The Italian Auction for Radio Spectrum Licences

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QUADERNI DI RICERCA n. 231

Aprile 2005

Comitato scientifico:

Sintesi

Sintesi in Italiano Questo lavoro affronta il tema delle aste per l'assegnazione di "beni pubblici". L'analisi si concentra sulla assegnazione di terza generazione per la telfonia mobile in Europa. Il lavoro prende in considerazione alcune tipologie di "asta" per analizzare l'appropriatezza di questo strumento nei vari paesi Europei. Quest'ultima analisi è condotta in modo approfondito per il caso Italiano e quello Britannico. Il principale risultato della ricerca riguarda l'inappropriatezza della tipologia di asta utilizzata in Italia, dove non si tenuto conto delle interconnessioni esistenti fra le varie aste Europee. In particolare, la forte complementarietà delle licenze nei vari paesi Europe, fa sì che chi si aggiudica alcune licenze ha un maggiore incentivo ad accaparrarsi anche le restanti. E questo sembra proprio essere il messaggio che scaturisce dall'analisi delle aste in Europa.

The Italian Auction for Radio Spectrum Licences*

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1 Introduction

A huge rise in the use of Auction Mechanisms has characterized government economic actions in recent years. In particular, several countries have been using this technique to assign[1] spectrum auction licences for third generation mobile phones.

Since 1994, U.S. government have run 33 spectrum auctions, assigning thousands of licences. Recently, some European countries have adopted the auction mechanism to assign licences for the third generation of mobile phones (UMTS licences). Among them the U.K. auction and the German auction are of particular interest. The U.K. government opted for a simultaneous multiple-bid ascending auction, while the German government devised a more sophisticated auction - the number of licences assigned to each winning bidder is endogenous, i.e. bidders can bid for more than one licence. The other European countries just mimicked these two models. Netherlands, Italy, Switzerland, Belgium and Greece adopted a simple simultaneous ascending auction as England. Austria used the German "endogenous" auction.

Looking at the outcome, in terms of revenue and efficiency, of these auctions it strikes the huge difference among them. Despite the similarity in the auction mechanisms actually used, results are very different in each country. While the UK and the German auctions seem to have been successful, the Italian, the Dutch and especially the Swiss auctions were not[2].

* *This paper is part of my MSc dissertation, I thank prof. Abhinay Muthoo for his support and useful help. Usual disclaimer applies.*

[1] Cramton (2001) pointed out the terminological difference between assignment and allocation. With allocation he refers to the process of splitting the spectrum in licences, while with assignment he considers the awarding process of licences to firms. However, since in this work I am talking just about the awarding process, I will use the words allocation and assignment as synonyms.

[2] The successfulness is measured with respect to the government's objectives.

The goal of the present paper is to analyze in detail the Italian and English auctions in order to shed some light on the different performance that a similar mechanism showed in the two countries.

The main point of the work is that the performance of an auction depends on the peculiar situation in which it is conducted. In particular, the auction for the UMTS licences is not independent of similar procedure conducted in other European countries. Therefore, the difference in performances between the Italian and the English auction depends on the fact that the Italian auction came after the English one.

The work is organized as follows: in the first part we survey the relevant economic literature on auctions; in the second part the Italian case is analyzed in detail; in the third we compare the Italian auction to the English and the Danish one. A final section summarizes the results.

2 The economic theory of auctions

The economic theory of auctions has experienced a great boom in the nineties. Actually economists have shown interest in auctions since economics was born as an independent field of study. However, only recently, auctions have received the due attention. Using a game theoretical approach economists have improved substantially the state of the art.

The main question addressed by the theory are: why to use an auction mechanism? What are the characteristics of auctions as an allocation mechanism?

Only recently auctions have been actually used to allocate public resources, such as telecommunications or electricity licences. Among methods used in the past are *Beauty contest* and *Lottery*. As regards the former, it is basically an administrative process, through which the government arbitrarily assigns rights (or licences) after hearing companies. It had been used for many years in the USA and it was used recently in some European countries to assign third generation mobile phone licences. The main side effects of this process are lack of transparency and waste of time; the government has to analyze a lot of applications and the final decision is based on a not so clear criterion. Moreover, as pointed out by Binmore and Klemperer (2002), usually it was used to assign rights to national companies, as a protectionist policy.

Also *lotteries* had been used by the U.S. government before switching to auction. It is a very simple method: government receives application and then rights (or licences) are assigned randomly. However, this very simple and quick procedure presents some problems. Firstly, it does not take into

any account efficiency issues, and even in the case of absence of transaction costs (with efficiency reached by the market through a re-selling process), few lucky winners are getting the high revenue that the government has left on the table[3].

The auction mechanism seems to overcome most of the drawbacks of these two methods. It is a transparent process which leaves few room for corruption or protectionism, and the procedure is relatively quick. Moreover, recent works have pointed out the efficiency features of auction mechanisms. In particular, most works focus on a broad concept of efficiency. This broad concept of efficiency can be interpreted according to three aspects:

1. efficient assignment of the licence(s)
2. revenue
3. efficient structure of the future market

According to the leading literature[4] auctions allow to reach these three objectives. As regards the first one, it is the "classical" concept of efficiency in economics. It simply implies that the firm with the highest willingness to pay should get the licence. This rests on the hypothesis that the firm most willing to pay is the one that has the best business plan and therefore is going to use the licence in the best way. The optimal auction mechanism should be designed so that the firm that is most willing to pay wins the licence. As regards revenue objective, it is implicit in the auction process that the revenue is split between the auctioneer and bidders. Therefore the share to the auctioneer depends on the design of the auction. This aspect is important from an efficiency point of view because it represents a non distortionary way to finance the Government budget (or at least less distortionary than taxes)[5]. The third goal is relevant in all cases in which the market structure will be determined by the assignment of the items, such as in Radio Spectrum auctions. The future mobile phone market is conditioned on the number of firms that are going to achieve a licence, and by the probability of an

[3]The U.S. lotteries produced this peculiar result: a lot of applications were sent to the government by companies build up just to participate in the lottery with the only aim to resell the right.

