auctions being adopted see Kwerel and Rosston (1999) and Hazlett (1998). As noted before, the FCC began asking for the authority to conduct spectrum auctions beginning in 1985 and this authority was finally granted in 1993. During this time, due to the political lobbying power of broadcasters, Congress was reluctant to grant auction authority. The basic explanation of why auction authority was eventually approved by Congress comes down to the large budget deficits that existed in the US in the late 1980's and early 1990's. In 1993, the political rhetoric about reducing these deficits reached a peak and this led to Congress looking for any source of revenue it could find. Their need for revenue sources was finally what overcame their reluctance to the idea. This also explains why the auction authority was granted in a Balanced Budget bill. Curiously enough, though, in the initial legislation, the FCC was forbidden from using any goal of increasing or maximizing revenue as part of its design considerations for the auctions. They were charged with making the auctions "fast, fair and efficient".

Once the FCC had been granted authority to conduct auctions, their approach for designing the auctions was particularly effective. The basic process used by the FCC was their standard approach to the design of policies which is that they released various "Public Notices" and "Reports and Orders" that outlined the FCC's plans for the auction and allowed time for public comment and then additional periods for parties to comment on the comments of other parties. During this comment period, many of the major telecommunication industry firms hired academic auction experts to write detailed auction design proposals as well as comments and critiques on the proposals of others. The FCC had itself hired a few academic experts to help it in sorting through the proposals and comments. Over the course of this process, many designs were put forward, some tossed aside and improvements were made to others. Also included in this process was a period of experimental testing detailed in Plott (1997) and Ledyard, Porter and Rangel (1997). Based upon this record of proposals by academic auction theorists as well as the empirical testing of experimental testers, the FCC was able to not only decide upon a methodology but also have some empirical verification that it had a chance of working. Rarely has there been such close cooperation between the academic community and a regulatory authority and in this case things worked out quite well. The high degree of success achieved by the FCC in their auction program over the years can likely be traced back to their willingness to work with the auction experts on the design.

Another lesson that can also be learned from this process is the value of experimental testing of auction mechanisms. During this phase, there were many

---

[1] As a technical note, this is precisely the origin behind the design of the second price or Vickrey auction and the ascending or English auction strategically mimics this auction. Traditional sealed bid first price auctions work a little bit differently, but the same general ideas are still embedded into why and how they work.

designs proposed but there was typically no way to rigorously compare the designs based upon theoretical grounds. Comparing auction designs through field testing was not possible either as most rational government regulators are a bit reluctant to engage in field-testing of different mechanisms by using them for multi-billion dollar auctions. These are the two traditional means economists use to evaluate different policy options and without them, we might be left with only having each proponent of an auction design try to make a convincing argument that theirs seems like it would work the best. This is not usually a reliable means of determining such things. Using economic experiments, however, it is possible to empirically compare the performance of different mechanisms prior to field implementation. The use of experiments in policy studies such as this has been going on since the early 1980's but there are some still resistant to the idea. The information obtained by the FCC through the experimental tests that were conducted was quite useful in helping them to decide on and have confidence in a design and should serve to show that this is both a valid and useful tool for such purposes.

3 OVERVIEW OF THE SIMULTANEOUS ASCENDING AUCTION

The auction format used in all but two of the FCC's auctions has been a version of a Simultaneous Ascending Auction (SAA) that is sometimes referred to as a simultaneous multiple round auction. It is important to realize that the specific form used by the FCC is just a specific parameterisation of a larger class of mechanisms. In this section, we will discuss the reasoning behind the design of the specific version used by the FCC and then discuss some generalizations that might be useful in other contexts.

To understand why the SAA was the chosen methodology, it is useful to consider the basic problem the FCC began with. We will use the AB-block PCS auction (FCC auction #4) as an example. For this auction, the FCC divided the US into 51 license areas called MTA's (major trading areas) and then allocated two bands with 30 MHz of spectrum in each. Their task was to find an auction methodology that would be capable of placing these 102 objects in the hands of the firms best able to use them. There are further complications to this problem due to the complexity of the preferences firms have for the items.

For example:

1. Two licenses close together will generally be worth more if won in a package than the sum of the value they would have if won separately. For example, a New York license is likely to be more valuable if you also have Philadelphia, Boston and Washington DC licenses. In fact, there could be minimum efficient scales that dictate the minimum size of operation necessary to be profitable, such as a firm must win at least three contiguous licenses for the licenses to have any use value at all.

2. Values depend on who else has won a license around you. If you are a provider intending to use CDMA technology, then there may be little reason to bid for an A block license in a market where another CDMA

provider is on the B block since you would be able to set up collaborative roaming arrangements later. Similarly if other CDMA operators are winning in areas around another license, that license may be more valuable than if only TDMA or GSM providers were bidding on the surrounding licenses.

3. Values are likely to be affiliated, rather than common or independent, across bidders. That is, bidders will be uncertain about their actual value for each license but all bidders will value a New York license more than a Montana license.

These and other factors led to very complex and highly contingent preferences on the part of the bidders. Complicating things even further is that quite often, the bidders themselves will have difficulty articulating and quantifying exactly how some of these issues affect their values. All of this indicates that the environment is an exceedingly complex one and one that it will be difficult to use a simple mechanism to solve the allocation problem.

When we begin to consider how to conduct such an auction, the most obvious possibility would be to use some sort of sequential auction such as is done in Sotheby's or Christie's style auctions when there are multiple items for sale. This would involve putting each of the 102 licenses up for sale in separate sequential auctions. This would be quite easy to run, but since bidders preferences and values for the New York license depend on who wins the Boston license it is quite difficult for them to come up with an effective bidding strategy for the New York license if it is auctioned first. A sequential auction is therefore highly likely to result in inefficient assignments in cases such as this. As a general rule, sequential auctions are useful when the objects being auctioned are independent from each other. If the bidders have values for the items that are interdependent across items, simultaneous auctions will generally be preferred.

This indicates a need to conduct a simultaneous auction in which the market for each item in the auction is simultaneously opened and closed. The difficult part now is deciding on what format to use. Standard theory of single unit auctions tells us that there are four basic formats to choose from: the sealed bid first price,[2] the Dutch or descending clock auction,[3] the second price sealed bid auction[4] and the English or ascending clock auction.[5] Which should be used? If our goal is efficiency, the theory of single unit auctions suggests that in equilibrium all of these should be efficient. This gives us no means of selecting between them. The one useful thing that our single unit auction theory can tell us is that when bidder values are affiliated, as they seem to be in this case, the English auction should be expected to raise the most revenue. This is derived from the Linkage Principle proved in Milgrom and Weber (1982). Since the auction authority legislation

---

[2] Each bidder submits a bid, the highest bidder wins and they pay the price they bid.

[3] A price clock starts very high and then begins counting down. The first bidder to accept the price wins the item at the price they accepted.

[4] Each bidder submits a bid, the highest bidder wins but pays a price equal to the second highest bid received.

[5] The price starts low and increases until only one bidder is left. They win and pay the price at which the last bidder dropped out.

prohibited the FCC from using such considerations in their decision, though, this could not be the official reason for adopting the format.

To determine if there are other reasonable arguments in favour of the ascending auction, it is useful to briefly consider the other three. The main problem with the sealed bid first price and the Dutch auctions is that trying to determine an optimal bidding strategy is highly difficult. To date, no one has been able to solve for an equilibrium bidding strategy in a situation of this complexity even theoretically, which gives little hope of it being done in practice. Consequently, we should expect serious mistakes and misallocations from such methodologies. In the second price auction, the well-known result from single unit auctions is that it is a dominant strategy to submit a bid equal to your true value, meaning that no matter what the other bidders do, this always makes you best off. One might suspect this would be easy enough to implement here. The problem, however, is that in order for that to be an equilibrium in the multiple unit context with interdependent preferences, we would have to use a generalized Vickrey-Groves-Clark mechanism[6] that would require individuals to submit their values for all 2^{102}-1 possible combinations of licenses. That is simply unworkable. This leaves us with the English or ascending auction.

To try to find a version of an ascending auction that will work, requires still more effort though. Simply taking the auction house approach and placing say 102 auctioneers around a room will not be workable either. Bidders will not have the informational processing capabilities to keep up with such a design. Instead of using a straight analogue of the auction house style English auction, we can consider a discrete process. The way the discrete version works is that bidding consists of several sequential rounds. In the first round of the auction, bidders are allowed to send in bids in a sealed bid manner so that no one can see anyone else's bids during the round. When that round is closed, the results are published including the high bidders from that round and the bids necessary to top them. Bidders are given time to analyse the results of that round and then a new round opens in which bidders are allowed to submit new bids if they choose.

This is the basic structure of the FCC's auction process. There are however, many additional rules used to accomplish certain specific goals. These are as follows:

1. **Simultaneous Closing Rule**: In a single unit English auction, the closing rule is simply to close after people stop bidding. The question is, what is the most reasonable multiple unit analogue? Many suggested an item by item closing rule in which after people have stopped bidding on a Kansas license, bidding on this license is closed even if people are still bidding on a New York license. The problem with such a closing rule is that it limits the ability of bidders to arbitrage between markets and pursue alternative options when they realize they can no longer compete in one market. If markets are closed individually, the other market they might want to bid in could be

[6] In this mechanism, bidders send in their bids as one bid for each possible combination of items. If there are two items, this means a bid for {AB}, a bid for {A} and one for {B}. Items are assigned by finding the set of mutually exclusive bids that sum to the highest revenue. Each winning bidder pays an amount equal to the cost they are inflicting on society. This is found by computing the total value achieved in the actual allocation leaving that bidders value out and then subtracting the value that would be achieved in the allocation that would have resulted had that bidder not sent in any bids.

closed by the time the bidder decides to start bidding on it. This should be expected to lead to efficiency and revenue loss. This implies the need for a simultaneous closing rule in which bidding is allowed on all items until bidding has ceased on every item. In the FCC's rules this is implemented at the auction closing after the first round in which there has been no new activity.

2. **Increment Requirements**: As a mechanism for pacing an auction, an auctioneer will typically employ some requirement that a new bid meet a minimum increment requirement. The FCC uses a variable increment that varies across licenses and usually ranges between 10 and 20% depending on the level of activity on the license. The greater the recent bid activity, the higher the bid increment. Bidders submit bids in integer multiples of this minimum increment.

3. **Activity and Eligibility Rules:** One problem in ascending auctions is that if given the option bidders would normally prefer to wait to bid as long as they can. This allows them to keep their intentions and information secret while observing the activity of others. Since everyone has this same incentive, without something to spur on activity, these auctions could take a very long time. The uncertain closing rule serves this purpose to some extent but in auctions as large as the FCC's, more is needed. As a means of accomplishing this, prior to each auction the FCC assigns a certain number of bidding units to each license in the auction. This number varies positively with the population covered by the license leading to the fact that licenses covering more populous and valuable areas have a higher number of bidding units associated with them. Also prior to the auction, bidders must submit an upfront payment that buys them a certain number of bidding units. This money is refunded at the conclusion of the auction if the bidder wins no licenses and applied to their total amount owed if they do win. During the auction, in order to place a bid on an item, a bidder must have a number of unused bidding units at least as great as the number associated with the license. Upon placing a bid, a number of bidding units equal to the number for the license become "active". For example, if there are two licenses in an auction, A and B, such that license A has 100 BU's and license B 75 BU's, then if a bidder were to buy 125 BU's with an upfront payment, in any given round this bidder could be active on either license A or B but not both. In order to be active on both in the same round, the bidder must purchase 175 BU's. This constitutes the eligibility rules, which dictate what licenses a bidder is eligible to bid on. The way the activity rules work is that the auction consists of three stages. In stage 1, a bidder will typically be required to be active on 70% of their bidding units. In the example above, if the bidder only places a bid on B, they are considered active on $75/125=0.60$ or 60% of their bidding units and would not meet the requirement. In that event, the bidders total number of bidding units would be reduced such that he would meet the requirement, or he would be reduced to having $75/.7=107$ BU's. Thus, if a bidder is not bidding actively their ability to continue bidding is jeopardized. As the auction progresses to stages 2 and 3, this requirement is increased to perhaps 85% and then 95%. Bidders are, however, allowed 5 activity rule waivers, which means that they

can waive the requirement during 5 rounds of the auction if they choose and not lose eligibility even if their activity is insufficient to meet the requirement.

4. **Withdrawals:** This last set of rules exists due to the fact that bidder values are interdependent. Assume there is a bidder interested in two licenses such that their value for either A or B independently is 100 but if they can get both their value for the package is 300. Imagine the situation in which the auction is progressing and this bidder is bidding on both licenses and the price of each hits the 100 mark. What should the bidder do? If they end up winning both, they can bid up to a total of 300. What happens though if they bid up to 125 on both and then some other bidder comes in and bids 400 on B. This means that the first bidder can no longer profitably win A and B but they are "stuck" with paying more for A than it is worth to them unless someone outbids them. This is known as the "exposure problem". In order to give bidders a way to deal with such situations, the FCC allows bidders to withdraw standing high bids in two rounds of the auction. When one bidder withdraws a high bid, the minimum required bid drops back to the second highest bid received on the license. To deter frivolous withdrawals, the withdrawing bidder has the possibility of paying a withdrawal payment. This payment is equal to the difference between the price they had bid and the price the FCC eventually sells the license for, assuming the final sale price is less than their bid. If the final sale price is greater, no payment is required. Bidders are also restricted to placing withdrawals in only two rounds of the auction although each bidder can choose the two rounds for themselves.

The set of rules used by the FCC are by no means the only way one might construct a SAA. There are of course several different ways one might structure the increment, activity, eligibility and withdrawal rules but perhaps the most important part of the specification used is the multiple round structure. This structure is necessitated by the large number of items and complex information processing that must occur after each set of bids has been announced. The problem with this structure is that it can lead to very long and drawn out auctions. Some of the early FCC auctions ran 3-6 months although most of their recent auctions have finished in 1-2. For some cases this is an acceptable trade-off but in smaller auctions where there is less complexity, there is little reason to use this format. An alternative is to consider using a continuous SAA. In this version of the auction, bids are announced as soon as they have been submitted and other bidders can respond immediately with a new bid. A reasonable closing rule for such an auction is to use a countdown clock that begins counting down from a certain amount of time, perhaps 15 minutes. Every time a new bid is submitted this countdown clock is reset, but should the clock reach 0, the auction closes. This is a direct analogue of the simultaneous closing rule discussed above. A more detailed description of such an auction can be found in Plott and Salmon (2001). A mechanism of this sort was designed and intended for use for some small broadcast licenses the FCC was scheduled to auction in 2000, but for various unrelated reasons these auctions were cancelled and the mechanism not implemented. Otherwise the only known field use of this mechanism has been for several real estate and other auctions run by the authors of the referenced paper.

It has functioned quite well and can be used to complete an auction in a few hours that might take weeks or months in the multiple round format.

4 LESSONS LEARNED FROM AUCTION RESULTS

Overall the FCC has enjoyed what is generally considered to be a successful series of auctions using the described methodology. There have, however, been a few spectacular failures in the FCC's past and thankfully the reasons for their lack of success are easy to identify and to avoid in future auctions. There are other more minor problems that have appeared in some of the FCC's auctions that are more difficult to eliminate. We will discuss many of these issues including some ideas on how to make sure such problems do not appear in similar auctions.

4.1 IVDS AND C-BLOCK

These are the two auctions that are considered to be the worst failures in the FCC's auction program and the main reason for failure in both is the same. We should also note that the IVDS (Interactive Video Data Service, FCC auction #2) auction was one of the only two auctions the FCC has run, not using the simultaneous multiple round format. This auction was conducted as a sequential series of ascending auctions, but this was not the prime cause of failure in this case.

As part of the FCC's mandate when given auction authority, they were charged with making sure that "designated entities" would have a fair chance to win licenses in the auctions. The phrase designated entities was used to refer to groups thought to be disadvantaged that Congress wanted to be sure were given a chance to compete and initially included new and small businesses as well as women and minority owned businesses. As a consequence, when the FCC was planning their large PCS auctions, they split the first part of the spectrum into three blocks of spectrum, A, B and C, each having 30 MHz of spectrum per license. The A and B blocks were auctioned first and any firm was eligible to bid in this auction. This auction attracted the well-established and large US telecommunication firms such as AT&T and Sprint. The total of the high bids in this auction was $7 billion for a total of 60 MHZ of spectrum covering the entire US. The C block auction (FCC auction #5) was held later and entry into it was restricted to "entrepreneurs" (defined for this auction as entities, together with affiliates, having gross revenues of less than $125 million and total assets of less than $500 million at the time the FCC Form 175 application was filed) and "small businesses" (defined for this auction as entities, together with affiliates, having gross revenues of less than $40 million at the time the FCC Form 175 application was filed). The total of the net high bids in this auction was just under $10 billion for 30 MHz of spectrum covering the entire US. The fact that a group of "small" businesses were offering to pay significantly more money for less spectrum than the large firms were, was a clear sign that something strange was occurring.

That something strange was related to the provisions the FCC had adopted in the C-Block auction to "help" the designated entities. In addition to reserving the auction just for them, the FCC had a belief that the main hurdle to these firms in

acquiring spectrum was access to capital. Consequently, the FCC instituted a system of very generous instalment payments on winning bids from this auction. These consisted of allowing 10 year financing with the first 1-6 years requiring no repayment on the principal at an interest rate based on the 10 year Treasury note. They used a similar scheme for the IVDS auction. The key detail is that these credit options were available to any high bidder in the auction and there was no credit screening at all to determine if firms would be able to pay. As is predicted in Wilkie (1996), such credit terms give bidders an incentive to bid significantly higher than they otherwise would and the bidders with the riskiest business plans will generally be the winners. Many of the firms that did win in this auction were intending to put out an IPO (initial public stock offering) as soon as the auction was completed to obtain financing for their business plans or as a means to quickly turn around and sell the rights to use the licenses they won in the auction. Unfortunately, the auction lasted 6 months (12/18/1995-5/6/1996) and during that time the market for telecommunication stocks suffered a significant downturn making this no longer a viable option. Soon after the auction was completed, many firms began declaring bankruptcy and defaulting on their instalment payments. Although the scale of the problem was much smaller, a similar series of events occurred after the IVDS auction.

The resolution of the bankruptcies for C-block has been a very long and torturous one for the FCC. Many firms after declaring bankruptcy sought refuge in bankruptcy courts to protect the licenses and in some cases the courts forced the FCC to accept significantly reduced payment for the licenses. Other bidders voluntarily returned their licenses, which led to two re-auctions of this spectrum. One was held immediately after the initial auction (FCC Auction #10 from 7/3/1996-7/16/1996) and one several years later (FCC Auction #22, 3/23/1999-4/15/1999).

Perhaps the most problematic case from this auction was Nextwave Communications. They were the largest winning bidder in the auction, winning 56 licenses with total net high bids of $4.2 billion and were one of the ones declaring bankruptcy. After extensive court proceedings, but before they were concluded, the FCC decided to have yet another C-block re-auction to sell Nextwave's licenses in late 2000 (FCC Auction #35, 12/12/2000-1/26/2001). The total of the net high bids in this auction was $16.9 billion. Unfortunately, in August of 2001, the court made its ruling and found that the FCC did not have the right to conduct the auction as the licenses belonged to Nextwave. The final resolution of this case still seems to be in some doubt as to how it will turn out.

There is no doubt that this auction was an unmitigated disaster for the FCC and in no way did it help small businesses as the financing options encouraged many to overbid leading to their bankruptcies. This should not have been surprising as any simple economic analysis, as that shown in Wilkie (1996) would have indicated that such a system was not a good idea. It is important to realize that although this auction was a failure, the problems were not a result of the auction design itself but of these peripheral rules relating to payment schemes. The lesson learned then is that instalment payments are not a good way to try to help small businesses. Why the FCC decided that these firms needed not only a block of spectrum set aside for only their use but also instalment payments is a question that does not appear to have any satisfying answer. Section 5 will deal in more

detail with how one might structure an auction design and a regulatory environment to help out small firms.

4.2 WCS AND LMDS

The WCS (wireless communication service, auction #14) and LMDS (local multipoint distribution service, auction #17) are two more auctions that are generally considered to be failures for the FCC. The WCS auction involved the sale of blocks of 5 and 10 MHz of spectrum in the 2300 MHz range. The LMDS auction involved the sale of 1,150 and 150 MHz licenses in the 2.8 GHz range. In both cases, revenue estimates prior to the auctions were quite large with both being in the billions of dollars. The actual revenue totals were $13,639,132 and $578,749,385 respectively with the most publicized example of these revenue totals being that many licenses in the WCS auction sold for $1 and one of the San Francisco licenses sold for $6. This led many, especially those in Congress after the WCS auction to believe that the FCC had made a serious mistake in these auctions. The question is, what was the mistake?

The mistake in both cases was fairly obvious. In both, the FCC had been forced to rush these auctions through in order to satisfy Congressional and other political pressures. These pressures were largely based on Congresses desire for additional revenues. At the time of the WCS auction, there was no existing equipment that was designed to operate at that frequency and the military, who operates around that part of the spectrum, had indicated that its operations would likely interfere with anyone choosing to operate in this band. In the case of LMDS, due to the fact that it was at such a high wavelength, there were a number of problems with the service having to do with such things as the fact that the equipment that existed at the time was not very effective during rain or even high humidity. An analysis of the post auction results shows quite clearly that the prices and probability that a license sold were significantly negatively correlated with the level of rainfall in the license area.

The LMDS auction is a particularly clear example of the problem due to the fact that a re-auction (FCC Auction #23) was held approximately 1 year after the initial auction in which several licenses that went unsold during the initial auction as well as several licenses returned after a default by a bidder were resold. In the intervening months, there had been a technological innovation in the industry that resolved many of the problems with the service. Due to that and to the fact that the minimum opening bids in this auction were set at a much lower level than the initial auction, competition in the re-auction was significantly higher than in the initial one. In the end, this collection of licenses that had been deemed to be of least value by the market in the previous auction such that no one was willing to purchase them, ended up selling for more in terms of $/MHz*pop than the licenses in the initial auction. This is a clear indication that the initial auction was held earlier than it should have been. There is also an indication that the very high minimum opening bids in the initial auction reduced the number of bidders entering the auction while the “bargain basement” minimums in the second auction led to a significantly greater level of entry.

In both of these cases, we see the problem that comes from rushing an auction to the market before the market knows quite what to do with what is being

auctioned. In such a case, bidders will not have time to form business plans around the spectrum offering and will not have time to obtain financing. Although it is generally considered to be a good thing to get the spectrum into the hands of the firms as soon as possible, the caveat to that should be that the spectrum should be allocated as soon as possible after the industry knows how to use the spectrum. It is important to a successful auction that bidders are given enough time to prepare for it. Otherwise the result is lower revenue and efficiency. It is important to note again though, that the reason for the failure of these auctions had nothing to do with the design of the mechanism but rather the regulatory environment in which the auctions were conducted.

4.3 DEF BLOCK

The DEF block auction (FCC auction #11) represents something of a mini-failure on the part of the FCC and it is discussed more in the report on collusion in auctions. This was the last of the large PCS auctions held by the FCC. It consisted of three blocks of 10 MHz licenses and is generally considered to be the auction in which the most collusive activity occurred.

To assess the potential degree of the problem from collusion, we can look at the revenue achieved by the auction. It raised $2.5 billion while the AB block auction raised $7 billion. A straight extrapolation from the AB results would have predicted an approximate revenue total of $3.5 billion for the DEF block auction since half the total amount of spectrum was offered. A more accurate extrapolation would need to account for the fact that each of the licenses might be less valuable on a per MHz basis in 10 MHz blocks rather than 30, and the fact that the DEF was conducted after most firms had obtained their core licenses. These licenses were mainly intended to fill minor holes in a carrier's coverage area. These and other reasons suggest that the revenue total from these licenses should have been less than the initial offering of AB licenses. Consequently, it is not obvious that the lower achieved level of revenue is due to collusive activity. There were, however, a large number of documented cases of bidders attempting to send collusive signals in the auction prompting many to suggest this had the effect of lower revenue, although no one has been able to provide a convincing estimate of the level of the effect. Without certain knowledge of what exactly caused the lower revenue it does seem reasonable to believe that the effect of any collusive behaviour was certainly not catastrophic, although it was likely non-trivial.

As discussed in the report on collusion, not long after this auction, the FCC closed many of the avenues bidders used to try to send collusive signals in this auction and subsequent auctions have not resulted in anywhere near at least the obvious levels of collusive activity. The problems have likely not been eliminated completely but there is some evidence to the effect that they have been significantly reduced. The lesson from this auction then, is that when designing an auction, it is important to do so in such a way as to limit the potential for collusive activity.

4.4 WITHDRAWALS AND THE NEED FOR COMBINATORIAL AUCTIONS

The final problem with the FCC's auctions is not necessarily endemic to any specific auction but has likely caused at least minor problems in almost every auction with more noticeable problems in others. These problems have to do with the existence of the ability to withdraw a standing high bid and more generally the exposure problem.

As has been explained above, the "exposure problem" is something that can occur in multiple unit auctions when bidders possess values for the items that are interdependent (meaning that bidders view some of the items as either substitutes or complements) but bids are only allowed to be placed on individual items. If a bidder is bidding on the assumption that they will win a group of licenses and be able to realize the synergy value obtained from owning the entire group but then manages to only win a part of the group, then they are likely to suffer a loss. This possibility of loss can lead to a number of things including efficiency and revenue losses as well as post-auction defaults. To minimize this problem the FCC allowed the possibility for bidders to withdraw standing high bids during the auction.

To illustrate this point more clearly we can go back to the example we had discussed earlier of the bidder who valued either license A or B separately at 100 but the combination at 300. The extra 100 that is added to the total value when the two licenses are won together is referred to as the synergy value of the package. When the prices on the individual items get to be 100, this bidder has a problem; do they continue bidding, splitting the synergy value across the items or stop? If they continue bidding, they could end up winning only a single item. This will cause them to make a loss on the auction and could lead them to defaulting on payment or bankruptcy. This is the essence of the exposure problem.

If they are worried about this possibility, then they might stop for fear of being left with only one of the items and having committed to paying a price greater than 100. If this bidder could have won the items by pursuing them, then their refusal to continue bidding hurts both efficiency and revenue. If the bidder would have lost, then only revenue is reduced. The idea for the withdrawal rule then is clear. It gives bidders an option that if they end up winning only one item in the package they can withdraw their bid on it and limit their possible loss. With this safety net, bidders should be more willing to aggressively pursue aggregations instead of ceasing to bid once the individual item values have been reached. Should this bidder end up withdrawing, the hope on the part of the FCC is that another bidder is able to place a bid on the license at the lowered price instead of leaving the license unsold. The intention of this rule then is to be both revenue and efficiency improving for the government and loss reducing for the bidders.

There is evidence that bidders have been able to successfully form the packages of licenses they desire in the FCC's auctions but there is also evidence that the interests of some bidders have been harmed by the exposure problem. The possibility of withdrawals has, however, led to a number of other problems. One is that it makes a strategy of "parking" early in the auction easier to implement and more damaging to the FCC. Parking involves a bidder bidding on items they have little interest in winning during the first part of the auction to draw attention away from the licenses they are interested in and then moving to their real

interests late in the auction. Without the possibility of withdrawals, bidders have to consider the fact that they could be stranded on a license they have little interest in if no one outbids them and this reduces the incentive to park. If the bidder can place withdrawals, however, they can mitigate the damage of such an occurrence by withdrawing their high bid on the license they do not want and shifting their eligibility over to the license they do want.

This exact sequence of events has occurred in many auctions with bidders bidding on licenses they did not want and then withdrawing to move to others late in the auction. The real problem occurs when they do this very late in the auction at a point when no other bidders have the eligibility necessary to place bids on those licenses the bidder withdrew from. This causes those licenses to remain unsold at the conclusion of the auction. Since withdrawal payments are assigned based on the final sale price and no sale has been made, the bidder causing the problem is not even assigned a withdrawal payment. With the licenses unsold at the end of the auction, service cannot be provided to the public with them until after a re-auction has been organized and for some services this can take a very long time.

It is obvious that something has to be done to correct for the exposure problem but allowing withdrawals is not a suitable solution due to the other problems that this option can cause. The alternative is to use a combinatorial auction that allows bidders to place bids on combinations or packages of items. If a bidder has the values of {A,100}, {B,100} and {AB,300} then they can place a package bid of 250 on the group AB and have no risk of only winning one. To do this in a standard auction, they would have to place bids of 125 on each and risk only winning one. A detailed discussion of such auctions is not possible here, but more detailed explanations of the issues involved as well as possible auction designs can be found Plott (2000), Ledyard, Porter and Rangel (1997) and Ledyard, et al. (1999). Such auction designs will be most appropriate for cases in which bidder values for items are interdependent or the amount a bidder is willing to pay for one item depends on the price of another. In auctions where all items are unrelated, or bidders are only allowed to win a single item, then there is little need for combinatorial auctions as the exposure problem is not an issue.

The FCC is currently intending to use a combinatorial auction for the first time in the upcoming auction of returned VHF television licenses in the 700 MHz range (FCC auction # 31). Although the FCC should be applauded for working to construct such an auction, there are many signs that their current design is not one that is likely to be successful. There is a long record of comments from various academic auction theorists and experimentalists on the problems with this mechanism[7] with perhaps the key comments found in Plott (2001), Plott and Salmon (2000) and Harstad (2000). While large-scale combinatorial auctions are by no means easy to design or administer, for certain applications they should be expected to lead to significantly better outcomes. In the past few years, there has been significant progress in the design of such auctions and they have begun to see limited field use. The results are encouraging and indicative of the fact that there is now enough knowledge about how these mechanisms work to support their use in the right circumstances.

---

[7] They can be found in their entirety on the FCC's webpage at: http://wireless.fcc.gov/auctions/31/releases.html .

5 COMPETITIVE EFFECTS

One issue that should be clear from the last section is that insuring a successful auction requires more than just having a well-designed auction mechanism. It is at least equally important to make sure that the auction is being conducted in accordance with a generally well-designed regulatory framework. As was seen before, most of the serious problems with FCC auctions have come through a failing in this area rather than in the area of the auction design itself. One area of the regulatory environment that is considered to be important for an industry such as telecommunications is the degree to which the market is competitive. This issue is so important in the design of license auctions since each license is a grant of some degree of monopoly power to the licensee. Insuring the market for service remains competitive requires more in regard to auction design than just obtaining an efficient allocation.

The FCC has attempted four primary methods to trying to insure that the telecommunications industry remains competitive after the adoption of auctions for license allocations. One of these approaches was the offering of instalment payments to designated entities to allow them a way to obtain financing on favourable terms, which could help them to compete against larger firms. This has already been discussed as an abysmal failure for the FCC. The other three approaches have fared a bit better.

Spectrum Cap

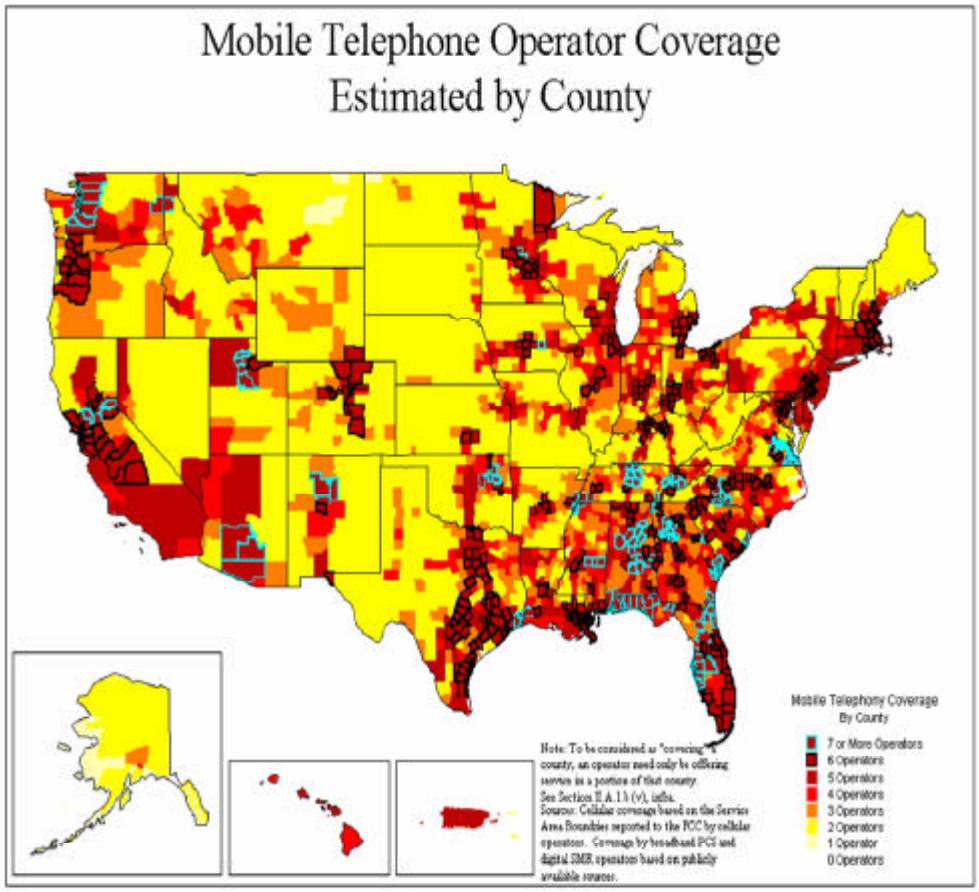
Early in the process of designing a regulatory framework for auctions, the FCC wanted to make sure that no single firm could dominate any market. This led to their imposition of a cap on the amount of spectrum any single firm could have licenses for in any given region. The rule applies to licensed broadband Personal Communications Service (PCS), cellular, or Specialized Mobile Radio (SMR) spectrum. Under the spectrum cap rule, no entity can hold more than 45 MHz (or 55 MHz in rural areas) of spectrum. Without such a cap many feared that it would be possible for a single firm to be the only provider of wireless telephony service in an area as they could acquire the entire available spectrum in the region.

This rule has definitely made certain that there is more than one carrier in each region and in many there are 7 or more different service providers for wireless telephony. As a means of tracking the level of competition in the industry, the Wireless Telecommunications Bureau in the FCC compiles a yearly competition report in which they carefully analyse any trends in increasing or decreasing competition in the industry. Figure 1 is a figure from the most recent report and shows the number of carriers in each part of the US. It shows quite clearly what the rest of the report argues in more detail, which is that the level of competition in this industry is quite healthy in the US.

Competition in the industry has recently been deemed healthy enough by the FCC that they have decided to eliminate the spectrum cap effective January 1, 2003. The belief on the part of the FCC is that the cap has done its job by inducing a large number of operators to enter into the industry and now that there seems to be enough to sustain competition, it is no longer necessary. There are, of course, some who disagree strongly with this viewpoint as evidenced by the dissenting statement released by Commissioner Michael J. Copps alongside the majority

ruling on the issue. His view is that the spectrum cap is working and repealing it is dangerous when there is no compelling reason to do so. While it is uncertain whether the FCC's recent decision to repeal the spectrum cap will help or hurt the industry, by most accounts it seems to have been an effective tool in encouraging competition in the industry.

Figure 1: Mobile telephone operator coverage estimated by county



Source: FCC's 6th Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services; Spectrum Set Asides

Bidding Credits

Another provision the FCC has used to help out designated entities in their auctions is bidding credits. These are essentially percentage discounts on the final payment by a winning bidder if they qualify. In each auction the qualifications will change slightly as will the level of the bidding credit. Typical requirements for bidding credits might be gross revenues less than $5 million/year to qualify for a very small business level for a 25-35% discount and gross revenues less than $25 million/year to qualify for a small business credit of 10-15%. If a qualifying bidder wins a license in the auction, the price they pay is lessened by the amount of the bidding credit.

