Auctioning Spectrum Rights

Juan-José Ganuza (UPF)

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Auctioning Spectrum Rights.

- Two Papers is the special issue:
  - "Auctions: How to allocate spectrum rights efficiently" Gabriela Antonie CEMFI and David Colino (CEMFI).
  - "Modificaciones en la gestión del espectro: Opciones y situación actual" .Claudio Feijoo (UPM) and Jose Luis Gomez Barroso (UNED)

Radio Spectrum

- Radio spectrum is a strategic and economically important resource (300.000 mill EU, 22.000 mill Spn).
  - It is used for television, radio, emergency services, military activities as well as for mobile phone and Wi-Fi.
- Radio spectrum is a scarce resource and has to be regulated (allocate property rights) for avoiding negative externalities.
  - Using the spectrum requires particular propagation, in-building penetration and antenna-size characteristics that restrict the usable frequency band. Moreover, we need to avoid interferences between emissions.
- Bandwidths have different characteristics and economic values.
  - Lower frequencies (such as 800 or 900MHz) will have better indoor coverage and reach further away than high frequencies (such as 1800 or 2100MHz), and thus have a higher value.

How to Efficiently Allocate the Spectrum Rights

- There is a demand for new spectrum: data in mobile phones X40 (2009-14), iphones and similar terminalsX4 (2009-2014).
- Spain is going to put on the market 310MHz of spectrum (250 MHz new and 60 MHz 'refarmed', 70% more!! due to
  - The 'digital dividend' in the 800MHz bandwidth. The switch-over from analogue to digital television (eight standard digital TV channels in the same spectrum width as previously used by one analogue channel.).
  - The 2009/114/EC directive allows the opening of 900MHz band to any technology. This 'refarming' permits network operators to introduce broadband Internet connections in a band previously strictly reserved for GSM use.
- The economic questions is how to allocate the new 800MHz (and redistribute the 900MHz) spectrum rights efficiently, so as to maximize social welfare and foster innovation.
  - We will finish by discussing the spectrum auction announced by the Ministerio de Industria.

Allocation Goals.

- Static Efficiency: Try to have as much value-added produced in its country as possible through the bandwidth release.
  - This objective is reached by awarding them to the firms who will use them in the best and most efficient ways.
  - These firms are also the ones willing to bid the highest for these rights in an auction, since they would earn the most from them. Therefore, any mechanism that awards the rights to the firms willing to pay the most is an efficient one.
- Dynamic efficiency. Guaranteeing low final prices through solid competition afterwards.
  - The decision over the number of licences is crucial.
- Revenue-raising be an objective in itself?
  - Auctions can be interpreted as a lump-sum taxation that does not produce distortions.
  - Once a telecommunication firm pays for the license, this decision does not reduce the investment nor does it affect future prices.
- We have to consider other goals, investment, employment??

Allocation Mechanisms

- The allocation methods most generally used are:
  - Auctions.
  - Beauty contests.
  - Lotteries.
- Just to give an example, in the 3G spectrum allocation of 2000-2002, half of the countries used auctions while the other have allocated the licenses through beauty contests.
  - The experience of 3G can show us the relative performance of the allocation mechanisms

Lottery allocations

- Lotteries are simply an arbitrary allocation of resources. They have the advantages of simplicity, speed and transparency, but their strong disadvantages....
- They were used in the US when the number of licenses to be granted increased considerably and, due to the time constraints beauty-contests and auctions were not an option any longer.
- In the US 3G spectrum case, lottery winners were often speculators with no experience and no intention of operating such a license.
    - This implied a strong fragmentation of the spectrum that delayed the upturn of investments and new technologies with, as a result, degradation in consumer services.

Beauty contests

- A significant number of European countries held beauty contests in order to allocate 3G spectrum rights between 2000 and 2001, including Finland, France, Ireland, Norway, Portugal, Spain and Sweden.
- In beauty-contests, non price competition, the policy-maker directly determines the most qualified firms for maximizing social welfare and licenses are granted based on a comparative study.
  - The government announces the criteria (scoring rule) that it is going to value in the project, and then firms decide to participate or not.
  - The right to operate is given to the companies that seem the most likely to take advantage of it. However...
  - as the British communications regulator (Ofcom) states, it is difficult to keep the selection procedure objective, non-discriminatory and transparent
  - As it is very subjective and the administration does not have enough information, there is no guarantee that it will place spectrum in the hands of those best able to use it to maximum economic advantage.