[4]Klemperer (1999) is the main reference for recent literature on auction design

[5]Ballard ed al. (1985) maintain that the welfare loss by taxation in the US economy is in the range of 17-56 cents per dollar of extra revenue, and Feldstein (1999) "*estimates, for the U.S. economy, that a marginal increase in tax revenue achieved by a proportional rise in all personal income tax rates involves a dead weight loss of two dollars per incremental dollar of revenue, although this is substantially higher than others' previous estimates*"(Klemperer, 2000, p.11).

entrant firm of getting a licence. Through a sensible design of the auction it is possible to influence the future structure of the market. For instance, by imposing that each firm cannot bid for more than one licence, the probability of having more firms in the future market is fostered.

Once decided that the auction mechanism is better than previous mechanisms, the next step is to define which type of auction allows to reach the most efficient allocation outcome.

The characteristics of the item to be auctioned are fundamental for the choice. It is possible to have a *single object* or a *multiple object* auction and it is also important to discern between *private value* and *common value* auctions. The specific features of any auction heavily depend on these characteristics. For instance, in a single object private value auction the *Revenue equivalence Theorem* applies and therefore each type of auction gives the same result, while in a multiple-object common value auction the outcome depends on the type of auction designed. Since we are dealing with Radio Spectrum licences, it is sensible to focus our attention on the multiple-object common value auction.

Recent literature[6] has focused on the analysis of two auction mechanisms: the ascending auction, and the sealed-bid auction. The main difference between the two is that the former is an open auction, in which bidders face each other in a "dynamic" competition, while the latter is a "close" auction in which there is no interaction between bidders during the procedure.

As regards the ascending auction, the main advantage is that bidders interact during the auction and a competitive price is formed. In particular, as Cramton (1998) pointed out, the auction mechanism is an answer to the question: who should get the item and at what price? The open auction answer to this question through a mechanism which resemble the market competition. The ascending auction "*allows the learning needed to identify the intersection of supply and demand, and hence the market price*"(Cramton, 1998). This learning process is very important in *common value* auctions, because although the actual value of the item is the same for all bidders, they have different private information on this common value, and therefore they can update their valuation only during the auction. Bidders interact so as to create a final allocation (and prices) very close to the competitive market one.

In the sealed-bid auction the possibility of learning from others' bid does not exist and the resulting allocation (and prices) is based solely on expectations of the other bidders' value. Hence, it is very unlikely that prices are close to the "market" ones. Moreover, the winning bidder in the open

[6]Klemperer(2002), Jehiel and Moldivanu(2001) and Cramton(1998)

auction is the one who is more willing to pay. This is because he can see the others' bid and top them, something that does not necessarily happen in the sealed-bid auction.

When we consider the other goal of the auction, the revenue, Cramton (1998) states that the open auction is better than a sealed one for mainly three reasons: the interaction between bidders, allowing learning process on the true value of the item, reduces the winner's curse[7], so that they can bid more aggressively; during the ascending process firms are pushed to compete; there is less strict budget constraint, because bidders have time to go to the Board to "renegotiate", giving new evidence for more finance support. However this open mechanism can also bring bidders to overestimate the item in an attempt to win at any cost the auction[8].

It seems that there is no doubt: the open auction is the best mechanism to assign Radio spectrum licences. However, this is not completely correct. All previous arguments are based on the following prerequisites: attracting bidders and preventing collusion.

In case of few bidders or collusion the nice properties of the open auction are hindered. If bidders agree to share the item, revenue will be low and the price is not a "competitive" price. If we consider these two aspects it is essential that the auction is designed to attract as many bidders as possible and to hinder collusion. When these problems arise, a sealed-bid auction regains some points. As shown in Cramton (1998) and in Jehiel and Moldivanu (2001), the sealed-bid auction can be preferred to the open one when bidders are not symmetric and in the case of few participants.

Ex-ante asymmetry among bidders tends to discourage "weak" bidders to participate, because they already know that they hardly win. The strongest bidder can always observe the bid of the weak ones and top them. Instead, in the sealed-bid auction "weak" bidders have a possibility to win. This is because the strongest bidders do not know how the others are going to bid, and face the following dilemma: should I bid very aggressively so as to win and risking the winner's curse, or avoid winner's curse risking to lose the licence?

When there are few bidders collusion is fostered. However, at least "tacit" collusion is more difficult in a sealed-bid auction than in an open auction. In the latter one bidders have the possibility to signal their strategies in the early stages and to punish deviation in the latter stages. There is a trade-off between efficiency and collusion. The more information is revealed in the

[7]The case in which a bidder wins because he has overestimated the object.

[8]As Cramton states firms think: *"if it is worth $ x to them, why it is not worth that much for us? Aren't we a good company?" Not raising a bid is a confession of inferiority*(Cramton, 1998)

auction process the easier is to collude.

A particular kind of auction that could tackle these problems is the so called "Anglo-Dutch" auction. It has been presented for the first time by Klemperer (1998), as a new formula to cope with problems of entry in the context of asymmetric bidders. It is a format in which the English (open) and the Dutch (sealed) auctions are mixed. As Klemperer (2002) shows, the procedure consists in a first phase in which bidders compete in an open ascending auction and in a second phase in which a sealed-bid auction is run among the winners of the first auction.