Assessing the success of this program is difficult. As already explained, the overall level of competition is healthy in the industry and perhaps some of this can be attributed to the existence of bidding credits. Bidders qualifying for these credits have won a significant number of licenses in the FCC's auctions but it is not clear that the same firms would not have won without them. It is also not clear that all of the companies claiming small or very small business status to obtain the credit were legitimately small or very small businesses. Many were potentially "shell" companies serving as a front for a larger firm.

What is more clear about the use of bidding credits is that there is little evidence that they have caused much in the way of harm to the FCC's auctions process and certainly not the same level of harm induced by the instalment payment program. The main problem with the implementation is trying to decide on the appropriate level at which to set the credits. A principled approach would involve a careful study of the degree to which small firms are disadvantaged in credit markets as well as the degree of inefficiency that the regulatory agency is willing to accept if it means increasing the level of competition in the industry. The FCC has not performed such detailed analysis but has set the credits in a fairly arbitrary way. This has the possibility of inducing more inefficiency than desirable and tilting the results too much in favour of one side or the other. In the end, either effect does not appear to have been terribly severe in FCC auctions thus far.

This is the final method the FCC has used in trying to help out smaller firms and it involves setting aside certain licenses that can only be won by firms meeting certain size restrictions at the time of the auction. The success of this policy has been hindered by the fact that the two auctions in which the FCC has used this most are the C-Block and DEF-Block auctions.

The C-Block result has already been discussed as an obvious failure, but the failure was not due to the fact that only designated entities were allowed to enter into the auction. One thing that should be clear is that once a band of spectrum has been set aside for small businesses there should be no need for instalment payments. If the problem for small firms winning licenses is obtaining financing, so long as they are all competing against other small firms, they all face the exact same constraint. Thus there is no reason to use instalment payments as a means of equalizing the playing field, as it is already equal. One would expect prices to be lower in a small business auction, but if the idea is to use the set aside to increase competition, this is not as important an issue.

In the DEF-Block auction, the F block was also set aside to only allow designated entities to win while the D and E, any firm could win. Not surprisingly, the prices on the F block licenses were lower than on the D and E, but again, this was not much of a problem. The real problem was that the F block licenses contained only 10 MHz of spectrum, which was unlikely to be enough for a small business to use to be able to compete against competitors all with 30 MHz or more if this was all they had won.

These complicating issues make it very difficult to assess the level of success of spectrum set asides on the part of the FCC. Theoretically, these will be more effective than either instalment payments or bidding credits in helping out small firms compete as it insures that they will be able to win licenses. The only issue of concern is if too many licenses are set aside like this and the small firms are not able to form legitimate businesses. This has a chance to harm consumers. So long

as that possibility is balanced with potential for increased competition in deciding how much to set aside, it seems that this may be the most effective approach where applicable.

6 CONCLUSION

The FCC was definitely a pioneer in the use of complex multiple unit electronic auctions and their history with using these auctions is an interesting one to learn from. By and large, they have realized a great success with their program, but their few failures have been severe. There are a number of small lessons that the FCC's experience has taught us about auction design but there are two that are pre-eminent above the others.

First, it is important to get the auction design correct. Designing a complex auction mechanism is by no means an easy task and it is very useful for regulatory agencies to work closely with academic auction theorists to try to find a design that seems to best fit the environment. It is also important to conduct rigorous economic experiments to compare alternative mechanisms to make sure that the design works as it is proposed to and also to compare it to other likely alternatives to gauge relative performance levels.

Second, the design and implementation of the auction must take place inside of a generally sound regulatory structure. When the FCC has had a failed auction this has generally been the cause. Either they have tried to use some sort of misguided approach to helping out small firms or they have rushed a band of spectrum to auction before the industry has been ready to absorb it. Either problem should be avoidable and to insure a successful auction program, they and similar problems must be avoided.

REFERENCES

Copps, Michael J. (2001) Dissenting Statement 2000 Biennial Regulatory Review Spectrum Aggregation Limits For Commercial Mobile Radio Services WT Docket No. 01-14, November 8, 2001,

http://www.fcc.gov/Speeches/Copps/Statements/2001/stmjc123.html

FCC Staff Report (2001), *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services* July 2001,

http://wireless.fcc.gov/auctions/data/papersAndStudies.html

FCC Press Release *FCC Announces Wireless Spectrum Cap to Sunset Effective January 1, 2003* WT Docket No. 01-14, http://wireless.fcc.gov/spectrumcap.html

Harstad, Ronald M. (2000) *A Blueprint for a Multi-Round Auction with Package Bidding,* Comment submission to the FCC.

Hazlett, Tom, (1998) Assigning Property Rights to Radio Spectrum Users: Why did FCC License Auctions Take 67 Years? *Journal of Law and Economics* v41, n2 (Part 2 Oct. 1998), 529-75.

Kwerel, Evan and Greg Rosston (2000) An Insiders' View of FCC Spectrum Auctions, *Journal of Regulatory Economics* v17, n3 (May 2000), 253-89.

Ledyard, John O., David Porter and Antonio Rangel (1997) Experiments Testing Multiobject Allocation Mechanisms, *Journal of Economics & Management Strategy*, Volume 6, No. 3, pp. 639-675.

Ledyard, John O., Christine DeMartini, Anthony Kwasnica and David Porter (1998) *A New and Improved Design For Multi-Object Iterative Auctions,* Social Science Working Paper No. 1054, November 1998, revised March 1999.

Milgrom, Paul R. and Robert J. Weber (1982) A Theory of Auctions and Competitive Bidding, *Econometrica*, Vol. 50 No. 5, pp. 1089-1122.

Plott, Charles R and Tim C. Salmon (2001) *The Simultaneous Ascending Auction: Dynamics of Price Adjustment in Experiments and in the UK 3G Spectrum Auction*, Florida State University Working Paper.

Plott, Charles R and Tim C. Salmon (2000) *Comment Sought on Modifying the Simultaneous Multiple Round Auction Design to Allow Combinatorial (Package) Bidding*, comment submission to the FCC.

Plott, Charles R. (1997) Laboratory Experimental Testbeds: Application to PCS Auction, *Journal of Economics & Management Strategy*, Volume 6, No. 3, pp. 605-638.

Plott, Charles R, (2000) *A Combinatorial Auction Designed for the Federal Communications Commission*, Report to the FCC, May 18, 2000.

Plott, Charles R. (2001), *The FCC Rules For the 700MHz Auction: a Potential Disaster* Caltech Working Paper.

7 MOBILE TELEPHONY (3G)

Tilman Börgers, Emiel Maasland and Benny Moldovanu

TABLE OF CONTENTS

1 INTRODUCTION 113

2 AUCTIONS VERSUS BEAUTY CONTESTS 113

3 DESIGN ISSUES 116

3.1 THE MAIN ASPECTS OF LICENSE AUCTION DESIGN 116

3.2 CASE STUDY: THE UK-EXPERIENCE 120

4 EVALUATION 125

4.1 THE UK-AUCTION 125

4.2 THE GERMAN AND AUSTRIAN AUCTIONS 129

5 CONCLUDING REMARKS 133

REFERENCES

1 INTRODUCTION

In the context of the MDW project "Auctions and Alternative Mechanisms", the present case study is of particular interest, since it is one of the few cases in which different countries have chosen for different allocation mechanisms to allocate similar goods. Many papers have already been written on the European 3G auctions.[1] All these papers however have a different emphasis than the current report. This report is structured around the two main research questions of the MDW project, namely:

1. Under what set of circumstances can one allocation mechanism be preferred over others?
2. What are the important issues when it comes to designing allocation mechanisms?

With respect to the first question, we may learn from the reasons why countries have chosen for a particular allocation mechanism and from the experiences these countries have with the choice for this particular allocation mechanism. Information particular to this question is gathered by means of a literature study and a questionnaire we have sent to the government agencies in a number of European countries. With respect to the second question, we may learn from the issues discussed in the individual countries in the preparation phase and from the ex post evaluations of the particular designs chosen.

The structure of this report is as follows. Section 2 relates to the first main question of the MDW project. It gives a comparative evaluation of the different allocation mechanisms used. Section 3, which relates to the second main question of the MDW project, discusses the main aspects of license auction design. The goal is not to give a complete picture, but rather to touch on the issues that in practice matter most for spectrum allocation. In this section we also give a detailed discussion of what the important design issues were when the UK decided for a specific auction. Section 4 provides an evaluation of the design of the UK, German, and Austrian auction.[2] In Sections 3 and 4, we mainly focus on auctions, because the ins and outs of beauty contest design will be discussed in Report 1 in this bundle, and because beauty contest designs are inherently very difficult to evaluate. Section 5 concludes.

2 AUCTIONS VERSUS BEAUTY CONTESTS

This section deals with the question whether one allocation mechanism can be preferred over another when allocating third-generation mobile frequencies. In order to make a relative comparison, it is convenient to make a categorization of allocation mechanisms. Surveying the different licensing methods used so far by

---

1 For survey articles, see for example Jehiel and Moldovanu (2000b), Klemperer (2002b), and van Damme (2002).

2 After reading Section 2, it will become clear why we have chosen for these particular three countries.

the different European countries, one should come to the conclusion that the usual distinction "auctions versus beauty contests" simplifies too much. There are in fact three distinctly different methods. One is that the questions how many licenses there should be, how large they should be, and to whom they should go, are all decided bureaucratically. Another is that bureaucrats decided how many licenses there should be, and how large they should be, but that an auction was then used to decide to whom the licenses should be allocated. The third method is that an auction procedure is used to settle also the number and size of licenses.

According to these three licensing methods, the European countries can be classified as follows:

Method I Finland, France, (Ireland), Norway, Spain, Portugal, Sweden

Method II Belgium, Denmark, Italy, the Netherlands, Switzerland, UK

Method III Germany and Austria

The matrix in Table 1 illustrates the classification of countries. The rows of the matrix refer to the decision by a country to use a bureaucratic procedure (B) or an auction (A) to allocate the licenses. The columns of the matrix refer to the decision by a country to use a bureaucratic procedure (B) or an auction (A) to settle the question how many licenses, and of which size, to award.

Table 1: Classification of countries

		Number and Size	
		B	A
Allocation	B	I	
	A	II	III

It is important to note that within one category variations between countries are possible. For example, the countries that used a beauty contest to allocate licenses, used different criteria and weightings. The countries differed also with respect to the number of phases. Sweden's beauty contest, for example, in contrast to most of the other countries that used a beauty contest, was in two phases. The first phase examined the applicants' financial and technical competence, requiring applicants to demonstrate that they had the capacity to fulfil the obligations to which their applications referred and sufficient capital to build the network. They also had to describe their technical, business and market plans, together with investment and financial information. There was no comparative evaluation in this first phase. Those who met the requirements of the first phase proceeded to the second phase, which involved a comparative evaluation of the applicant's commitments relating to rate of development and coverage, both from a geographic and population viewpoint. Licenses were awarded to those who guaranteed the best coverage and rate of rollout. Among the countries that used an auction to allocate the licenses there were also substantial differences. Some countries chose for an open auction format, other countries for a closed auction format. These countries also differed with respect to the question whether they worked with a pre-qualification stage or not.

We now focus on the question whether or not an auction is to be preferred over a (weighted) beauty contest when allocating radio-spectrum licenses for third-

generation services. We restrict ourselves here to a comparison between methods I and II (III). For the pros and cons of methods II and III we refer the reader to Section 4.2. It is however immediate that method III might be preferable in case there is – within the government - high uncertainty on the minimum spectrum requirements and the number of viable operators.[3] The dominant opinion is that auctions are almost always the best way to allocate radio-spectrum licenses. The main reasons are the following (see Klemperer, 2000). First and foremost, a well-designed auction is the most likely method to allocate resources to those who can use them most valuably. Rather than rely on government bureaucrats to assess the merits of competing firms' business plans, an auction forces businessmen to put their "money where their mouths are" when they make their bids, so the auction extracts and uses information unavailable to the government. Second, even if the government did have access to good information allocation by bureaucrats leads to the perception of favouritism and corruption. Third, auctions are objective, transparent, and relatively fast. As beauty contests are subjective and not transparent, a beauty contest is likely to generate a legal challenge. Practice confirms theory in this matter. In Spain, newcomer France Telecom who failed to secure a license has challenged the outcome in courts. In Sweden, incumbent Telia who did not managed to get a license started a legal procedure too.[4]

We now summarize the arguments we got to our questionnaire why countries have chosen (will choose) for a beauty contest instead of an auction and reason why we agree or disagree with these arguments:

- The competition can be designed to ensure that important factors, such as a speedy roll-out and the extent of coverage, can be requested and marked on a comparative basis, thus encouraging applicants to excel in this crucial area.
- In a comparative selection process winners can be chosen who guarantee the lowest costs to consumers and highest quality to consumers, stimulate most creativity, etc.
- In considering the development of effective competition in the market, supply side considerations, such as the ability of 3G operators to roam on 2G networks and the entitlement of third parties to access mobile networks (MVNOs, resellers, etc) are very important. Through a comparative selection process there is an opportunity to request offers from bidders and, by marking these in a comparative fashion, to encourage the voluntary commitment to allow access.
- Performance guarantees may also be invited from bidders and scored on a comparative basis to underpin commitments.

---

[3] In Germany, an earlier design which prescribed a fixed number of 5 licenses has been abandoned because the flexible design was thought to offer "a fair, undiscriminating, and efficient market solution to the problem of finding the optimal number of licenses" (REG-TP, 2000).

[4] One should however not draw the conclusion that auctions are not prone to legal fights. In the Netherlands and Italy, two countries where the 3G licenses were awarded through an auction, there were legal fights too. In general, the motive to start a legal fight is however different in case licenses are awarded through an auction. The motive usually relates either to the auction design or the behavior of the other participants in the auction.

We agree with the first argument only partly. A (weighted) beauty contest (provided that it is well-designed) might be superior to auctions (with a pre-qualification stage) as in the latter only minimal requirements can be specified.[5] There is therefore no room to excel in auctions. On the other hand, the objectives as specified in the first argument can easily be made explicit and built into the score function of a multi attribute auction. On practical grounds we disagree with the second argument. We do not believe that firms can guarantee consumer prices and quality standards for 5-20 years in the future for products that do not yet exist. Furthermore, the creativity criterion is very vague and difficult to score on. Given the experiences of countries that have chosen for an auction we tend to agree with the third argument. In the UK, for example, the auction was postponed for at least three months, because part of the incumbents mounted a legal challenge on the way the roaming condition was imposed. We disagree with the fourth argument since these performance guarantees can in our view also be built in the auction process by imposing appropriate rules and license conditions.

In conclusion, we can say that the answer to the question whether an auction is to be preferred over a beauty contest when allocating radio-spectrum licenses for 3G services cannot be answered without a clearly defined goal: a high revenue, high-quality services (products), a competitive market after the auction, etc. In case quality considerations play a crucial role, but quality is not objectively measurable, then a (weighted) beauty contest might be best.

3 DESIGN ISSUES

In this section, we discuss the second main question of the MDW-project: What are the important issues when it comes to designing allocation mechanisms? We will mainly focus on auction design issues. For beauty contest design issues, we refer the reader to Report 1 in this bundle.

This section is structured as follows. Section 3.1 gives a general survey of the main issues pertaining to efficiency and revenue maximization in license auctions. Section 3.2 focuses on the design issues that played a role in the preparation process of the UK auction.

3.1 THE MAIN ASPECTS OF LICENSE AUCTION DESIGN

The most important issues in the *design* of license auctions are placed at the intersection of industrial organization and mechanism design. License auctions or (other procedures such as beauty contests) do not only allocate scarce goods, but also determine the nature of whole industries where entry is otherwise very difficult. Hence the outcome of any allocation procedure influences the future interaction among winning firms, regulator (i.e., government) and consumers. This effect should be taken in account for applications of auction theory to license auctions since valuations (which depend on expectations about future market structure) are determined by the allocation procedure itself, and are therefore

[5] A problem with setting minimum requirements is that they cannot be set too high, because otherwise there is a chance that no applicant can meet them.

endogenous. Thus, potential acquirers of licenses will anticipate the future scenarios as a function of the auction's outcome, and they will condition their behaviour before and during the auction on those expectations (Jehiel and Moldovanu, 2000a,b). Failing to take into account these basic strategic motives at the design stage can have harsh consequences for governments and/or consumers.

3.1.1 THE MAIN GOAL: ECONOMIC EFFICIENCY

The main goal of most license allocation procedures is economic efficiency, which, correctly interpreted, means the maximization of a (possibly weighted) sum of consumer and producer surplus. This maximization exercise must necessarily consider several alternative future market scenarios. A secondary goal in most license auctions has been raising revenue for the government.

A serious hurdle on the way to economic efficiency is due to the fact that consumers do not directly participate at the spectrum auctions or beauty contests. Moreover, an ex-ante measurement of expected consumers' surplus in various market constellations is very difficult. Therefore, consumer surplus does not naturally play a role, unless special provisions are made in a careful auction design. Unfortunately, at the design stage the regulators operate in the dark since information about consumer welfare in various future scenarios cannot be easily measured or anticipated. Only after a regulatory scheme which satisfactorily deals with this problem has been chosen, it is possible to concentrate on an auction format that aims at maximizing the value for firms or the government's revenue.

3.1.2 EFFICIENCY AND ENTRY

There are myriads of oligopoly models which make various predictions about the relations between concentration measures (that aggregate the number of firms and their respective outputs), industry profits and welfare. There is no conclusive theory. Several standard oligopoly models predict that in, reasonable ranges, both consumers' surplus and overall efficiency increase with increased competition among firms. This justifies the pursuit of the goal "create sufficient market competition" as a proxy for economic efficiency. But creating sufficient competition means that entry should be encouraged as long as it is economically viable. Obviously, the duplication of fixed costs and other factors specific to network industries imply that new entry cannot be forever welfare increasing. Entry encouragement must come at the licensing stage since, unlike standard industries, which do not require a tedious licensing process, entry is either impossible or very difficult at later stages (due to spectrum scarcity, strong network effects, regulatory constraints, etc.).

The most important variable for controlling entry is the number of licenses. Since the "right" number must take into account also the future consumers, its determination is, in practice, very difficult. Note that this is, primarily, an issue of industrial organization, not of auction design![6]

[6] Most countries adhered for their UMTS auction to the following rule-of-thumb formula in order to determine the "right" number of licenses: Number of 3G Licenses = Number of GSM Incumbents + 1.

3.1.3 ASYMMETRY BETWEEN INCUMBENTS AND ENTRANTS

Why should one choose a design where entry is likely? Why is it not enough to choose a design that gives all firms equal chances to acquire licenses? Because entry is encumbered by a basic asymmetry in license valuations among the firms that already operate a GSM network in a given country (incumbents), and those that do not (entrants).

For any bidder, the "pure" economic value of a license with a fixed capacity is obtained by subtracting from the value of future expected profits the fixed cost required to build a network and start operations.

Note that the value of expected profits increases if the license is endowed with more capacity, and decreases if more firms are licensed.

The asymmetry between entrants and incumbents has three main causes:

1. The fixed cost of setting up the infrastructure required for 3G services is very large, but some of the 2G incumbents' fixed costs are already sunk, since they can use parts of their already existing facilities (e.g., base station sites).

2. Many incumbents enjoy large customer bases and strong brand names, and have accumulated significant marketing know-how. In particular they will enjoy a positive cash-flow also during the years till full deployment of 3G services.

3. Since per-firm industry profit tends to decrease in the number of active firms, incumbents are additionally driven by entry pre-emption motives (e.g., the need to avoid cannibalisation of their existing profits by additional entrants) which translate into increased willingness to pay for licenses and capacity (see also Gilbert and Newbery, 1982, and Katz and Shapiro, 1986 in the context of patents).

To sum up, incumbents will tend to have higher valuations for licenses than new entrants even if the respective firms are otherwise comparable in terms of operating costs, technical know-how, managerial skill, etc. (see also the commercial evaluations made by investment banks such as Deutsche Bank, UBS, and WestLB Panmure in 2000). Hence, incumbents will be willing to bid higher than entrants, and we should always expect that all GSM incumbents get 3G licenses. Otherwise stated, entering the market by directly overbidding a GSM incumbent seems possible only if the new entrant is much more efficient and therefore expects much higher profits in the future.

If potential entrants understand this logic, they will either choose not to participate at the auction, or they will try to form consortia with incumbents. Both types of behaviour have been amply observed in many of the UMTS auctions, with adverse effect on competitiveness (and hence ultimately on efficiency), and on revenue. Hence, a main question for practical design exercises is how to alleviate the incumbent-entrant asymmetry and to encourage entry.

Special circumstances may lead to an entrant having a higher value than an incumbent. For example: 1) a particular country license may be the "last piece in the puzzle" for a global firm which, consequently, may be willing to pay more than a small incumbent with only local interests; or 2) due to idiosyncratic circumstances (e.g., after buying expensive licenses elsewhere) an incumbent may

have a tight budget constraint. But such features are hard to predict, and are subject to constant change since firms form and break alliances, change business plans, stock exchange valuations fluctuate, etc. In our view considerations based on such transitory features should not play a major role in auction design.

There are several other features, not directly pertaining to the rules of the allocation procedures, that influence the probability of entry. The adoption of all or some of the following rules has the effect of decreasing the infrastructure costs (including financing costs), with a stronger relative effect on entrants. They can play an important role in levelling the field between entrants and incumbents.

Mandatory roaming. This stipulation requires GSM incumbents to grant an entrant access (for an appropriate fee) to their networks while the entrant builds its own infrastructure. This means that a new entrant can immediately start to offer 2G services and generate a positive cash flow for the several years it takes to build a new network. The UK design originally included this feature, but it was overturned following a suit brought by an incumbent (DT's subsidiary OneToOne). A "voluntary" agreement between the government and two other incumbents will now guarantee free roaming. In Germany the incumbents complained that a free roaming stipulation infringes on their existing rights, as defined by the terms of their GSM licenses, and the idea was abandoned. The regulatory agency argued that roaming agreements can and will be achieved by bilateral bargaining.

License fee payment by instalments. Another way to ease the financial constraints is to parse the license fee over several years. While this rule benefits all firms, it is particularly important for new entrants whose cash flow is going to be negative in the first years, due to the large infrastructure investment. UK adopted such a plan, but the required interest rate was so high that firms chose not to use this opportunity. In contrast, Germany required full payment just 10 days after the auction. As it became clear that the fees are going to be enormous, adverse reactions on the share prices and bond ratings were triggered. These reactions were partly responsible for the timing of the auction's end (see details below).

Mandatory site sharing. This stipulation requires GSM incumbents to grant access to their antennae and relay installations, so that several firms can use the same facility. Note that 3G networks will require a denser cell structure than existing 2G networks. Moreover, it is increasingly difficult to obtain authorization for new sites, due to planning and environmental restrictions. Dealing with this issue is thought to constitute a sizable share of the infrastructure costs. Hence, mandatory site sharing can considerably reduce these costs. Not surprisingly, incumbents have argued that, due to technical constraints, site sharing is not feasible on a large scale. In Germany there are new considerations about the feasibility of such plans, and it is now conceivable that not all licensed firms will build independent networks.

3.1.4 REVENUE MAXIMIZATION

Till now we discussed efficiency aspects. Another important goal has been revenue maximization. Often this goal has been (erroneously) regarded as the main one by the media, the public, and even by some academic commentators that tend to compare auction outcomes on the basis of the associated revenue. Revenue maximization seems a legitimate goal, particularly in the cases where it is

believed that this form of taxing firms is more efficient (i.e., less distortionary) than other, more traditional taxation schemes.

The revenue-maximizing format for multi-object auctions is not known at a good enough level of generality (see Report 4 in this bundle for some theoretical results). Pure revenue maximization often calls for bundling of objects, which, in the context of license auctions may lead to unacceptable monopolization (see Jehiel and Moldovanu, 2001). But there are several simple insights that may be used in order to obtain satisfactory revenues:

1. Besides the value of the objects, the most important factor determining revenue is the amount of competition during the auction. As we argued above, the design itself may affect the firms' participation decisions (e.g., if entrants see no chance of winning licenses they will stay out). In this respect the ratio of new to old licenses is crucial, and the Dutch experience showed what could happen when this ratio is equal to 1.

2. Proper reserve prices that reflect the scarcity of spectrum and its other potential uses should be imposed. Such a feature can avoid catastrophic results even if, ultimately, there is not enough competition coming from the bidder side.

3. An important aspect is collusion avoidance. Collusion during the auction must be based on some exchange of information (note that the simultaneous ascending design is rather favourable to such exchanges). Hence, a restrictive disclosure policy during the auction will make collusion harder (some commentators even suggest the use of sealed-bid or mixed, ascending-sealed designs), but it will also hamper the flow of information that may be relevant in order to achieve a value maximizing outcome (this aspect is important in instances where there are strong common elements in the valuations of different firms). There is also a relation between collusion and the incumbent-entrant asymmetry mentioned above. From the point of view of incumbents, who want to avoid entry, sustaining the collusive is more difficult if there is no focal, symmetric method which allows the incumbents to share the pre-emption cost without exchanging side-payments, which is usually illegal. In such a case there will be free-riding among incumbents (leading to increased entry) since each one of them prefers to let other incumbents pay the cost of pre-empting the entrants.

3.2 CASE STUDY: THE UK EXPERIENCE[7]

The principal goal of the United Kingdom's government for the UMTS spectrum auction was to achieve the efficient use of the available spectrum. Revenue generation was also mentioned as a goal, but it was clearly ranked second in the hierarchy of goals of the UK auction, behind efficiency.

---

[7] As the title of Section 3 suggests the discussion will focus on the *auction* design. This means in particular that we shall not discuss the considerations which affected the design of the *licenses* in the UK. The case provides in particular insight into the different choices concerning design made at different stages of the preparation process and the reasons for these choices.

As the UK decided to offer a fixed number of licenses efficiency meant that the licenses were to be awarded to those who would "use them most valuably". In some government documents it was further specified that efficiency related primarily to the interest of the private and business customers of the mobile telephone industry.

The primary goals of the UK auction were, of course very general. It is important to consider the more specific concerns that dominated the discussions of the auction, and the relation between these specific concerns and the underlying goals. The most frequently raised concerns are listed below.[8]

– Participation of outsiders was to be encouraged.

  Participation was regarded as important for efficiency because the auction was meant to be the means by which the government would discover which companies would use UMTS licenses most valuably. The auction would be able to perform this task only if all potentially interested mobile telephone companies actually participated in the auction. Participation was also seen as important for revenue generation. The auction would generate higher revenues if there was more competition for licenses.

  It was taken for granted that the incumbent operators of mobile telephone networks in the United Kingdom would participate in the auction, but it was not taken for granted that outsiders would participate. Therefore, discussions about participation focused on outsiders.

– Information exchange among bidders was to be facilitated.

  It was felt that it would be important to allow bidders to observe the other bidders' bids during the auction. It was not made explicit in the discussions of the UACG *why* this was regarded as desirable. However, as this point was raised by economic advisors, presumably standard economic arguments were behind this point. The most prominent standard argument is as follows. Open and observable bids allow bidders to draw inferences about other bidders' valuations, and hence other bidders' business plans. Thus, in a certain sense, information exchange among bidders is possible. This can be good for revenue. This is because information exchange among bidders reduces in expected terms the amount by which bidders shade their bids to protect themselves from the "winner's curse". The "winner's curse" affects winners who win an auction only because they have had partial, excessively optimistic information.

  It was probably also expected that information exchange would be efficiency enhancing. If information exchange was facilitated bids would be based on better information, and thus the auction might come closer to assigning the licenses to those bidders who would use them most valuably.

---

[8] The main source for the discussion that follows are the minutes of the meetings of the UMTS Auction Consultative Group (UACG) which was set up in early 1998 as a forum in which the UK government's proposals for the auction of UMTS licenses could be discussed by the industry. These minutes are available on the internet at: http://www.spectrumauctions.gov.uk/3gindex.htm. An additional source is "The biggest auction ever: the sale of the British 3G Telecom Licenses" by Ken Binmore and Paul Klemperer (forthcoming in the *The Economic Journal)*. This paper makes no use of confidentially acquired information.

Of course, not every form of information exchange was regarded as desirable. Where information exchange could facilitate collusion, it was clearly undesirable. Collusion will be discussed further below.

– Bidders were to be encouraged to bid close to their true valuations.

  Like in the case of the previous point it was not explicit *why* this was regarded as important. However, one consideration clearly must have been that this would enhance efficiency. If bidders bid their true valuations, and if the highest bidders are awarded licenses, then those with the highest valuations will be awarded licenses. Assuming that bidders' valuations of the licenses, i.e. their anticipated profits, are an indication of the extent to which they will use spectrum valuably one thus obtains the conclusion that efficiency is achieved. Of course, efficiency could be achieved in other ways as well, for example if each bidder bids exactly one half of its true value. But bidders bidding their true valuation will, under most auction formats, lead to higher revenue. Thus, this point might be motivated by a combination of efficiency and revenue considerations.

– Collusion was to be prevented.

  Collusion could endanger the efficiency of the auction, for example by allocating spectrum in a potentially inefficient negotiation process among bidders before the auction. Collusion clearly could also reduce the governments' revenue, for example if bidders found some agreeable allocation of licenses in advance of the auction, and then agreed to bid only in accordance with this allocation. Bidding would then not proceed very far, and the final license prices would be very low.

– Bidders should be able to express preferences for specific licenses.

  The licenses offered in the UK auction were designed by the government, and even if the government thought the licenses to be identical the bidders might disagree and might have preferences for specific licenses or specific spectrum bands. If this was the case then efficiency required that the license allocation reflected these preferences. Therefore, the auction should offer bidders the possibility to express preferences for specific licenses.

These were the main considerations which were regarded as important in the discussions preceding the UMTS spectrum auction in the United Kingdom. A further interesting question is how these considerations were applied when different auction formats were considered. Roughly speaking, the discussion preceding the UK auction focused on the relative merits of open, ascending bid auctions in comparison to certain sealed bid auctions. The sealed bid auctions which were considered typically had elements of "first price auctions" in which bidders pay their bids, whereas open, ascending bid auctions implement payment rules where bidders pay the price at which the last competing bidder dropped out of the auction.

Open, ascending bid auctions are a more standard format for spectrum auctions. The main reason why the UK considered nevertheless also sealed bid, first price auctions was that it was hoped that such auctions would encourage participation by outsiders. Economic theory predicts that under a sealed bid, first price format bidders who are known to have high valuations will sometimes place bids which

risk being overbid by bidders known to have lower valuations. This possibility makes it worthwhile for bidders with lower valuations to participate.[9]

Another potential advantage of a sealed bid auction was seen in the fact that it would be harder to collude under a sealed bid format. With open bidding, deviations from collusive agreements can be discovered while the auction is still going on, and can hence be threatened with effective punishment in the auction. By contrast, under sealed bidding, deviations from collusive agreements can be discovered only once the auction is already over, and are therefore more difficult to punish. Thus, collusive agreements appear to be harder to enforce in sealed bid auction formats than in open auction formats.

These potential advantages of first price, sealed bid auctions over open, ascending bid auctions had to be compared to possible drawbacks. Open, ascending bid auctions obviously facilitate information exchange whereas sealed bid auctions don't. Moreover, in sealed bid auctions bidders do not have an incentive to bid their true valuations, but rather shade their bids. By contrast, in open ascending bid auctions bidders have an incentive to stay in the auction until the price reaches their true valuation. Finally, it is much easier to offer bidders the possibility to express their preferences over licenses in open ascending formats than in sealed bid formats. In sealed bid auctions for non-identical objects a co-ordination problem easily arises. If, for example, all bidders prefer a particular license, but differ in their additional willingness to pay for this license, a sealed bid format makes it hard to avoid the outcome where all bidders bid for this license, and no bidder bids for alternative licenses.

Turning now to the precise auction formats considered in the UK one has to distinguish three phases of the discussion. The first phase is the preparation period up to approximately November 1998. In this phase of the preparation it was assumed that the UK would offer four approximately identical UMTS licenses. In November 1998 the possibility was first mentioned that five licenses might be available. The second phase lasted until May 1999. In this phase the government was involved in consultations regarding the number of licenses. In May 1999 the government confirmed that it would auction five, not quite identical licenses. The final phase lasted from May 1999 until November 1999, when the government announced formally the rules of the auction.

In the first phase of the auction preparation, i.e. before November 1998, the encouragement of participation was viewed as a major concern. This was because the number of available licenses was exactly equal to the number of incumbent operators of mobile telephone networks. Outsiders thus might view it as a forgone matter that all the incumbents would obtain a license and might therefore prefer not to participate. In order to encourage participation the discussions therefore focused on an auction design that involved a sealed bid stage.

On the other hand, information exchange was also regarded as important, and therefore a hybrid construction was proposed in which an open, ascending bid auction took place until all but five bidders had dropped out of the auction. The remaining five bidders would then participate in a sealed bid auction. The

---

[9] The theoretical paper on which this argument was based is: Klemperer (1998). The argument is more general than this paper, though, and the version of the argument presented here is somewhat different from Klemperer's construction.

minimum bid in this auction would be the price at which the sixth bidder had dropped out of the auction. This hybrid construction was called "Anglo-Dutch auction" because the open, ascending auction format is also known as the "English" auction, and the sealed bid format implements the same outcome as the descending clock auction that is known as the "Dutch" auction. The "Anglo-Dutch auction" was the working hypothesis of the UK government until November 1998.

Two formats of the sealed bid stage of the "Anglo-Dutch auction" were considered, one in which each bidder had to pay his own bid, and one in which all bidders had to pay the fourth highest bid. Note that even with the latter format a bidder runs the risk of paying his own bid, since any bidder's bid may happen to be the fourth highest bid. It is in this sense that this auction format has important features in common with "first price auctions".

An additional problem that played a role in the discussions preceding November 1998 was the question how to deal with the possibility that bidders might have preferences among licenses. This was regarded as a second order issue because the licenses would be designed to be very similar to each other. Thus, neither the English, nor the Dutch phase of the proposed auction format would deal with possible differences. Instead, the English and Dutch phases of the auction were supposed to be followed by a third phase which had again elements of an open, ascending bid auction, and in which bidders could bid for specific licenses. Two different versions of this phase were considered and tested experimentally. However, as this phase was never implemented, and as this was regarded to be a second order issue we omit the details here.

Following the announcement in May 1999 that five licenses would be available, and that moreover these licenses would clearly not be identical to each other, the advantages of a sealed bid auction were perceived to be much lower. Encouragement of entry was a much lower priority with five licenses than with four. Moreover, the government had decided to reserve the largest available license for an outsider. This was expected to provide additional incentives for outsiders to participate. The differences in the licenses meant that a sealed bid format would create complicated co-ordination problems. As a consequence, the government adopted an open, ascending bid format.

The chosen auction format was very similar to that used in US spectrum auctions. All licenses were offered at the same time. The auction was organized in rounds. Bids were made for specified licenses. In each round the currently leading bidders for a license were committed to their bids, and could not make any new bids. All other bidders could either overbid one of the currently leading bids, or they had to drop out of the auction. Licenses were allocated only after there was no further bidding for any of the licenses.

A concern that was raised in the final phase of the preparation of the UK auction rules was that outsiders might end up paying more money per MHz of spectrum for their license than incumbents. This was seen as undesirable because if this were possible entry would perhaps be less encouraged than was hoped. Several mechanisms for constructing endogenous reservation prices for unreserved licenses were proposed which were intended to ensure that the per MHz price of unreserved licenses was not lower than that of the license reserved for an outsider.