Auctions

- In Europe about half of the countries opted for an auction-based method for the allocation of 3G spectrum rights.
- The advantages of using auctions as a market mechanism in the allocation of resources are mainly efficiency and revenue raising by the regulator.
  - UK chose a auction for 3G and got €37.000 million (€650 per capita), Spain chose a beauty contest and raised only €456 million (€11 per capita).
- Nevertheless, not all auctions were as successful as the British one, Switzerland used an auction and it obtained a similar outcome than Spain.
- So, what is the best auction? What aspects should be taken into account when designing such a process? We need to review the basic auction theory

Simple Auctions Formats

- **English (oral):** price increases until only one bidder is left; the remaining bidder gets the good and pays the highest bid.
- **Dutch (oral)**: prices decreases until a bidder accepts the price; this bidder gets the good and pays the price at acceptance.
- **Second Price (sealed bid)**: each bidder submits a bid in a sealed envelope; the highest bidder gets the good and pays the second highest bid.
- **First Price (sealed bid)**: each bidder submits a bid in a sealed envelope; the highest bidder gets the good and pays the amount of his bid.

Revenue Equivalence

- Main assumptions:
  - Independent private valuations.
  - Risk Neutrality.
  - Symmetry
- Seller's revenue:
  - English = 2nd = 1st = Dutch.
  - Optimal auction, any of them with a reserve price.
- This result is known as the equivalence theorem (Vickrey (1961), Myerson (1981)).
- But, if the conditions of the theorem are not met, the design of the auction matters

What aspects should be taken into account when designing an auction.

- Asymmetric Bidders
  - Competition is greater with the first price auction, as strong bidders attempt to limit risk by bidding higher, and weaker bidders have more chance of winning.
- Uncertainty about the value of the licence
  - Better English than first price auction, this result mainly relates to winner's curse
- Entry
  - Setting a first-price rather than a second-price/English auction will potentially attract more bidders
  - Number of licences is crucial.
- Collusion.
  - Control bidder communication during the auction, better sealed bid formats, but second price auction is a bad format.

3G Spectrum Auctions: some successful cases

- The UK. English auction with four incumbents and five licenses. Nine new entrants bid seriously against the incumbents. The government managed to raise 650€ per capita during the auction.
- Germany's auction. English auction with twelve spectrum blocks to be divided either in four or six licenses. Seven bidders, but and one of them (Debitel) exit soon. The auction success only for the behavior of Deutsche Telekom.
- The Danish auction. Four licenses with four incumbent operators, but they run a sealed-bid auction to foster entry and thus competition. Danish auction managed to raise around 95€ of revenue per capita through its sealed-bid auction, almost doubling most estimates.

3G Spectrum Auctions: some failures cases

- The Netherlands' auction followed the British one in July 2000. English auction with five licenses to award, and also five incumbents in the market. Outcome, very little competition, 3000mill
- Switzerland mimics the British design to award four licenses. Swiss authorities also allowed joint bidding for licenses. This shrank the number of participants from nine to four joint ventures in the week prior to the auction. Therefore, the bidders only had to pay the reserve price, which was misguidedly set too low, and the auction only raised 20€ per capita.
- The Austrian auction design copied the German one, with an ascending auction in which twelve spectrum blocks could be divided in either four or six licenses. The ascending design disincentived entry as only six bidders competed for the licenses. As could be expected, these bidders decided to settle for the six-license setup and stopped bidding just above the reserve price, which had been set very low, only 100€ per capita..

4G Spectrum Auctions

- Before analyzing the Spanish case, we can review the German 4G auction which took place in April-May 2010.
- Germany conducted a unique ascending (English) multi-unit auction to allocate spectrum rights in the 800, 1800, 2000 and 2600 MHz frequency band, raising over €4.3 billion.
  - Six licenses of 2x5MHz Frequency-Division Duplexing (5MHz FDD from now on) where auctioned in the 800 MHz band, the most valuable one, and Telefónica, Vodafone and Deutsche Telekom each got two of them, at an average price of €600m each.
  - The fourth incumbent, KPN, dropped out of the auction and will have to work as a virtual network operator in that bandwidth.
  - There seemed to be enough competition for the licenses (four incumbents for three packs of two licenses each) and a simple ascending auction mechanism was thought to be enough, probably since no further entry of potential competitors was needed or pursued.