The main features of this format is that it combines the advantages of the open and the sealed auction. In particular, in case of entry problems the sealed phase gives the opportunity for the "disadvantaged" bidders to win. The problem is that few theoretical and empirical works have been done in this field, therefore the actual effects, on efficiency, of the Anglo-Dutch auction are not clear and they need further investigation.

Klemperer proposed this kind of format for the UK Spectrum auction, because of the entry problem deriving from the presence of four incumbent firms and four licences. When the Government decided to auction five licences, there was no more need for this special format and they decided to quit the Anglo-Dutch format in favor of the "Ascending auction".

To summarize the recent literature on auctions tends to view the auction as a mechanism that can reproduce market allocations and market prices, and thus generates an "efficient" allocation. However, in order to fully exploit these benefits it is necessary to look very carefully both at the nature of the items awarded and at the "environmental" economic conditions of the country in which the auction takes place. As klemperer said it is not "*one size fits all*"(Klemperer, 2002, p.29). Details are very important in a successful auction.

3 The Italian auction for UMTS

The Italian auction for Radio Spectrum licences took place in November 2000. The auction is just a part of the whole administrative procedure designed to assign the licenses. This procedure consists of two steps. A first step in which the government decides whether a company is qualified or not to go through the second step: the actual auction. The whole procedure can be considered as a mix between a "beauty contest" and a pure auction. It is a peculiar feature of the Italian auction, in no other European contest participants are supposed to be screened in this way before taking part to the auction.

3.1 Object of the auction

The auction process has been designed to assign licences for third generation mobile phones. The so called UMTS, *Universal Mobile Telephone System*, is the technology designed for the frequencies auctioned. It is the third generation because it comes after the *analog line* and the *GSM*, which represent the first and the second generation respectively. This new technology allows the transmission of a wide range of information, from vocal to images, making possible to use each mobile phone as an internet computer gate. It will become a *multimedia* device through which it would be possible to communicate, exchange information, have remote access to your home, put in effect bank transactions, make purchases, and view your favorite football team goals, soon after they score.

The implication and the value of this kind of licence is very high for all companies. For entrant companies it represents the possibility to enter the market of mobile phones, one of the most dynamic of the past years, and for the incumbent firms it is important in order to consolidate their position in the market, exploiting their existing network of second generation mobile phones. As an example of the importance for the incumbent firm to get a licence, it is sufficient to watch at the case of *Blu*, the incumbent which withdrew from the auction, is now in great financial troubles, and probably its assets will be acquired by the other companies in the market[9] At the moment this value is decreased a lot, partly because of the general crisis of the new technology industry and partly because companies found out that demand for new services is not so high, i.e. it is not increasing at the forecasted speed. The auction mechanism has been blamed for this bias in forecasts, companies had been pushed to spend a lot of money for the 3G licences. However, it is just a short run perspective, because the value of the 3G licences has to be measured also in the long run. Moreover, just the possibility to run a new service, even if it does not mean immediate revenue, it is still an asset for the future.

The government has planned to provide a maximum of five equal licences. The actual part of the spectrum that will be assigned to each company is not known during the auction. Only after the auction has ended the spectrum is actually awarded. Thus the licences are perfect substitutes for the bidders. Each licence consists in a 2x10 MHz band of symmetrical spectrum and a 5 MHz band of asymmetric spectrum. In order to make the procedure more interesting for new entrant firms, the Italian government prescribed that to all new entrants who win a licence is reserved the possibility to bid for a

[9]BLU's main assets have been divided and assigned to TIM, Vodafone, Wind, and H3G

further licence of 2x5 MHz (symmetric)[10].

Each licence lasts 15 years[11], and the validity starts from the 1st of January 2002. To avoid resale of licences the government imposed that the licence cannot be sold within 48 months after the assignment. This last restriction prevents the participation in the auction of companies whose only aim is to speculate on the value of the licence, although they have no intention to use it. However, it does not hinder the possibility of ex-post joint ventures (or any other form of property sharing) between winners and losers.

3.2 Design of the auction

The Italian auction is similar to the English one. But the whole procedure is rather different: it prescribes a first step in which the government screens possible bidders. This fact plays an important role when comparing the outcome of the Italian auction and the English one.

The first part of the procedure, that we can call the *administrative phase*, requires companies, that aim to participate in the auction, to submit to a government agency a business and technological plan, in which they have to state their ability and capacity to exploit the licences. The government can prevent or allow the company to bid in the auction.

As far as the auction is concerned, the government decided for an ascending simultaneous bid auction. The same kind of auction worked very well in England. The main feature of this kind of mechanism is the presence of several rounds in which bidders, simultaneously, submit their bids for the licences. At the end of each round each bidder knows about the other bidders' bid. The auction ends with the round in which no one raises his bid. The licences are assigned to the first five bids (in case of five licences).

3.2.1 Auction rules

A closer look to the Italian auction rules is useful to have a clear view of what (presumably) were the objectives of the government.

First of all, to assure competition among bidders the government had decided to reduce the number of licences auctioned if the number of participants is less than six. The reason for that is to ensure that the number of bidders is larger than the number of licences to be awarded. In fact, since

[10]There are two licence of this kind available to entrant firms, but they can get just one extra licence each.

[11]The Italian government has eventually raised this term to 20 years, officially to conform to the European standards, but most probably to alleviate the difficult economic situation of the telecommunication industry.

each company is allowed to get only one licence, when five companies bid for five licences, there is no need for an auction.

Another important set of rules concerns the "pace" of the bidding. In particular, the government may control the speed of the bidding process through three instruments:

1. *Minimum opening bidding* It has been set at 4,000 bn ITL (about € 2 million). In case the companies' valuation of the object is close to that mimimum bidding, it could be taken as a partial explanation of the slow speed of the Italian auction. Anyway, in most of the cases the minimum bid has no big effects on the auction, unless it is too high (in this case it may happen that some objects remain unsold) or too low (in case of weak competition among bidders it may cause a very low revenue, as demonstrated in the Swiss auction).