Although these proposals were discussed in the UACG in May 1999, they were never implemented.

4 EVALUATION

In this section, we evaluate the UK-auction (representative of method II), and the German/Austrian auctions (representatives of method III). For both cases, we make a comparison between the auctions' outcomes and the models' predictions.

4.1 THE UK AUCTION

In this section we examine whether the bidders in the UK auction behaved as predicted by economic theory. One of the conclusions will be that bidders bid irrationally, implying that we cannot assess whether the auctions achieved the main objective of the auction (ex-ante efficiency). We therefore also do not know whether the UK auction has been a success or not. We first describe briefly the design and the outcome of the auction (see also Section 3.2).

Design

The chosen design revolves around a simultaneous multiple-round ascending auction, augmented by various activity rules that control the speed of the auction and limit to some extent gaming behaviour. After each round all bids were revealed to the bidders. The simultaneous approach and the concept of activity rules have been introduced and widely employed by the US Federal Communication Commission. In our view, the most important decision concerned the number of auctioned licenses, which was finally fixed to be 5, one more than the number of GSM incumbents. Moreover, only new entrants were allowed to bid on license A, which was also endowed with the highest capacity, 2 x 15 MHz (paired spectrum) +1 x 5 MHz (unpaired spectrum). Bidding on licenses B,C,D and E was open to all qualified bidders. License B was endowed with 2 x 15 MHz ,while licenses C, D, E were endowed with 2 x 10 +1 x 5 MHz each. Hence, both the number of licenses and their capacity endowments were fixed in advance by the regulator.

Outcome

There were 13 participating bidders, and 150 rounds of bidding. 4 licenses were acquired by the 4 GSM incumbents (with the largest unreserved license going to Vodafone), while the reserved license A was acquired by an entrant, TIW. Total revenue was £22.5 billion. The identical licenses C, D, and E sold for the same price (slightly more than £4 billion), while licenses A and B were more expensive (they were endowed with more capacity). In spite of the high prices, and in spite of "expressions of shock" uttered by various firms, analysts do not believe that firms have overpaid, i.e., the discounted value of expected profits minus infrastructure costs is likely to be higher than the license prices.

Assessment

Considering first participation in the auction the economists' prediction that incumbent operators of mobile telephone networks would participate, and that

outsiders would find participation attractive as well was confirmed. All four incumbents and, in addition, nine outsiders entered the auction.

The economists' predictions regarding participation were also confirmed in a second, more subtle sense. The economists involved in the design of the UK auction had been concerned about participation because they thought it likely that all incumbents would win licenses, and that outsiders would understand that. The outcome of the UK auction was indeed that all four incumbents won licenses.

Turning secondly to the issue of collusion, there was no public suggestion that any collusion took place in the UK auction, and the bidding data do not contain any indication of such collusion. Indeed, the winning bidders in the UK auction paid more per head of the population for their licenses than in any other European country. Therefore, if collusion was attempted, it was certainly not very successful. This confirms the intuition derived from economic theory that collusion in an auction in with many participants is more difficult to achieve than collusion in an auction with few participants.

For the following remaining issues it is more difficult to judge whether the outcome of the auction follows the predictions of economic theory: Did information exchange play a significant role? Did bidders bid up to their true valuations? Did bidders express consistent preferences among licenses? Indeed, it is not always clear what the predictions of economic theory regarding each of these issues are.

For a first approach to these issues it is useful to neglect the issue of information exchange among bidders. Indeed, suppose for simplicity that bidders had fixed valuations which were possibly different for different licenses, but which were not affected by information held by other companies, or by information released during the auction. Then there is indeed a sense in which economic theory predicts that bidders will bid up to their true valuations, and that they will consistently express their preferences among licenses. This will be true if bidders bid "straightforwardly", i.e. they bid in each round for the license which offers in that round the highest "surplus", i.e. difference between value and minimum admissible bid, and they drop out once the highest available surplus becomes negative. Straightforward bidding in this sense is indeed a prediction of economic theory for the UK auction in the sense that it constitutes one equilibrium of the UK auction.[10]

Did the bidders in the UK auction bid straightforwardly? The answer is unfortunately not unambiguous.[11] For some aspects of bidding the answer is "yes", but for some certain other aspects of these bidders' bidding the answer is "no". A positive conclusion can, for example, be obtained if one focuses on how bidders chose for which of three apparently identical small licenses to bid. Most bidders' bids suggest that they were indeed indifferent among these licenses. These bidders placed bids only for that license among the three small licenses which offered currently the highest surplus. Some bidders expressed a clear

---

[10] It appears possible that other "equilibria" exist as well. Theoretical research in this area is still ongoing.

[11] The following discussion is based on "Strange Bids: Bidding Behaviour in the United Kingdom's Third Generation Spectrum Auction", and "Rationalizing the UMTS Spectrum Bids: The Case of the UK Auction", both by Tilman Börgers and Christian Dustmann, and both available as discussion papers at the "Centre for Economic Learning and Social Evolution" (ELSE) at University College London.

preference among these licenses, which is also in line with straightforward bidding. This also confirms that the economists' concern about possible heterogeneity of apparently identical licenses was justified.

A similar positive conclusion can be obtained if one focuses exclusively how bidders chose among large licenses the particular license for which they wanted to bid. However, if one focuses on bidders' choice of bidding for a large versus bidding for a small license a more problematic picture emerges. If bidders had bid straightforwardly, then their choices would have revealed a consistent estimation of the difference in value between a large and a small license. Straightforward bidding implies that bidders bid for a large license as long as the minimum admissible bid for a large license does not exceed that for a small license by too much, but that if this difference exceeds some threshold bidders switch to bidding for a small license. The threshold equals the bidders' estimate of the difference between the value of a large license and the value of a small license.

Several companies' choice between large or small licenses deviated in the UK auction very significantly from straightforward bidding. In particular, there are several companies whose initial bidding behaviour suggests that they have a relatively low estimate of the added value which a large license would provide, but that their estimate is dramatically revised upwards during the auction. An example is British Telecom, one of the incumbents. In the first half of the auction British Telecom's bids suggested that their estimate of the difference in value between a large and a small license was about 300 million Pounds, but towards the end of the auction they placed bids which suggested that their estimate of this difference was then about 1,800 million Pounds. Other companies for which such upward revisions of the estimated value difference were observed include TIW, the outsider who ultimately won a license in the UK, and NTL Mobile, the company whose withdrawal from bidding triggered the close of the auction.

The discussion of bidding in the UK auction so far has been based on the assumption that information exchange during the auction did not play a significant role. Now it is important to consider whether the phenomena described above can be reconciled with economic theory if one allows for informational exchange. Thus, for example, British Telecom might have deduced from its observations of other companies' bids in the auction that the extra value of a large license was much larger than they had thought initially. This seems possible, and this argument would provide a possible rationalization of their bids. A problem is that the effects, which were observed, are quantitatively very large. Using again British Telecom as an example, it is difficult to imagine which substantial information might have led British Telecom to revise an estimate of the value difference of 300 million Pounds to obtain an estimate of 1,800 million Pounds, i.e. six times the original estimate.

Bidders in the United Kingdom's auction thus seemed to infer from the way in which the auction was proceeding much more than can conceivably be rationalized. They read much more into their competitors' actions than can plausibly deduced from these actions. One possible explanation is that this is an artificial effect, and that early bids in the auction are simply meaningless, because all bidders know that the auction won't close soon. If that is the case, then information exchange did not take place in the early rounds of the auction, and the UK auction format facilitated less information exchange than was hoped.

Alternatively, one might see the bids as a reflection of an excessive spirit of competitiveness in the auction. Bidders might have aimed to outbid their competitors independent of whether their bids were justified by business cases or not. If that is correct, then a legitimate concern about the use of auctions in spectrum allocation is that auctions might stimulate such an excessive spirit of competitiveness. It should be noted, though, that this is a highly speculative point, and that much further evidence is needed before any policy advice can be based on this point.

Other suggested explanations of the phenomena observed in the UK auction include that bidders might have learned information that affected their valuation not from the auction itself, but from events outside of the auction. The most plausible candidate is that bidding might have been affected by information contained in share prices. However, the analysis of the relation between bidding and share price movements has so far not uncovered any regularities. One might also think that bidders might have changed their bidding behaviour in response to changes in their anticipations about the auction outcome. For example, once it became clearer which outsiders were financially strong, and which would drop out of the auction early, companies might have made their business plans more precise, and might have consequently changed their bidding strategies. A detailed scrutiny of the bidding data for the UK auction does not, however, provide strong evidence in favour of this hypothesis.

It is impossible to judge whether the irregularities in bidding which were found in the UK data have affected the efficiency of the UK auction in any way. They have certainly not had adverse effects on the revenue of the auction. It seems nonetheless important to record these deviations of observed behaviour from expected behaviour. More experience with similar auction formats is needed before a definite interpretation of the available observations is possible. The UK experience simply indicates that economic theory does not fully understand let alone fully predict all that goes on in spectrum auctions.

Another point regarding the UK auction which is worth noting is that bidding in the UK auction seemed to be strongly affected by the companies' credit constraints. For example, five companies all dropped out at the same time in the middle of the auction. It seems likely that these companies dropped out not because the bids had reached their reservation value but because the bids had reached their credit constraint. If this is correct, then the efficiency of the auction is crucially linked to the efficiency of the credit market. With asymmetric information economists typically do not expect credit markets to be efficient.

What do we conclude from this analysis? Firstly, because the benchmark scenario (straightforward bidding) is so clearly rejected, it is not obvious that efficiency was achieved in the auction. There is no known theoretical argument which would suggest that efficiency was achieved. *Thus we question whether the widely held view that the UK's auction was an unambiguous success is supported by evidence.* Note, of course, that we do not assert the opposite, i.e. that the efficiency objective was not achieved. We do not have evidence to support such an assertion. We also emphasize that the question whether the UK's government fully achieved its objectives is different from the question whether the UK's government could have done better. We are in no position to answer this question either. Our analysis suggests that advice offered to governments and to potential bidders must be cautious

about the extent to which it promises full efficiency, and that it should not suggest that straightforward bidding is necessarily the correct solution to bidders' strategic problem.

4.2 THE GERMAN AND AUSTRIAN AUCTIONS

The purpose of this section is to make an assessment of the German and Austrian auctions and to analyse the benefits and disadvantages of a "variable prize" auction relative to a "fixed-prize" auction. We first describe briefly the design and the outcome of the auctions.

Design

The rather complex design (which was shared by both countries) involved two consecutive auctions. The first auction allocated licenses together with so called "duplex" or "paired" spectrum frequencies. The second auction allocated paired spectrum that has not been sold at the first auction, together with additional "unpaired" spectrum. Both auctions were of the "simultaneous multiple-round ascending" type.

At the first auction, bidders did not directly submit bids for licenses. Instead, the auctioned objects were 12 abstract blocks of paired spectrum (i.e., their location in the spectrum range was not known prior to the auction). A bidder obtained a license only if he acquired at least two blocks, but a bidder was allowed to acquire (at most) three blocks. The number of licensed firms was therefore variable (between 0 and 6). If all blocks get sold, then there were bound to be at least 4 licenses (this equals the number of GSM incumbents in both Germany and Austria).

Each block had a reserve price of DM 100 Million in Germany and Euro 50 Million in Austria. At each round a bidder had to bid on at least two blocks. Strangely enough, although the blocks were abstract and identical, bids carried nametags! Bidding on only two blocks at one round precluded bidding on three blocks at later rounds. After each round, only the temporary winning bids on each block were announced (together with the identity of the temporary winners). In particular, it was not always immediately known whether a firm did bid on two or three blocks, but partial re-constructions were possible after observing activity in a few stages.

A block could have remained unsold either because there were no bids for that block above the reserve price, or because the bidder who submitted the last highest bid on that particular block ultimately failed to acquire two blocks, in which case he was not required to make a payment.

The purpose of the second auction was to allocate additional capacity among the bidders that were licensed at the first auction. This means that only those bidders that previously acquired at least two paired blocks of 2 x 5 MHz are allowed to participate.

Besides unsold paired blocks from the first auction, the second auction allocated additional 5 unpaired blocks of 1 x 5 MHz each. Bidders could acquire any number of unpaired blocks, but are not allowed to acquire more than 1 paired block (if any were left from the first auction). Each unpaired block had a reserve price of DM 50 Million in Germany, and Euro 25 Million in Austria.

Outcomes

In Germany there were 7 bidders (including 4 GSM incumbents), after 6 other qualified bidders ultimately withdrew from the auction. The auction lasted for 3 weeks and 173 rounds of bidding, and resulted in 6 licenses being awarded (4 of them to the existing GSM operators). The licensed firms were the 4 incumbents and two new entrants (one of them already operating as service provider). Each licensed firm acquired 2 blocks of paired spectrum, paying approximately Euro 8.4 Bn (or Euro 4.2 Bn per block).

The most interesting thing occurred after one of the potential entrants, Debitel, left the auction after 125 rounds and after the price level reached Euro 2.5 Bn per block. Since 6 firms were left bidding for a maximum of 6 licenses, the auction could have stopped immediately. Instead, all remaining firms (and in particular the two large incumbents, Deutsche Telekom and Mannesmann) continued bidding in order to acquire more capacity. But no other firm was willing to quit. One by one, firms stopped trying to acquire more capacity, and bidding stopped in round 173. Compared to round 125, there was no change in the physical allocation, but firms were, collectively, Euro 20 Bn poorer! Luckily for the government, the outcome produced both high revenue and two new entries.

In the second auction 5 firms (3 incumbents and 2 entrants) each acquired an additional block of unpaired spectrum. There was no serious bidding in which firms tried to acquire more capacity - note that the pre-emptive motive was greatly reduced in that stage since the number of licenses was already determined. It seems that the enormous price paid at the first stage did not allow further flexibility (in particular, the smallest incumbent Viag Interkom was so budget constrained that it could not afford serious bidding at all).

In Austria there were exactly 6 bidders (4 of them GSM incumbents) for a maximum of 6 licenses. Hence, in principle, the license auction could have ended immediately, at the reserve price (Euro 100 million per license). Nevertheless, the auction continued for another 16 rounds, before stopping with 6 licensed firms (4 of them to the existing GSM operators), each paying on average about Euro 118 million per license. Hence, about Euro 108 million have been again spent for nothing. There have been allegations that bidding occurred only to create a public impression of some “real” competition In any case, it seems that observing the German alarming outcome enabled the Austrian bidders to learn and reduce their demand much quicker.

Benefits and Disadvantages of a “Variable Prize” Auction

A perceived advantage of the German auction was its flexibility. It has been argued that ex-ante carving of spectrum in fixed chunks of capacity cannot be efficient, since the regulator is less informed about the precise operational needs of the involved firms (see Grimm et. al., 2001). On the same vein, since the regulator does not really know how many firms are efficient, why not let firms themselves determine the number of licenses in a competitive bidding process? These arguments are not entirely correct, since they confuse value maximization (for the involved firms) with efficiency, thus neglecting consumers. From the point of view of value maximization, a design that allows for a variable number of small and large licenses seems more desirable than those designs where the number of licenses and their capacity were fixed ex-ante. While this argument is

correct, its implementation in the German and Austrian design mixed flexibility in that dimension with flexibility concerning the number of firms. Since per firm profits probably fall in the number of firms while consumer surplus probably increases, letting the firms decide how many will be able to operate in the market is problematic for consumers efficiency. Consider a hypothetical story where the regulator proposes the following regulatory scheme to existing firms in the market: each firm has to pay a hefty fee to the state; depending on the paid fees, the regulator allows more or less (possibly none) new firms in the market, with higher fees meaning less firms. This was, roughly speaking, how the German and Austrian designs operated.

It is instructive to judge the design in terms of its ability to achieve value and/or revenue maximization (for some of the relevant theoretical results, see also Report 4 in this bundle):

1. By introducing bidding on 1, 2, or 3 blocks rather than directly on licenses, the auction artificially created a situation with multi-unit demand, and therefore offered scope for demand reduction gaming effects. Demand reduction is a strategic option in auctions where bidders have multi-unit demand, and where all units are sold at uniform prices: since bidding for the last unit, say, raises the price for all other units, bidders will artificially reduce their demand on that last unit. Such effects usually lead to inefficiencies, but here they may, in fact, have had some positive effect since they can partly combated the opposite demand increasing effect due to the incumbents' pre-emptive motives (see point 3 below).

2. Complementarities existed among blocks. The first block was worth nothing, the second a lot, and the third had a positive value. Complementarities among the auctioned goods are usually a hindrance toward efficiency (see McAfee and McMillan, 1996 and Cramton, 1997 for some US experience) and also create exposure problems (see point 5 below).

3. Since the number of firms was endogenous, the auction called for strategic behaviour in order to reduce the number of licenses, and created an artificial demand-increasing effect. It is impossible to bid "straightforward" in the Germany auction, since there are, for the same set of parameters, multiple equilibria with very different outcomes. The intrinsic value of a third block of capacity was greatly augmented in feasible scenarios where acquiring such a block leads to less firms in the market. The rules implied that in any possible outcome with entry (with 5 or 6 licensed firms) there is at least one new firm with the minimum mandated two blocks. If that firm looses one block, it looses the entire license. Thus, besides getting "pure" economic value by acquiring one block of capacity in excess of the minimum two, an incumbent may get substantial extra value by denying an entire license to a new entrant. (In order to achieve an outcome with only 4 licenses some more co-ordination was needed among 3 incumbents; see also point 6 below).

4. A revenue-maximizing seller may extract revenue by "threats" to sell exactly to those agents that create strong negative externalities on others (see also Report 4 in this bundle). It seems that this argument was well understood

by the auction designers. By allowing 4 to 6 firms, a threat to sell to newcomers was in effect operative, and it was, in principle, avoidable for a high enough price. Some commentators argued that the German design was therefore much better geared towards revenue maximization. If the endogenous entry decisions prior to the auction are neglected, this argument is correct.

5. The multi-unit-demand and complementarity features created an exposure and regret problem for the involved firms. The exposure problem arises in multi-object auctions where the objects are complements (i.e., the value of a bundle is higher than the sum of the values of its contained items), and where combinatorial bids on entire bundles are not allowed. In such a scenario, a bidder bids high on two items hoping to win them both, but, since he does not know the others' valuations, ultimately he gets stuck only with one item for which he has a low valuation. The exposure problem in the German design was a direct consequence of the fact that dominant incumbents tried to push entrants out of the market, but were ultimately unsuccessful (see Ewerhart and Moldovanu, 2001). The attempt to create a more concentrated market structure drove prices up for all acquired frequency blocks without changing the final allocation (thus causing regret). There are several potential explanations for this failure. First, there was an intense pressure from stock markets and bond-rating agencies to stop bidding. Second, since there were only two financially strong incumbents, and since prices were already high when Debitel stepped out, at least one entry looked plausible. As one entry was likely to occur, the value of avoiding a second entry was reduced. Auctions that create exposure and regret phenomena are not attractive for bidders, which may rationally decide to avoid bidding altogether.

6. The simultaneous ascending auction (through its dynamic, iterative structure) is well suited for incumbents who wish to co-ordinate in order to prevent entry, without the need of external monetary transfers. Towards the end of the auction there was clear signalling activity among the two large incumbents who tried to sort out whether to continue bidding in order to reduce the number of entrants. Mannesmann made several bids where the smallest free digit (i.e., taking into account the rules that allowed only bids in multiples of DM 100000) was 6, suggesting that it was finally ready to accept an outcome with 6 firms. Initially, DT responded with bids ending in 5, suggesting that it was willing to bid even higher in order to reduce the number of licenses to 5. Only after further price increases and increased nervousness in the stock markets bidding stopped.

Assessment

The German design allowed both a flexible allocation of capacity and a flexible number of licenses. This is a clear advantage vis-a-vis less flexible designs. But the pre-emption effects stemming from market structure considerations (combined with the presence of incomplete information) created a significant exposure for bidders, which affected the financial stability of the telecommunications industry. The Austrian bidders quickly learned to avoid this pitfall, and the Austrian auction generated little revenue.

Because the flexible design allows incumbents to fight entrants, the prices paid in the flexible design can be strictly higher than those resulting from a less flexible design yielding the same outcome. But the flexible design included the risk of creating a more concentrated market structure, with adverse effects on consumers.

For these reasons, we question the efficiency gains obtained by the flexible design as it was used. A small modification, with flexibility between 5 or 6 licenses (which ensures entry and therefore reduces the pre-emptive motives and exposure) seems to us preferable. The outcome of the German auction can however be considered as a big success: the German government ended up with both high revenues and an unconcentrated mobile-phone market!

5 CONCLUDING REMARKS

In the recent allocations of spectrum for UMTS mobile telephone services European governments had to decide two issues. The first was what to allocate and how many. The second was to which companies should the licenses be sold and at what price. The first issue should be solved before the second one. The good to be allocated (i.e. part of the radio spectrum) should be defined unequivocally. The length of the contract, the speed of network roll-out, the requirement for geographic and/or population coverage should all be specified ex ante. The same holds for the question whether firms that get a license have to provide roaming conditions for firms that do not have a 2G network. By determining the number of licenses, one determines the number of competitors in the market[12]. When settling this first issue, one should already have a clear goal in mind: efficiency, high revenue, high-quality services (products), etc. Only when this first issue is settled, the second issue can be dealt with. Should the good be allocated by an auction or a beauty contest. In this report we have argued that an auction is the best way to allocate 3G-licenses, unless quality is not objectively measurable. In the latter case, (depending on the goal) the good should be allocated either by an auction with pre-qualification stage or a (weighted) beauty contest.

With respect to the second key question of the MDW-project (design issues), we have argued that in complex environments it is necessary to base practical auction engineering on a sound theoretical foundation that combines the insights of Auction Theory with those of "Industrial Organization". Overlooking market structure details can have far-reaching consequences for the shaping of one of the most important future markets.

As license auctions, besides allocating spectrum, also shape future market structure in almost irreversible ways, a successful design must level the playing field among incumbents and potential entrants. The asymmetry among incumbents and entrants is a constant feature of most license auctions, while many other features (such as particular aggregation interests or particular alliances across countries) are of a more transitory nature. Designs that encourage entry

[12] One should not forget that choice for the number of licenses also influences the allocation process of next generation licenses.

will result in increased efficiency, but they will also generate more revenue since more bidders will be attracted by the auction if they perceive real chances of winning.

Given the increased global nature of the telecommunication industry, it may be worthwhile thinking about the advantages and disadvantages of some kind of "European super-auction" that allows the aggregation of continent (or EU) wide licenses besides the national ones. Even if spectrum allocations remain national affairs for the foreseeable future, some harmonization measures may be required. At the moment, many firms have complained that beauty contests always favour national incumbents, while those incumbents (which often got licenses almost for free in their own country) can freely compete with deep pockets in foreign auctions.

A last issue is whether it is easier for governments to stick to the license conditions and to enforce the prices at which the licenses were sold when an auction or a beauty contest is used. This question is of interest as European governments have come under pressure to ease some of the burdens on operators due to dramatically deflated expectations for the 3G offerings. Many European governments, such as Germany and the Netherlands, do already allow the sharing of 3G networks. The French government went a step further: it backtracked and slashed the up-front payment fees for third-generation wireless licenses October last year.[13] The government also extended the duration of the French licenses from 15 years to 20 years. From the answers to our questionnaire we have sent to the government agencies we did not find a systematic proof for the fact that it is more difficult for governments to stick to the license conditions and to enforce the prices at which the licenses were sold when a beauty contest was used.

REFERENCES

Binmore, K., and P. Klemperer (2002) The Biggest Auction Ever: the Sale of the British 3G Telecom Licenses, *The Economic Journal*, forthcoming.

Börgers, T., and C. Dustmann (2001) *Strange Bids: Bidding Behaviour in the United Kingdom's Third Generation Spectrum Auction*, discussion paper, Centre for Economic Learning and Social Evolution (ELSE) at University College London.

Börgers, T., and C. Dustmann (2001) *Rationalizing the UMTS Spectrum Bids: The Case of the UK Auction*, discussion paper, Centre for Economic Learning and Social Evolution (ELSE) at University College London.

Cramton, P. (1997) The FCC Spectrum Auctions: An Early Assessment, *Journal of Economics & Management Strategy* 6(3) 431-495.

Deutsche Bank (2000) *UMTS, The Third Generation Game*, Deutsche Bank Equity Research.

[13] The government's about-face on third-generation pricing follows a short-lived revolt by one of the only two operators that had stepped up for four licenses. France had to soften the terms in order to find applicants for the remaining two licenses it is expected to offer early 2002. French 3G operators will now pay EUR 619 million for the licenses, plus annual payments related to their revenues from 3G services. Previously, operators faced EUR 4.95 billion in charges, a large portion of which was due before 3G services will be launched, likely in 2004.

European Commission (2001) *Study on Administrative and Frequency Fees Related to the Licensing of Networks Involving the Use of Frequencies*, Directorate General Information Society, 14th November.

Ewerhart, C., and B. Moldovanu (2001) *The German UMTS Design: Insights From Multi-Object Auction Theory*, working paper, University of Mannheim.

Ewerhart, C., and B. Moldovanu (2002) *A Stylized Model of the German UMTS Auction*, working paper, University of Mannheim.

Gilbert, R., and D. Newbery (1982) Pre-emptive Patenting and The Persistence of Monopoly, *American Economic Review* 72, 514-526.

Grimm, V., Riedel, F., and E. Wolfstetter (2001) *The Third Generation (UMTS) Spectrum Auction in Germany*, working paper, Humboldt University, Berlin.

Jehiel, P., and B. Moldovanu (2000a) *License Auctions and Market Structure*, discussion paper, Mannheim University and CEPR.

Jehiel, P., and Moldovanu, B. (2000b) *The European UMTS License Auctions*, discussion paper, Mannheim University and CEPR.

Jehiel, P., and Moldovanu, B. (2001) A Note on Efficiency and Revenue Maximization in Multi-Object Auctions, *Economic Bulletin* 3(2), 2-5.

Katz, M. and C. Shapiro (1986) How to License Intangible Property, *Quarterly Journal of Economics* 101, 567-590.

Klemperer, P. (1998) Auctions with Almost Common Values: The "Wallet Game" and its Applications, *European Economic Review* 42, 757-769.

Klemperer, P. (2000) Spectrum on the Block. *The Asian Wall Street Journal*, Oct 5. p.8 and available at www.paulklemperer.org.

Klemperer, P. (2002a) What Really Matters in Auction Design, *Journal of Economic Perspectives*, forthcoming.

Klemperer, P. (2002b) How (Not) to Run Auctions: the European 3G Telecom Auctions, *European Economic Review*, forthcoming.

McAfee, R.P., and J. McMillan (1996) Analyzing the Airwaves Auction, *Journal of Economic Perspectives* 10, 159-175.

Pratt, A., and Valletti, T. (2001) Spectrum Auctions Versus Beauty Contests: Costs and Benefits, *Rivista di Politica Economica*, vol. 91, n. 4-5, 59-109.

REG-TP (2000) *Entscheidung der Praesidentenkammer vom 18.02.2000 ueber die Regeln fuer die Durchfuehrung des Versteigerungsverfahrens zur Vergabe von Lizenzen fuer UMTS/IMT-2000; Mobilkommunikation der dritten Generation* - Aktenzeichen BK-1b-98/005-2.

UBS Warburg (2000) *3G Hysteria! Not everyone's idea of fun and Games*, mimeo, UBS Global equity Research.

van Damme, E (2002) *UMTS-Auctions in Europe*, working paper, Tilburg University.

The Wall Street Journal Europe: In a Surprise Move, France Cuts Cost Of 3G Licenses, 17 October 2001.

WestLB Panmure (2000) *UMTS. The countdown has Begun*, mimeo, WestLB Panmure, Pan European Equity.

8 MATCHING MARKETS FOR US MEDICAL INTERNS

Benny Moldovanu

TABLE OF CONTENTS

1 INTRODUCTION 139

2 THE MATCHING MARKET FOR US MEDICAL INTERNS 140

3 THE THEORY OF TWO-SIDED MATCHING MARKETS 141

4 THE MARKET OF MEDICAL INTERNS REVISITED 144

5 CONNECTIONS TO AUCTIONS AND BEAUTY CONTESTS 146

REFERENCES

1 INTRODUCTION

The most basic goal of markets is to achieve a matching among buyers and sellers, or, more generally formulated, a matching between individual agents and physical or financial goods. In a commodity market (such as the market for gold) the price determines whether an agent becomes a seller or a buyer. But, in many other markets (such as regulated labour markets, or government sponsored auctions or beauty contest for UMTS licenses) the roles of the agents are relatively well defined, and each agent operates at most on one side of a bilateral market.

Whereas in an auction or in a decentralised market based on a system of overlapping bargained agreements, the allocation of objects to buyers and of money to sellers is achieved based on, and simultaneously to, the determination of prices, many other bilateral markets operate only on the matching dimension since, for various institutional reasons, money either does not enter the system or prices are determined in an exogenous way. For example, many entry-level job markets focus on matching fresh graduates to employers at relatively fixed wages.

The theory of two sided matching offers fundamental insights into the functioning of markets and identifies the main issues that need to be addressed when designing such markets. In particular, once money is introduced in the system, this theory offers the basis of auction and market design. Moreover, there exist well-documented and successful large-scale applications that can guide further practical work on the design of various allocation procedures. A major broad conclusion is that markets require a good deal of organisation. This runs counter to the view implicit in much of the economic literature, which is that markets are largely self-organising entities that do not require thoughtful design.

The present report will address the following main questions:

1. Which allocations can be seen as satisfactory matchings in a bilateral market, and when do satisfactory matchings exist?
2. Which allocation mechanisms tend to produce satisfactory matchings?
3. How does the choice of a matching mechanism influences the strategic incentives of agents on each side of the market, and how do strategic manipulations influence the final outcome?
4. What are the main lessons for the design of auctions and beauty contests?

The report has the following structure: In Section 2, we first describe a famous case study: the US market for medical interns. In Section 3 we survey the main theoretical models and results. We consider one-to-one and many-to-one matching models without money. A good textbook is Roth and Sotomayor, 1990. In Section 4 we revisit the market for medical interns and explain the observed events in light of the theory. In section 5 we extend the model by introducing money, which allows us to connect the matching results to auctions. We conclude with the main lessons for the design of auctions and beauty contests.

2 THE MATCHING MARKET FOR US MEDICAL INTERNS

One of the most famous applications of market design is the organisation of the US market for medical interns (or residents). Interns are medical students at the end of their study who get an additional year of concentrated clinical exposure. By employing interns, hospitals get cheap labour. From the start of the programme around the turn of the century, the number of offered positions was much greater than the number of applicants, and there was intense competition among hospitals. A consequence of these conditions was that the date at which contracts were signed advanced by 1944 to about two years before the student's graduation! Since this was considered to be ridiculous, the Association of American Medical Colleges (AAMC) decided that a student's grade transcripts and letters of references would only be released in the summer of graduation. The entire matching of students to positions moved to the last summer previous to employment, and, more often than not, students were sitting on offers hoping to get better positions at hospitals where they on the waiting list. In many cases, students reneged on agreed offers, after obtaining better ones. In 1945 the AAMC succumbed from pressure from the American Hospital Association (AHA), and ruled that students could sit on an offer at most ten days. In 1946 this was shortened to eight days, in 1949 to twelve hours, and in 1950 to one minute (these offers were called "explosive")! Since more time squeezing was impossible, it became clear that a new approach must be found. In 1951 a centralised algorithm has been proposed in which students and hospitals submitted Rank Order Lists (ROL) of preferred hospitals and students, respectively, and were then matched based on the submitted preferences. After a trial-run students complained that the algorithm encourages "clever" manipulation of submitted preferences, and the procedure was slightly modified. The centralised market is still in use today and fills about 20000 positions per year in about 3000 hospital programmes. Most tellingly, although participation in the centralised scheme is completely voluntary, till the mid-seventies the participation rate was about 95% (!) of eligible students and hospitals. Participation dropped in the mid-late seventies to about 85%. Another growing concern has been the fact that rural hospitals were often left with empty positions. In the mid-nineties, the market began to suffer a crisis of confidence, and students (supported by vocal consumers' rights advocates such as Ralph Nadir) complained that the outcome was unreasonably favourable toward hospitals. A new algorithm was devised by a Alvin Roth, a distinguished Harvard economist, and used from 1998 onwards (see Roth and Peransson, 1999).

Several questions beg here for an answer:

1. Why the frantic re-contracting activity and the "explosive" offers immediately disappeared once the voluntary centralised market was introduced?
2. Why was a participation rate of 95% initially achieved by the centralised procedure, even if all agents were able to continue and contract privately?
3. What prompted the drop in participation rates in the late-seventies?

4. Is it possible to change the rules of the matching algorithm such that more positions get filled at rural hospitals? What other repercussions will such a change cause?
5. Were the recent students' complains justified, and does the new mechanism perform better?
6. What is the main lesson for other matching markets?

In order to answer these questions, we first take a brief look at the basic theory of two-sided matching markets, and then revisit the US market for medical interns.

3 THE THEORY OF TWO-SIDED MATCHING MARKETS

The One-To-One Matching Model

The two-sided matching model is probably the simplest market model in the whole economic science. It consists of two distinct groups of agents. In this sub-section we will plastically call the members of the first group "men" and the members of the second group "women". An agent is characterised by a *rank order list* (ROL) over the members of the group to which it does not belong. The ROL describes the ordinal preference of the particular agent over potential matches, and it means: "I prefer to be matched to the individual appearing first on my list; if this is not possible, then I prefer to be matched with the individual appearing second on my list, and so on. An individual ROL may not include all members of the other side of the market, with the implication that an individual with an incomplete ROL prefers to remain single rather than be matched to one of the non-listed agents (which are then considered unacceptable partners for that particular individual).

The basic economic problem is to find a "satisfactory" matching between men and women. A *matching* consists of several matched pairs, and several unmatched (i.e., single) individuals. The main question is what "satisfactory" should mean. A first easy criterion is one of no-coercion (or individual rationality): no individual should be matched to a non-listed (i.e., non-acceptable) partner. The second criterion is efficiency: a matching is efficient if there is no other matching where at least one agent is better off (i.e., matched to another, more preferred agent) while all other agents are at least as well-off.

But, apart from efficiency and no-coercion, another important criterion is needed. To illustrate this, consider first the following simple example of how to achieve an efficient, individually rational matching:

Order the agents on one side of the market (say the women) alphabetically[1] (e.g., Ana, Betty, Britta, Carla, etc.). Match Ana with her most preferred man (say Maarten) in the set of men that she regards as acceptable and that regard her as acceptable. If such a man does not exist, let Ana be single. Then match Betty to her most preferred man (say Benny) among those remaining which are acceptable

[1] Any well-defined order will do here.

to her and that regard her as acceptable, otherwise let Betty be single, and so on. It is obvious that any other matching will make at least one woman less well-off. Hence, the proposed matching is efficient.

Nevertheless, the above proposed matching is not satisfactory, since the following problem may appear: in the proposed matching Maarten and Betty are not together (since Maarten is matched to Ana). But it may well happen that, in fact, Betty prefers to be matched to Maarten rather than with Benny, and, also, that Maarten prefers to be matched with Betty rather than with Ana. Unfortunately, the matching procedure did not make the pair Betty-Maarten possible. Hence the pair Maarten-Betty will prefer to leave their actual partners, in order to form a pair themselves. This behaviour destabilises the entire proposed matching (since we must find new partners for Ana and Benny, etc.…), and a "matchmaker" using the above procedure will soon loose her reputation, and possibly her job.

