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Bargaining in spectrum auctions: A review of the German auction in 2015

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ABSTRACT

Germany was the first country in Europe that auctioned off spectrum in the valuable 700 MHz band for mobile telecommunication usage. The German regulator decided to sell this spectrum together with spectrum in the 900 MHz and 1800 MHz legacy bands. With only the three incumbent operators bidding in the auction and a relatively transparent auction design, it was possible to get a very clear impression of the actual bidding behaviour. We show that in the beginning of the auction, bidders were actively searching for a way to allocate the available spectrum that all bidders could agree to at low prices. Bidders were teaching each other what they should bid and were providing carrots and sticks. When the excess demand was concentrated in one band only, bidders started to compete head on leading to a war of attrition. This competition only stopped when bidders started to raise prices in bands that were already cleared. We interpret this bidding behaviour in terms of bidders expressing allocative externalities and conclude that the ability to do so may be regarded as a positive aspect of the transparent design.

1. Introduction

Economists have long argued that auctions will promote efficiency when governments award spectrum licenses to private companies (Coase, 1959).[4] Theoretical research on the properties of auctions played a key role and provided central arguments for the use of auctions for spectrum sales.[5] To understand whether or not auctions in general, and specific auction designs in particular, have lived up to this expectation of promoting efficient allocations, we should not only understand the theoretical properties of these auction designs, but especially see how bidders behave in particular auctions in the field. If bidders actually behave quite differently from what the theoretical model assumes, the value of theoretical predictions concerning auction properties is limited.

In this paper, we analyze bidder behaviour in the recent 2015 German auction in detail. One advantage of studying bidding behaviour in the German auction is that the regulator made the highest standing bids after each round publicly available. Bidders

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[4] The first implementation had to wait until 1994 when the US Federal Communications Commission (FCC) used the simultaneous multi-round auction (SMRA) for the sale of radio spectrum for *personal communication services* (PCS). See Porter and Smith (2006) for a historical overview that finally led to this auction.

[5] For example, Milgrom (2000) writes that "the auction design made detailed use of the ideas of economic theory and the recommendations of economic theorists."

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even learned about all bids submitted after each round. This allows us to use publicly available data to analyze actual bidding behaviour in detail. We show that simple straightforward bidding does not explain bidder behaviour. Our analysis identifies different kinds of deviations from straightforward bidding and we rationalize these deviations with economic arguments and a simple model.

The German auction used the SMRA format.[6] If the blocks are substitutes for each other and bidders bid straightforwardly in each round, then the SMRA terminates in a Walrasian equilibrium (Milgrom, 2000). Gul and Stacchetti (1999) showed that even if the substitutes condition is satisfied, then ascending and linear-price auctions such as the SMRA cannot implement the VCG outcome. In contrast, demand reduction has widely been observed in the field and analyzed game-theoretically (Ausubel, Cramton, Pycia, Rostek, & Weretka, 2014). The SMRA is a family of auction rules, where the common feature is a multi-object version of the English auction: bidders express bids in increasing fashion, the auctions stops when no bidder expresses new bids and winning bidders pay their last own bid(s). SMRAs differ along many dimensions, but an important differentiation is the level of transparency after each auction round. In many countries, bidders in an SMRA only learn the minimum bid price for a license in a new round, but they do not learn what other bidders are winning or even what they have bid on in the last rounds. The SMRA implementation used in Germany is different in this respect. Bidders learn the entire bid history of other bidders from the start.

Our description of bidding behaviour in the 2015 auction and the simple game theoretic explanations of different behaviours suggest that *bargaining about the full allocation* serves as an adequate description of bidding behaviour. In an initial *cooperation phase*, bidders try to implicitly coordinate on an allocation at low cost. If bidders cannot agree on a focal point they bargain about different allocations with costly signals in a *competition phase*. The bidding behaviour indicates that bidders care about the full allocation and not only about the share of the spectrum supply they themselves acquire. They do so by indicating to others ("teaching others") that they should reduce their spectrum demand. Whether the spectrum is equally distributed among the operators in a market or whether there is a dominant player who owns a large share has a substantial impact on the competition in the downstream market. So, it is not surprising that the relative size of a bidder's package compared to that of the other bidders matters.