2. *Bid increment* A new bid to be acceptable must be a multiple of 10 billion ITL [12]. The increase in the bid is subject to a minimum and a maximum value. In particular, for the first 10 rounds, the increase has to be greater than the 5% of the lower previous bid; in the following rounds the limit is 2%. The maximum increase is the 50% of the fifth larger bid. Since the early withdrawal of one of the bidders setting a higher minimum increase could have been beneficial in the Italian auction. Indeed, any bidder started with very small increases (an average increase of 4,5%[13]).

3. *Rounds per day* It is the most direct tool to influence the auction pace. Before the first round of a day begins, the auction "referee" states the daily starting and ending time. He also sets the length of each round. Thus the government can easily change the speed of the auction.

An other important feature of the auction is the concept of "*active*" bidder. Any participant has to be active in any round. A bidder is *active* if either:

- his bid in the previous round is among the five highest bids, or
- he has submitted a valid bid in this round, or
- he asked for a temporary break (each bidder does have three *waive* rights, which allows him to step aside for a day).

[12]This trick sets aside tacit collusion problems deriving from sending signals through the last digits of the bid. This case of collusion was experienced in some U.S. auctions.

[13]This figure refers to the increase in the bid with respect to the own previous bid. So, it is not in contradiction with the 5% minimal increase rule.

Hence formally the auction ends when the number of active bidders is equal to the number of licences auctioned.

3.3 Participants in the auction

Eight companies did participate to the Italian auction. This is the list of the companies:

1. **TIM** Company controlled by *Telecom Italia Mobile* which owns 60.1% of the shares. It is the biggest company in the Italian mobile phone market.

2. **OMNITEL** Company controlled by *Vodafone* and the American *Bell Atlantic*, with respectively the 76.9% and 23.1% of the shares. It is the second biggest company in the mobile phone market.

3. **WIND** Company controlled by *Enel*, the Italian state owned company operating in the electricity market, with 73.4% and by *France Telecom* that owns 26.6% of the shares. WIND is a relatively new operator in the mobile phone market, it has entered the market in March 1999.

4. **BLU** Consortium of companies, among which the most important are: *Autostrade SpA* state owned company controlling 32%, *British Telecom* that owns 20%, *Benetton* holding 9%, *Mediaset* the Italian private company in the television market, and *Bnl* one of the biggest Italian banks, holding 7%. BLU is the last entrant in the mobile phone market. It started to offer GMS services in March 2000, however its main objective is to participate in the auction for the UMTS licences. Indeed, after his withdrawal the consortium collapsed and now there is a plan to sell all the assets of Blu to other companies[14].

5. **ANDALA** New company created to participate in the auction, and one of the four new entrant competing for the licences. It is owed by the following groups: *Hutchison Wampoa* Hong Kong company operating in the telecommunication market and holding 51% of the shares; *Tiscali* Italian company in the telecommunication industry, holding 25% of shares; *CIR* Italian company in the food market, holding 15%; and *SanPaolo-Imi* Italian bank holding 5% of the shares. After the auction the company changed its name in H3G and the Hutchison Group raised its share to 88,2%.

[14]The plan consists in sharing the assets among the incumbent companies and the new entrat company ANDALA (H3G)

6. **IPSE** It is a new company created to participate in the auction in which the most important stockholders are *Telefonica* a Spanish company which holds more than 45.49% of the shares, *Sonera* a Finnish company that holds 12.55%, and *Banca di Roma* one of the most important Italian banks which holds 10% of the shares.

7. **ATI-TU Mobile** Consortium of companies created to participate to the auction. The major stockholders are *TLC Utilities* and *Les*, two Italian companies operating in the telecommunication market.

8. **ANTHILL** Consortium of small companies from the south of Italy, with the financial and technical support in case of victory of *Deutsche Telekom*, *knp* a Dutch company and *Ntt DoCoMo* a Japanese company.

Among these companies four are incumbents and four are new entrants. During the first step of the procedure (the analysis of the businnes and technical plan) two entrant bidders, *ATI-TU Mobile* and *ANTHILL*, had not been allowed to go to the auction phase. Hence, the actual bidders had been reduced to six: four incumbents and two new entrants[15].

3.4 The auction at work

The auction took place on October 19th and lasted for just 3 days. On the first day there were four rounds, while in the second day six rounds. On the 20th *BLU* asked for a break. The auction continued and ended on October the 23rd, after just one more round.

It is clear that the auction has been heavily hindered by the withdrawal of *BLU*. After just eleven rounds the competition ended, so it is difficult to find out a clear dynamic in the bid process. However, up to that point the process showed that all bidders were very cautious. As can be seen in the Appendix there has been no aggressive bidding; each bid was only slightly above the minimum. The reservation price was 4,000 billion ITL for each licence, i.e. a minimal total revenue of 20,000 billion ITL (about € 10 billion), which means that the actual revenue (about € 12 billion) has been just 15% over the "reservation" revenue. The average increase in the bids was only € 0.1 billion. The average increase in the price paid for the license by the winning companies has been 710 billion ITL (€ 0,36 billion).

These figures show that all bidders were very prudent at the beginning. However, they were ready to pay much more. For example, *Andala*, looking

[15]That is exactly the number of licences auctioned plus one, as the rule of the auction prescribed.

at the outcome of the English auction, decided to ask the financial help of a big international group as Hutchison Walpoa, who entered the consortium in the summer 2000. This testify that they were expecting to pay much more for the licences.