The above problem leads to the following important definition:

An individual *blocks* a matching *m* if he/she is paired to an unacceptable partner. A woman-man pair *blocks* a matching *m* if they are not matched to each other in *m*, but each prefers the other to their current partner in *m*. A matching is *stable* if no individual or pair blocks it.

The most important and surprising result in matching theory is due to Gale and Shapley, 1961: A stable matching always exists.[2] The proof is constructive, by means of the *deferred-acceptance algorithm* (which, by the way, is the precursor of the simultaneous ascending auction). The algorithm functions as follows: To start, each man proposes to his favourite woman (of course there is an analogue procedure where women propose). Each woman rejects the proposal of any man who is unacceptable to her, and each woman who receives more than one proposal rejects all but her most preferred of these. Any man whose proposal is not rejected is kept "engaged". At any further step, any man who was rejected at the previous step proposes to his most preferred woman among those who have not yet rejected him (or does not make proposals if all remaining women are unacceptable). Each woman receiving proposals "engages" the most preferred man in the group consisting of the new proposers together with any man she may have kept engaged at the previous step. The process stops after a step in which no man is rejected anymore, and the matching obtained at this step is the final one.

It can easily be shown that the algorithm stops after a finite number of steps and that it always produces a stable matching: If a man *h* prefers a woman *f* to his final partner, then he must have proposed to her and been rejected. Hence the woman *f* cannot prefer *h* to her final partner.

Gale and Shapley also showed that there exists a stable matching which is optimal for the men in the sense that all men prefer this matching to any other stable matching and that the deferred-acceptance algorithm with men proposing yields exactly that matching[3] (analogously, when women propose, a woman-optimal

---

[2] It is interesting to note that stable matching always exists only in bilateral markets (i.e., they do not always exist in unilateral, trilateral markets, etc.).

[3] This may explain the widespread custom where men (now in the literal sense) propose marriage to women, rather than vice-versa.

matching is obtained). Moreover, it can be shown that an individual who remains single in a stable matching necessarily remains single in all stable matchings.

An important feature which we neglected so far concerns strategic. The question is: do agents have incentives to submit their true preferences to a matching algorithm (or, equivalently, to behave according to the rules in a "dynamic" procedure such as the deferred acceptance one) ? For example, if it is known that a particular woman is very popular and hence that there are very slight chances to actually marry her, it may be worthwhile for a man to manipulate the ROL and rank higher another preferred woman, thus increasing the chances to marry that second-best alternative.

If agents distort their reported preferences, a stable matching obtained for the reported preferences may not be stable for the true preferences, and hence the outcome will be destabilised by blocking pairs. It can be shown that (see Dubins and Freedman, 1981, Demange and Gale, 1985), in any procedure that yields the men-optimal stable matching, it is for all men optimal to state their true preferences, i.e., any man optimises by submitting his true ROL, independently of what other agents are doing (and, vice-versa, in any procedure that yields the women-optimal stable matching, for all women it is optimal to state their true preferences).[4] In addition, no coalition of men can improve their position by jointly distorting their reported preferences. There is generally no algorithm that makes it optimal for both sides of the market to state their true preferences. In particular, when the stable matching for one side of the market is chosen, members of the other side have the incentive to manipulate, and the easiest way to do so profitably is to submit a ROL where some acceptable partners are simply not listed.

The Many-to-One Matching Model

An important extension to the above model is obtained by allowing agents on one side of the market (call them now "firms") to be matched to several agents on the other side (call them now "workers"). This corresponds to the situation where a hospital may employ several interns. As before, workers rank all acceptable firms from most to least preferred, but firms have preferences of entire subsets of workers. Since such preferences over entire groups are necessarily more complex than rankings of individual agents, the existence of stable matchings (see Kelso and Crawford, 1982) is now ensured only if firms regard workers as *substitutes*. This means that, if a firm prefers to employ a group that includes worker *w*, then it will want to employ this worker even if other workers in that group become unavailable. For example, assume that a firm needs *n* workers, that it can rank all workers using a ROL, and that it always prefers to hire the highest ranked available *n* workers. Then this firm regards workers as substitutes since it will want to hire a sufficiently high ranked worker even if other workers become unavailable. In contrast, consider an economics faculty that has a fixed budget and wants to build either a strong group in auction theory or a strong group in macroeconomics (but is not interested in two weak groups in each discipline). Then the desirability of a particular auction theorist crucially depends on the

[4] As we will see, these results are the precursors of analogous results for second-price auctions.

availability of other auction theorists, and professors are *complements* rather substitutes. In this case, stable matchings may not exist. Many properties we discussed above generalise to the many-to-one model, but there are exceptions. In particular, even if the firm-optimal matching is implemented, firms may have an incentive to manipulate their reported capacities.

4 THE MARKET OF MEDICAL INTERNS REVISITED

In light of the above theoretical results, we can now answer the questions raised in Section 2.

1. The frantic re-contracting activity and the "explosive" 1-minute offers immediately disappeared, and a voluntary participation rate of 95% was achieved because the algorithm was choosing a stable matching. This implies that a student unhappy with the hospital he was assigned to, was not able to find outside the centralised system another better hospital that was willing to employ him (and vice-versa for hospitals). A. Roth analysed the algorithm in 1984 (about 30 years after it was devised) and discovered that, although it functioned differently from the deferred-acceptance procedure, it nevertheless achieved the hospital-optimal stable matching. Hence, the doctors and engineers that devised the algorithm preceded Gale and Shapley's seminal analysis by about 10 years.
2. See 1.
3. The drop in participation rates in the late-seventies had a prosaic reason: more and more married coupled (both members were doctors) began to apply for internships. Such couples necessarily have more complex preferences than usual ROL's, since they usually prefer being together in one hospital or city. It was noticed that couples tended to avoid the centralised market, and privately tried to arrange a match. The original algorithm was changed in order to get better matches for couples, but to no avail. Is this a problem of the particular scheme that was used? The answer is "No". It can be shown that in a system with complex preferences for couples, the set of stable matching may be empty, and therefore no algorithm can produce a stable matching.
4. The meagre distribution of students to rural hospitals is unavoidable if students do not like going there, and if a stable matching is desired. Recall that the set of single individuals (or the set of unfilled positions) always remains the same, no matter what stable matching is chosen. Hence, it is impossible to simultaneously choose a stable matching and fill positions at rural hospitals, which were not already filled by the original algorithm. Indeed new routines were introduced in the matching algorithm in order to give certain priority to rural hospitals.
5. Since we now know that the original algorithm was the hospital-optimal one, the students' complains (that the system favours hospitals, and that clever students can successfully manipulate the system by submitting false

ROL's) seem eminently reasonable. Therefore the new algorithm introduced in 1998 was devised in order to achieve the student-optimal matching. This also makes sense form a welfare point of view, since probably hospitals do not differentiate too much between their 7th and 17th candidates, but students may care a lot whether they live in Miami or in Seattle, independently of the quality of the respective hospitals. The new algorithm was also optimised with respect to married couples (but, as mentioned above, a fully satisfactory solution for this problem does not exist). The designers of the new algorithm performed an intriguing experiment: they used the new matching rules on the ROL's submitted to the system in previous years, and focused on the resulting differences. To their surprise, these differences were very small: about one applicant in 1000 was affected by the choice of the algorithm (or, otherwise stated, the requirement that a matching be stable determined already 99.9% of all student-hospital matches). The reason is that hospitals and students tend to list each other only following an interview. Since the number of feasible interviews is constrained by time and travel costs (to a generous maximum of about 10 interviews per student), one can show that in a very large market where students' lists contain only a few acceptable hospitals there is almost always a unique stable matching, which therefore must be picked by any stable algorithm. In addition, we now know that the best advice to students must be: "submit your true ROL" since possibilities of manipulations are almost non-existent, and since manipulation (which calls for deleting some acceptable hospitals from the submitted list) introduces the additional risk of not being matched at all.

6. Although the original matching algorithm was not devised based on existing theory, later theoretical developments (combined with simulation and experiments) completely explained the main features of the problem and its solution, and paved the way for a new, carefully devised algorithm (rather than the more or less "blind" adjustments made previously). Moreover, it is now possible to use similar solutions in many other contexts. Roth and Sotomayor (1990) and Roth and Xing (1994) describe the history of many highly specialised markets where matching plays an important role (a few examples are professional athletes in team sports, Canadian lawyers, new professors, US football bowls, UK medical specialities, etc.) Although each and every one of these markets displays unique characteristics, it is possible to say, roughly, that only those market institutions that tended to produce stable matchings survived in the long run.[5]

[5] Some unstable mechanisms survived if they were complemented by rules that made "divorce" very costly (a good example are the cumbersome transfer rules in professional sports) . But such rules create lots of friction and are often subject to prolonged legal battles.

5 CONNECTIONS TO AUCTIONS AND BEAUTY CONTESTS

In almost all European UMTS license auctions there was a fixed number of licenses with a fixed capacity, and it was stipulated that no firm could buy more than one license. Hence, we had a classical one-to-one matching problem. In other situations, such as the US spectrum auctions of regional licenses for mobile telephony or the allocation of regional radio licenses in Holland, one firm can buy several licenses. These are many-to-one matching problems. Of course, money also plays an important role, at least in the instances were prices were not fixed and auctions were used. In order to understand the implication of the two-sided matching theory for such situations, and in order to connect the above insights to auctions, we need first to extend the basic model in order to allow for money. We do it here briefly for the one-to-one matching model, and refer the reader to Roth and Sotomayor, 1990 and to Gul and Stacchetti, 1999 for the parallel results in the many-to-one case.

The One-to-One Matching Model with Money

Consider, as above, two distinct groups of agents, called now "buyers" and "sellers". Each seller s owns an indivisible object, say a house, and has a reservation price for the house, say r_s (i.e., the seller is prepared to sell the house for a price which is at least r_s). Each buyer has money, and is characterised by a list of reservation prices for the individual houses, i.e., a list of maximal prices that this buyer is prepared to pay for each house. Let r_{bs} denote the reservation price of buyer b for the house owned by seller s . Then, the pair $\{b,s\}$ can be characterised by the associated gains from trade $v_{bs} = \max(0, r_{bs} - r_s)$. A matching m consists of a set of buyer-seller pairs, a set of unmatched agents, and a set of prices for each house, where p_s denotes the price of the house owned by s. If $\{b,s\}$ are matched and trade at price p_s, then the buyer's payoff is $r_{bs} - p_s$, and the seller's payoff is $p_s - r_s$. A matching is *stable* if no matched buyer pays more than his reservation price for the house he buys, no matched seller gets less than her reservation price, and if, for any unmatched buyer-seller pair $\{b,s\}$ there is no price p_s such that trading at that price makes both traders in the pair better off. A system of prices for which we can find a stable matching consistent with those prices is called a *competitive price system*.

The main results for this model are as follows (see Shapley and Shubik, 1971): A stable matching always exists. The set of competitive prices has a minimal element which is optimal for the buyers (i.e., a price system such that all other competitive price systems yield higher prices for all houses) and a maximal element which is optimal for the sellers (i.e., a price system such that all other competitive price systems yield lower prices for all houses) This last result generalises the existence of men-optimal and women-optimal stable matches in the above section. For example, in a market where a single house is available, the set of competitive prices is precisely the interval between the highest and second highest reservation prices. The minimal competitive price (which is optimal for buyers) is the second highest reservation price, which may belong either to a buyer or to the seller.

The generalisation of the Gale-Shapley deferred-acceptance algorithm takes the form of a *simultaneous ascending auction*. For the version where buyers are active this works roughly as follows (see Demange, Gale and Sotomayor, 1986): At the first stage the auctioneer fixes the prices equal to the sellers' reservation prices. At these prices, each buyer announces ("bids") which house (if any) he wants to buy. If no house receives more than one bid, the auction stops, and each bidder obtains the house for which he bid at the seller's reservation price. Otherwise, the price of those houses that obtained more than on bid is raised by a small increment (while other prices remain constant). Again, buyers announce which houses they want to buy, and so on. The auction stops with the attained price level after a step in which no house receives more than one bid.

Recall that, for the matching model without money, the deferred-acceptance algorithm yielded the optimal stable matching for the proposing party, and that the members of the proposing party had an optimal strategy - to reveal their true preferences. The present model with money yields analogous results: The auction stops with the minimum (i.e., buyer-optimal) competitive price system. Moreover, in any mechanism that yields the stable matching associated to the minimum competitive price system, submitting the true reservation prices for each house is optimal for each buyer.

Recall that in a market with a single house, the minimum competitive price is exactly the second highest reservation price. Thus, the optimality of truthful bidding for buyers generalises to multi-object auctions Vickrey's famous result about the one-object second-price auction. Although buyers have an optimal strategy to state their true preferences, collusion becomes profitable here since buyers may make side-payments among each other. For example, in a single-object auction, the highest bidder may want to bribe the second-highest bidder in order for the later to decrease her bid (this can effectively be achieved by a pre-auction organised among the potential buyers).

Lessons for auction and Beauty Contest Design

1. Beauty contests that allocate objects to firms at fixed prices (which may be zero) can be seen as simple matching problems. If the allocated objects are heterogeneous (e.g., licenses with different capacity, different geographic coverage, etc.) firms will be able to rank the objects in order of preference. Sometimes these preferences are obvious (and are the same for all firms). In other instances, the preferences are subtler, and it makes sense to actually ask for them (while explaining how this information will be used by the regulator in order to obtain an allocation). This will also give some information about the degree of scarcity inherent in the situation. The resulting allocation needs to be "stable" in the sense that no firm should feel entitled (by the implicit rules of the contest) to a bundle that it prefers to the one it actually got. If an unstable allocation is chosen unnecessary tensions accrue in the system, and legal battles may follow. In addition if several firms feel this way, re-contracting may follow the allocation procedure, thus undermining the purpose of the entire exercise.

2. The choice auction procedure in many recent auction applications has been the simultaneous ascending auction. We have seen that this procedure is the natural monetary analogue to Gale and Shapley's deferred acceptance

algorithm, and that it has very desirable properties in a simple model. This relation offers the most solid theoretical basis for the widespread faith in the virtues of this procedure.[6]

3. In many contexts (e.g., the planned Dutch auction for regional radio licenses), bidders are allowed to buy several licenses. The correct application of the deferred acceptance algorithm now calls for allowing bidders to express preferences on entire bundles - in auction parlance, this is called a *combinatorial* ascending auction. The rules of such an auction are more complex for both auctioneer and bidders (e.g., how to determine which prices get adjusted upwards at each step becomes more delicate). The simple simultaneous ascending auction is a good substitute for the combinatorial auction only if a bidder's willingness to pay for a bundle is close to the sum of the willingness to pay for the individual objects in the bundle.

4. In situations where bidders are allowed to buy several items, the objects may be *complements* (e.g. regional radio licenses in adjacent geographical areas). This means here that the willingness to pay for a bundle of objects is higher than the sum of the willingness to pay for the individual objects. As we have seen above the existence of stable matchings in many-to-one situations is ensured only if the objects are substitutes rather than complements. Thus even combinatorial auctions (which are much better suited to allow the expression of preferences over bundles) may not be able to achieve a stable matching if the complementarity is strong and varies across bidders and objects. In this context, it is interesting to note that the US Federal Communication Commission (who long favoured the simultaneous ascending auction because of its simplicity) considers now the use of combinatorial auctions in a forthcoming event.

5. In settings with complex preferences as the ones mentioned at points 3, 4 above it is doubtful that beauty contests (which allow only a partial revelation of preferences and are prone to heavy strategic manipulation) will be able to achieve efficient allocations (not to speak about stable ones).

6. We assumed so far that agents only care about their own match. But, in license auctions, firms that will compete in one market may also care about other aspects of the entire match (e.g., who else get what licenses). In other words there are external effects (for more on this topic see Report 4 in this bundle). Such features tend to destroy most theoretical results we displayed so far (in particular the existence of stable matchings is not ensured). The simple mechanisms discussed in this report will satisfactorily perform only if these effects are not too strong. Otherwise, more thinking is required when devising an allocation procedure for a particular situation with strong external effects.

7. Recall that there are no stable matching mechanisms that make it optimal for both sides of the market to reveal their true preferences. In particular, this means that in a simultaneous auction where buyers are active and make

---

[6] Curiously, auction theorists or practitioners seldom acknowledge this heavy intellectual debt.

proposals (thus achieving the buyer-optimal stable matching), the seller can increase revenue by the choice of reservation prices. Fixing reservation prices becomes an important strategic issue for the seller. But note that all the results so far discussed the welfare properties connected to stability, and did not even mention revenue. Using a simultaneous ascending auction is not an insurance policy against low revenue (as some recent UMTS auction which closed near the reservation prices amply showed), unless appropriate reservation prices (that reflect the degree of scarcity implied by alternative or future uses) are chosen. In this context it is also useful to recall the fate of the unmatched rural hospitals. The lesson is that unattractive objects may get matched only if additional sweeteners are offered, and one may consider negative reserve prices (i.e., subsidies) if a match is desired by the designer. Good examples are the Dutch *designated* radio stations that are strongly constrained in their programming.

8. If the optimal matching for one side of the market is chosen, the agents on that side do not have incentives to collude in the model without money. The situation changes in the model with money, and this implies that the simultaneous ascending auction is not immune to collusion among bidders. In particular, in most applications bidders raise prices themselves instead of the auctioneer. This flexibility (e.g., jump bids) can be used as a signalling device which co-ordinates collusion. Hence, it sometimes makes sense to restrict the bidding operations (e.g., by introducing strict activity rules and maximal bids at each stage) in order to get closer to the format discussed here, where the auctioneer raises prices on over-demanded objects by a pre-set minimum increment.

REFERENCES

Demange, G. and D. Gale (1985) The strategy structure of two-sided matching markets, *Econometrica* 53, 873-888.

Demange, G., D. Gale and M. Sotomayor (1986) Multi-item auctions, *Journal of Political Economy* 94, 863-872.

Dubins, L. and D. Freedman (1981) Machiavelli and the Gale-Shapley algorithm, *American Mathematical Monthly* 88, 485-494.

Gale, D. and L. Shapley (1962) College admissions and the stability of marriage, *American Mathematical Monthly* 69, 9-15.

Kelso, A. and V. Crawford (1982) Job matching, coalition formation and gross substitutes, *Econometrica* 50, 1483-1504.

Roth, A. and E. Peranson (1999) The redesign of the matching market for American physicians, *American Economic Review* 89, 748-780.

Roth, A. and X. Xing (1994) Jumping the gun: imperfections and institutions related to the timing of market transactions, *American Economic Review* 84, 992-1044.

Roth, A. and M. Sotomayor (1990) Two-sided matching, *Econometric society Monograph* No.18, Cambridge University Press.

Shapley, L. and M. Shubik (1972) The assignment game I: the core, *International Journal of Game Theory 1*, 111-130.

Vickrey, W. (1961) Counterspeculation, auctions, and competitive sealed tenders, *Journal of Finance* 16, 8-37.

9 SALE OF GOVERNMENT BONDS IN A VARIETY OF COUNTRIES

Tilman Börgers and Joseph Swierzbinski

TABLE OF CONTENTS

1 INTRODUCTION 153

2 WHICH AUCTION FORMAT, UNIFORM PRICE OR DISCRIMINATORY AUCTION, IS LIKELY TO LEAD TO HIGHER REVENUES? 157

2.1 THEORETICAL CONSIDERATIONS 158

2.2 EMPIRICAL CASE STUDIES 161

2.3 CONCLUSIONS 165

3 HOW DO INTERACTIONS BETWEEN TREASURY AUCTIONS AND THE TREASURY BOND MARKET AFFECT POLICY CHOICES? 166

3.1 DOES THE CONDUCT OF AN AUCTION ACCELERATE THE REVELATION OF INFORMATION HELD BY BIDDERS? 166

3.2 DOES THE DEGREE OF UNCERTAINTY IN THE BOND MARKET AFFECT THE DESIRABILITY OF CONDUCTING AN AUCTION? 168

3.3 DO AUCTIONS OPEN UP THE POSSIBILITY THAT A BIDDER CAN "CORNER THE MARKET" OR OTHERWISE MANIPULATE THE MARKET PRICE? 171

3 CONCLUSIONS 172

REFERENCES

1 INTRODUCTION

Many billions of dollars of bonds are sold in Treasury bond auctions each year. In terms of the total value of the items auctioned each year, treasury auctions are among the world's most valuable auctions. The performance of these auctions in raising revenue has the potential to increase or reduce a government's cost of borrowing. Whether to use auctions to issue new government bonds, and, if so, which format to use, must therefore be a matter of great concern to governments.

The issues that Treasury auctions raise are of more general relevance to other auctions. In particular, as the use of auctions in government policy becomes more widespread, the same issues that are raised by Treasury auctions will need to be faced in other contexts, too. On the other hand, it needs to be acknowledged that certain government auctions are quite different from Treasury auctions, and the considerations that are important for the design of these auctions are different from the considerations affecting Treasury auctions. We therefore begin our paper with a discussion of the main features of Treasury auctions, and the extent to which these are shared by other government auctions.

A first important feature of Treasury auctions which determines the specific issues that need to be considered is that the typical bidder in a Treasury auction bids for very many identical units that are offered for sale rather than for just one unit. The existence of multi-unit demand raises many important questions in auction design that are not present if bidders bid for only a single unit, as they do in certain license auctions, for example. There are other important allocation problems that resemble Treasury auctions in this respect. An example is the allocation of pollution permits. Auctions have been proposed as a method for establishing an initial allocation of pollution permits, and typically companies will seek to acquire many pollution permits, not just one.

Second, Treasury bond auctions are distinctive in that the bonds being auctioned will typically be traded in a very liquid market after the auction. Moreover, close substitutes for the auctioned bonds are also typically traded in the bond market prior to the auction. In some cases, the auctioned bonds may actually be identical to bonds already traded in the bond market. Bond auctions are again not the only auctions with this feature. For example, the auctions for pollution permits mentioned in the previous paragraph also interact with the market for tradable pollution permits. The U.K. plans to use an auction as part of its programme for starting an emission-trading scheme for carbon. (See, for example, DEFRA (2001) and other documents available from DEFRA's website www.defra.gov.uk/) Similarly, European governments are considering trading in radio spectrum, and, if allowed, the interaction between such trading and the spectrum auctions will be important. However, it may well be that permit markets and spectrum markets will even in the long run be much less liquid than bond markets. This will mean that the interaction with existing markets will be less important for these auctions than for bond auctions.

Treasury bonds are bought for many different reasons, but one prominent reason is that they provide a safe (and legal) form of investment for pension funds. The ability of a pension fund to operate depends on its ability to gain access to government bond markets. In a sense government bonds constitute an essential

"input" for pension funds operations. In a similar way, pollution permits constitute an essential "input" for many businesses, and licenses to use spectrum are a required "input" for firms providing wireless communication services. However, the importance of a spectrum license for a mobile telephone company might be much larger than the importance of a pollution permit for some other business, or the importance of any particular bond issue for a pension fund. Thus, while a spectrum auction often shapes the future structure of an industry, the same cannot be said of Treasury bond auctions or of pollution permit auctions. The specific difficulties arising from the endogenous determination of industry structure thus do not arise in bond auctions.

This report reviews selected empirical case studies of auctions for Treasury bonds in a number of countries. The cases which we consider include Treasury auctions in the United States of America (Cammack (1991), Nyborg and Sudaresan (1996) and Simon (1994)), Swedish Treasury auctions (Nyborg and Sundaresan's (2001)), and Mexican bond auctions (Umlauf (1993)).

As we consider the case studies of Treasury auctions, we focus on several issues that we expect are relevant for policy makers. Below, we outline these issues, indicate our main conclusions, and then comment on whether these conclusions are of wider relevance than just for Treasury bond auctions.

The first issue is the choice of auction format. This choice has received considerable attention in the U.S. and elsewhere and continues to be a topic of debate. There are two leading formats for auctioning Treasury bonds, uniform price auctions and discriminatory auctions. Most Treasury auctions in the United States and in a number of other countries are of the discriminatory type. However, some economists such as the Nobel Prize winners Milton Friedman and Merton Miller, have argued that the uniform price auction design would raise more revenue and so reduce the government's cost of borrowing. From time to time the U.S. Treasury has experimented with uniform price auctions, and Simon (1994) and Nyborg and Sundaresan (1996) report on the results of some of these experiments. Umlauf (1993) reports on a similar experiment in Mexico. From a review of these studies, we conclude that the case for switching from a discriminatory to a uniform price auction is inconclusive.

One reason why we find this conclusion might be that for the auction price of treasury bonds is so closely tied to the market price that the choice of auction format cannot matter much. However, as we indicate in the next few paragraphs the evidence seems to suggest that important information is revealed in bond auctions which was not contained in market prices. It is then less clear why there is no significant difference between discriminatory and uniform price auctions. Theoretical analysis of these auctions is so incomplete that we can't really compare our finding to theoretical predictions. However, as the explanation of our finding does not seem to be the existence of a liquid secondary market, the finding is potentially relevant in other circumstances where multiple identical units are sold to bidders with multi-unit demand, for example permit auctions.

A second set of issues concerns the interaction between the auction and the bond market and how this interaction might affect the choice whether or not to use an auction, and the choice of the auction format. The first issue to consider is how the use of auctions to issue bonds influences the information flows in the bond market. This is a matter of importance to policy makers and indeed anyone

interested in or affected by the workings of capital markets. Indeed, a financial market is often called (informationally) "efficient" if it quickly incorporates information into asset prices. We consider whether the conduct of a Treasury auction accelerates the revelation of information about future bond prices held by bidders. Cammack's (1991) study of U.S. Treasury auctions provides positive support for the view that such auctions do release information which affects the bond price. This finding supports the use of auctions to issue bonds. Of course, the argument for the use of auctions as allocation mechanisms is even stronger if the secondary market is not as liquid as it is for Treasury bonds.

The second issue which we consider under the general heading of interaction between auction and bond market is how the degree of uncertainty in the market price affects the desirability of conducting an auction, and, in particular, whether auctions create "sorry" bidders who suffer from the "winner's curse". To explain this issue in more detail we first note that, if there were no transactions costs, then the underlying value of the bonds being auctioned would be the same for all bidders since the future market price of these bonds is the same for everyone. Thus Treasury auctions are common value auction where the differences in bidders' valuations for the auctioned bonds result entirely from differences in information that produce different forecasts of the future market price. Although transaction costs may be important in Treasury auctions, the common value assumption is often taken as an appropriate starting point for models of Treasury auctions.

The theory of common value auctions for a single item warns that uncertainty in the bond market price can have a serious deleterious effect on the outcome of such an auction if bidders are not sufficiently sophisticated. If a bidder learns that his forecast of the future market price is higher than that of any of his rival bidders, he should probably conclude that his initial forecast was too optimistic. Unless a bidder correctly incorporates the potential information contained in rival bids into his own bidding strategy, a winning bidder may find himself "cursed" with negative profits by bidding too high in the auction. In many of the case studies we surveyed, bidders on average do appear to react to the uncertainty in the bond market sufficiently to avoid the persistent negative profits associated with the winner's curse.

The possibility of "sorry" winners due to a winner's curse arises in many other contexts as well. For example, spectrum licence auctions raise this possibility. It is important for the policy maker to form a judgement whether bidders will be sufficiently sophisticated and anticipate the winner's curse in their bids. It is reassuring that the literature finds that at least the highly sophisticated and experienced bidders who participate in Treasury bond auctions do anticipate the winner's curse.

A final policy question which we briefly consider is whether a Treasury auction opens up the opportunity for a bidder to "corner the market" or otherwise manipulate the market price. Whether policy makers need to be concerned about a "market corner" depends on the answer to two questions. (1) Is there a serious possibility that one or a few bidders might purchase most of the bonds in a Treasury auction? and (2) Can a bidder who wins a large share of the bonds in a Treasury auction use these bonds to successfully manipulate the market price? The case studies we consider indicate that the answer to the first question is "yes"

at least for some auctions. The answer to the second question depends in large part on the size of transaction costs and the availability of close substitutes for a particular type of bond. Jordan and Jordan (1996) consider the extent to which Salomon Brothers was able to manipulate the price of a certain U.S. Treasury Bond after it successfully purchased more than 80 percent of the amount being issued. Thus, this appears to be a potentially important issue. Policy makers can address this issue by restricting the proportion of an issue which any individual bidder can purchase.

This issue will be even more important in the context of other auctions with a stronger potential impact on subsequent market structures. A bond trader who corners the market thereby creates a monopoly for himself in the secondary market. Similarly, a spectrum bidder who corners the market thereby creates a monopoly for himself. This monopoly could be a monopoly in the market for spectrum, where such a market exists, but it could also be a monopoly in the market in which spectrum users compete, such as the market for mobile telephone services. Here, too, it might be enough to restrict the proportion of supply which any individual bidder can acquire. But more sophisticated tools, such as those provided by general competition law, might be needed as well.

Our discussion of the issues listed above will focus on empirical case studies. However, these case studies will be preceded by brief reviews of the relevant parts of economic theory. The purpose of these reviews is to provide an appropriate framework from which to view the empirical evidence. In considering both the theoretical arguments and empirical case studies discussed below, the reader should keep in mind the limited state of economic knowledge concerning multi-unit auctions such as treasury auctions. This concerns both the state of economic theory of auctions with multi-unit demand, and also our experimental and empirical understanding of these auctions. At present, any conclusions concerning such auctions should be regarded as both preliminary and tentative. It is the limited nature of our knowledge of Treasury auctions that makes the format of case studies particularly appropriate for the current paper.

Most of the case studies which we review, focus on information about the average prices paid in these auctions. However, a study of Swedish auctions by Nyborg and Sundaresan's (2001) forms an exception. These researchers had access to the bids submitted by individual bidders in a series of auctions.

In Table 1, at the end of the paper, we provide an overview of the case studies discussed in this paper. Many of the conclusions reported in these case studies involve some comparison of the average price in an auction, which we denote by p_A, with a measure of the market price for these bonds, p_M, near the time of the auction. In particular, the difference in these prices, $p_A - p_M$, can be interpreted as a measure of the average profit of bidders participating in the auction. It is interesting to know whether this difference is positive indicating that bidders in the auction earn positive profits on average. It is also interesting to compare this difference as the auction format changes from a uniform price to a discriminatory auction. If the average profit of bidders decreases with a change in auction format, this suggests that the change in format results in higher revenue for the government. Other related comparisons include a comparison of the market price of a bond shortly before and shortly after an auction. Such a comparison figures

prominently in Cammack's (1991) analysis of the information released in U.S. Treasury auctions.

Table 1 collects information concerning comparisons of the average auction price and the market price gathered from a number of the case studies. When reading table 1, it is important to remember that the details of these comparison differ considerably from study to study. Differences include the way in which the market price is measured and how the price difference is normalized. We discuss the some of these differences in more detail in the text as we describe the various case studies.

2 WHICH AUCTION FORMAT, UNIFORM PRICE OR DISCRIMINATORY AUCTION, IS LIKELY TO LEAD TO HIGHER REVENUES?

Uniform price and discriminatory auctions for Treasury bonds are the most commonly used and discussed formats for Treasury bond auctions. Before comparing them we should point out, however, that it has been argued that other formats might have advantages over both uniform price and discriminatory auctions. These formats have not yet been used in practice for government bonds. Treasury bonds could, in principle, be sold in an open, ascending-bid format where, for example, the auctioneer raises the price while bidders announce the amount of bonds they would be willing to buy at each successive price. The U.K. plans to use an open auction as part of its procedure for setting up a trading scheme for carbon.

Uniform price and discriminatory auctions are examples of sealed-bid auctions, and their designs share a number of other important features. In both types of auction, each bidder submits a demand curve specifying the maximum price he is willing to pay for each successive bond that he is offered. For any given price, the number of bonds with a maximum price greater than or equal to the given price thus represents the bidder's total demand for bonds at that price. The auctioneer then adds up the bidders' demand curves to determine a total demand curve for the bonds. As long as the demand is sufficiently large, the clearing price for the bonds is simply the price at which the total number of bonds demanded by all bidders is equal to the supply of bonds on offer. In both types of auction, each bidder is allocated the number of bonds that he demands at the clearing price.

Uniform price and discriminatory auctions differ in the way that the price a bidder pays for the bonds which he receives is calculated. In the uniform price auction, a bidder simply pays the clearing price for each bond. Hence, a bidder's total payment in the uniform price auction is the clearing price multiplied by the number of bonds the bidder receives. In contrast, in a discriminatory auction a bidder pays the maximum price he is willing to pay for each bond as indicated by the demand curve which the bidder has submitted. Hence, a bidder's total payment in a discriminatory auction is given by an area under the bidder's submitted demand curve. Since the price paid for each bond in a discriminatory auction is the maximum price specified by the bidder's demand curve, discriminatory auctions are sometimes referred to as pay-your-bid auctions.

For each bond which a bidder receives, the clearing price (which is also the price paid for each bond in a uniform price auction) is less than or equal to the price which a bidder pays for that bond in a discriminatory auction. Hence, for the same submitted demand curve, a bidder's total payment in a uniform price auction is always less than or equal to the bidder's total payment in a discriminatory auction. Why then do economists and treasury officials continue to debate which of these auction designs raises the most revenue?

The comparison in the previous paragraph fails to take into account that a bidder may wish to shade the maximum prices specified in the demand curve submitted to the auctioneer below the bidder's true valuations. Once it is realized that the degree of bid-shading is likely to depend on the auction design, it is no longer obvious which auction design will produce the higher expected revenue.

A bidder in a discriminatory auction will typically wish to submit a demand curve with maximum prices that are below his true valuations. For, if a bidder in a discriminatory auction bids "honestly" and submits his true valuation for each bond, then the bidder pays his full valuation for each bond that he is allocated and always obtains a net profit of zero. Since one can also obtain zero profit by simply not entering the auction, who would enter an auction if they had no hope of earning a positive profit?

Although it is not so obvious, a bidder in a uniform price auction may also have an incentive to shade his submitted demand curve below his true valuations. Hence, it becomes a matter of theoretical debate and empirical evidence as to which type of auction is likely to produce the higher average revenue.

2.1 THEORETICAL CONSIDERATIONS

At least four types of theoretical intuition have been advanced in the debate comparing uniform price and discriminatory auctions. These intuitions unfortunately lead to different conclusions regarding the auction format which is likely to produce the highest revenue for the government.

1. The first argument suggests that the greater strategic simplicity of the uniform price auction is likely to produce higher expected revenue by encouraging entry.
2. A second argument suggests that implicit collusion among bidders to maintain a low price is likely to be more difficult in the discriminatory auction, which thus may produce higher expected revenue.
3. A third argument suggests that bidders have a greater incentive to submit lower demands in an effort to reduce the clearing price in a uniform price auction. This argument suggests that discriminatory auctions may produce higher expected revenue.
4. A fourth argument suggests that the uniform price auction is more likely to reveal information about uncertain common factors such as the future market price of bonds, and thus leads to greater competition among bidders and higher expected revenue.

Thus considerations of simplicity and entry and the revelation of information have been advanced in favour of the uniform price auction. Arguments involving

implicit collusion and the incentives to manipulate the clearing price may be advanced in favour of the discriminatory auction.

In the rest of this section, we discuss the intuitions listed above in somewhat more detail. But the reader is reminded that the current economic theory concerning treasury bond auctions is highly incomplete. Back and Zender (1993) and Ausubel and Cramton (1998) further discuss some of the economic theory relevant to the comparison of uniform price and discriminatory multi-unit auctions.