4G Spectrum Auctions: Spanish Case.

- The allocation process proposed by the Ministry of Industry mimics quite closely the German one, with also six 5MHz FDD licenses available in the 800 MHZ band, as well as multiple licenses in the 1800 and 2600 MHz frequency bands.
- We focus on licences in 800 and 900MHz, as for the licenses in the other frequency bands, the German example again shows that they are not that valuable.
- Mimicing is natural, but Spain is different...contrary to Germany
  - There are nowadays only three incumbents in the 900MHz band, while another firm (Yoigo) only has rights in the 2100MHz band.
  - Spectrum rights in the 900MHz bandwidth in Spain will also be reshuffled, refarmed and reallocated. In return for the refarming, the regulator has called back 4.2MHz of FDD bandwidth, which added to a free spectrum of 0.8MHz will allow it to issue a new license of 5MHz FDD, for which Vodafone and Telefónica will not be able to bid.
  - On top of that, some existing spectrum rights of Movistar will expire in 2015, freeing two more licenses (5 and 4.8MHz FDD).

4G Spectrum Auctions: Spanish Case.

- In summary, the Spanish regulator is planning to issue six licenses in the new 800MHz band and three in the refarmed 900MHz band (one of the licenses being slightly smaller than the others).
  - Vodafone and Movistar will be barred from bidding for one of the 900MHz licenses
  - 800MHz and the 900MHz band will have very similar valuations.
- All these licenses will expire in 2030, although two of them in the refarmed band will only be available from 2015 onwards.
- Moreover, Vodafone will keep two licenses in the 900MHz band, while Movistar (Telefónica) and Orange (France Télécom) will keep one license each.

4G Spectrum Auctions: Spanish Case.

The auction design for 800 and 900MHz:

- English Auction.
- Several rounds with time constraints(internet)
- binding increments in bidding (to limit communication possibilities between bidders).
- Reserve prices set at 170 and 169 mill of euros.
- Commitment to invest in the deployment of the new mobile high speed networks in small towns (less than 5000 hab). Guaranty 30Mb in 2020.
- Firms will not be allowed to own or operate on more than 20MHz FDD (i.e. four licenses) in the 800 and 900MHz.
- Any firm owning 10MHz or more in the 900MHz band will have to allow for virtual networks using its grid.
    - 4.8MHz licence more valuable than the 5MHz one?.

4G Spectrum Auctions: Spanish Case.

- Put together there are nine licenses to seize in the 800 and 900MHz band, with four more in the hands of the three incumbents (91% market share) until 2020, thirteen in total, while no firm can own more than 4 licenses, i.e. twelve in total.
- Therefore, the success of the auction rests fully on the entrants, but:
  - Yoigo is quite small (4% market share) and it can get easily one licence in 900 and other cheap spectrum in 1800.
  - Simyo, which is owned by KPN (one of the participants in the German 4G auction), but it is very small in Spain.
  - Cable companies most likely are interesting in buying 2600 MHz
  - For completely outsider entrants the design is not very attractive.
- Likely outcome: the three incumbents will get 4 licenses for something closer to the minimum price.
  - We consolidate a market of three incumbents with equal capacity.

4G Spectrum Auctions: Spanish Case.

- Problem: Therefore, there will probably not be enough competition for the amount of licenses to be allocated. Then:
  - Maybe other designs than the ascending English auction could be set up, as for example a first-price sealed-bid auction, which is better suited to foster entry.
  - Also, a reduction in the bandwidth auctioned, i.e. in the number of licenses, could be envisaged, maybe leaving some free bandwidth for unlicensed use by the public (as the FCC is to do in the USA with part of its spectrum below 700MHz).
    - Why for example do not wait to allocate the 900MHz licences that spires in 2015?. This has sense, since seems to be enough size for an independent operator. There will not be new spectrum until 2030...
  - The reserve price is likely to play an important role, is right, (too low, too high ??)
  - Why not, wait and see the UK auction?
  - I would not include the commitment to invest.