Even if the auction lasted for only eleven rounds, it seems that the strategy adopted by most of the bidders is the follow: a company bids in the current round and then, in the subsequent rounds, it waits to bid until the previous bid is topped by five other bids. Clearly this strategy is fostered by the fact that the licences were identical, so that the best outcome for a company was to end the auction at the fifth place.

3.5 Outcome of the auction

As mentioned in the previous section the auction ended after just three days. The identity of the winning companies and the price they paid are displayed in table 1.

Table 1: Winning bidders and awarding prices

Company	Price (Billion ITL)	Price €
OMNITEL	4,740	2,448,005,702
IPSE	4,730	2,442,841,133
WIND	4,700	2,427,347,426
ANDALA	4,700	2,427,346,426
TIM	4,680	2,417,018,288

Source: Governo Italiano - Presidenza Consiglio dei Ministri

If we look at the English or German auction prices for the licences were much more higher. In particular, the English auction raised € 37.08 billion and if we consider the population, it has been the biggest auction ever conducted, with € 129.4 per capita, about 233% higher than the Italian per capita revenue. Clearly the total revenue is far from what expected. The total revenue was about € 12,164 billion.

This low performance of the Italian auction is certainly due to the abrupt withdraw of BLU, which left only five bidders for five licences. However, it is important to examine whether this possibility could have been forecasted. In particular, the screening process which prevented two firms to participate in the auction, leaving just six firms for five licences, has worsened the already low presence of bidders.

The other important outcome of the auction is concerned with the future structure of the market. The auction mechanism allowed the entry of new

	Tot. revenue	Total MHz	€/population	€/MHz
Italy	12.164	125	42.37	97.31
Germany	50.51	145	103	352
UK	37.08	140	129.4	264
Austria	0.704	145	18.47	5.74
Netherlands	2.683	120	33.74	22.35

Table 2: Average revenue per license in Europe (*"Tot. revenue" figures are in billion of Euros*)
Source: Jehiel and Moldovanu (2002)

companies. Of the five licences available three had been assigned to incumbent firms and two to entrant firms. This is the only case in Europe of an auction ending with an incumbent firm without any license[16]. This is clearly due to internal problems of *Blu*, and not to the rules of the auction.

3.6 Has the Italian auction reached its goals?

The main factors to take into account in analyzing the process of assignment of Radio Spectrum licences are:

- efficiency
- market structure
- revenue

The first issue refers to the efficient allocation of the radio spectrum. Efficient allocation means that the licences must be awarded to the firms that value them the most. Firms that are more willing to pay for licences are the ones that are more likely to use them in the most efficient way. This is the line of reasoning behind all claims of efficiency in the auction theory. The item of the auction is assigned to the bidder with the highest value and therefore the one who is more willing to pay for it. This line of reasoning is not so straight when dealing with items, such as radio spectrum licences or any right to exploit a public resource. In this case we have a so called *public value* auction. The value of the object is the same for all bidders, but they don't know it with certainty. It depends on the forecasted conditions of the market.

[16]Actually also in the Danish auction one incumbent did not get any licences, but the auction mechanism was different. They used a sealed-bid auction instead of an open auction.

An open auction is better than a sealed-bid auction because bidders can interact and exchange information on the value of the object. Thus, the Italian government seems to follow this line of reasoning when it designs a simultaneous open auction.

It is useful to note that the whole procedure is not composed of the auction alone. There is a previous step in which the government "chooses" firms that will participate in the auction. This fact heavily hinders the efficient outcome of the auction. The auction mechanism is allowed to operate only amongst bidders selected by the government.

The lack of competition hinder the beneficial effects of the open auction. The screening process in the Italian auction reducing the number of bidders reduced the competition and most important increased the risks of collusion.

The second aspect concerns the future structure of the market. The outcome of the auction determined the structure of the Italian mobile phone market, at least for the next 20 years. The government had been very careful to design a procedure which encouraged new entrant to participate. Two portions of the spectrum (2x5 MHZ each) are reserved to entrants which succeed in getting one license; moreover, since a company can get only one license, having five licences and four incumbents, leaves room for at least one entrant firm. However, it is important to highlight that these measures, which foster the entry of new firms, have a negative impact on the efficiency of the auction mechanism. In particular, fixing at one the maximum number of licences obtainable, prevents the possibility of a market structure determined endogenously by market forces. There is clearly a trade-off between efficiency, in the sense explained before, and rules favoring the entry of new firms. This advantage for entrant firms is justified with the idea that and incumbent firm should suffer a greater loss than the entrant firm if she loses the auction. However, the two entrant companies, *Andala H3G* and *IPSE*, are controlled by firms that are incumbents in the telecommunication market of other countries. An entrant firm whose capital is detained by an incumbent firm in a neighboring country has a similar incentive to win the auction as the incumbent firm. Hence, it is not really necessity to set rules supporting entrants while hindering the efficient outcome of the auction.

The third issue is revenue. Auction mechanisms are considered by governments as an easy way to raise a huge amount of money, avoiding the dead-weight loss associated with taxation. Under this aspect the Italian auction did not perform very well. Even if it is not the worse result in Europe, it is nevertheless far from what expected.

From the analysis conducted it seems that the Italian procedure was not so appropriate for the goals the Italian government aims to achieve. In particular, the first step of the procedure (the administrative screening

of potential bidders) may have prevented the ascending auction to reach an efficient outcome. Moreover, with that step the government actually designed the future structure of the market. Thus the only goal left to the auction seems to be to raise revenue. But, if this is the aim, it is no more true that the auction designed is the best possible type of auction. For example, a sealed bid-auction could have brought better results, as demonstrated by the Danish case, which registered a revenue of about € 95 per capita (against € 42.37 of the Italian auction).