1. Nobel Prize winning economists Merton Miller and Milton Friedman have been among those who argued that the problem of choosing a profitable bidding strategy is simpler in a uniform price auction. In particular, the simple strategy of submitting your true demand curve, while not necessarily optimal, has at least the potential to produce positive profits in a uniform price auction. In contrast, bidding your true valuation for each bond will produce only zero profit in a discriminatory auction. Advocates of a uniform-price auction further suggest that the availability of such a simple, potentially profitable strategy is likely to encourage more entry in a uniform price auction, especially among smaller, possibly "unsophisticated" bidders. A greater number of bidders could, in turn, lead to more aggressive bidding and higher average revenue in a uniform price auction.

   Friedman and others sometimes go one step further and claim that a bidder can do no better than to bid his true demand curve in a uniform price auction. If such a claim were true, it would certainly strengthen the case for the strategic simplicity of the uniform price auction. However, as shown, for example, by Back and Zender (1993) and Ausubel and Cramton (1998), submitting your true demand curve is not generally optimal in the uniform price auction. Friedman and others appear to have been misled by an incorrect analogy with the second-price, sealed-bid auction for a single unit where it is often optimal to bid your true valuation.

   How different auction designs affect the incentives for entry is clearly an important unresolved question in the economics of multi-unit auctions. However, the argument described so far in favour of the uniform price auction does not seem fully persuasive. Relatively simple strategies are also available for the discriminatory auction --- for example, shade the valuations that determine your true demand curve downward by a fixed percentage. Such strategies are potentially profitable although probably not optimal for a bidder in a discriminatory auction.

2. In a uniform price auction, a bidder may find it optimal to submit a demand curve that is initially very steep and then falls to a relatively flat, low level. Demand curves with such a shape can facilitate implicit collusion while reducing the clearing price, and hence the revenue obtained in a uniform price auction, to a low level. Binmore and Swierzbinski (2000) study a very simple example with only two bidders using graphs. Back and Zender (1993) and Ausubel and Cramton (1998) compare the theoretical outcomes in uniform price and discriminatory auctions for a wider class of cases.

   By submitting initially steep demand curves in a uniform price auction, bidders who wish to coordinate on a low price can limit the gains from

cheating on a collusive agreement. For a bidder who wishes to cheat on a collusive outcome does so by raising his submitted demand curve slightly to increase the amount he can buy at the low collusive price. But when the other bidders' demand curves become steep at levels of demand not much below the levels tacitly agreed on, the prospective bidder runs risks of shifting the total demand so that demand equals supply where the total demand is steep and the clearing price is much higher than the intended low price.

The cost of submitting an initially steep demand curve is likely to be low in a uniform price auction. When a bidder submits such a demand curve, that bidder is bidding a high maximum price for the first units that he wishes to buy. But it is not likely that these initial high bids will be a factor in determining the clearing price --- and it is the clearing price which the bidder actually pays. In contrast, a bidder in a discriminatory auction who submits a steep demand curve can be sure to pay a high price for the first units he buys.

3. Compared to bidders in a discriminatory auction, bidders in a uniform price auction also appear to have a greater incentive to submit low bids for units when those bids may affect the clearing price in the auction. By submitting a bid that reduces the clearing price, a bidder in a uniform price auction reduces the price that he pays for every unit that he buys. In contrast, a bidder in a discriminatory auction who reduces the clearing price by bidding low for the last unit he purchases simply reduces the price he pays for that last unit.

   Concerns about implicit collusion and the incentives for demand reduction seem most relevant when there are a relatively small number of large bidders. For large numbers of bidders, the difficulty of coordinating on a collusive agreement seems prohibitive, so that the enforcement of such an agreement becomes moot. Moreover, it also seems unlikely that any one bidder's demand can significantly affect the clearing price when there are many bidders all of whom are small.

4. As we have already observed, Treasury auctions are often modelled as common-value auctions where the differences in the valuations of different bidders are due to differences in the information available to these bidders when they forecast the future market price of the bonds up for auction. The theory of single-unit, common-value auctions predicts that if bidders bid in an unsophisticated way, they may fall prey to a winner's curse and earn negative expected profits. If the bidders bid as theory suggests, they may earn positive profits and these profits may be interpreted as a return to the private information which the winning bidder possesses.

   Auction theorists such as Paul Milgrom (1989) have used the theory of single-unit, common-value auctions to propose the linkage principle as an informal guide to comparing auction designs for common value auctions. If bidders' profits represent a return to private information, then auction designs that link the price paid to the information of other bidders might "dilute" the effect of this private information, reducing a bidders' expected profit and increasing the auctioneer's expected revenue. In a uniform price auction, the price paid by each bidder is "linked" to the bids made by others

through the clearing price. The linkage principle suggests that bidders' expected profits will be lower and so the auctioneer's expected revenue will be higher in a uniform price rather than a discriminatory auction. See Milgrom (1989) for a further discussion of the linkage principle.

2.2 EMPIRICAL CASE STUDIES

We now turn to case studies. Typically, the case studies do not allow us to identify closely which of the four intuitions, or possibly other effects, are at work, but we can only observe the overall comparison between the two auction formats. However, in some cases one can try to infer more detailed conclusions about individual effects, and we point out were this is the case.

The empirical case studies described in this section of the report involve "natural experiments" where the U.S. or Mexican Treasury switched from one auction format to the other when conducting actual auctions. A serious difficulty complicates the interpretation of virtually all natural experiments. Many other factors that might potentially affect the performance of the auctions being studied are also typically changing at the time the auction format is switched. What fraction of any observed change in performance is due to the switch in format and what fraction is due to changes in other factors? One may attempt to model or otherwise account for the effect of factors other than the change in auction format. For example, the studies considered attempt to control for changes in the value of the auctioned bonds by using a measure of the difference between the auction and market price as a basis for comparison. Nevertheless, isolating the effect of the change in format may be difficult or impossible. This caveat should be kept in mind when considering the results reported below.

A study that is not affected by the problems of natural experiments is Hortaçsu's (2001) innovative analysis of Turkish Treasury auctions. Hortaçsu considers only discriminatory price auctions. The data available to him are the complete demand functions submitted by bidders. Using econometric techniques he reconstructs from the demand functions the bidders' true valuation functions. Then he conducts the counterfactual experiment what expected revenue would have been had the auction format been uniform price. He finds that a switch to a uniform price format would have caused average revenue losses of 14.23%. This is surprisingly large. However, he indicates that the potential random error in these results is very large, too.

Hortaçsu's analysis of the bidding functions relies on strong assumptions about bidders' behaviour. In particular, it is assumed that bidders bid rationally, and thus do not follow simple rules of thumb, as discussed in intuition (1) above. He also assumes that bidders do not collude, thus ruling out effect (2) above. The correct interpretation of his results is probably that he indicates the likely size of the effect described in intuition (3) above, if we are willing to assume that the other effects are not at work. His findings then suggest that effect (3) is present, although its statistical significance ex ante is not easy to establish.

US Treasury Auctions

The U.S. Treasury typically sells its bonds using a discriminatory auction. However, in the 1970's and again in the 1990's the Treasury experimented with

uniform price auctions. Simon (1994) describes the results of experiments in the 1970's while Nyborg and Sundaresan (1996) consider experiments that occurred in the 1990's.

Simon compares the results of five uniform price auctions and ten discriminatory auctions that took place from 1973 to 1976. Since the summer of 1974, a competitive bid in a Treasury bond auction consists of a combination of a desired amount of bonds and a yield to maturity. Bidders can submit multiple bids and so effectively submit a demand curve by submitting several bids with different yields to maturity. The yield to maturity, the coupon interest rate, and the maturity and face value of a bond together determine the bond's price.

The face value, which is the amount the bond pays when it matures, and the maturity, which is the number of years until the bond pays its face value, are set in advance of the auction by the Treasury. The coupon interest rate is a percent of the face value that is paid to bond holders, typically on an annual or semi-annual schedule. For some of the auctions Simon considered, the coupon rate was also set in advance. In other cases, the Treasury used the results of the auction to set a coupon interest rate close to the average yield bid in the auction. The bonds Simon considered had maturities ranging from 15 to 30 years.

Simon measured the average bidder's profit from an auction by using the difference between the average yield to maturity in the auction and the market yield to maturity near the time of the auction. Simon refers to this difference as the mark-up. In calculating this mark-up, Simon usually uses a market yield based on transactions in the when-issued market. In a few cases, where the auctions represented the sale of additional amounts of bonds that were already being traded and when-issued data was not available, Simon used the market yield of the traded bonds.

The when-issued market in the United States is a forward market that operates before and shortly after each Treasury auction. In this market, prospective bidders and other traders can trade claims to the bonds being auctioned. Trades in the when-issued market are settled after the results of the auction become known. For more information on the when-issued market, see Bikchandani and Huang (1993) and Nyborg and Sundaresan (1996).

Using data which Simon reports in table 1 of his paper, one can calculate that the quantity weighted average mark-up in yield for the discriminatory auctions that Simon considers is 1.58 basis points of yield. (A basis point is .01 percent.) The corresponding mark-up for the uniform price auctions he considers is 1.92 basis points. Hence, switching from a discriminatory to a uniform price auction format appears to have increased the mark-up by 0.34 basis points of yield. After attempting to control for various factors that may have affected the auction or market yields, Simon concludes that the switch to a uniform price format increased the mark-up by 7 to 8 basis points.

A higher yield to maturity corresponds to a lower bond price. Hence, the positive yield mark-ups reported by Simon correspond to positive average profits for bidders. For coupon rates and maturities similar to those considered by Simon, a small difference in yield must be multiplied by approximately a factor of 10 to obtain the corresponding difference in the bond price measured as a fraction of the bond's face value. Using this approximation, the yield mark-up of 1.58 basis points for discriminatory auctions corresponds to a price mark-up of 15.8 basis

points or an average profit for bidders of 1,580 dollars for every 1 million dollars of face value purchased. The corresponding profit for the bidders in the uniform auctions was 1,920 dollars per million dollars of face value purchased.

Subtracting these two measures of profit indicates that the switch from a discriminatory to a uniform price format increased bidder's profit (and, therefore, reduced the Treasury's revenue) by 340 dollars per million of face value. Controlling for other factors, Simon estimates that the switch from a discriminatory to a uniform price format resulted in a loss in revenue to the Treasury of between 7000 and 8000 dollars per million of face value. These are relatively large loss estimates, but their plausibility depends on the degree to which Simon has adequately controlled for the effects of other factors. Simon's analysis does not allow us to distinguish the potential impact of the different intuitive effects discussed earlier.

Nyborg and Sundaresan (1996) study auctions of 2-year and 5-year U.S. Treasury notes that took place in 1992 and 1993. (It is a common convention in financial economics to refer to Treasury bonds with very short maturities (e.g. 90 days) as "Treasury bills". Bonds with moderate maturities such as those studied by Nyborg and Sundaresan are referred to as "Treasury notes" while the term "Treasury bond" is reserved for bonds with long maturities.)

As in Simon's study, Nyborg and Sundaresan calculate the average bidder profit in terms of the yield mark-up. Nyborg and Sundaresan also used the when-issued forward market to obtain an estimate of the market yield to maturity near the time of the auction. Their when-issued data consisted of all the transactions made by Garban Inc., one of the active participants in this market.

Table 8 of Nyborg and Sundaresan's paper lists the average yield mark-ups for their auctions. They find that the average yield mark-up depends sensitively on the maturity of the bond being auctioned and the exact time that the when-issued yield is calculated as well as on the auction format. For discriminatory auctions of 2-year notes, Nyborg and Sundaresan calculate an average yield mark-up of 0.527 basis points when the when-issue yield is measured at the time bids are submitted and a yield mark-up of -.03 basis points when the when-issued yield is measured at the time the auction results are released. For discriminatory auctions of 5-year notes, the corresponding yield mark-ups are 0.44 basis points and 1.52 basis points. For uniform price auctions of 2-year notes, Nyborg and Sundaresan calculate an average yield mark-up of - .048 basis points for a when-issued yield measured at the time bids are submitted and a mark-up of 0.695 for a when-issued yield measured at the time the results of the auction are released. The corresponding average yield mark-ups for uniform price auctions of 5-year notes are 0.698 basis points and -0.601 basis points.

For the two-year and five-year maturities considered by Nyborg and Sundaresan, a small difference in the yield to maturity can be approximately translated into a small difference in the price of the bond by multiplying the yield difference by the bond's maturity. The result is a price difference expressed as a fraction of the bond's face value. Using this approximation, we obtain the following estimates for a bidder's average profit per million dollars of face value that the bidder buys at auction. (One basis point of price difference corresponds to 100 dollars of profit per million of face value.) For discriminatory auctions of 2-year notes, the estimated average profit is either 105 dollars of profit or a 6 dollar loss depending

on which when-issued yield is used. For discriminatory auctions of 5-year notes, the corresponding profit measures are either 222 dollars or 762 dollars of profit per million of face value purchased. For uniform price auctions of 2-year notes, Nyborg and Sundaresan's profit estimates are either a 9.6 dollar loss or a 139 dollar profit per million face value. The corresponding profit estimates for uniform price auctions of 5-year notes are a 349 dollar profit or a 300 dollar loss depending on the time at which the when-issued yields are measured.

Recall that an increase in bidder's profit corresponds to an identical reduction in the government's revenue. By comparing the average bidder's profits listed above across auction formats, one can therefore conclude that the switch from a discriminatory to a uniform price format in the auctions for 2-year Treasury notes resulted either in a gain in revenue of 115 dollars or a loss in revenue of 145 dollars per million of face value purchased. Similarly, for 5-year Treasury notes, the corresponding changes in average revenue are either a 127 dollar loss per million of face value sold or a 1062 dollar gain depending on when the when-issued yield is calculated. Thus, Nyborg and Sundaresan's analysis seems inconclusive.

Mexican Treasury Auctions

Umlauf considers auctions of 30-day Mexican Treasury bills (denominated in pesos) that took place from 1986 to 1991. These short-term notes did not have coupons. The auctions occurred weekly and followed procedures similar to those used in U.S. auctions. A competitive bid in the Mexican auction consisted of an offer to purchase a given quantity of bills at a price specified in terms of a discount from a reference level. Bidders could submit multiple bids and so effectively submit a demand curve. Competitive bidders included government banks, private banks, stock brokerages and insurance companies. The auctions began in 1986. From 1986 until June 1990, the auctions used the discriminatory format. In July 1990, the Mexican Treasury switched to a uniform price format which was used during the remaining period considered by Umlauf. Umlauf's data includes the results of 181 discriminatory auctions and 26 uniform price auctions.

One reason why Umlauf's data are interesting in the context of our discussion is that according to Umlauf it was widely believed that the six largest bidders in the Mexican auction formed a bidder's cartel. In this regard, it is interesting to note that although there were an average of 25 competitive bidders in each auction, the six largest bidders purchased an average of 72 % of the bonds. As we discussed above theoretical intuitions suggest that the operation of the cartel should be easier in the uniform price auction than in the discriminatory auction. We now ask whether Umlauf's data confirm the above intuition.

In the Mexican auctions bids were submitted on Tuesdays with the results announced Wednesdays morning. According to Umlauf, the bulk of the auctioned bonds were resold in the market on Wednesday afternoon. Umlauf uses the difference between the Wednesday resale price and the average price paid in the auction as a measure of the average profits earned by bidders. Umlauf reports this difference as a fraction of the average price paid in the auction.

For the discriminatory auctions, the average profit earned by bidders was 1.84 basis points or 184 dollars profit for every 1 million dollars spent in the auction. For the uniform price auctions, Umlauf reports a profit of - 0.3 basis points, that

is an *average loss* of 30 dollars for every one million dollars spent in the auction. Subtracting the above two measures of profit indicates that the switch from a discriminatory to a uniform price auction reduced the average bidder's profit by 214 dollars per million spent and, hence, appears to have increased the Mexican government's revenue by this amount.

Thus, Umlauf's data do definitely *not* confirm the theoretical intuition. However, firstly the effect might be present and might just be outweighed by other effects which operate into the opposite direction. Moreover, it is interesting to note that Umlauf calculates that the average profit of the supposed bidder's cartel was 206 dollars per million spent in the auctions with a discriminatory format and - 44 dollars per million spent in the uniform price auction, that is a loss of 44 dollars per million, with uniform price auctions. These average profits seem small and the existence of losses is surprising. If the six bidders did form a cartel, it does not seem to have been very effective at generating profits.

2.3 CONCLUSIONS

Regarding the effect of a switch from a discriminatory to a uniform price auction, Simon estimates that such a switch resulted in a relatively large loss in revenue for U.S. Treasury auctions in the 1970's. Umlauf, on the other hand, estimates that such a switch resulted in a moderate gain for the Mexican Treasury. Finally, Nyborg and Sundaresan's results suggest that such a switch might result in either moderate gains or losses for the Treasury with the estimates depending, among other things, on exactly when the when-issued yield is measured. Overall these results seem inconclusive.

It is difficult to find in these case studies direct confirmation of the four intuitive effects listed above. However, it does seem plausible that the straightforward effect that uniform price auctions create stronger incentives for demand reduction is present. On the other hand, we have not found direct evidence of the implicit form of collusion which the uniform price auction in principle makes possible. We have also not found evidence that bidders would not know how to shade their bids correctly, and would therefore either use simple rules of thumb, or fall prey to the "winner's curse". These effects may be present, however, even if we cannot document them at this stage.

It is worth reiterating that the interpretation of natural experiments such as those reported here is complicated by the difficulty of accounting for the effects of changes in factors other than the auction format. In particular, Umlauf, Simon, and Nyborg and Sundaresan all compare auction formats using a profit rate that uses the difference between the auction price and some market price. If we assume (1) that a change in auction format affects the auction price but not the market price and (2) that changes in factors which affect the underlying value of the bonds being auctioned influence both the auction and the market price in a similar way, then such a procedure can be a useful way to control for changes in factors other than the auction format. If, on the other hand, the market price is also sensitive to a change in auction format, then there is a problem. In this regard, it is troubling that Nyborg and Sundaresan's paper also suggests that when-issued yields may indeed be affected by the auction format.

3 How do Interactions between Treasury Auctions and the Treasury Bond Market affect Policy Choices?

3.1 Does the Conduct of an Auction Accelerate the Revelation of Information held by Bidders?

In a classic article, Fama (1970) highlighted the importance of the informational role of financial markets. He called a financial market (informationally) "efficient" if the prices of assets traded in the market "fully reflected" all available information. The importance of the "informational efficiency" of financial markets (and the degree to which these markets are indeed informationally efficient) is a theme that has been taken up by many financial economists since Fama.

If the conduct of periodic auctions of Treasury bonds accelerates the release of information held by bidders, then auctions may have an important role in contributing to the informational efficiency of bond markets. Cammack (1991) examined this question in an influential study of U.S. auctions for short-term Treasury bonds (often called Treasury bills because of their short maturity). Much of Cammack's analysis involved comparing the market price of these bills shortly before and shortly after each auction. Cammack also compared the market price to the auction price to calculate the profits earned by bidders.

Cammack studied auctions that were conducted on a weekly basis by the U.S. Treasury during the period from 1973 to 1984. Each Monday in the early afternoon, competitive bidders could submit multiple price-quantity bids for Treasury bills maturing in 91 days or 182 days. The auctions were discriminatory auctions in which each competitive bidder paid his bid for the bonds won at auction. Although we have not emphasized this point up to now, in many Treasury auctions in the U.S. and elsewhere including the auctions considered by Cammack, small investors can also submit "non-competitive" bids which entitles them to buy bonds at a quantity-weighted average of the bid prices. The presence of non-competitive bids turns out to feature in Cammack's analysis.

The auction results were announced on Monday evening. By Tuesday the bills were being actively traded in the bond market. Although Cammack focuses on the auction for 91 day bonds, the presence of an auction for 182 day bonds was also important for her analysis. In addition to an active Tuesday market for bills with a 91 day maturity, the auction of 182 day bonds three months previously meant that on Monday before the auction there was already an active market for bonds with a 92 day maturity -- and these bonds should be a very close substitute for the 91 day bonds being auctioned. (See Cammack (1991) for more detail on the exact timing of trading and delivery for the various bills she considers.)

Cammack studies three prices as well as profit measures or mark-ups based on these prices. Following Cammack, let P_A denote the mean auction price. Let P_M denote the market price on Monday (before the auction results are announced) of

the 92 day Treasury bill adjusted for the one day difference in maturity. Finally, the quantity P_T denotes the Tuesday market price of the auctioned bonds.

Cammack calls the normalized difference between the Monday market price and the mean auction price, $(P_M - P_A)/P_A$, the "Monday bidding adjustment". Similarly, the normalized difference $(P_T - P_A)/P_A$ is the "Tuesday bidding adjustment". Finally, the "Tuesday return" is the normalized difference $(P_T - P_M)/P_M$. All these differences are reported in percentages or basis points.

As a point of clarification that may be helpful to readers of Cammack's paper, Cammack actually reports the natural logarithm of price ratios. For example, ln (P_M/P_A) is the Monday bidding adjustment. The interpretation of these price ratios as normalized price differences is obtained using the Taylor approximation that $ln(1+x) = x$, which should be highly accurate for the small values of x that are relevant here.

Cammack finds that the mean Monday bidding adjustment is approximately equal to the mean Tuesday bidding adjustment and both are equal when averaged over her entire sample to approximately 1 basis point. Hence, by buying in the auction and selling in the Tuesday market, bidders could earn an average profit of 100 dollars for every million dollars spent in the auction.

As a second point of clarification Cammack often refers to the one basis point difference in the price as a "difference of four basis points". When she does so, she is converting price to yield measured on an annual basis.

Cammack also finds that "the standard deviation of the Monday bidding adjustment is approximately one-half that of the Tuesday bidding adjustment." Cammack attributes the additional variability in the Tuesday bidding adjustment to the arrival of information during the 24 hours from Monday to Tuesday. Some of this information may be from the release of the auction results on Monday evening. But some or even all of the additional variability may be due to the random arrival of other information.

In an attempt to isolate the effect of information contained in the auction on the Tuesday market price, Cammack regresses the Tuesday return, $(P_T - P_M)/P_M$, on variables that proxy for the information contained in the auction results. One such variable is the ratio of competitive bids placed to competitive bids accepted. A second variable is the ratio of non-competitive bids to the total amount of bills auctioned. These variables are measures of the demand for the auctioned Treasury bills by bidders and small investors. Finally, Cammack considers the logarithm of the difference of the mean and low auction prices, which she regards as a measure of the dispersion of opinion concerning the bonds' value.

For each independent variable, Cammack first uses a time series model to decompose the variable's value into an anticipated and unanticipated component. "News" from the auction is assumed to be conveyed primarily by the unanticipated component. Whether or not the unanticipated components of demand-related measures are significant in explaining the variability in the Tuesday return depends in part on how other variables are controlled in the regression. However, the unanticipated component of Cammack's "dispersion of opinion" measure is significant in explaining the variability in the Tuesday return suggesting that the results of the auction do release information to the market. This seems in principle to offer support for the conduct of auctions as they increase informational efficiency.

3.2 DOES THE DEGREE OF UNCERTAINTY IN THE BOND MARKET AFFECT THE DESIRABILITY OF CONDUCTING AN AUCTION?

Since Treasury bonds are typically traded in an active after-market, the underlying value of these bonds must be nearly the same for all bidders. Moreover, differences in bidders' values for the auctioned bonds seems likely to be due in large part to differences in the bidders' forecasts of the future market price. As we have previously observed, these features of Treasury auctions suggest that the theory of common value auctions may be relevant for explaining behaviour in Treasury auctions.

As was also mentioned in the introduction, the theory of single-unit, common value auctions warns that there is a danger that bidders may bid too optimistically in such auctions. When a bidder in a common value auction wins the auctioned item by bidding high, the very fact of winning is a signal that the bidder's initial forecast was too optimistic. Unless the bidder shades his bid downward in a way that takes appropriate account of the information contained in the bids of other participants in the auction, he may fall prey to a "winner's curse" paying more for items than they are worth and earning ex post negative profits.

As observed, for example, by Laffont (1997), the winner's curse in common value auctions became a matter of great practical concern in the context of auctions for oil drilling rights in the Gulf of Mexico. In spite of the large amount of oil available in the Gulf, bidding companies appeared to be making low profits that did not produce an adequate return on investment. It was suggested that over-optimistic bidding was the cause. As Laffont also notes, later empirical work calls into question the degree to which the winner's curse was operating in these oil auctions. But a long debate ensued as to the appropriate way to bid in auctions for oil leases.

The degree of bid shading required to avoid the winner's curse increases as uncertainty about the underlying value of the auctioned items increases. In the context of Treasury auctions, this suggests that bidders are more likely to run afoul of the winner's curse and earn low or even negative profits when market uncertainty is high. Is there a threshold level of market uncertainty where an auction is not even advisable? Or do bidders learn to appropriately adjust their bids in response to market uncertainty?

Nyborg and Sundaresan (2001) draw on an earlier analysis of Ausubel to observe that the appropriate response to uncertainty is more subtle when bidders can submit demand curves as is the case in Treasury auctions. Unlike the discrete win-lose signal that occurs in a single unit-auction, there is a continuum of possible signals in a Treasury auction. The more a bidder wins in a Treasury auction, the stronger is the signal that the bidder's initial forecast of the future market price was too optimistic. When bidders submit demand curves, the appropriate response to uncertainty may involve not only a downward shading of the average price bid but also a change in the shape of the submitted demand curve, making it steeper.

One way to assess the practical significance of the winner's curse in Treasury auctions is to consider the average profits of bidders in such auctions. Many of

the studies we consider attempt to measure these average profits by comparing the mean auction price to some measure of the market price. We summarize the information on average profit from these studies in table 1. At the crudest level, the profit estimates contained in table 1 do not suggest to us that the bidders in Treasury auction bid so aggressively as to earn large negative profits on average. A few case studies do report relatively small average losses but we do not find these results persuasive. For example, in Nyborg and Sundaresan's U.S. study, whether they estimate an average loss or an average profit depends on the fine details of how the market price is estimated.

Umlauf (1993) also reports a small average loss in uniform price Mexican auctions, but asserts that these losses occurred when a bidders' cartel was supposedly operating and earning negative profits. If there was a bidder's cartel, why was it earning a negative average profit? One explanation may be the degree of uncertainty characterizing the Mexican economy during the time period of Umlauf's study. Umlauf reports that during this period there occurred a foreign debt crisis, hyperinflation, and a Presidential election that Umlauf describes as "highly contested." Thus, although in principle one could argue that Umlauf's results show that the cartel was incompetent in dealing with the "winner's curse", the uncertainty with which the cartel was dealing might have been so unusual that this comment is unfair.

Although not shown in table 1, which reports only the average profit over all auctions - which was positive, Nyborg and Sundaresan (2001) also find negative average profits in auctions involving Swedish bonds with certain times to maturity. However, Nyborg and Sundaresaon also note that their measure of profit is likely to be an underestimate because of the way the market price of bonds was calculated.

In considering the evidence presented in table 1, a reader should keep in mind that we have not discussed what level of profit provides an appropriate level of compensation for the risk involved in participating in the auction and later reselling in the bond market. The degree of risk surely varies from country to country. One wonders, for example, whether the 184 dollar average profit which Umlauf estimates for discriminatory Mexican auctions is really adequate compensation for the risk involved in these auctions. However, other than noting this issue we do not propose to consider it further in this report.

It is interesting to ask whether bidders in Treasury auctions respond to market uncertainty as the theory of common value auctions suggests by lowering the average price bid and adjusting the shape of the submitted demand curve. To best address these questions, data on the behaviour of individual bidders are useful.

Nyborg and Sundaresan (2001) report results from a series of Swedish Treasury auctions where data on the actual demand schedules submitted by individual bidders was made available (with the identity of the bidders protected). They find that the level of market uncertainty has an effect on both the average price a bidder submitted and the shape of the bidder's demand curve that is statistically significant.

Nyborg and Sundaresan (2001) studied more than 400 auctions of Swedish bonds that occurred from 1990 to 1994. The auctions were discriminatory. The majority of the auctions considered involved Treasury bills with a maturity of 14 months or less. Approximately one third of the auctions were for Treasury bonds with

maturities ranging from 6 to 16 years from the original issue date. Since most of the auctions involved additional sales of already existing bonds, the actual time to maturity of the Treasury bonds ranged from 1 to 8 or more years.

Although almost all the bonds considered by Nyborg and Sundaresan appear to have been actively traded in the bond market, the transaction prices in this market are not made available to the public. Nyborg and Sundaresan typically used the median prices quoted by a number of dealers shortly after the auction as a proxy for the transaction price in the secondary bond market.

Average bidders' profit in each auction was calculated as the difference between the post-auction market price and the quantity-weighted average of the winning bids in the auction. Averaged over all the auctions, the mean profit was 2 basis points of the face value of the bond. This corresponds to an average profit of 200 kronor per 1 million of face value purchased. This mean profit is reported in Table 1.

The average profit in Nyborg and Sundaresan's auctions increased with the remaining time to maturity of the bonds being auctioned. For bonds with short maturities, average profit in the auction was sometimes negative. For example, for bonds with a time to maturity close to 1 year, Nyborg and Sundaresan estimate an average loss of 140 kronor per 1 million of face value purchased. (See Table 4 of Nyborg and Sundaresan (2001).) However, Nyborg and Sundaresan also suggest that their measure of average profit is likely to be an underestimate because they were unable to use transaction prices to estimate the market price of the bonds.

To describe the demand curves submitted by individual bidders, Nyborg and Sundaresan use three numbers. The "discount" is the difference between the market price shortly after the auction and the quantity weighted average price of the bids submitted by the bidder. The discount is a measure of bid shading. The shape of the bidder's submitted demand curve was measured by the "dispersion" which was the quantity-weighted standard deviation of the prices bid by the bidder. If demand is linear than larger "dispersion" corresponds to a steeper slope of the demand curve. Nyborg and Sundaresan's third variable is the "quantity", that is the maximum number of bonds bid for by each bidder, measured as a fraction of the total size of the auction.

The average discount observed by Nyborg and Sundaresan was 9.2 basis points of the face value of the bonds. If all a bidder's bids were winning bids, then the discount would be the profit that the bidder earns in the auction. Hence, bidders on average shaded their bids by 920 kronor per million kronor of face value compared to the (estimated) post-auction market price. Of course, not all the bids were winning bids, so the actual profit earned was less than 920 kronor per million of face value.

The average dispersion was also positive with a value of 4.6 basis points. Hence, on average bidders submitted downward sloping demand curves. This result is itself interesting in that it indicates that bidders typically do use the flexibility afforded to them by the opportunity to submit a downward sloping rather than a flat demand curve. On the other hand, the minimum value of the dispersion was 0 indicating that at least some bidders did submit a flat demand curve. Nyborg and Sundaresan report that the average number of bids per bidder in an auction was 4.9 with a mode of 2 for the shorter maturity Treasury bills and a mode of 4 for the longer maturity Treasury bonds.

How do the discount and dispersion that describe an individual bidder's submitted demand depend on market uncertainty? Nyborg and Sundaresan measure market uncertainty near the time of an auction by fitting a time series model to data on bond returns to estimate the one-day volatility in the market price. The average level of the estimated one-day volatility was 26.7 basis points and there was considerable variation in this number across auctions.

Nyborg and Sundaresan regressed both the discount and the dispersion of bidder's demand curves against their estimated market volatility. In each regression, the coefficient multiplying volatility was positive and highly statistically significant. The regression coefficients were also significant in an economic sense. An increase of 10 basis points in market volatility caused an average increase in the discount of 4.4 basis points which is a substantial increase in the level of bid shading. An increase of 10 points in market volatility also increases the average dispersion by 2 basis points. The mean dispersion of the bidder's demand curves was 4.6 basis points so that an increase of 2 basis points in the dispersion is also substantial. Thus, Nyborg and Sundaresan's findings overall suggest that bidders in Swedish treasury bond auctions are well adapted to the "winner's curse", and that the possibility of a "winner's curse" does not constitute a valid argument against the use of auctions in issuing bonds.

3.3 DO AUCTIONS OPEN UP THE POSSIBILITY THAT A BIDDER CAN "CORNER THE MARKET" OR OTHERWISE MANIPULATE THE MARKET PRICE?

Should policy makers be concerned that a bidder can acquire a sufficient number of bonds in an auction to manipulate prices in the bond market? One relevant fact is that the U.S. Treasury remains sufficiently concerned about this possibility to limit the amount that a single bidder can purchase in one of its auction to 35 % of the auctioned bonds. It is also noteworthy that in Swedish auctions, where there is no 35 % rule, Nyborg and Sundaresan (2001) report that a single bidder purchased all the bonds at auction in about 10 percent of the more than 400 auctions which they studied.

The observations in the previous paragraph suggest that one or a few bidders may be able to win most or even all of the bonds sold in an auction. Whether these bonds can then be used to manipulate the bond market also depends on the availability of close substitutes for the auctioned bond. In Sweden, for example, most of the Treasury auctions involve adding more bonds to an existing issue that is already actively traded. If the amount sold in any one auction is a relatively small fraction of all the outstanding bonds, it may not matter if a single bidder purchases the entire amount being auctioned.

In U.S. Treasury auctions, there are three markets that are potentially vulnerable to manipulation. One is the bond market itself. The other is the when-issued forward market where claims to the bonds being auctioned are traded and a related market known as the "repo and reverse market."

Bikchandani and Huang (1993) describe how the when-issued market might be manipulated. A seller of a forward contract in the when-issued market guarantees to deliver a quantity of the bonds being auctioned after the auction occurs.

According to Bikchandani and Huang, primary dealers often sell contracts in the when-issued market to institutional clients who wish to ensure that they will be able to purchase some of the bonds being auctioned. If many of the sellers in the when-issued market are unable to acquire the needed bonds in the auction, a "short squeeze" may occur. In this case, the sellers must either pay a high price to repurchase their when-issued contracts or borrow the needed securities in the "repurchase and reverse" market. Borrowing securities in this market can be costly for the borrower and profitable for the lender.

The frequency with which short squeezes occur and the extent to which they are caused by deliberate action or merely chance events is a matter open to question. See Bikchandani and Huang (1993) for further references that are relevant to this debate as well as a fuller description of the repo and reverse market.

In considering possible manipulation in U.S. Treasury markets, it is interesting to note the case of an attempted market corner by Salomon Brothers in 1991. Jordan and Jordan (1996) discuss the incident and attempt to measure the level of Salomon Brothers profits. In May of 1991, the U.S. Treasury auctioned more than 12 billion dollars of Treasury notes with a 2 year maturity. In spite of the Treasury rule limiting the purchase of bonds being auctioned to no more than 35 % of the total, Salomon Brothers was able to purchase over 80 % of the issue. According to Jordan and Jordan, Salomon purchased over 40 % of the bonds in its own name and purchased additional bonds by using unauthorized customer bids.

The Salomon Brothers incident received considerable public attention. Without admitting any wrongdoing, Salomon Brothers later reached a settlement with the Securities and Exchange Commission and other U.S. agencies that, according to Jordan and Jordan, cost 290 million dollars including $122 million paid to the Treasury to settle securities violations, $68 million paid to the Department of Justice, and $100 million paid to set up a fund to compensate injured parties. Evidently, at least some members of Salomon Brothers were willing to take substantial risks in the hope of profitably manipulating the bond market via the auction.

Jordan and Jordan note that one of the ways that Salomon Brothers was able to profit from its corner was by obtaining special deals in the repurchase and reverse market from firms that needed to settle contracts in the when-issued market. Jordan and Jordan also attempt to measure the degree of mispricing in the bond market itself that was caused by Salomon Brothers' manipulations. They conclude that the two year note was significantly overvalued for approximately six weeks after the auction. Thus, Salomon Brothers seem to have manipulated the market, and imposing quantity bounds in bond auctions appears to be an important policy instrument.