Our paper not only provides new insights into how bidders bid in real-world auctions. It also adds a new perspective on questions regarding auction design. As we have indicated above, and we will show in more detail in the main body of the paper, the transparent auction design of the German auction(s) allows bidders to express their preferences over the full allocation. Some authors have argued that there is too much transparency in these auctions, as it enables bidders to implicitly coordinate their behaviour on a low-revenue outcome (cf., Grimm, Riedel, & Wolfstetter, 2003 and Cramton & Ockenfels, 2016). Although, we agree with this argument (and we show there are clearly some elements of this present in the 2015 German auction), we also think that a transparent design has certain advantages in the presence of significant allocative externalities. If bidders do not learn during the auction how the spectrum is divided among all players, they face a substantial strategic problem. In an intransparent auction a bidder might expect the final allocation to be fairly balanced. If, however, one strong player emerges instead, who wins most of the complementary licenses, then the net present value for his package would be much lower, because end consumers will often decide to switch to the operator with the best network, i.e., the one with most spectrum. Transparency may help bidders to express these allocative externalities as they can veto undesirable allocations with their bids. One insight we provide is that there is a trade-off when deciding on the level of transparency in an auction. On one hand, allowing for some transparency enables bidders to express their allocative externalities in a simple way. On the other hand, allowing for too much transparency may facilitate implicit coordination among bidders. However, such implicit coordination would hardly lead to an asymmetric allocation of spectrum with a dominant player. Since regulators aim for a sustainable competition in the end consumer market, transparency might actually be positive in markets where allocative externalities matter.

Allocative externalities are particularly important in national markets with only a few competitors (which is what we have in most countries worldwide), and considering these externalities sheds a different light on the question how efficient auction markets should be designed. Thus, this paper suggests taking allocative externalities more serious in the spectrum auction design literature.[7]

At this point it is important to understand the primary design goals of a regulator. European Directives are clear that regulators should mainly aim at creating a competitive and innovative market after the auction. For example, Article 8 of Directive 2002/21/EC states in paragraph (2): "The national regulatory authorities shall promote competition [...] by [...] (a) ensuring that users, including disabled users, derive maximum benefit in terms of choice, price, and quality; (b) ensuring that there is no distortion or restriction of competition in the electronic communications sector; (c) encouraging efficient investment in infrastructure, and promoting innovation; (d) encouraging efficient use and ensuring the effective management of radio frequencies and numbering resources."[8] These ideas are also reflected in and enforced by the German telecommunication law where it is stated in Section 2, paragraph 2: "The aims of regulation shall be: 1. to safeguard user, most notably consumer [...]; 2. to secure fair competition and to promote telecommunications markets with sustainable competition [...]; 3. to encourage efficient investment in infrastructure and to promote innovation;" Thus, revenue cannot be the main objective of an auction and implicit coordination on a low price outcome therefore does not necessarily point at a major failure of the auction.[9] In a transparent auction design, bidders can submit bids to avoid a

[6] Theoretically, equilibrium bidding strategies are not easy to derive for an SMRA. A full Bayesian analysis for general valuations is quite challenging (Goeree & Lien, 2014) and theoretical models need to make restrictive assumptions, which do not always carry over to the field.

[7] There is some literature on the fact that bidders' bidding behaviour is affected if allocative externalities play a role (see e.g., Jehiel and Moldovanu (2000), Goeree (2003), Jehiel, Moldovanu, and Stacchetti (1996), Janssen and Karamychev (2009), Janssen and Karamychev (2010), Klemperer (2002). However, when it comes to auction design, the traditional assumption that bidders only value their own share and not the full allocation is predominant.

[8] See also Article 13 of Directive 2002/20/EC (the Authorisation Directive or Auth D).

[9] Note that the goals described in the telecommunication law are different from allocative efficiency of an auction, which might well be a monopoly or dominant position of one of the players (Bichler, Goeree, Mayer, & Shabalin, 2014)

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