4 Italian versus British and Danish auction

In order to investigate whether the peculiar outcome of the Italian auction is due to the design of the auction or to particular unfortunate events, we can consider the performances of the auction mechanism in other countries. The English and the Danish auctions offer an example of two mechanisms which seem to achieve most of the objectives their government had planned.

4.1 The UK auction

The English auction was the first European auction for Radio Spectrum licences. It took place on March and April 2000. It is also the most impressive auction ever run in term of revenue, € 37,08 billions which weighted by population means € 129.4 per capita. This striking result in term of revenue was really unexpected. Previous auctions of Radio Spectrum in the U.S., for a comparable 2x10 MHz + 5 MHz license, have raised "only" 15.1$ and 7.0$ per person, which could not create the expectation that a similar auction, three years later, would have raised 107.2$ per person.

However, this is not the only good result the English auction achieved. Among the goals raising revenue is maybe the less significant. It is far more important to get an efficient allocation of the resources and an efficient structure of the future market.

Table 3 shows the outcome of the English auction. It is evident that any incumbent firm[17] gained one license and that only one new firm entered the market. This accounts for the fact that when the number of licences are equal to the number of incumbents none of the entrants can get a licence (Jehiel and Moldovanu (2000)). This point of view is reinforced by the empirical evidence in other European countries. In the Netherlands and Switzerland , only incumbent firms obtained a license.

[17]The incumbent firms in the UK market were: Vodafone, British Telecom, One2One and Orange

Table 3: Performance of the English auction

License	Bandwidth MHZ	Company	Price (€ Bn.)	Price (£ Bn.)	Price/Pop (€)	Price/MHz (€ Mil.)
A	2x15 + 1x5	TIW	7.23	4.38	126	206
B	2x15	Vodafone	9.84	5.96	172	328
C	2x10 + 1x5	BT	6.65	4.03	116	266
D	2x10 + 1x5	One2One	6.60	4.00	115	264
E	2x10 + 1x5	Orange	6.76	4.10	118	274

Source: Jehiel and Moldovanu (2001)

As concerns the future structure of the market there is no substantial difference between the English auction and the Italian one. Both countries designed a procedure which encourage entrant firms to participate in the competition, by prescribing that each bidder can obtain only one license. Moreover, the English auction reserved a license[18] for a new entrant firm.

This additional, and very strong measure, was introduced in order to facilitate entrant firms and to balance the strong market power of the incumbent firms, in the future market. However, this measure could have hindered the efficiency feature of the auction mechanism, because the widest license was reserved to a new entrant firm. The fact that the incumbent *Vodafone* was awarded with a worse license for a higher price than the entrant *TIW*, could be seen as a hint of the inefficiency of the rule which reserves a particular license to entrant firms.

Apart from this criticism, the British auction seems to have reached most of the goals set by the government. In particular, a lot of firms participated in the procedure. There were thirteen companies, among which four incumbents and nine entrants. This is probably one of the main reasons of the success of the auction. It produced a lot of competition in the auction, as prescribed by the theory. It seems that this huge presence of entrants is mainly due to the fact that at least one entrant would win a license (the one which is reserved to them). In fact, a similar rule was set also in the Italian auction, but the result was very different. Moreover, in the Italian auction a *mandatory roaming* was prescribed , which binds the incumbent firms to allow access to their network to new entrant. Despite this effort there were only 4 incumbents. Even if we consider the two entrant firms, that were stopped by the government in the first phase of the Italian auction, there were just nine participants. Therefore, the reason why a lot of companies participated in the British auction is

[18]It is the biggest license (2x15 + 1x5) which is reserved to new firms

not clear. Two hypotheses have been made in the literature (Klemperer (2002)). Firstly, since the English auction was the first one to take place, it is possible that firms did not know what to expect from the auction mechanism, but when they saw the final prices for the licences, most of them decided that it would be useless to participate in the other auctions. Indeed, also in the German auction, that raised a lot of money, there were just seven firms participating. A second hypothesis states that the first auction to take place is seen by companies as a way to signal their intentions. In particular, bidding very aggressively in the first auction can discourage entrant firms to participate in the following auctions.

As regards efficiency, despite the reservation of one license to entrant firms, the British auction seems to have worked as forecasted by the designer of the auction: licences have been assigned to the firms most willing to pay (and they paid a lot as shown in table 3).

The main difference between the English and the Italian auction is not in the design of the auction itself but in the design of the whole procedure. In the Italian case there is a first phase in which the government screens firms. In the UK on the other hand there is not such a preliminary qualifying stage. Thus allowing the auction mechanism to "choose" the most efficient.

Another important difference lies in the object of the auction. The radio spectrum had been allocated in a different way in England. In the Italian auction there were five *identical* licences, while in the English one licences were not identical. As shown in table 3 there are five licences labeled A, B, C, D, and E of different size.

This last difference makes the Italian procedure very different from the UK one and therefore the adoption of the same type of auction mechanism necessary leads to a different outcome.

4.2 Danish auction

The Danish government is the only one, among European countries which adopted a *sealed-bid auction*. In particular, they designed a sealed-bid forth price auction, which implies that all four licences are paid at the price of the forth highest bid. It is a *second price sealed-bid* version for multiple objects. The Danish auction has the following characteristics:

- **Object** : four identical licences
- **Participants** : five bidders, the incumbents *TDC Mobile*, *Telia Mobile*, *Orange* and *Sonofon*, and the entrant firm *HI3G Denmark*
- **Rules** : Forth price sealed-bid auction

The sealed-bid auction, as it has been exposed in section 2, is dramatically different from the open one. It does not allow firms to interact and to exchange information in order to reduce the uncertainty. However, the sealed-bid auction has the advantage to hinder tacit collusion behavior, and in case of few firms competing gives better results, in terms of revenue and efficiency, than the open auction.