4 CONCLUSIONS

One of the case studies reviewed in this paper suggest that bond auctions can serve as information discovery mechanisms even in the presence of active secondary markets. This speaks in favour of using auctions for the sale of bonds. There is at most weak evidence that auctions create "sorry losers" who suffer from the winner's curse. In general bidders seem to rationally adjust to the

presence of the winner's curse. The two most prominent auction formats for bond auctions, uniform price and discriminatory auctions, do not seem to lead to very large differences in governments' expected revenues. However, it does seem important in some cases to limit the proportion of any single issue which an individual bidder can purchase.

REFERENCES

EMPIRICAL CASE STUDIES

Cammack, E. (1991) Evidence on Bidding Strategies and the Information in Treasury Bill Auctions, *Journal of Political Economy*, vol. 99, pp. 100 - 130.

Hortacsu, A. (2001) *Mechanism Choice and Strategic Bidding in Divisible Good Auctions: An Empirical Analysis of the Turkish Treasury Auction Market*, unpublished draft, University of Chicago.

Jordan, B. and S. Jordan (1996) Salomon Brothers and the May 1991 Treasury Auction: Analysis of a Market Corner, *Journal of Banking and Finance*, vol. 20, pp. 25 - 40.

Nyborg, K. and S. Sundaresan (1996) Discriminatory versus Uniform Treasury Auctions: Evidence from When-Issued Transactions, *Journal of Financial Economics*, vol. 42, pp. 63-104.

Nyborg, K. and S. Sundaresan (2001) Bidder Behavior in Multi-Unit Auctions: Evidence from Swedish Treasury Auctions, forthcoming in the *Journal of Political Economy*. Available from: www.london.edu/faculty_research/Working_Papers/working_papers.html.

Simon, D. (1994) The Treasury's Experiment with Single-Price Auctions in the Mid-1970's: Winner's or Taxpayer's Curse? *Review of Economics and Statistics*, vol. 76, pp. 754-760.

Umlauf, S. (1993) An Empirical Study of the Mexican Treasury Bill Auction, *Journal of Financial Economics*, vol. 33, pp. 313 - 340.

OTHER REFERENCES

Ausubel, L. and P. Cramton (1998) *Demand Reduction and Inefficiency in Multi-Unit Auctions*, University of Maryland working paper, available from: www.cramton.umd.edu.

Back, K. and J. Zender (1993) Auctions of Divisible Goods: On the Rationale for the Treasury Experiment, *Review of Financial Studies*, vol. 6, pp. 733-764.

Bikchandani, S. and C. Huang (1993) The Economics of Treasury Securities Markets, *Journal of Economic Perspectives*, vol. 7, pp. 117 - 134.

Binmore, K. and J. Swierzbinski (2000) Treasury Auctions: Uniform or Discriminatory, *Review of Economic Design*, vol. 5, pp. 387 - 410.

Fama, E. (1970) Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, vol. 25, pp. 383 - 417.

Laffont, J. J. (1997) Game Theory and Empirical Economics: The Case of Auction Data, *European Economic Review*, vol. 41, pp. 1 - 35.

Milgrom, P. (1989) Auctions and Bidding: A Primer, *Journal of Economic Perspectives*, vol. 3, pp. 3 - 22.

U.K. Department for Environment, Food, and Rural Affairs (DEFRA) (2001) *Draft Framework Document for the UK Emissions Trading Scheme*. This and other documents relating to the U.K. programme for trading carbon emissions are available from the department's website, www.defra.gov.uk.

Table 1. Summary of Comparisons from Case Studies Calculating the Average Profit in Auctions by Comparing the Average Auction Price to an Average Market Price

Study	Type of Auction	Profit Measure	Numerical Value
Cammack (1991)	Discriminatory U.S. Auctions; 1973-1984; 3 month Treasury Bills.	$P_M/P_A - 1$	1 basis point or 100 dollars profit per million purchased in auction
Umlauf (1993)	Discriminatory Mexican Auctions; 1986-1991; 1 month Mexican Treasury Bills.	$P_M/P_A - 1$	1.84 basis points or 184 dollars profit per million purchased in auction
	Uniform Price Mexican Auctions; 1986-1991; 1 month Mexican Treasury Bills.	$P_M/P_A - 1$	-0.3 basis points or 30 dollars loss per million purchased in auction
Simon (1994)	Discriminatory U.S.Auctions; 1973-1976; 15 to 30 Year Treasury Bonds.	$(P_M - P_A)/F$	15.8 basis points or 1,580 dollars profit per million of face value purchased in auction
	Uniform Price U.S.Auctions; 1973-1976; 15 to 30 Year Treasury Bonds.	$(P_M - P_A)/F$	19.2 basis points or 1,920 dollars profit per million of face value purchased in auction
Nyborg and Sundaresan (1996)	Discriminatory U.S.Auctions; 1992-1993; 2 Year Treasury Bonds.	$(P_M - P_A)/F$	1.05 basis points or -06 basis points depending on measure of market price Corresponds to 105 dollars profit or 6 dollar loss per million of face value purchased in auction
	Uniform Price U.S.Auctions; 1992-1993; 2 Year Treasury Bonds.	$(P_M - P_A)/F$	-096 basis points or 1.39 basis points depending on measure of market price Corresponds to 9.6 dollar loss or 139 dollar profit per million of face value purchased in auction
	Discriminatory U.S.Auctions; 1992-1993; 5 Year Treasury Bonds.	$(P_M - P_A)/F$	2.22 basis points or 7.62 basis points depending on measure of market price Corresponds to 222 dollar profit or 762 dollar profit per million of face value purchased in auction
	Uniform Price U.S.Auctions; 1992-1993; 5 Year Treasury Bonds.	$(P_M - P_A)/F$	3.49 basis points or -3 basis points depending on measure of market price Corresponds to 349 dollar profit or 300 dollar loss per million of face value purchased in auction
Nyborg and Sundaresan (2001)	Discriminatory Swedish Auctions; 1990-1994; 14 month Swedish Treasury Bills and 6 to 16 year Swedish Treasury Bonds.	$(P_M - P_A)/F$	2 basis points corresponds to 200 dollar profit per million dollars of face value purchased in auction

PA: Average Auction Price; PM: Average Market Price; F: Face Value of Bond; a basis point is .01 percent

10 COMPETITIVE PROCUREMENT OF REINTEGRATION SERVICES IN THE NETHERLANDS

Maurice Dykstra and Jaap de Koning

TABLE OF CONTENTS

1 INTRODUCTION 179

2 OBJECTIVES PROCUREMENT PROCEDURE 180

3 PROCESS 181

3.1 TWO GENERAL PROCEDURES AND ONE EXPERIMENTAL 181

3.2 NOTIFICATION 182

3.3 PRE-QUALIFICATION 182

3.4 BIDDING 184

4 BEAUTY CONTEST DESIGN 184

4.1 ATTRIBUTES 184

4.2 SCORE FUNCTION 186

4.3 EVALUATION OF DESIGN 186

5 NEGOTIATION AND CONTRACT SETTLEMENT 187

6 RESULTS 188

6.1 OUTCOME BIDDING PROCESS 188

6.2 MARKET OUTCOMES 189

7 ASSESSING QUALITY OF SERVICES; A FUNDAMENTAL PROBLEM 190

8 CONCLUDING REMARKS 193

8.1 CONCLUSIONS 193

8.2 RECOMMENDATIONS 193

REFERENCES

1 INTRODUCTION

One of the major labour market instruments in the Netherlands is the so-called reintegration service which aims at helping people back to work. Reintegration of disabled or unemployed people aims at increasing labour market participation. Reintegration services span the entire process from registration of an unemployed or disabled person through an intake interview, drawing up of a mediation plan (a plan how client and Rib wish to progress in order to obtain paid employment), supplying education and training up to placement of the client in paid employment.

During the last decade the organisation of public employment services (Arbeidsvoorziening) has constantly changed. Up to 1991 Arbeidsvoorziening was a part of the Ministry of Social Affairs and Employment. In 1991 it was transformed into a tripartite organisation, administered by the social partners and the government jointly. Furthermore, the state monopoly in job brokerage was abolished. The impact of this step was rather small, however, because the activities of the tripartite Arbeidsvoorziening were still completely funded by government. Owing to this situation, private providers had few opportunities to compete with Arbeidsvoorziening, with the exception of temporary work. In the second half of the 1990s a second important step was taken in limiting the role of Arbeidsvoorziening. Increasingly, the funding for reintegration was transferred from Arbeidsvoorziening to the organisations responsible for unemployment and disability benefits (the so-called Uvis) and to the municipalities responsible for social assistance.[1]

The Uvis procure trajectories for unemployed or disabled people from firms offering reintegration services (the so-called Ribs).[2] There are 5 Uvis: Cadans, GAK, Guo, Sfb and Uszo.). The different Uvis operate in different sectors of industry. In turn each Uvi is also organised regionally.

For the time being both Uvis and municipalities were obliged to involve Arbeidsvoorziening as the only service provider. This obligation was only temporary. Later on also private providers could be involved and finally the part of Arbeidsvoorziening dealing with reintegration pathways was privatised. It is called Kliq and is now one of the private service providers that have to compete for the contracts that are tendered by the Uvis and the municipalities.

What has been privatised is the implementation of the special services (job counselling, training and subsidised labour) aiming at reintegrating jobless people that are labelled as 'hard-to-place' (the so-called categories 2, 3 and 4).

In addition to the privatisation, competition has been introduced in the market for reintegration services. The government hoped to achieve a more effective and efficient reintegration of unemployed and disabled. by the introduction of competition. The largest existing Ribs in 1999 were the former public organisations. Each of these Ribs has historic links with each Uvi. In addition to

1 Uvi: in Dutch "Uitvoeringsinstelling".

2 Rib: in Dutch "Reïntegratiebedrijf".

the former public organisations a large number of new private firms offering reintegration services, have sprouted up.

Another player in the field of social security is the Lisv, the National Institute for Social Insurance, which functions as a kind of regulator.[3] The Lisv developed a set of rules for the competitive procurement of reintegration activities. The Uvis were compelled to follow this procurement procedure when purchasing reintegration trajectories. This set of rules is a type of beauty contest. In the year 2000 the first round of beauty contests have been held for the first time.

In this paper we evaluate the 2000 procurement round of reintegration services in the Netherlands as conducted by the Uvis. This paper is based on previously held evaluations of the 2001 procurement round. No new fact-finding has taken place. Instead we try to shed some new light on the various findings by looking at it from the perspective of theory of auctions and beauty contests and the theory of industrial organisation in general.

2 OBJECTIVES PROCUREMENT PROCEDURE

The objective of the introduction of the procurement procedure was to increase competition in the market for reintegration services in order to raise cost efficiency of Ribs and increase effectiveness of reintegration services (raise percentage of successful trajectories). The procedure was supposed to aid competition by increasing the transparency when purchasing trajectories, i.e. clarify on what grounds a Rib is chosen and by helping ensure that the number of Ribs operating in the market increases, especially innovative niche players. The Lisv acknowledged the danger of preferential treatment of reintegration firms, which formerly belonged to the same holding as the present Uvis.

A major problem the Lisv faced, was how to introduce effective competition on the one hand, and on the other ensuring that a winning firm has the capacity to operate successfully. It does not want to award it to a firm that offers the best on paper, but later fails to deliver what is promised.

Because the market for reintegration services is so new, only the former public Ribs have a track record in this area. New firms have little to show for that matter. If the firms conducting reintegration services are limited to the former public companies it is questionable whether effective competition will arise. It is therefore requisite that newcomers can obtain a slice of the pie. On the other hand a certain level of confidence that a newcomer can operate successfully has to be obtained. Bids have to be credible. Non-credible bids are not in the interest of clients.

[3] Lisv: in Dutch “Landelijk Instituut Sociale Verzekeringen”.

3 PROCESS

3.1 TWO GENERAL PROCEDURES AND ONE EXPERIMENTAL

The Lisv procurement procedure, generally speaking, follows that of the European Service Directive. The Uvis can choose from two procedures: an open procedure and a restricted one. Additionally the Lisv procurement procedure opens the possibility for an experimental procedure. In this procedure it is possible to grant a maximum of 2 contracts to bids which – by the rules of the game - did not fulfil all the criteria or come out as winners. The Lisv wanted to give the Uvis the possibility for experimentation with procuring reintegration trajectories for clients who are extremely difficult to place in the labour market. The value of these contracts may not be more than € 201.000. This experimental procedure thus plays a very small role in the course of affairs. We therefore leave the experimental procedure for what it is.

Open

In the open procedure the Ribs can directly make a proposal based on the request for proposal, which were made public in the national Dutch newspapers. The Uvi must then choose the winning bid from all proposals offered, based on the awarding criteria.

Restricted

In the restricted procedure there are two phases: pre-qualification and the contest itself. In the first phase the Ribs can show their interest for one or more lots. Based on criteria, which were made public, each of the Uvis select a minimum of 5 Ribs, which are granted the opportunity to make a competitive bid. From these bids each Uvi chooses the winning bid, based on the awarding criteria.

Pros and cons

Two Uvis (GAK and Cadans) used only the open procedure, while Guo, Sfb and Uszo, used only the restricted procedure. Because GAK and Cadans are by far the largest Uvis, this resulted in more than 80 percent of the competition for the trajectories being conducted according to the open procedure.

The open procedure has the advantage of generating a large number of bids, which in itself enhances competition. With each additional bid the chance of finding a very high quality one increases. The mirror side is that the chance of winning a bid is relatively low for an individual firm. It then makes sense for a bidder not to put too much effort in the bid. This will reduce the quality of the bids made. An additional disadvantage of the open procedure is that the process is much costlier. This applies for both the Ribs and the Uvis. The Ribs have to make more complete bids than is the case in a restricted process. In addition, for the bids to be qualifiable all formal requirements have to be fulfilled. This results in extra administrative burden The Uvis in turn have to examine more bids fully. This also results in higher administrative costs.

All lots were put up for sale simultaneously. This resulted in an enormous amount of work that had to be done in a short period of time for both bidders (Ribs) and evaluators (Uvis). One can thus expect the tendency to arise that both bids and evaluations will be quick and dirty, resulting in low quality bids and low quality evaluations.

3.2 NOTIFICATION

The Uvis placed advertisements in the national Dutch newspapers in order to interest potential bidders. No notification was made in the EU Official Journal.

The Lisv states that the formulation of the requests for bids have to contain at least:

- The address data of the Uvi.
- A description of the lot.
- Whether or not firms can apply for a part of the lot (a specific sub-group of clients).
- Date before which the bid must be received.
- The number of bidders which will be invited to make definitive offers in the case of the restricted procedure.
- The criteria by which the bids will be judged.

The procedure contained no specific requirements for the description of the lots. In the lot descriptions the Uvis did not define the required results, but only defined the groups of clients and the number of clients per lot. The clients were in most cases classified by industry sector, region and if they were unemployed or disabled. Only in a few cases were lots offered which consisted of a narrowly defined group of clients. In order to make such lots sufficiently large, they were not defined regionally. The composition of the lots was therefore very heterogeneous. This made it next to impossible to make fine tune bids for niche markets.

Even though the Uvis explicitly requested for bids for specific sub-lots, the Ribs have barely made such offers. Nearly all bids were made for the entire lot. Attempts to show a certain affinity with specific groups of clients within a lot could hardly be discerned from the bids made.[4]

3.3 PRE-QUALIFICATION

When awarding contracts the Uvis want to ensure that the winning firm has the capacity to operate trajectories successfully. It does not want to award it to a firm that offers the best on paper, but later fails to deliver what is promised. Pre-qualification can help weed out unsuitable firms.

The Uvis could choose from two procedures: an open one and a restricted one as set out in section 3.1. The majority of the trajectories followed the open procedure. In the open procedure there is no pre-qualification stage. The Lisv

[4] KPMG/BEA (2001).

defines two types of criteria: qualifying criteria and rewarding criteria. In the restricted procedure, the qualifying criteria relate to the pre-qualification stage. In the open procedure there is no formal pre-qualification stage. The bids however are first evaluated according to the qualifying criteria. The bids that pass this tests are then evaluated according to the bidding criteria.

The Lisv prescribed certain criteria to the Uvis. These can be grouped into the following criteria:

- **Structural criteria** such as not being in a state of bankruptcy, not being convicted for a criminal offence which may endanger professional integrity; having fulfilled all obligations related to tax and social security payments; registered at the chamber of commerce etc.
- **Process criteria** which relate to the way in which the trajectories of clients are handled, availability of required monitoring information; privacy regulation, complaints regulation; the requirement to able to conduct certain stages of the trajectories self and not sub-contract these out to another firm etc. In this stage, a business plan also has to be submitted. In the business plan an overview has to be given of the personnel with its relevant qualifications and which part is at present engaged with the firm and which part will be hired in.
- **Outcome criteria.** The bidder has to state that he can place a minimum of 35 percent of the clients in paid employment.

The Uvis were however free to add more criteria. All Uvis have made use of this opportunity with the intention of filtering out firms making incredible bids. The number of additional criteria differs widely. GAK for instance added several dozen of formal criteria. If a bid failed on one of these criteria it was ruled out. In addition GAK also took a very formal stance. If the slightest piece of information was missing from the bid, it could not be added later.

The procedure as implemented by GAK misses the goal it was meant for, namely to select the credible bids. It is questionable in how far there is a correlation between the degree of having ones paper work in tip-top shape and the credibility of ones bid. We expect that the marginal value of information gained through adding additional criteria will quickly diminish. Applying many formal criteria then becomes an inefficient procedure in assessing the credibility of bids. The procedure also carries high administrative costs for firms bidding as well as for the GAK.

Other Uvis took a much more relaxed viewpoint. Certain omitted items could be added to the file later on in the process. The widely differing procedure leads to the fact that similar bids are treated in very different fashion. These differences are harmful for the transparency of the market. This is illustrated by the fact that more than 80 percent of firms that did not pre-qualify believe that the Uvis committed errors in the pre-qualification procedure.[5]

[5] Vinke and Cremer (2001).

3.4 BIDDING

The format of the competition is what may be called a “sealed first score” type. Bidders present bids in a sealed envelope which are opened publicly at a pre-specified time by the awarding authority. The bid includes both description of quality offered and of the price offered. The winning bidder is obliged to produce the services at the offered level of quality and at the offered price.

A disadvantage of this format is that it precludes bidders learning from one another. Bidders have less information on other bidders’ estimates of the value of a particular lot. This can give rise to the so-called “winner’s curse”. The winning bidder is the unfortunate one who, out of ignorance underestimates the costs of the lot. In order to decrease the possibility of making a loss on the particular lot, the bidders will adjust their bids upwards. As a result bids may actually yield a higher price than in an open bidding system. The costs for the Uvis may thus be higher than in an open bidding system.

On the other hand collusion between bidders is generally considered to be less likely with sealed bids than with open bids. Bidder’s defections from collusive agreements (that is the submission of a bid under the collusive price) are harder for other bidders to prevent than in an open bidding system.

If bidders are inexperienced, they may be less likely to correct for winner’s curse under a sealed bid with the result that the sealed bid procedure may actually yield a lower price under these circumstances. An additional reason why inexperienced bidders may offer low prices is exacerbated by the fact that newcomers have little working experience to show in the area of reintegration. Working experience is one of the criteria on which the bids are judged. In order to make competitive bids newcomers will have to especially compete on price, which – so can be expected - will lead to low price bids on their behalf.

The sealed first score is probably the only workable format possible. Other basic formats which may be theoretically possible use ascending bids, descending bids and “sealed second score”.[6]

4 BEAUTY CONTEST DESIGN

4.1 ATTRIBUTES

4.1.1 INTRODUCTION

The Lisv procedure gives the Uvis the opportunity to stipulate the bidding criteria more specifically. Adding extra criteria, which are not in line with the criteria as set out by the Lisv, is however not permitted. Each Uvi has made additional specifications to the bidding criteria. The Lisv procedure defines five criteria:

- Expertise personnel.
- Results achieved in the past.

[6] With very few lots and a small number of bidders an ascending format is possible. In practice this will come close to negotiated bidding.

- Throughput time.
- Percentage of clients placed in job.
- Price.

The first four criteria are quality attributes and the final one is the price attribute. The nature of the quality attributes differ widely.

4.1.2 QUALITY

Structural features:

- Expertise personnel.
- Results achieved in the past.

This refers primarily to characteristics of the bidder itself. These criteria are rather signals of quality than actual quality. Structural features signal whether or not the bidder can do the job or not if he/she wins the bidding competition. In how far can he/she guarantee that the bid made is upheld? The rewarding authority should have a certain level of confidence that the bidder can fulfill his/her obligations.

Notice that that the criterion expertise personnel also already figured in the pre-qualification criteria.

Process features

Throughput time. This criterion is not defined in the Lisv procedure. Consequently the Uvis and the Ribs have defined it very differently. Throughput time can relate to the entire time between registration up to placement, excluding time spent on education and training, or e.g. it can relate to the waiting time between the various stages of the process. To say the least, it is remarkable that this criterion is not defined.

Outcome features

The procedure defines only one outcome criterion: the percentage of people placed in job. The Lisv defined placement to be the case when the trajectory of the client results in client working in paid employment for a period of at least 6 months. From the supplemental explanation given by Lisv it becomes clear that the definition refers to the signing of an employment contract by a client for that period and not that of actually working for that stretch of time.

In a bid the Rib has to specify the percentage of clients it believes it will place within one year.[7] Note that in the pre-qualification stage the bidder already had to state that he can place a minimum of 35 percent of the clients in paid employment.

Despite the Lisv stating that adding extra criteria, which are not in line with the criteria as set out by the Lisv, are not permitted by the Lisv, Gak added one criterion, namely the drop-out rate. The drop-out-rate is the percentage of clients, which for some reason leave the trajectory *prematurely*. The drop-out-rate does *not*

[7] The period of one year is counted separately for each individual client. The period starts at the moment that the mediation plan of an individual has been approved by the Uvi. The period also does not include time spent on educational activities.

include clients who have passed through all stages of the trajectory, but who in the end are not employed.

4.1.3 PRICE

In the Lisv procedure price is defined rather loosely as the price of an average trajectory. Most bidders present in their bids a list of products and services, which can be used in the trajectories of clients. The number and kind of products and services will vary per per client. The Lisv expects the Uvis to be able make an educated estimate of the quantity and quality of the necessary products and services for the clients in the particular lot.

The bidders do not have to quote an average price. They only have to quote price per product and service.

4.2 SCORE FUNCTION

The procedure is typical for an unweighted beauty contest.

- The score per attribute is determined judgmental. Ratings reflect the subjective views of the awarding authority.
- The total score is determined judgmental. Ratings reflect the subjective views of the awarding authority.
- There is no exact representation of the relationships between the attributes.
- Bidders do not know exact algorithm how the awarding authority calculates the total score.

The Lisv determines the winner to be determined on the basis of the most economic bid. What most economic bid means or how it should be made operational is however not prescribed or described. The evaluations also do not make clear how the Uvis tackled this problem. The evaluation by KPMG/BEA suggests that the Uvis had some sort of weighting for the attributes.

From the evaluations it does not become clear whether the Uvis adopted weights, or what these weights were. In each case, they were not known to the bidders at the time of bidding.

4.3 EVALUATION OF DESIGN

The quality attributes are very different by nature. The structural features relate to the supplier and only indirectly to the product or service, while the outcome features relate directly to the product. Put differently, structural features are means by which a goal can be achieved. The question posits itself - when assessing the values of the various attributes - whether means and goals should be lumped together. If the answer is negative this entails that structural features and outcome features should be treated as complementary. Structural features then belong to the pre-qualification stage. Once it is ascertained that the bidder can produce services of sufficient quality, signalled by “expertise personnel” and “results achieved in the past” these attributes should no longer play a role in the bidding itself.

When assessing the structural features the Uvis place very different weights on expertise personnel and results achieved in the past. According to KPMG/BEA Cadans puts much more value on expertise on personnel, while on the other extreme Gak does not value expertise at all, but only looks at results in the past. The other three Uvis hold intermediate views.

Because the market for reintegration services is so new and few firms can show directly relevant experience and given the objective that the procedure was introduced to stimulate newcomers the Cadans approach seems not only the more reasonable but also the more informative approach of the two. Newcomers are effectively shut out in the Gak approach.

5 NEGOTIATION AND CONTRACT SETTLEMENT

Each Uvi uses a standard contract, which apply to all Ribs the Uvi has contracted. The contracts are however not identical with regard to the product prices of the trajectories and throughput time. The product prices and throughput time the Ribs included in their bids are also included in the contract. This helps to ensure that the Ribs make credible offers.

Placement

The definition of placement differs widely between the Uvis. Uszo uses the strictest formulation. Placement must have been at least for a period of 6 months, with a minimum of 20 hours per week and with benefit payment less than 50 percent of total income. Gak on the other hand has made no specification of placement whatsoever.

Uszo uses a clear result criterion and for the rest lets the Ribs determine for themselves how this result can be reached. On the other side of the spectrum, Gak has no clear criterion, but instead follows a bureaucratic procedure. It tries to monitor results by closely looking over the shoulder of a Rib in every step it takes.

The costs for both Uvi and Rib, resulting from the way Gak operates will be much higher than that of Uszo. The number of individual administrative actions that Gak requires to be reported over is considerably more than Uszo requires. All these tasks will have to be looked into by Gak, additional information asked for when unclear, reported on in turn etc. This involves extra costs for Gak as well. It is by no means clear that all this administrative work – for Rib and Uvi - will lead to higher placement percentages.

Drop-out

Guo and Gak use drop-out as a bidding criterion. Drop-out is In the contracts they close with Ribs the offered drop-out percentage is included in the contract. These vary from 5 to 20 percent depending on the client group.[8]

Throughput time

Only the maximum time between registration of the client and the delivery of the trajectory plan of the client are standard items in the contracts. Only Cadans has

[8] KPMG/BEA (2001).

made further specifications by including the offered waiting-times between the various stages of the trajectory in the contract.

Bonus system

At the level of the a complete trajectory the price of a trajectory is not fixed. For every activity the Rib takes with regard to a client, as part of a trajectory, the Uvi can be charged. Only the content and the prices of the various activities are specified in the contract. In the contract there is in general no incentive to try to raise the percentage of placements.

At the level of the separate activity the contracts can be characterised as a fixed price contracts. For each separate activity undertaken, e.g. writing up a mediation plan, the price is fixed. There thus is a strong incentive for a Rib to reduce costs at the level of the separate activities.

As mentioned above the contracts can be characterised as a cost-plus type. This kind of contract provides little incentives in terms of raising the placement percentage. KPMG/BEA (2001) notes that all Uvis accept Sfb have some type of bonus system, which should provide an incentive to strive for higher results in terms of placement percentage. How these bonus systems work, is not specified however.

6 RESULTS

6.1 OUTCOME BIDDING PROCESS

Expertise personnel

Whether or not a certain affinity with specific sub-group of clients could be shown barely influenced the final score in the bid assessment of four of the five Uvis (all but GUO). This point was never made specific as an explicit criterion. With regard to experience of personnel or results achieved in the past, the point was in a few instances raised. These minor points were however insufficient for a bidder to clearly distinguish itself from a competitor on these grounds. An innovative niche player thus has little opportunity to identify himself as such. This makes it problematic to achieve the objective of increasing the number of innovative niche players.

Eliciting information

The Uvis put several hundred lots up for sale. This should give them ample opportunity to acquire information from the bids. This kind of information increases the transparency of the market. Uvis obtain more insight in the costs of integration services for various types of clients. However due to the fact that the contents of the individual lots are very heterogeneous and ill defined it is difficult to compare bids between lots. Bids can then only be compared one lot at a time. This limits the amount of information that can be elicited from the bids. More information could be elicited from the bids if the lots were defined more tightly and made more homogenous. With closer defined product combinations the costs for each such combination becomes better known. Instead of being a rich data source the large number of lots then become a costly low information affair. The

poor definition of the lots is thus a missed opportunity for increasing the transparency of the market.

Fallacious comparisons

The procedure is rigged against firms specialising in difficult market segments; i.e. with clients which are difficult to place. The results for these difficult market segments are low while the costs are high. When these offers are compared to other bids which involve a mix of easy and difficult groups of clients, and these different mixes are not accounted for by the evaluator, the bids of specialised firms will be turned down. Taken at face value the results of the specialised firms are worse while their price is higher. This obviously is a fallacious comparison.

Lack of quality specification

The lack of quality specification results in cherry picking. Since the Ribs are accountable on a total percentage of all trajectories within a lot it makes sense from a cost perspective if Ribs conduct as little as possible effort in the high cost trajectories. As little as possible is then a minimum set up in the contract or it can be some self-imposed minimum which makes them credible to the Uvis.

Difficulties for entrants

It can be easily argued that entrants in this market for reintegration services have less information about which groups are more difficult or relatively easy to reintegrate in the labour market. Incumbents have more experience in this respect. This makes it that it is easier for incumbents to pick the cherries than for entrants. Accordingly, newcomers tend to have higher prices so that innovation does not come about so easily.

Tackling cherry picking

The present approach to cherry picking is by means of regulation and monitoring. A simpler approach would be to ensure that cherry picking simply can not come about. This is the case of perfectly homogenous groups. In homogenous groups there are simply no cherries which can be picked. All group members are identical. Of course some degree of heterogeneity will always exist within a group. In making lots on which can be bid it is essential to strive for clients having the same background characteristics. These can be education, age, sex, profession, physical handicap, psychological handicap etc. In order to achieve homogeneity it may be necessary to make small groups.

6.2 MARKET OUTCOMES

Market shares

The reintegration of disabled people to a new employer was until 1998 conducted by a branch of Gak: Gak-Arbeidsintegratie (Gak-AI). Gak-AI was disconnected from Gak and placed within the organisation Arbeidsvoorziening (Arbvo). The Uvis were compelled to buy a minimum of 80 percent of the trajectories from Arbvo. The other trajectories could be bought from private Ribs.

We do not know the exact market shares in 1999 per Rib. It is nevertheless obvious that major shifts in shares have taken place. A few years ago Kliq, which then was part of Arbeidsvoorziening was virtually monopolist. Its drop in market

share has continued in 2000. The other former public Ribs Argonaut (ex- Gak) en Abp witnessed increasing market shares in 2000. Most of the firms which were operating in the market in 1999 won a number of trajectories in 2000.

In total 36 percent of trajectories were contracted to the former public Ribs. The degree in which Uvis have contracted trajectories to the former public Ribs varies from 10 percent for Cadans to 57% for Uszo.

The fear that Ribs, which were formerly part of the Uvis, would be favoured is partly justified. In the case of Gak, Uszo and Guo the Ribs receiving the largest number of trajectories are the former partners (Argonaut, ABP Reïntegratie and Relan respectively). Sfb and Cadans haven't dished out trajectories to their former partners.

Remarkable newcomers are Alexander Calder, Serin, Fourstar and Creyfs Interim. Cadans has by far contracted the most newcomers.

7 ASSESSING QUALITY OF SERVICES; A FUNDAMENTAL PROBLEM[9]

The purpose of outsourcing placement activities to private agencies is to improve the efficiency of the services, to raise their quality or to have both of these improvements. In case of an auction the emphasis is likely to be on efficiency. The government will specify a number of quality standards and agencies that comply with these standards are given the opportunity to bid. Competition between these agencies will have a downward pressure on prices. In the case of beauty contests the focus is on both price and quality. Which agencies can ensure the highest quality-price-combination?

Whatever the option chosen, service quality seems to be of the utmost importance. In the previous sections it became clear that still a lot can be improved in the way Uvi's deal with the outsourcing of reintegration pathways. By using more consistent procedures and eligibility criteria and by introducing incentive schemes for the service providers (for example, by making funding dependent on output) one might expect to achieve improvements in service quality. However, this is still rather vague unless we really try to define and measure service quality. What is service quality in relation to job placement? One might be inclined to define quality in terms of placement rates. This is what actually has been done. Agencies are then said to offer quality services when they place at least, say, x per cent of their clients. However, the problem is that placement rates do not say anything about the impact of the service. A considerable part of the unemployed has a relatively high chance to find a job without special support. This is even true for the long-term unemployed. The matter has been investigated for many types of re-employment schemes in many countries. The general conclusion is that often the net impact of the schemes or measures is low and that in some cases it is even negative. Net impact is than defined as the job entry chance in the situation with "treatment" minus the job entry chance in the situation without 'treatment'. The results in terms of net

[9] Based on De Koning and van Acht (2000).

impact are perhaps somewhat better for some specific groups. Gross placement rates are meaningless. From several studies one can even observe the tendency that high gross placement rates go hand in hand with low or even negative net placement results. Gross placement figures, then, may even lead to completely wrong conclusions about the "real" impact of the services involved.

One might argue that the reintegration services involved deal with the more disadvantaged groups by definition. The probability of finding a job for these groups is, the reasoning may go, relatively low. For these groups then, gross placement rates may still be good indicators for net results. The facts are different, however. If we look at the clients that are labelled phase 2 to 4, the clients that are eligible for special reintegration services, a considerable part of them still have reasonable job entry prospects. This is reinforced by the trend towards a pro-active labour market policy implying that "treatment" takes place at a relatively early stage of the unemployment period.

If quality must be defined based on net impact, what does this imply for the selection of private agencies by auctions or beauty contests? It is possible, for example, that the quality requirement in an auction is that agencies have to realise an average net (absolute) increase of *y* per cent in the job placement rate of their clients? Making such a requirement only makes sense when it is possible to verify it afterwards. This is only possible under the following assumptions:

- The clients are randomly assigned to the agencies.
- One group of clients is randomly assigned to the control group and is not treated.

Then the client groups and the control group can be monitored. Based on the job entry rates the net impact may be computed ex-post.

There may be a number of reasons why random assignment is not applied in practice. It may be legally impossible to exclude individuals from 'treatment'. Then, we would have to choose the control group from the ones that did not wish to be "treated" or are not selected for treatment by the authorities. However, this is most likely a selective group making the comparison with the participants difficult if not impossible. Although methods have been developed to deal with this type of selectivity, these are far from reliable. Finally, the "sluitende aanpak" may imply that each individual is selected for participation in a labour market programme, so that there is nobody left for the control group. In that case impact assessment on the basis of aggregate data may be a way out.[10]

When a control group approach is not feasible, it may still be possible to compare the results of the various service providers. As long as clients are assigned randomly to providers, this is straightforward. However, there may also be reasons for not assigning clients randomly to service providers. The most obvious reason is that providers may be specialised in the problems of specific groups of clients. Or the auction may be structured in such a way that different groups are identified, some easier to place than others, and that providers can bid for each

[10] There is also another reason for aggregate impact assessment. The point is that owing to displacement and substitution the aggregate impact of a programme can be small even when the programme participants benefit greatly from the programme. Therefore, impact assessment on the basis of individual data may overestimate the results.

group separately. In these cases it will be more difficult or even impossible to determine the (relative) effectiveness of the services.

It is important to find out whether the reintegration services really made a difference. Have placement rates been higher as a result of these services. Which service providers have performed above average and which ones below-average? Answering these questions is not only important from the viewpoint of accountability, but also gives relevant information for future auctions or beauty contest. However, from the previous discussion it is clear that the possibilities for answering these questions depend heavily on the design of the auction or the beauty contest. Furthermore, arrangements have to be made in advance to ensure the collection of sufficient and reliable data for the impact assessment.[11] So far, however, hardly any attention has been given to these points. Therefore, it will probably be impossible to answer the previous questions for the reintegration pathways in 2000.