Probably the main reason for using this kind of auction is to foster the participation of entrant firms. In this case the possibility for an entrant firm to bet higher than an incumbent firm is enhanced. In the Danish auction an entrant has got the license at the expenses of an incumbent firm[19]. While in the Dutch and the Belgian auction, incumbent firms have got all the available licences. Indeed, in the Belgian auction only three bidders came up and they got the licences at the reservation price.

As stated by Klemperer (2002) the Danish government made the right choice, because the possibility of attracting a lot of participants was very low, as it results from the other European auctions. Therefore the main advantages of the open auction would have not been exploited.

The high performance obtained is also more valuable if we consider that it came in a period of decreasing performance of the telecommunication industry, as testified by the collapse of the stock market prices and the fact that the Finnish company *Sonera* returned its license for the Norway market.

Table 4: Main figures of the Danish auction

Winning bidders	HI3G, TDC, Telia Mobile, Orange
Reserve price	€ 67,567,567
License price	€ 128,376,757
Total revenue	€ 513,507,028
Revenue/pop	€ 96,21

Source: Danish Telecommunication Agency

4.3 Why different performances?

From the analysis of the British and Danish auction it is possible to get some interesting insight in the performance of the Italian auction. The British auction represents the kind of auction that the Italian designers tried to mimic, while the Danish auction represents the alternative model that they could have used.

[19]The incumbent *Sonofon* has been squeezed off by the new entrant firm *HI3G Denmark*.

Firstly, even if Italy opted for the same auction format as the UK, the whole procedure was different. The "screening" phase hindered the efficiency of the open ascending auction. Secondly, it is the different "environment", in which the auction was held, that has to be blamed for differences in outcome. When few companies are competing, the open auction is subject to collusion problems. Only few companies participated in the Italian auction and since one soon withdrew the revenue raised was lower than the English one. It is still not clear if the withdrawal of BLU was a coordinated strategy, or was just a matter of chance. Anyway, running an open auction with just six bidders competing for five licences is a risk.

The Danish auction shows that in case of lack of competition the sealed-bid type allows to reduce collusion problems and to raise higher revenue. It is very likely that the sealed-bid auction would have worked well also in Italy, since the "environmental" situation was more similar to the Danish one than to the English one.

Of course, ex-post it is easy to highlight the problems that actually occurred. And it is not possible to just switch to a different auction mechanism when the procedure has already started. However, erasing the screening phase could have increases the chances of competition. Also a different pace rule could have helped to raise the revenue.

4.4 Can the European auctions be independently analyzed?

Another factor to take into consideration when we analyze the Italian auction is the interdependent nature of the European auctions. It seems sensible to assume that licences in different countries are complements, i.e. the value function for getting the licences is *superadditive*. As table 5 shows, almost the same companies participated in all European auctions. Therefore, there is a link among the auctions, and it is not possible to analyze the auction of the Radio Spectrum in one country without considering the other European countries. It may be the case that the outcome of the Italian auction is conditioned on the results of previous auction. In this context, the chronological order of the auctions is very important. As stated in klemperer (2002), the English auction could have been used by companies to send signals and to frighten potential entrants.

In the auction for UMTS licences there were at least two strong incentives that driven the results.

1. Incumbent firms have a higher value for the licence than the entrant.

Firms	Countries
Hutcheson	Great Britain, Italy, Austria, Germany, Netherlands, *Switzerland*, Denmark
Vodafone	Great Britain, Italy, Austria, Germany, Netherlands
BT	Great Britain, *Italy*,Germany, Netherlands
DT	Great Britain, Austria, Germany, Netherlands, *Switzerland*
FT	Great Britain, Italy, Germany, Netherlands, Switzerland, Denmark
Sonera	*Great Britain*, Italy, Germany
Telefonica	*Great Britain*, Italy, Austria, Germany, Switzerland

Table 5: Participation of bidders in the European auctions (*in Italic countries where the firm did not get any license*)

2. Obtaining a licence increases the value of obtaining a licence in the following auctions.

Bearing in mind these two hypothesis we can consider firms that have got a license in the British auction as incumbent firms in the European market, and therefore licences in Europe have been awarded only to incumbent firms. Indeed, in the Italian auction, both entrants are financed by groups that have obtained other licences in Europe. Andala 3G is controlled by *Hutcheson Wampoa Group* which had already won a license in the English auction, while Ipse2000 is financed by the Spanish company *Telefonica* which had already got a licence in Germany.

Moreover, Italian incumbents, in the sense of being already present in the mobile phone industry, are looking for international agreements to exploit the economies of scale in the service, e.g. Wind reached a deal with other European companies.

One conclusion that can be drawn from these facts is that firms that are neither incumbent in the industry nor have already acquired a licence are not going to participate in the auction.

Following this line of reasoning, firms could have strategically overbid in the first (chronologically) auction. The high revenue from the British auction it is not just a result of a biased forecast on the value of the licences, it is also a strategy that increases the power of the company in the next auction.

5 Conclusion

The whole analysis has focused on the auction mechanism as a device to reach the following goals: obtaining an *efficient* allocation of the resources; devising a particular structure of the future market; and raising revenues.

The most evident reason for different outcomes amongst European auctions is the lack of competition, i.e. few participants in the auction. In the Italian case three main facts can be blamed for the "failure" - in terms of efficiency and revenue.

Firstly the abrupt withdrawal of one consortium soon after the beginning of the auction. After BLU withdrew, only four bidders remained to compete for four licences. The Italian government sued BLU for unfair behavior, the tribunal in Rome has not yet issued a verdict. This is probably more a matter of chance than a collusive behavior, and anyway it is not the only reason for the "failure" of the Italian auction. Even if Blu had not withdrew the number of participants was much lower than the participants in the English auction, and therefore the positive effect of competition is hindered by the higher possibility of collusion.

Secondly, looking at the design of the Italian procedure there are some weak points. The design of screening phase, as a first step of the auction procedure, prevented the full exploitation of the efficiency features of the open auction, i.e. assigning the licence to the best firm. The government actually screened among firms. In this context, the open auction does not seem a sensible choice. Moreover, by designing a screening phase, it seems that the only objective of the government was rising money. Therefore, given this goal and the economic context, instead of mimicking the English auction a sealed-bid format would have been more appropriate. It is not possible to change the format of the auction once the procedure has started, therefore the Italian government could not modify the rules of the auction once so few participants showed up. However, the risk of having few participants in the auction could have been reduced using a different procedure. The "Anglo-Dutch" auction can overcome entry problems, by pushing more firms to take part at the auction, and maintain all the efficiency features of the ascending auction. In the case of very few bidders it collapses in a simple sealed-bid format. In particular, since in Italy just six bidders participated in the auction, the Anglo-Dutch format would have collapsed in a simple sealed-bid auction. Therefore the outcome could have been similar to the Danish auction.

A third reason is that it is not possible to consider the Italian auction independently from the other European auctions. In particular, the importance of the chronological aspect is essential to understand the actual performance. Apart from the German one, auctions run after the British had not been successful. That is because strategies to prevent entry are possible and the "complementarity" nature of licences can discourage companies to participate in subsequent auctions. Bidders can be discouraged to participate in a subsequent auction when there are asymmetries amongst them. The

key point is the auction format. If we consider as second auction a sealed-bid one, the "losing" bidder has still an incentive to participate. Indeed, in the sealed-bid auction there is no interaction among bidders, and the bidder asymmetries plays a smaller role (Klemperer 1998).

In conclusion, the auction mechanism may still represent a valid device for an efficient allocation of resources, but it has to be designed keeping in mind the objectives to be pursued and the environmental conditions[20] in which it is supposed to operate.

[20]It is not possible to think about a single country as if it was the only existing economy.

A Appendix: Bid sequence in the Italian Auction

Data of the Italian government, from the web site: *www.governo.it/dossier/umts/scheda.html*

First day 19th October 2000

Round 1			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
ANDALA	4,200	2,169,118,976	3
WIND	4,200	2,169,118,976	3
IPSE	4,000	2,065,827,596	3
OMNITEL	4,000	2,065,827,596	3
TIM	4,000	2,065,827,596	3
BLU	4,000	2,065,827,596	3

Round 2			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
OMNITEL	4,230	2,184,612,683	3
WIND	4,220	2,179,448,114	3
BLU	4,210	2,174,283,545	3
ANDALA	4,200	2,169,118,976	3
IPSE	4,000	2,065,827,596	3
TIM	4,000	2,065,827,596	3

Round 3			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
OMNITEL	4,250	2,197,941,821	3
WIND	4,220	2,179,448,114	3
TIM	4,220	2,179,448,114	3
IPSE	4,220	2,179,448,114	3
BLU	4,210	2,174,283,545	3
ANDALA	4,200	2,169,118,976	3

Round 4			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
ANDALA	4,430	2,287,904,063	3
OMNITEL	4,250	2,194,941,821	3
WIND	4,220	2,179,448,114	3
TIM	4,220	2,179,448,114	3
IPSE	4,220	2,179,448,114	3
BLU	4,210	2,174,283,545	3

Second day 20th October 2000

Round 5			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
BLU	4,440	2,293,068,632	3
ANDALA	4,430	2,287,904,063	3
OMNITEL	4,250	2,194,941,821	3
WIND	4,220	2,179,448,114	3
TIM	4,220	2,179,448,114	3
IPSE	4,220	2,179,448,114	3

Round 6			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
IPSE	4,450	2,298,233,201	3
BLU	4,440	2,293,068,632	3
ANDALA	4,430	2,287,904,063	3
OMNITEL	4,250	2,194,941,821	3
WIND	4,220	2,179,448,114	3
TIM	4,220	2,179,448,114	3

Round 7			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
BLU	4,490	2,318,891,477	3
OMNITEL	4,480	2,313,726,908	3
WIND	4,470	2,308,562,339	3
ANDALA	4,460	2,303,397,770	3
IPSE	4,450	2,298,233,201	3
TIM	4,440	2,293,068,632	3

Round 8			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
TIM	4,680	2,417,018,288	3
IPSE	4,680	2,417,018,288	3
BLU	4,490	2,318,891,477	3
OMNITEL	4,480	2,313,726,908	3
WIND	4,470	2,308,562,339	3
ANDALA	4,460	2,303,397,770	3

Round 9			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
WIND	4,700	2,427,347,426	3
ANDALA	4,700	2,427,347,426	3
TIM	4,680	2,417,018,288	3
IPSE	4,680	2,417,018,288	3
BLU	4,490	2,318,891,477	3
OMNITEL	4,480	2,313,726,908	3

Round 10			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
OMNITEL	4,740	2,448,005,702	3
IPSE	4,730	2,442,841,133	3
WIND	4,700	2,427,347,426	3
ANDALA	4,700	2,427,347,426	3
TIM	4,680	2,417,018,288	3
BLU	4,490	2,318,891,477	3

Third day 23rd October 2000

Round 11			
Participants	Bid (Billion ITL)	Bid (€)	Available breaks
OMNITEL	4,740	2,448,005,702	3
IPSE	4,730	2,442,841,133	3
WIND	4,700	2,427,347,426	3
ANDALA	4,700	2,427,347,426	3
TIM	4,680	2,417,018,288	3
BLU	4,490	2,318,891,477	3

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