So far, we have briefly discussed the possibilities for an ex-post assessment of service quality. In that case we deal with the full-scale, national implementation of placement measures. However, before implementing a measure on such a scale, one may want to have sufficient indication that the measure will work. A small-scale experiment could be helpful in this respect. Such an approach, however, seems to be difficult to fit into the current procedure.

The inability to assess the quality of reintegration services may cast doubt on the added value of the privatisation process. Competition may lead to lower prices than in the case of public service provision, but perhaps at the cost of a lower quality of the services. As long as private service providers are not judged on net impact, profit maximising behaviour may induce them to go for the "easy" successes. The favourable labour market situation has helped to produce high placement rates during the previous years. However, an objective judgement of the effect of the privatisation process on the cost-effectiveness of reintegration services is impossible based on the available information.

A final observation is that in the Dutch situation there seems to be no room for clients to choose between service providers. In Australia, where public employment services have also been privatised, this freedom of choice is a corner stone of the system. The Australian system is a license system in which service providers have to meet certain criteria in order to get a license for service provision. The government determines for each unemployed person to what type of reintegration service he or she is entitled. Then, the client can choose between the different providers. Payment is partly based on placement results. In this system providers really have to compete for clients. In principal such a system could be combined with an auction for the licenses. The problem of quality or impact measurement is also present here, however.

[11] Taking into account that private providers will have a strong incentive to produce 'good' results, at least optically.

8 CONCLUDING REMARKS

8.1 CONCLUSIONS

The objectives of the introduction of the procurement procedure was increase transparency when purchasing trajectories, i.e. clarify on what grounds a Rib is chosen, and ensure that the number of Ribs operating in the market increases, especially innovative niche players.

The instrument would thus assist in increasing competition in the market for reintegration services in order. In turn this would be beneficial to raising cost efficiency of Ribs and effectiveness of reintegration services (raise percentage of successful trajectories

Unfortunately the procedure is a good example how to obscure the market. The differed strongly both in terms of the process followed as well as in content. Uvis were free to choose from open and restricted bidding; definitions of products and services ranged widely; number and content of criteria differed; implicit weights of attributes varied between the uvis.

In the hypothetical case that the same group of firms is bidding on two identical lots offered by two Uvis, there is no guarantee that the same firm will win both lots. For a contest to be efficient this is.

In addition to obscuring the market, the procedure also leads to unnecessary costs for bidders. Bidders have to fine-tune their bids to each separate Uvi. Even for identical lots, bidders will have to provide different bids to different Uvis.

The lots were in general heterogeneous, which makes the transparency for bidders, with regard to what they are exactly bidding on, low. Because lots are heterogeneous little can be learned about the costs of different types of clients and whether it is cost efficient to specialise in certain client groups instead of non-specialisation.

Because the Uvis are allowed to adopt own definitions, little empirical knowledge can be learned about for instance the efficiency of the Ribs or of the efficiency of the Uvis.

In certain cases information was asked from bidders which had very low relevancy to the beauty contest.

8.2 RECOMMENDATIONS

In this section we round up with a number of conclusions specific to this particular beauty contest, but which carry over to other competitions.

Adopt one bidding procedure. In this case a restricted bidding procedure is the preferred option. It is minimises costs related to the procurement competition for both the Ribs and the Uvis. If the number of firms which is invited to bid is not set too low (5-7), the level of competition is also sufficient.

Define products and service clearly. This provides clarity to bidders and is requisite for information gathering by the Uvis and the accountability of the Uvis.

Provide as much information as possible both ex ante and ex post, without disclosing company specific information. Ex ante with regards to the content of the lots, the content of the criteria and the weighting of the criteria. Ex post with regard to price and placement percentage of winning bids for various client groups.

Make lots as homogenous as possible, keeping in mind the administrative costs for the Uvis and bidding costs for Ribs that arise from additional lots.

Consider beforehand whether the information asked for, provides insight into the credibility of the bidder.

Before designing a contest take a wide range of bidding procedures into consideration and question the relative merits of the procedures for the specific problem at hand. In this preparatory stage it is sensible to make use of external expertise on procurement. The procedure followed here can by no means be labelled as a well-considered design. It is not difficult to come up with viable alternatives. An alternative may be a multi-attribute auction. This could be designed as follows.

Place more emphasis on the pre-qualification stage. Deal entirely with the question of credibility in this stage, and then leave the question of credibility to rest. In this stage process quality can also be handled. Define required process quality such as throughput time. In order to qualify, bidders have to underwrite this level of quality and make credible that they can achieve it. The contest itself can then be considerably simplified, with more focus on the most important issues: placement percentage and price. Bids need only to consist of these items The bid with the highest placement percentage/price –ratio wins.

REFERENCES

Algemene Rekenkamer (2001) *Reïntegratie arbeidsongeschikten*, Tweede Kamer der Staten-Generaal, Vergaderjaar 2001–2002, 28131, Nr. 2.

Cordia, L.A.J., A. Lucas, M.W.J.M. Buurman, E.W. Kruisbergen (2001) *De kunst van het aanbesteden. Onderzoek naar werking van de aanbestedingsprocedure bij inkoop van reïntegratieactiviteiten*, CTSV, Zoetermeer.

Fermin, B.M.F. (2001) *Evaluatie Aanbestedingsprocedure Reïntegratiecontracten, Rol sectorraden in de aanbestedingsprocedure*, TNO-rapport 5441/2510106, TNO Arbeid, Hoofddorp.

Haan, H.F. de (red.) (2001) *Evaluatie Aanbestedingsprocedure Reïntegratiecontracten, Zelfevaluatie Lisv, Juridische aspecten*, TNO-rapport 5441/2510106, TNO Arbeid, Hoofddorp.

Haan, H.F. de (2001) *Evaluatie Aanbestedingsprocedure Reïntegratiecontracten, De rol van de Uvis*, TNO-rapport 5441/2510106, TNO Arbeid, Hoofddorp.

Koning, J. de, J. van Acht (2000) *De rol van incentives, marktwerking en regelgeving in de sociale zekerheid*, (The role of incentives, competition and regulation in social security), SEOR bv , Rotterdam.

KPMG/BEA (2001) *Evaluatie Aanbestedingsprocedure*, deel 2 Eindrapport, Lisv.

Vinke, H., R. Cremer (2001) *Evaluatie aanbestedingsprocedure. Ervaringen van reïntegratiebedrijven en hun branche-organisaties*, TNO rapport 5441/2510106, TNO Arbeid, Hoofddorp.

11 ALLOCATION OF RAIL FRANCHISES

Luisa Affuso and David Newbery

TABLE OF CONTENTS

1 INTRODUCTION 197

2 THE NEW INDUSTRY STRUCTURE IN BRITAIN 198

3 THE AUCTION OF RAIL FRANCHISES IN DIFFERENT COUNTRIES' EXPERIENCE 200

3.1 FRANCHISE ALLOCATION IN BRITAIN 200

3.2 EXPERIENCE IN OTHER COUNTRIES 202

4 CONCLUDING DISCUSSION 204

1 INTRODUCTION

In 1994 the existence of British Rail (BR) as a national, vertically integrated company came to an end, marking an important step in the reform of the railway industry in Britain. Yet following the restructuring and privatisation of BR, many of the fundamental problems faced by the previous regime remain. A stable solution to the dilemma of how to sustain an extensive railway network while containing public expenditure has not yet been found.

The reorganisation of the rail network in Britain following the Railway Act (1993) has been radical. Under the new structure, based on a "structural separation" rationale, the industry is divided into separate firms: train owners, train operators, track owners and many providers of supporting services. The result is that over 70 firms now provide the services once provided by a single firm. More specifically, Train Operating Companies (TOCs) which operate the passenger services in a specific franchise area lease stock from Rolling Stock Companies (ROSCOs) and pay for access to the network to the monopolistic operator Railtrack, from which they also lease some railway stations. In addition, two authorities were created, an independent regulatory body, i.e., the Office of the Rail Regulator (ORR), and a governmental body, the Office of Passenger Rail Franchising (OPRAF), to overlook the functioning of the system.

Privatisation and regulation of railways is an extremely complex and controversial process because of the particular economic complexities of the industry. Railway infrastructure and rolling stock are long-lived assets. Perhaps more importantly, they are sunk to a large extent since most of the capital equipment is highly specific. The number of alternative uses (or routes for the rolling stock) in which assets could be redeployed may be quite small and in some instances non-existent. This gives railways particular features not present in other transport sectors, such as buses or air transport, where outside markets exist for second-hand assets. In other words, railways are not a contestable market. Furthermore, scale and scope economies are pervasive in the railway industry (integrated railways experience large economies from traffic density). Another key feature of the railway industry is the high degree of interdependency among its different components, which gives rise to numerous (1) externalities (e.g., delays and congestion on the track) and (2) technical complementarities (e.g., interdependencies between infrastructure and mobile assets). These technical and economic complexities can be taken into account in a vertically integrated structure. When the industry is vertically separated, however, accounting for these factors becomes much more difficult. Contractual schemes between firms could to some extent internalise them, but this would entail large monitoring and enforcing expenditures. In other words, the transaction costs involved might offset any expected gain from vertical separation.

Railway restructuring experience across the world has provided two alternative viable models: (1) the Swedish model (vertical separation) and (2) the Argentinean model (geographical separation of integrated companies). The Swedish model relies on vertical separation of infrastructure ownership and service operation. The main feature of this system is that infrastructure provision, in public sector hands, is priced at marginal cost, and therefore subsidised by a government deficit grant. Hence, passenger services can be competitively provided at a profit by the

private sector. Furthermore, the charges regime for railways mirrors road vehicle taxation arrangements in order to harmonise competition between these two transport modes. The Argentinean model, instead, relies on a rail network divided geographically line-by-line into a series of vertically integrated exclusive franchise units. In this model the subsidy is injected through the franchising mechanism.

Each model has distinctive virtues and drawbacks. The Swedish model emphasises allocative efficiency. It also has the merit of addressing the problems of intermodal competition between road and rail and of encouraging intramodal competition in the rail service provision by the private sector. The Argentinean model, on the other hand, promotes cost efficiency through the periodic competition process. By restricting rail competition it makes surplus available to franchisees, thereby minimising the subsidy bill. Furthermore, by retaining a vertically integrated structure it avoids the cost burden of internalising externalities by the contract mechanism. The British system has adopted a mixture of features from both vertical and geographical separation models. Many problems have arisen from this choice prompting ad hoc interim measures.

Successful restructuring of state railway enterprises should satisfy some key policy objectives like provide appropriate incentives for investments in railway infrastructure and rolling stock, as well as product innovation, and reduce the budgetary burden on the public sector.

What is the best way to design and allocate contracts that guarantee the achievement of these objectives? The resolution of this major problem is essential to wider transport policy goals.

Section 2 of this study examines the railway system resulting from the reforms implemented in Britain. Section 3 discusses in more detail the mechanism adopted for the allocation of rail passenger franchises in Britain and abroad. Finally, Section 4 draws conclusions.

2 THE NEW INDUSTRY STRUCTURE IN BRITAIN

The British restructuring took the important step of separating the ownership of railway infrastructure from the operation of train services. Recently most EU countries have been responding to the 1991 Directive 91/440/EEC of the European Commission, which requires member states to separate operations from infrastructure and to provide infrastructure access to operators from other countries.

The decision to separate service operation from infrastructure was dictated by the need to separate the natural monopoly element (track) from the potentially competitive elements (service operation) in order to introduce competitive forces into the industry where possible.

Passenger train operations were separated into franchises lasting from five to fifteen years, with the majority of franchises lasting for seven. Operations to be franchised were set up as separate companies with their own staff, assets and supporting contracts, and were then offered to open tenders. The loss making franchises running services under public service obligation were awarded on the basis of a least subsidy payment. The payment profile consisted of a schedule including a price for each year of operation. Tight restrictions were incorporated

into the franchise specifications as it was feared that the loss making nature of many franchises would mean that franchisees would resort to lowering the quality of service or increasing fares to improve profitability. Franchisees were required to conform to punctuality, cancellation and crowding requirements and to participate in certain inter-operator agreements. These conditions were enforced by financial penalty or by the threat of the removal of the franchise itself. Restrictions were made even tighter by constraining certain fares to rise by no more than the Retail Price Index (RPI) for a three-year period and then by RPI-1% thereafter.

In order to facilitate competitive entry into service operation, TOCs are prevented from owning their rolling stock.[1] Three rolling stock leasing companies (ROSCOs) were created. These companies owned and leased out passenger locomotives and rolling stock to franchisees. Leases were determined on purely commercial terms making the ROSCOs profitable in their own right.

The privatisation of the monopolistic network owner required the introduction of a rail regulator. The Office of the Rail Regulator (ORR) was given the responsibility for regulating Railtrack's access charges for track access, preventing abuse of dominant position, and approving access agreements.

A Government body was established, the Office of Passenger Rail Franchising (OPRAF), later reformed to become the Strategic Rail Authority (SRA), whose responsibility was to award passenger service franchises to determine the minimum service and quality standards to be met by franchisees, and to allocate and pay subsidies to franchise operators.

The approach taken in Britain of retaining the national infrastructure as a single entity but separating it from train operations is based on the assumption that competition in rail services is best facilitated by franchises competing to run train operations on that infrastructure given that many franchisees share the same infrastructure. If one of these franchisees also owned the infrastructure this could have given rise to problems of market foreclosure, especially in view of the introduction of open access competition as originally planned. Giving a train operator the ownership of the infrastructure upon which he operated might prevent the development of competition either on the track or for the franchise. The franchisee as owner of the infrastructure would also be responsible for carrying out long-term investment in the tracks. This would be at odds with the need to periodically re-tender the franchise.

There was, however, some unease at the separation of infrastructure from operations, not least because of the complexity and specificity of the technical interconnections between structural and operational matters. Moreover, vertically separating operations from track increases the transaction costs of negotiation between the separate parties potentially leading to coordination problems.

[1] In order to acquire a fleet of new tilting trains, Virgin Rail had to set up a separate company (GL Railease).

3 THE AUCTION OF RAIL FRANCHISES IN DIFFERENT COUNTRIES' EXPERIENCE

3.1 FRANCHISE ALLOCATION IN BRITAIN

Separation of the infrastructure from service operation is not sufficient to guarantee competition in the rail industry. In Britain 25 franchises were created, roughly corresponding to the different profit centres in the BR system (e.g., regional, intercity). These franchises were auctioned in three main tranches between 1994 and 1997.

In general terms, franchising involves the granting of a licence, usually to the winner of a competitive bidding process, to operate a defined service and to receive associated revenues. Typically franchises are introduced in natural monopoly situations, where competition *for* the market constitutes an alternative to the unviable competition *in* the market. In other words, franchising may be the only mean of introducing competitive pressures by creating an incentive to reduce costs and improve quality, and the periodical bidding process can guarantee that such pressures are maintained over time.

Nonetheless, exclusive franchises are in some instances adopted also for operations which are not natural monopolies. For example, in the case of railways, exclusive franchises can be adopted by the government in order to maximise the proceeds from privatisation. In the British example the exclusivity was limited only to an initial short period, and open-access competition was to be introduced gradually from 1999, to be completed by 2002. The original time-limited exclusivity was believed necessary in order not to depress the interest from the private sector and their potential bids.

However, since franchise arrangements constitute contractual arrangements, they involve the need for a certain degree of monitoring to ensure compliance. Franchisees assume – in varying degrees- the risks associated with unanticipated events both on the revenue, as well as the cost sides. As a result, a number of franchise renegotiations have occurred, especially in cases where the services provided by the franchisees were of public/strategic interest, and thus gave the franchisee a strong bargaining position with the government to obtain better conditions.

One of the crucial choice elements in the specification of franchise contracts for rail operation is the duration of the contract. Longer franchises generally guarantee higher returns to the franchising agency, but at a cost of reducing the incentives towards improved efficiency which are generated by the re-procurement process. The British government resisted pleas from bidders to extend contract lengths because this would reduce the incentives towards improving performance, and because long franchises might enable the incumbent franchisee to establish barriers to entry that would undermine competition for the market at the time of re-tendering and the ultimate plan of open access competition.

The decades-long underfunding of the industry became obvious after privatisation, when the new industry structure highlighted some underlying

problems with track and operation. In an attempt to incentivise new investment from all players in the industry, the plan for the introduction of open access competition was indefinitely postponed. It was felt that, on the one hand, the elimination of the threat of competition for the franchisees would create incentives for new investments, and, on the other hand, it might simplify the future of an industry whose structure was already extremely complicated, without the addition of open access.

The 25 franchises tendered are very heterogeneous. Some of them are profitable, while some have to be subsidized. It was thought that franchise bidding would guarantee that the subsidized franchises would be given at the lowest subsidy, while the profitable franchises could raise the highest returns for the Government. However, the franchise agency, OPRAF, did not have clear information on the value to be expected from these franchises. Hence, the winning bids did not seem to reflect the underlying economics of the operations. Some bids were over-optimistic, and led to early re-negotiation, while some are believed to have generated very high returns to the bidders. The latter was especially the case due to an unpredicted increase in demand of about 30% since privatisation. Potential bidders had to supply a bid including a price schedule for each year of operation, and could also suggest some investment plans additional to those required, if any, by the conditions of the franchise to be awarded. As a result, very heterogeneous bids were received and, although the auction was preceded by pre-qualifying discussions, it was not clear how the franchising agency could compare entirely heterogeneous bids for the same franchises. In some countries different systems were adopted that were made clear to the participants prior to the auction (see the discussion on Argentina below).

In Britain OPRAF did not explicitly illustrate the choice criteria adopted for the choice of heterogeneous bids. As it later became clear that some of the conditions finally agreed with the winners were not realistic, the Strategic Rail Authority, SRA, (which succeeded OPRAF) has entered a phase of contract "replacement" (basically renegotiation with a more neutral name) with the aim of changing some contractual conditions. The entire replacement plan is reported here by the SRA.[2] Among the elements for re-negotiation it was originally thought that franchises should be extended to last for a minimum duration of 15-20 year, to a maximum of 30. More recently, however, the government changed its position on this issue, and long contracts are no longer part of the new contract terms.[3] The replacement plan will include some consolidation of the original franchises. The final new franchise plan will be published by the SRA by the end of January 2002.

The railway reforms that have taken place in other countries over the last couple of decades have equally aimed to combat excessive government spending and to

---

2 http://www.sra.gov.uk/sra/news/Default.htm (19 December, 2001; and 14 January 2002).

3 Affuso and Newbery ("Investment, Reprocurement, and Franchise Contract Length in the British Railway Industry," 2000. Centre for Economic and Policy Research (CEPR) Discussion Paper, 2619) find evidence that shorter franchise lives, in fact, can increase incentives to invest. Their explanation for this finding is that shorter franchises mean that TOCs facing reprocurement sooner tend to invest in order to signal their commitment to the regulator and thus increase the probability of the franchise being re-awarded. Public threats of fines and non-renewal of franchises from the regulator have served as a strong incentive. Moreover, investing near the end of a contract also signals aggressive behaviour to potential entrants that raises their entry costs.

improve the service quality and the cost effectiveness of their provision. In addition, rail reforms within Europe have been spurred on by European regulation, in particular European Directive 91/440, which states that the rail infrastructure and train operations need to be accounted for separately.

3.2 EXPERIENCE IN OTHER COUNTRIES

Below we outline the processes implemented in some countries that have adopted tender processes for the award of contracts for the operation of rail services.

By 1989 the Argentinean state-owned railway company, Ferrocariles Argentinos (FA) had an operating deficit of US$ 2 million per day. Restructuring began in mid 1990 and by the end of July 1994, FA was no longer running trains. Six commercially viable freight concessions were defined and were allocated to successful bidders for a period of thirty years with a ten-year renewal option. The concession holders were responsible for operations, maintenance, and the investment to which they had committed themselves in the bidding. Responsibility for the Intercity passenger services, which were thought to be commercially unviable, was passed to the provinces who could either decide to support them through subsidies or terminate them. Commuter services in the Buenos Aires region became the responsibility of FEMESA, a State owned corporation separate from FA. However, not long after the creation of FEMESA, it was decided to offer the commuter services as concessions as well. These concessions were very similar to the freight concessions with the government owning the rolling stock, infrastructure and facilities but the concessionaire placed with the responsibility for train operations and maintaining the infrastructure. Concessions were granted for ten years with ten-year extension periods.

In fact in both in Latin America and in Africa many railway systems have been privatised by means of long term concessions. In most instances an outsider, generally an agency, was given total control of the tender process. The concessions awarded were mainly for freight operations. Their duration tended to be long, about 30 years on average (Chile chose a 20 years duration, while Mexico preferred a 50 year option given the presence of alternative networks that generate effective competition).

The process for the allocation of the concessions varied, however, three main approaches adopted for the award of the concession/sale of the shares in companies holding the concessions, these were (a) sealed bids, (b) public auctions (Brazil), and (c) direct negotiation.

Sealed bid was the system adopted in the majority of the cases, with the concessions being awarded to the best offer. Not many countries determined a minimum acceptable price for the bid process, leaving to the market the identification of the economic value of the operation. The auction in Brazil had to set a minimum price according to their legal requirements, the determination of this price however was a very costly operation. In other cases the Governments had a (private) value which determined their minimum acceptable price. This information was not disclosed to the bidders, with the result that some auctions did not reach this minimum value and the concessions were withdrawn (Mexico). As in the British experience, also Latin American and African countries preferred to adopt a pre-qualifying stage for the determination of the bidders to be allowed

to bid for the concessions. This was also a way to discuss issues that cannot be included in the bid as they cannot be easily quantifyable, so the government/agency could screen the potential bidders and allow a 'pre-qualification'.

The system for the identification of the winning bid varied. Different forms of "points formulae" were adopted. Below in Table 1 we illustrate the example of Argentina, which is interesting in its choice of the relative weights for the different elements of the bids:

Table 1 Example Argentina

Factor	Maximum points
Bidder's experience, personnel and business plan	23
Basic investment plan amount and quality	33
Additional Investment proposed	5
Annual payment to Government for infrastructure concession	10
Toll to be charged to other operators for use of the track	5
Number of former railway employees to be hired	15
Argentine presence in concession	9
Maximum Total Points	100

Source: Thompson, Budin and Estache (2001). 'Private Investment in Railways'. The World Bank, mimeograph.

The main objective of the formula adopted was to include all most important features of the bid and quantify them, with monetary values where possible, so as to limit arbitrariness in the final choice, however, different weights were given to various aspects of the bids depending on circumstances.

The formula of Table 1 was adopted in one of the early concessions awarded in Argentina. Their experience with the performance of these concessions however demonstrated that the formula encouraged unrealistic and unpredictable bidding. This led to subsequent renegotiation of some concessions. An interesting case was that of Bolivia, where the highest bid won, and the winner was expected to transfer the cash for the entire price on the day of the award. This money however, was not retained by the Government but was instead used to invest in rail assets to be used by the company.

An interesting bidding system was adopted for the Buenos Aires Metro, where the bidders were asked to bid for (1) monthly flow of subsidy required for their operation, and (2) the timing suggested for a detailed capital program requested by the Government, subject to maximum fares and minimum service requirements. The winning bid was determined on the basis of the minimum present value of the sum of the subsidy and investment

The sums raised by auctioning long term concessions were quite substantial. The Brazilian Federal Railway (RFFSA) was losing around US$500 million annually; this was transformed into a payment to the Government of US$1.7 billion. In

Mexico, annual losses of around US$400 million were transformed into a positive payment of US$2.4 billion.[4]

The winners of the concessions saw a quite large participation by local consortia. It was originally felt that local participation to the tender process should be encouraged because of political concerns over privatisation of state-owned assets. Some concessions were declared critical to "national interest" and required government approval particularly for bidders including a majority participation of foreign. Local participation was in fact encouraged by the fact that there was no immediate capital requirement on the bidders' side to build a new capital asset base, and in some cases this still remained a responsibility of the governments. As a result most winning consortia had local majority ownership, with foreign participation limited to specific expertise, mainly on the commercial aspects. Thompson, Budin and Estache (2001) suggest that the consortia have functioned quite well.

The allocation of each individual service by auction remains an untried option in rail. The design of current contracts (franchises or concessions) implies the presence of internal cross-subsidies. Peak-time trains subsidise off-peak services. Some profit-making services subsidise some loss making ones. An auction system for the separate allocation of each individual service could minimise the subsidy required for each loss making service and maximise revenues from profit-making ones. Although efficient, it was widely believed that such a system would be far too complicated to implement. Some experiments have been conducted within a research project sponsored by the EU Commission, the Europe-trip.

The Europe-trip[5] project calculated algorithms to:

- Allocate capacity to maximise revenue.
- Allocate costs and;
- Generate efficient timetables in a vertically-separated system

Although feasible in experiments, this system is very demanding on computing capacity and the skills of rail operators. And it can become almost intractable if, as could often be the case, some companies face economies from operating more than one service which made a combinational auction the most efficient system.

4 CONCLUDING DISCUSSION

Among the different countries' experiences illustrated above, the greatest degree of separation has occurred in Britain, where ownership of infrastructure and rolling stock was separated from the operation of trains and the operation of passenger trains was divided between twenty-five different franchise operators. In Japan, there has been no vertical separation of infrastructure and rolling stock from train operations. Instead six vertically integrated passenger companies and one freight company were created. Sweden, in contrast again, separated infrastructure from operations but introduced no degree of horizontal separation

[4] Thompson, Budin and Estache (2001). 'Private Investment in Railways'. The World Bank, mimeograph.

[5] http://europa.eu.int/comm/transport/extra/europtripia.html.

of the industry. Argentina, and other Latin American and African countries introduced concessions, which run train operations in geographically separated areas on tracks over which they have responsibility.

One of the key elements in deciding upon the amount of horizontal or vertical separation to introduce was the degree of perceived competition within the railway industry and with other modes of transport in the country. Sweden provides an interesting case in that it allows a coordinated transport strategy by considering both road and railway within the same framework.

In Sweden, public transport authorities were given the freedom to purchase train operations from any suitable contractor. Two operators, BK –Tag and Linjetag, have attempted to enter the market, though only BK-Tag was successful in winning a contract. SJ responded to the competition by cutting tender prices by an average of 30%. It has since secured all contracts and has displaced BK-Tag from its two contracts.

The Japanese restructuring separated the infrastructure and operations in vertically integrated regional operations. However, a number of private companies exist in Japan. More than 100 private companies offer local and commuter rail services and operate 6000 km of intra metropolitan track, which interconnects with the network operated by JNR's successors.

The Argentinean system, where six freight concessions were given exclusive use of the tracks except the requirement to grant access to passenger operations in return for a compensatory track fee, is of interest, as the concessions were of long duration and some renegotiation occurred. The risk of long franchise duration without competition consists in the inability of the regulator/government to determine when the companies are performing adequately or when they are abusing their market power. If there is a fixed unit of demand and firms submit bids to supply that unit, as with franchise bids, then allocative, productive and distributional efficiency all increase as competition measured by the number of rival firms increases. It is more likely that there will be more rivals if the franchise is for a short period since it reduces the ability of the incumbent franchisee to erect barriers to entry by exploiting their informational advantage.

In addition, limiting the number of participants in an industry compounds the problems of asymmetric information and leaves the regulator less able to establish whether firms are behaving efficiently. Thus competitive pressure or at least the presence of "yardstick" competition may actually lead the franchisees to increase their investment, since they do not intend to risk losing their franchise if they are seen to under-perform. Concessions, like franchising, were used to keep competition at each tendering. However, competition from road freight in Argentina was so intense that it led to a consequent failure by some concessionaires to undertake their specified investment programs.

Long concession lengths, like the thirty years, and vertical integration could result in diminished incentives towards efficiency and large incentives towards opportunistic behaviour. Longer contracts make it progressively more difficult to establish whether the incumbent franchise holder is abusing its monopoly position when asking the government for renegotiation of financial terms in the presence of unforeseen events.

We conclude with three final remarks.

1. The crucial question for determining the best form of railway privatisation is: what is the most appropriate framework for each specific country? This will depend on a large number of factors, including the geography of the country, the composition of the traffic, and its distribution between freight, passenger, the average distance traveled, whether it is mainly short journeys like in Britain, or rather long distances; what is the degree of competition faced by rail from other modes like air and road. Experience (see for example Argentina) demonstrates that freight dominated networks are much easier to privatise than passenger dominated ones.

2. The British experience demonstrates that the competitive tendering of franchises has delivered positive results in terms of higher efficiency[6] as compared to performance under BR. Lack of information is crucial at the first tender stage, as such, one would expect that there will inevitably be some informational rents being passed on to some franchisees. However, a short-term contracting framework, with repeated auctions of the franchises, enables the Government to gain information and reduce the size of this rent at reprocurement stage, as compared to a long term concession framework. In the latter the risk of renegotiation is higher, but so are the returns that such concessions generate for the government.

3. Rail restructuring systems used in different countries cannot be ranked against each other in their merits. The restructuring process is inherently situation-specific, and should be developed in each particular country framework. In some cases though, political agendas can prevail over economic principles. Nonetheless, the underlying principle of introducing a competitive system for allocating rail passenger services where possible undeniably reduces the government's burden.

---

6 Affuso, Angeriz and Pollitt (2002) *Comparative Efficiency of Train Operating Companies in Britain*, Department of Applied Economics, University of Cambridge, Working Paper, forthcoming.

12 BEAUTY CONTEST OF FLEMISH COMMERCIAL RADIO

Maurice Dykstra and Emiel Maasland

TABLE OF CONTENTS

1 INTRODUCTION 209

2 FLEMISH RADIO LANDSCAPE 210

3 PROCEDURE 211

3.1 CHRONOLOGY 211

3.2 CRITERIA 212

3.3 RULES 213

4 OUTCOME 214

4.1 APPLICATION AND QUALIFICATION 214

4.2 ADJUDICATION 215

4.3 REACTION TO VCM'S DECISIONS 216

5 EVALUATION 217

6 CONCLUDING REMARKS 219

REFERENCES

APPENDIX I: TIME SCHEDULE

APPENDIX II: EVALUATION OF INDIVIDUAL BIDS

1 INTRODUCTION

Last year VCM (Vlaams Commissariaat voor de Media / Flemish Commissioner for the Media) awarded two licences for national commercial radio in Belgium to Q-Music and 4FM. The two available licenses were allocated by means of a weighted beauty contest. A weighted beauty contest is an allocation mechanism where the proposal of participants is evaluated according to a number of criteria that are specified in advance. The weight of each criterion is also known in advance. Decisions by VCM are definite. Neither the Flemish government nor the parliament is able to alter the decisions taken. This can only be done by the 'Raad van State' (the Supreme Administrative Court) in case it notices irregularities in the way files are evaluated. Almost all losers of the beauty contest challenged the decision by VCM. According to the losers there were inconsistencies in the way VCM had evaluated their business plans.

Quality considerations are important when allocating the right to use radio frequencies to commercial parties, but it is not immediately obvious how quality considerations can best be introduced. The case will provide insight into the way Flanders conducted the beauty contest.

Questions we will deal with are:

- How was the beauty contest executed?
- Were the criteria defined unequivocally?
- Is there room to question the decisions made by VCM?

Based on the answers given to these questions, lessons for the design of beauty contest in general, will be drawn.

The research has been organised as follows. Information was gathered by means of desk research and interviews with representatives of the parties involved. We held two interviews: one with the executive secretary of VCM (Mr. Roland Masyn), and one with the director of Radio Contact Vlaanderen, one of the losing parties (Mr. Rudy Dierckx).

The structure of this report is as follows. Section 2 describes the Flemish radio landscape. Section 3 describes details of the procedure that was followed. Section 4 discusses the outcome and the scores that were given on each evaluation item. Section 5 evaluates the beauty contest and Section 6 gives some concluding remarks.

2 FLEMISH RADIO LANDSCAPE

Before the allocation of the two licenses for national commercial radio, Flanders had six national public radio stations, 312 local commercial radio stations (of which 60% are working in a cooperation), and five cable radio stations.[1]

The VRT, the public radio broadcast, exploits six stations: Radio 1 (news, newsreel), Radio 2 (popmusic), Radio 3 / Klara (classic music), Studio Brussel (alternative radio for the youngsters), Radio Donna ('the fun-and-hits mix'), and Radio Vlaanderen Internationaal (worldservice). VRT Radio broadcasts the content of these six stations digitally.

At the moment the six national public radio stations have a market share of about 85 percent, the 312 local commercial radio stations together have a market share of about 10 percent. The market share of the five cable radio stations is negligibly small. The next table shows the evolution of the market shares of the radio stations over time in the Flemish community (in percentages).

Table 1 Market shares.

Radio	1996	1997	1998	1999	2000	2001
Radio 1	8	8	8	8	7	7
Radio 2	36	35	34	34	32	33
Radio 3 / Klara	2	1	2	1	2	2
Studio Brussel	10	11	8	7	7	8
Radio Donna	23	24	27	30	36	36
Total Local	18	16	16	13	10	9
Total Cable	0	0	0	0	1	0
Other	2	2	2	4	3	3

From the table it becomes clear that with the exception of Radio Donna and the local radio stations the market shares of the stations are more or less constant over time. Only Radio Donna has gained market share over time at the expense of the local commercial radio stations, probably by partly copying the commercial format.

[1] By decree of 7 July 1998, participation in cooperations of local radio stations is no longer prohibited. The following chains show up clearly in the present Flemish radio landscape: radio Contact, Top Radio, radio Mango, Family radio, NRJ, FM Limburg, and Spitsradio.

3 PROCEDURE

In Section 3.1 we give a chronological overview. In Section 3.2 we give a detailed description of the criteria. In Section 3.3 the rules of the beauty contest with respect to the participants and VCM will be given.

3.1 CHRONOLOGY[2]

In 1998, the Flemish Minister of Media, Dirk Van Mechelen of the liberal VLD, proposed to auction an (at that time) non-specified number of licenses for national commercial radio in order to break down the VRT radio broadcast monopoly.[3] The Flemish parliament agreed with the Minister to allocate licenses for national commercial radio, however disagreed with the Minister on the allocation mechanism. Eventually, the Minister gave in on this issue. The general opinion in parliament was that the licenses should not end up in the hands of the parties with the deepest pockets, but in the hands of the parties that are best qualified. As in a (weighted) beauty contest the quality element also can play a role, the majority in parliament preferred this allocation mechanism to an auction. The precise definitions of the criteria of the weighted beauty contest were not (extensively) discussed in parliament. There was also no discussion in parliament about alternative allocation methods, for example about a so-called "coloured auction", i.e. an auction in which radio broadcasting licenses are sold with a pre-specified format.

The goal of the weighted beauty contest is nowhere described clearly. According to the executive secretary of VCM, Roland Masyn, the goal was to create a diverse commercial radio landscape.[4] The commercial radio stations were required to have a varied program and were required not to be target group specific.[5] Importantly, the goal was not to create a diverse overall (public and commercial) radio landscape, in other words the new commercial radio stations were not required to bring a new sort of radio, not yet present on the public radio stations.

On 14 July 1998 the Flemish government (at the instigation of the Flemish parliament) decided to hold a weighted beauty contest to allocate licenses for national commercial radio broadcast services, fixed the qualification criteria and percentages, and commissioned VCM to do the evaluation. In fact, all later decisions only contain minor modifications and/or additions to this decision.[6] On 8 June 2001 the precise frequency packages have been made known. The Flemish government decided to allocate two licenses – a small (lot 1) and a large one (lot

---

2 Appendix I gives a detailed chronology.

3 The 312 local commercial radio stations (capacity < 100 Watt) were not able to do this.

4 VCM is an independent college that awards licenses and looks on the media sector in Flanders. VCM is composed of a chairman, two commissioners and three deputy commissioners. They are appointed by the Flemish government, for a period of 6 years.

5 The first requirement follows from the qualification criteria and the decree of 1 December 2000. The second requirement follows from parliamentary preparation documents by the Ministry of Media.

6 The Vlaamse Mediaraad gave advice to the Flemish government on certain decisions.

2) - for a period of nine years. The large one had a coverage of about 90 percent in the economic heart of Flanders, where about 70 percent of the population lives. The small one had a coverage of about 65 percent in the economic heart. The licenses were awarded on 6 September 2001. As the allocation of the licenses was disputable in the eyes of many, a hearing in the Flemish parliament took place on 25 September 2001, in which VCM had to elucidate her decision.

3.2 CRITERIA

The criteria and the relative weights used were: content of the programme (50%), media experience (20%), the quality of the business plan (20%), and the technical infrastructure (10%). We now give a more detailed description of the criteria.

Programme Content

The content of the programme and the broadcasting plan, in particular the variety in the programming are characterised by:

- Format of the national radio broadcasting service;
- Duration of the broadcast;
- Kind and point in time of the broadcast;
- Qualitative content and variety of the programmes, in particular the own programmes with respect to music, information, and relaxation;
- Attention herewith paid to the programme mix, to the news, to the information and informative programmes, to the culture, to the musical choices, to the service programmes and programmes having a combination of information and entertainment.

The concrete filling-in of the programmes with respect to information should be carried out by an own radio news service, with particular attention to:

- Number of planned news broadcasts.
- Variety of topics in the news broadcasts.
- Planned coverage of social and cultural events within the service area.
- Number of acknowledged professional journalists, trainees, and other editorial staff.
- Development of an own radio news service.
- Planned investment in the news service.
- Already acquired experience of the applicant in regard to media reporting.

Media experience

Media experience of the legal person, of the cultural, clerical, and technical staff, especially in respect of radio broadcasting and the creative contribution of the employees.

Business plan, including financial plan

The criteria with regard to the business plan consist of:

- Financial situation of the applicant, with particular attention to the solvency and investment ability of the applicant;

- Strategic vision for the long run and the aims for developing the national radio broadcast;
- Insights with respect to advertising attraction and promotional support;
- Intended investments and the prospects with respect to earning income, and the intended actions and the investment willingness in view of the promotion of the national radio broadcast;
- Marketing plan, the personnel plan, the financial plan, the investment plan, the financing plan and the annual account of the latest financial year of the legal person.

Technical infrastructure

Under technical infrastructure is included:

- Technical quality and aspects of the proposed configuration, with particular attention to the technical and operational knowledge present;
- Prospects in respect of technical investments;
- Planned technical equipment, infrastructure, transmission, implantation and expansion of the transmitter conglomerate;
- Schedule for the development of the broadcast and the necessary frequency packages.

3.3 RULES

In this section we describe the rules of the beauty contest with respect to the participants and VCM respectively.

Rules of the beauty contest with respect to the participants:

- A candidate has to pay a non-refundable fixed fee of EUR 24.800 to the Ministry of the Flemish Community, department Science, Innovation and Media to cover the costs in connection with frequency researches and administrative actions.[7]
- A candidate can submit at most one file per frequency package.
- In case a candidate submits the same file for each frequency package, he has to pay the non-refundable fee only once.
- In case a candidate submits different files for the two frequency packages, he has to pay the non-refundable fee twice.
- In case the candidate submits files for both frequency packages, he may indicate his preference for one of the two frequency packages.
- The candidature files - written in the Dutch language - should be submitted within 30 days after publication.
- Neither direct nor indirect connections are allowed between the legal persons who are candidates for a national commercial radio license.

[7] As this fee is considerably high, it can be regarded as a kind of an entry fee.

- The winners of the beauty contest should start their broadcasting services within 9 months after the licenses have been awarded.
- The winners of the beauty contest have to pay a yearly fee for the use and aintenance of the awarded frequency package. From the second year on, a fixed yearly fee was asked of 150.000 EUR and a pre-specified percentage of the gross earnings (the percentage is dependent on the market share). The price did not differ for the two licenses.
- Without approval of VCM, the licensees are not allowed to deviate from their proposals submitted in the beauty contest. Whether VCM will approve or disapprove the proposed deviation depends on the impact of the deviation on the pluralism and on the diversity in the radio landscape.
- Yearly, the licensees should produce an operation and financial plan for VCM. Herewith VCM is able to check whether the licensees stick to their proposals.

Rules of the beauty contest with respect to VCM:

- Within 14 days after the deadline of submitting files, VCM should determine which candidatures are admitted.
- VCM should award the licenses within two months after the deadline of submitting files.
- VCM should examine the admitted candidatures on the basis of the criteria specified by the Flemish government and published in the "Belgisch Staatsblad" on 12 May 2001.
- After the adjudication of the licenses, all admitted candidates should receive a letter in which VCM motivates its decision.
- At any moment in time VCM can suspend or withdraw a license in case the license holder fails to stick to the stipulations of the decrees.

4 OUTCOME

In Section 4.1 we show which candidatures were admitted and which were dismissed and on which grounds. In Section 4.2 we summarise the evaluation of the individual bids as conducted by VCM.[8] In Section 4.3 we present a number of reactions to VCM's decision.

4.1 APPLICATION AND QUALIFICATION

When the contest finally was announced, the following participants showed an interest in the two frequencies.

[8] Appendix II gives detailed summaries of the evaluations by VCM for all candidates.

Table 2 Participants.

Candidates	Radio station
N.V. VMM	Q-Music
4FM Groep N.V.	4FM
Vloro N.V.	Contact 2
N.V. Feiten & Muziek	Nova FM
Radio N.V.	N-Joy FM
Energy Vlaanderen N.V.	Energy
Finnpage Oy	Eva

The candidature of Finnpage Oy, a Finnish Group (part of the American Metromedia), was dismissed on grounds that not all required certificates were included in the file submitted. All other candidatures were admitted.

4.2 ADJUDICATION

VCM was responsible for evaluating the individual bids. It is important to note that VCM did not have the authority to check the submitted files on correctness. The correctness of the data had to be checked ex post. VCM did not hire external experts. The individual bids - more than 1000 pages thick - were very detailed[9]. For example, for each hour of the day the radio broadcast service profile was specified. The adjudication procedure - being not prescribed by the government - was as follows. In the first stage, the three commissioners and the executive secretary each individually evaluated the bids with respect to one criterion.[10] In the second stage, they discussed each other's reports and decided collectively on the final scores. The Flemish Ministry of Media itself also evaluated the bids. The commissioners used these reports as a double check for their decision. The two best candidates won the beauty contest. The one with the highest total score got the largest license, the one with the second highest score won the smaller license. After the decision has been made, all evaluation reports including the scores were made public. The files of the bidders however remained closed. Each candidate had the opportunity to ask VCM for an explanation. The adjudication by VCM per candidate per criterion is given in Appendix II.

The following table summarizes the adjudication by VCM. Each cell gives for each candidate the number of points scored and the maximal attainable number of points per criterion.[11] As Q-Music scored most points in total, Q-Music won the large license. As 4FM was second-best, 4FM won the smaller license.

9 All candidates submitted the same file for both lots and preferred the large lot to the smaller one.

10 Programme content, media experience, business plan, and technical infrastructure.

11 Note that all candidates got per criterion at least 50% of the maximal attainable number of points.

Table 3 Adjudication by VCM.

	Participants					
Criteria	Q-Music	4FM	Contact 2	NOVA FM	N-Joy FM	Energy
Programme Content[12]	38/50	40/50	35/50	30/50	30/50	25/50
Media Experience[13]	19/20	18/20	15/20	12/20	12/20	10/20
BusinessPlan[14]	17/20	13/20	14/20	12/20	11/20	11/20
Technical Infrastructure	7/10	8/10	8/10	7/10	7/10	7/10
Total number of points	81/100	79/100	72/100	61/100	60/100	53/100

4.3 REACTION TO VCM'S DECISIONS

The evaluation of the files by the commissioners of VCM was heavily criticized. In particular, the way in which VCM has given points to the media experience of the six candidates raised questions. The high score of Q-Music, 19 out of 20, was no surprise. Q-Music is owned by VMM, which in turn is in the hands of large media players De Persgroep (Het Laatste Nieuws, De Morgen, Dag Allemaal) and Roularta (Knack, Trends, De Streekkrant, Kanaal Z). The relatively high score of 4FM, 18 out of 20, was however contested. 4FM, that only existed for less than two years, was given 18 points, while the Contact Group, having radio broadcast experience for more than twenty years and serving more than 80 local radio stations, did not come further than 15 points. Energy Vlaanderen, an initiative of the publishers Concentra (Belang van Limburg, Gazet van Antwerpen), VUM (De Standaard, Het Nieuwsblad, Het Volk), and NRJ (one of the most successful French Radio Groups) got only 10 points. Many candidates also contested the scoring with respect to the content of the program and the broadcasting plan. According to them, the format of 4FM is not economically viable. All losing candidates contested the scoring with respect to the business and financial plan. The scoring was such that VCM apparently has more doubts about the financial capabilities of the three large companies Concentra, Vum, and NRJ than that of 4FM and shareholder Think Media. This is in contrast to what the commissioners wrote down in the evaluation report: "VCM is with respect to the financial continuity not without doubts as 4FM is fully dependent on Think Media". The evaluation of the technical infrastructure of the six candidates was more or less equal, although there were clear differences according to a number of candidates. Both N.V. Vloro and Energy Vlaanderen N.V. considered legal steps against the decision by VCM. Eventually, they decided not to do it, mainly because they could only challenge the decision on procedural grounds.

12 Generally speaking, target group radio stations did not well in the evaluation.

13 The media experience of the legal person did play a subordinate role.

14 According to VCM, it was impossible to compare the financial plans of the individual candidates. Therefore the candidates were only scored with respect to their business plan.

Also in the Flemish parliament the evaluation of the beauty contest raised questions, primarily because one of the licenses was awarded to 4FM.[15] Carl Decaluwé (CVP) has asked VCM to motivate its decisions in parliament.

5 EVALUATION

To evaluate the Flemish beauty contest of commercial radio stations, one should have a well-defined goal of the beauty contest. As the goal is nowhere described clearly, a good evaluation is in fact impossible. In this section, we evaluate the beauty contest with respect to the goal as described in Section 3.1: creating a diverse commercial radio landscape. As the price element does not play a role, the Flemish government has probably done right to choose for a (weighted) beauty contest instead of a price auction, because in a (weighted) beauty contest quality elements are endogenous.

The weighted beauty contest was however neither well-designed nor well-run for the following reasons:

- The precise goal of the beauty contest cannot be found in any document. Even a diverse commercial radio landscape is nowhere defined. Without definition, it is not clear how to score for example a pop/classic/jazz profile relative to a profile providing a whole spectrum of pop music.
- The criteria were too vague and sometimes internally inconsistent. For example, take the second criterion: media experience. The media experience of the legal person does not have to correspond with the media experience of the personnel. Also, nowhere is defined what is meant with a "creative contribution".
- All criteria are composed of many components. It was not clear ex-ante what the relative weight was of each component. An extreme example is given by the fourth criterion: technical infrastructure. All weight was assigned to whether or not the radio station will make national radio broadcast with an own transmitter conglomerate.
- VCM gave every candidate per criterion at least 50% of the maximal attainable number of points. This way of scoring works to the advantage of candidates that have a mediocre file with respect to a criterion. As the way of scoring determines in a large measure the outcome of the allocation process, it would have been better if the way of scoring would have been known ex ante, preferably specified by the Flemish government.
- Target group radio stations scored badly. This does not corresponds entirely with the criteria as specified in the decree.
- The way the beauty contest was designed can go against the goal of the beauty contest (diverse commercial radio landscape); as the candidates were evaluated independently of each other, two companies can win with similar formats.

[15] Think Media, mother company of 4FM was also accused of foreknowledge. In the week before the adjudication, the share value of Think Media doubled in value.

- There was no hearing in which the candidates could elucidate their bids. With a hearing clarity on several points could have been given (e.g. whether or not personnel has already been recruited) could have been taken away.
- In principle, new comers were at a disadvantage. The evaluation was positively influenced in case personnel were already recruited. A new station with less media experience but with a better format could have lost from a station with more media experience but with a worse format.
- The commissioners evaluated the bids on their "beauty" and did not examine whether the proposals were feasible. The commissioners should have been given the authority to check the files on their correctness and feasibility.
- As the commissioners each individually evaluated the bids with respect to one criterion, the evaluation tends to be very subjective. The time constraint prevented the commissioners to evaluate the bids with respect to more than one criterion.
- It is questionable whether the three commissioners (being judges) have enough knowledge of the radio broadcasting business to evaluate the bids in a proper way.
- Although the commissioners did not have the expertise to evaluate the financial plan and the technical infrastructure, they did not hire external experts.
- Although the financial continuity of 4FM was concluded not to be without doubts, the commissioners still awarded a license to 4FM.

The candidates were allowed to submit two files, for each lot one. Candidates could have had an incentive to submit, in addition to their original file, a file with a niche profile. This could have improved the diversity of the commercial radio landscape. Furthermore, as the proposals are very detailed (over 1000 pages), and because the licensees should yearly produce an operation and financial plan for VCM, VCM has a relatively easy job to check whether the licensees stick to their proposals and whether promises have been fulfilled. Without approval by VCM, the stations are for example not allowed to change their profile over time.

It is now easy to draw some lessons for the design of beauty contest in general. We summarize them point-by-point:

- Define the goal of the beauty contest clearly.
- Define the criteria unequivocally.
- It should be clear ex-ante what the relative weights are of each component of a criterion.
- The way of scoring should be known ex ante, preferably specified by the government.
- Let the criteria reflect the goal of the beauty contest in the right way.
- The allocation method should be in agreement with the goal of the beauty contest.
- Organize a hearing (ex ante and ex post).
- Consider whether a level playing field should be created or not.

- The persons that evaluate the files should have the authority to check the files on their correctness and feasibility. Furthermore, they should either have the expertise to do the job, or the possibility to hire external experts.
- There should be enough time to evaluate the bids.
- Depending on the goal of the beauty contest, the candidates should be offered the opportunity to bid on one or more lots.
- Let the candidates write detailed proposals.
- Do not allow the licensees to deviate from their proposals without approval.
- Let the licensees produce regularly an operation and financial plan.

6 CONCLUDING REMARKS

The Flemish government has eventually chosen for a weighted beauty contest to allocate two licenses for national commercial radio stations in order to break down the VRT radio broadcast monopoly. The Flemish government wanted to allocate the two licenses in such a way that a diverse commercial radio landscape would be created. To achieve this aim, a (weighted) beauty contest is in principle a better allocation mechanism than an auction, because in a (weighted) beauty contest quality elements are endogenous. A (weighted) beauty contest (provided that it is well-designed)[16] is probably also to be preferred to a so-called "coloured auction", i.e. an auction in which radio broadcasting licenses are sold with a pre-specified format as in such an auction only minimal requirements can be specified. The only potential relative disadvantage of a (weighted) beauty contest is that companies are usually more prone to challenge the outcome of the allocation process.

Although the Flemish government was probably right to choose for a (weighted) beauty contest, question marks can however be put behind the specific design chosen. Our main critique was that the criteria were too vague and sometimes internally inconsistent. The manner how to score per criterion was not specified ex ante. Also, as the candidates were evaluated independently of each other, a diverse commercial radio landscape does not necessarily result.

As the sole aim of the Flemish government was to create a diverse commercial radio landscape, one might argue that the chosen (weighted) beauty contest - in which criteria not being directly relevant for creating a diverse commercial radio landscape played a role - was not optimal. The following (weighted) beauty contest with pre-qualification round might have led to superior results. In the pre-qualification round, the candidates should fulfil certain (minimal) conditions with respect to the business plan, financial plan, and technical infrastructure. In the beauty contest itself, the candidates are to be evaluated only with respect to criteria that are directly relevant for creating a diverse commercial radio landscape.

[16] For example, the criteria should be defined unequivocally.

REFERENCES

Belgisch Staatsblad, Besluit van de Vlaamse regering houdende de vaststelling van de procedure voor het Vlaams Commissariaat voor de Media en houdende de aanvullende kwalificatiecriteria om te worden erkend als landelijke radio-omroep, 20 August 1998.

Belgisch Staatsblad, Besluit van de Vlaamse regering houdende wijziging van het besluit van de Vlaamse regering van 14 juli 1998 houdende de vaststelling van de procedure voor het Vlaams Commissariaat voor de Media, 27 April 2001.

Belgisch Staatsblad, Vlaams Commissariaat voor de Media. – Bericht betreffende de erkenning als landelijke radio-omroep, 16 June 2001.

De Financieel-Economische Tijd, Al drie klachten tegen toekenning Vlaamse radiofrequenties, 7 September 2001.

De Financieel-Economische Tijd, Regelgeving toewijzing zendvergunningen landelijke commerciële radio aan evaluatie toe, 26 September 2001.

De Standaard, Voorkennis doet Think Media exploderen, 7 September 2001.

De Standaard, Winnaars opgelucht, verliezers ontgoocheld, 7 September 2001.

De Standaard, Commissariaat Media twijfelt aan financiën 4FM, 8 September 2001.

De Standaard, Licentie 4FM roept veel vragen op, 8 September 2001.

De Standaard, De lakmoesproef van het VCM, 12 September 2001.

De Standaard, Gerecht onderzoekt koersstijging Think Media, 22 December 2001.

De Standaard, Kandidaten voor commerciële radio lijken sterk op elkaar, 8 August 2001.

Dirk Van Mechelen, Vlaams Ministerie van Economie, Ruimtelijke Ordening en Media, Beleidsnota 2000-2004.

Ministerie van de Vlaamse Gemeenschap, “Vlaamse decreten betreffende de radio-omroep en de televisie,” 30 March 2001.

Vlaams Commissariaat voor de Media, Proces-verbaal betreffende het ontvankelijkheidsonderzoek van de kandidaturen ingediend voor erkenning als landelijke radio-omroep, 25 July 2001.

Vlaams Commissariaat voor de Media, Proces-verbaal van onderzoek ten gronde van de kandidaturen (N.V. VMM, 4FM Groep N.V., Vloro N.V., N.V. Feiten & Muziek, Radio N.V., Energy Vlaanderen N.V.) voor erkenning als landelijke radio-omroep, 6 September 2001.

APPENDIX I: TIME SCHEDULE

14 July 1998	Decision by the Flemish government (fixation of the procedure for VCM plus fixation qualification criteria and percentages of the weighted beauty contest)
20 August 1998	Publication of the Decision of 14 July 1998 in the “Belgisch Staatsblad”
27 April 2001	Decision by the Flemish government (modification of decision 14 July 1998)
12 May 2001	Publication of the Decision of 27 April 2001 in the “Belgisch Staatsblad”
8 June 2001	Decision by the Flemish government (final fixation of the two licenses)
16 June 2001	Call for submitting files in “Belgisch Staatsblad”
15 July 2001	Final date for submitting files
25 July 2001	The candidature of Finnpage Oy was dismissed
6 September 2001	VCM awarded the two licences to Q-Music and 4FM
25 September 2001	Hearing in the Flemish parliament

APPENDIX II: EVALUATION OF INDIVIDUAL BIDS

II.1 Q-MUSIC

Programme Content

Q-Music presents itself as a general broadcasting service. The programming is well balanced with attention to social and cultural events. The VMM has experience qua media reporting. The radio news service looks well. The planned development of the service is concrete. The programming can mean a surplus value for the Flemish radio landscape. The file of this applicant satisfies the qualification requirements with respect to the content of the programme and the broadcasting plan. VCM awards the following score: 38/50 (38 points of the maximal attainable 50).

Media experience

VMM has as legal person itself already more than ten years of media experience, in particular with respect to broadcasting. This experience is on the one hand based on the exploitation of a television broadcast service and on the other hand on offering TOPradio and Radio Mango programming, i.e. supplying a common programming via licensed local radio stations. On the basis of this, VMM shows in its file clearly to have disposal of cultural and clerical personnel with sufficient media experience, in particular with respect to broadcasting, although the file does not contain a curriculum vitae of any employee.[1] As VMM exploits a television broadcast for already more than ten years, it has disposal of much technical broadcast experience. The entire file shows that the employees have the required creative skills. The file of this applicant satisfies amply the qualification requirements with respect to media experience. VCM awards the following score: 19/20 (19 points of the maximal attainable 20).

Business plan, including financial plan

The VMM indicates that, with the recognition as national broadcast service of her radio-unit Radio Q-Music, it pursues the development of an audio-visual company with general character, as a alternative to the public radio stations.

In the business plan and the financial plan is stated that VMM already now has disposal of the required means (shareholders' equity: 1.785 million BEF), qualified personnel (to extend the radio news service to 23 units), knowledge of radio (via TOPradio and Radio Mango) and an operational radio direction (Airtoo). The findings of the Ministry confirm the reliability of the stated data and underline that VMM is the only operational company that for a relatively long time already wants to start a national radio broadcasting service. The proposed market share of 6% within 1 year is probably too optimistic. For the rest, VCM agrees with the positive findings of the Ministry. VCM awards the following score: 17/20 (17 points of the maximal attainable 20).

---

[1] Q-Music has bought personnel from the Flemish public broadcast VRT.

Technical infrastructure

In the state of affairs, it seems to be difficult for the candidates to submit a strong file with respect to technical infrastructure. This probably explains why the data of the candidates with respect to the infrastructure does not show that much of a difference. VCM does make a distinction between candidates that have or intend to acquire their own transmitter conglomerate and candidates that will lease their transmitter conglomerate. VMM appears not to possess or intend to acquire a transmitter conglomerate. VCM therefore awards the following score: 7/10 (7 points of the maximal attainable 10).

II.2 4FM

Programme Content

4FM presents itself as a general broadcasting service. The programming is well balanced with clear attention to social and cultural events. 4FM has experience qua radio making and media reporting. The planned development of the radio broadcasting service is concrete. The radio broadcast service supply is worked out exceptionally concrete. The programming can mean a surplus value for the Flemish radio landscape. The file of this applicant satisfies the qualification requirements with respect to the content of the programme and the broadcasting plan. VCM awards the following score: 40/50 (40 points of the maximal attainable 50).

Media experience

4FM has as legal person itself already, although recently, media experience, in particular with respect to broadcasting. Qua cultural, clerical, and technical personnel everyone, except one, is known. They all have sufficient media experience, in particular with respect to broadcasting. The entire file shows that the employees have the required creative skills. The file of this applicant satisfies amply the qualification requirements with respect to media experience. VCM awards the following score: 18/20 (18 points of the maximal attainable 20).

Business plan, including financial plan

The 4FM Group, a separate legal entity, is a connection of four radio producers and one financier (N.V. Think Media, formerly N.V. De Beukelaer). Since September 2000 is the 4FM Group active in operationally making radio programmes spread via the cable, together with attracting advertisements. The group aims primarily at people aged 30-40, which normally will result in a share that is higher in the advertisers' market than in the listeners' market, with positive consequences for the revenues. The market share of the group is estimated on 19.40% of all radio listeners. This number is according to VCM rather high. 4FM however thinks that this number is reachable because of the high quality of its music mix and the expected shrinking share of the public radio stations. In the file an agreement between 4FM and SABAM, dated 6 July 2001, is enclosed. There is special attention to digital development. The file of this applicant has very nicely been put together and well-founded.

VCM has mainly objections against the issue of the continuity of the financial means. Next to the partnership capital of 20 million BEF, 4FM Group indicates

to have a backward debenture stock of 90 million BEF subscribed by N.V. Think Media and a forward credit of 15 million BEF. In case one of the national broadcast licenses will be awarded to the 4FM Group, the Group will acquire an additional 215 million BEF. The finance source is not mentioned though, probably N.V. Think Media. End 2000 the 4FM Group had a negative working capital of 68.8 million BEF. This means that the fixed assets are financed with short-term debt, which has consequences for the liquidity. N.V. Think Media states to be very active on complementary areas of the media business, interpreted in the broadest sense of the word (De Vrije Pers and the real estate company N.V. DB Invest). It is clear that the lot of radio 4FM depends on the continuity in the investment willingness of the N.V. Think Media. Despite the strong plan, VCM is with respect to the financial continuity not without doubts. In the context of the endurance of the radio broadcast, it is positively to be evaluated that 4FM committed itself to develop its own transmitter conglomerate despite of the heavy financial burden attached to it. The proposed investments in the other fixed costs are however rather weak. VCM awards the following score: 13/20 (13 points of the maximal attainable 20).

Technical infrastructure

As 4FM will make national radio broadcast with an own transmitter conglomerate, VCM awards the following score: 8/10 (8 points of the maximal attainable 10).

II.3 CONTACT 2

Programme Content

Contact 2 presents itself as a general broadcasting service. The programming is well balanced with attention to social and in a lesser extent to cultural events. Vloro has experience qua radio making and media reporting. The planned development of the radio broadcasting service is concrete. The programming can mean a surplus value for the Flemish radio landscape. The file of this applicant satisfies the qualification requirements with respect to the content of the programme and the broadcasting plan. VCM awards the following score: 35/50 (35 points of the maximal attainable 50).

Media experience

N.V. Vloro does not have media experience as legal person. It does however have long-term media experience via its two shareholders. With respect to the cultural personnel, it is unclear whether the 5 persons are already recruited or not. VCM presumes they are. They have however sufficient experience. For the general logistics N.V. Vloro can make an appeal on the general services within its shareholders. An additional number of persons will be recruited. With respect to marketing activities another 10 full time employees will be recruited. With respect to the technical personnel, N.V. Vloro appears to have disposal of 4 technicians, 1 internet specialist included. From the other, apart from the delegate administrator, no curricula vitae are included or an overview of the media and broadcast experience. The already recruited personnel has however disposal of experience. The entire file shows that the employees have the required creative skills. VCM awards the following score: 15/20 (15 points of the maximal attainable 20).

Business plan, including financial plan

The partnership capital of the N.V. Vloro, a separate legal entity, is 110 million BEF, which can be increased to 150 million BEF. N.V. Vloro also has disposal of short term means in the sum of 51.5 million BEF. The N.V. Vloro was founded by N.V. Contact and the N.V. Contact Vlaanderen. N.V. Contact (60.8%) is the mother company of the Group Radio Contact and is controlled for 40% by Lemaire Electronics N.V., 35% RTL Group, 12.5% by Freddy Neyts, and 12.5% HP Consult N.V.; the solvency of N.V. Contact per 31.12.2000 amounts to 27.9%, the solvency of the RTL Group as 68.9%. N.V. Contact Vlaanderen (39.2%) consists of a number of free radio broadcast franchisees and Flemish industrialists, who secure the Flemish embedment. Goal of N.V. Vloro is to make radiobroadcasting services, specifically adult contemporary radio, primarily aimed at people aged 25-45, based on a mix of music, relaxation and news. According to Vloro, this target group is the least served group by the VRT, who occupies three fourth of the market. According to VCM a choice for radio Contact 2 guarantees pluriformity and professionalism in the Flemish radio landscape, however also for a commercial approach in the strongest sense of the word. VCM awards the following score: 14/20 (14 points of the maximal attainable 20).

Technical infrastructure

As Vloro will make national radio broadcast with an own transmitter conglomerate, VCM awards the following score: 8/10 (8 points of the maximal attainable 10).

II.4 NOVA FM

Programme Content

Nova FM focuses primarily on the highly educated. It therefore disqualified itself as a general broadcasting service. The emphasis lies unarguably on the music. The radio news service should still be started up. The file of the applicant does not satisfy completely the qualification requirements with respect to the content of the program and the broadcasting plan. VCM awards the following score: 30/50 (30 points of the maximal attainable 50).

Media experience

N.V. Feiten & Muziek does not have media experience as legal person. N.V. Feiten & Muziek does however have experience as cable radio via shareholder S&SI and has therefore media experience. With respect to the cultural personnel, VCM finds that, apart from an editor in chief ad interim, everyone should still be recruited. N.V. Feiten & Muziek is only able to give curricula vitae of persons who will be recruited after the license is acquired. For the general logistics N.V. Feiten & Muziek can make an appeal on the general services within the shareholders. With respect to the technical personnel, it is unclear whether 5 of the proposed 7 persons are already recruited. All five have technical media experience; two of them with respect to radio broadcast and three of them have acquired the technical skills within N.V. Publishing Company Tijd. The sixth person has sufficient media experience for sure, in particular with respect to broadcasting, the seventh, the web master of Radio Roxy, has primarily Internet experience. As many employees should still be recruited, it is not clear whether all

employees will have the required creative skills. VCM therefore awards the following score: 12/20 (12 points of the maximal attainable 20).

Business plan, including financial plan

N.V. Feiten & Muziek, a separate legal entity, is a combination of the N.V. Publishing Company Tijd and the N.V. S&SI (radio Roxy). The partnership capital of 2.501.074 BEF can be increased to 52.522.550 BEF. Together with a long term loan of 12 million BEF, N.V. Feiten & Muziek has disposal of around 67 million BEF. The shareholders' equity of N.V. S&SI is negative. Thus the financier will be De Tijd, and later possibly other shareholders. Core target group are the young professional, higher educated aged 25-44. Nova FM will bring financial and socio-economic information. A market share of 4% and 14.5% is aimed for in year 1 and 9 respectively. The investment program is still rather limited. Nova FM will start with 21 employees, of which 9 journalists. VCM has the impression that, on the one hand, the radio broadcasting activity is seen as a businesslike supplementation of another media activity and that, on the other hand, N.V. Feiten & Muziek has just as much interest in a cooperation in another radio broadcast connection as for an own radio broadcast. As Nova FM is strong in providing information, value will be added to the Flemish radio landscape. Another question is whether there is sufficient demand for such a radio broadcasting service. The radio broadcasting service seems to be elitist conceived rather than general. VCM awards the following score: 12/20 (12 points of the maximal attainable 20).

Technical infrastructure

As N.V. Feiten & Muziek does not possess or will acquire an own transmitter conglomerate, VCM awards the following score: 7/10 (7 points of the maximal attainable 10).

II.5 N-JOY FM

Programme Content

Radio N.V. does not present itself as a general broadcasting service because it aims primarily at young people aged 20-29 and secondary at people aged 15-34. The emphasis lies unarguably on music. The radio news service should still be started up. It appears however not to be an essential pillar of the radio station. VCM awards the following score: 30/50 (30 points of the maximal attainable 50).

Media experience

Radio N.V. does not have media experience as legal person, but is as granddaughter able to lean on SBS Broadcasting S.A. Apart from its program director, editor in chief and three journalists, Radio N.V. is only able to give names of advisors and of persons who will recruited after the license is acquired. Qua clerical personnel Radio N.V. should recruit everyone, except of a number of advisors. With respect to the technical personnel Radio N.V. has one of its two technicians. This person has radio technical experience. For the rest Radio N.V. is able to rely on the engineers of Nozema. As many employees should still be recruited, it is not clear whether all employees will have the required creative skills.

VCM therefore awards the following score: 12/20 (12 points of the maximal attainable 20).

Business plan, including financial plan

Radio N.V. aims with its "Hot Adult Contemporary" music primarily at young people aged 20-29, and secondary at people aged 15-34. One can infer from this that Radio N.V. will be a niche player. With respect to this, VCM makes two objections. Firstly, according to the decree of 1 December 2000 (breaking down the VRT radio broadcast monopoly) the national commercial radio broadcast services should be as broad as possible. Question is of Radio N.V. suits in this picture. Secondly, a commercial radio broadcast service should earn their money mainly through advertisements. By restricting the target group, one restricts reasonably the advertisement volume. Examining the business plan, inclusive the financial plan, one should also bear in mind that SBS Broadcasting still has to carry the financial burden of its recently by VCM awarded television broadcast services VT 5 and SBS 5. VCM awards the following score: 11/20 (11 points of the maximal attainable 20).

Technical infrastructure

As Radio N.V. does not possess or will acquire an own transmitter conglomerate, VCM awards the following score: 7/10 (7 points of the maximal attainable 10).

II.6 ENERGY

Programme Content

Energy does not present itself as a general broadcasting service because it aims exclusively at young people aged 12 and over. The emphasis unarguably lies on hit music. The radio news service will be clearly no essential pillar of the radio station. The file of this applicant remains vague with respect to the content of the programme and the broadcasting plan. VCM awards the following score: 25/50 (25 points of the maximal attainable 50).

Media experience

Energy Vlaanderen N.V. does not have media experience as legal person, but has to lean on its shareholders. For radio broadcast services, it leans on the experience via the main shareholder of one of its shareholders. Group Energy is for 85% shareholder of N.V. Vlaamse Radio Vennootschap, which is for only 33,3% shareholder in Energy Vlaanderen N.V. Until now, Energy Vlaanderen has no disposal of cultural and clerical personnel; a number of curricula vitae are included from persons who are potentially interested to work for Energy after acquiring the license. Energy Vlaanderen N.V. says it will work with one technician and gives five names and curricula vitae, from which can be inferred that this technician still should be recruited. Moreover, their experience varies between 1 and 3 years. As all employees (apart of the editor in chief) should still be recruited, it is not clear whether the employees will have the required creative skills. VCM therefore awards the following score: 10/20 (10 points of the maximal attainable 20).

Business plan, including financial plan

N.V. Energy Vlaanderen was founded on 9 July 2001 (Staatsblad 10 July 2001), with as shareholders, each for one third, N.V. Concentra, N.V. VUM and N.V. Vlaamse Radio Vennootschap (which belongs to the French group NRJ), with a partnership capital of 150.000 EUR (6.1 million BEF). Energy tries to acquire a market share of 12.2% of the listeners in 2001, concentrating on the central areas Antwerp, Brussels and Gent. In spite of specialisation and segmentation, Energy aims to reach a sufficient large public with specific relaxation and information in order to develop an economic healthy radio broadcast. However the target group will be restricted to people aged 12-35. According to the candidate such a specific radio station is lacking at the moment for this group. Within this target group, 30% should be reached in 2004. Remarkably, for its radio knowledge Energy will make an appeal to the French group NRJ. Energy will have 24 employees, of which 5 are reported to be journalists. Probably the candidate leans on the editorial staff of Concentra and VUM, for collection and processing news. Strikingly, the candidate should make a exceptionally large effort in the start up period to acquire name reputation. A disadvantage of this candidate is that, although it is a legal entity, it ends up in groups with very different activities and a multitude of interests. Without NRJ a national radio broadcasting service is probably not possible. VCM awards the following score: 11/20 (11 points of the maximal attainable 20).

Technical infrastructure

As Energy Vlaanderen N.V. does not possess or will acquire an own transmitter conglomerate, VCM awards the following score: 7/10 (7 points of the maximal attainable 10).

AUTHORS

CO-ORDINATOR

Maarten Janssen, professor of Microeconomics at Erasmus University Rotterdam

OTHER TEAM MEMBERS

Luisa Affuso, research associate at the Department of Applied Economics, University of Cambridge

Tilman Börgers, professor of Economic Theory at the Department of Economics, University College, London

Maurice Dykstra, regulation researcher at SEOR (Erasmus University Rotterdam)

Jaap de Koning, professor of Labour Economics, director of SEOR (Erasmus University Rotterdam)

Emiel Maasland, auction researcher at SEOR (Erasmus University Rotterdam)

Benny Moldovanu, professor of Economics at the University of Mannheim

Yves Montangie, researcher in law, University of Antwerp

David Newbery, professor, director of the Department of Applied Economics, Cambridge University

Tim Salmon, assistant professor at the Department of Economics, Florida State University

Joseph Swierzbinski, researcher / lecturer at the Department of Economics, University College, London

Roger Van den Bergh, professor of Law and Economics at Erasmus University Rotterdam

Nico van der Windt, director of SEOR (Erasmus University Rotterdam)