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Optimal auction design under non-commitment ☆

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Abstract

We characterize revenue-maximizing mechanisms in Myerson's (1981) environment when the seller behaves sequentially rationally, in the sense that she cannot commit not to propose a new mechanism if the previously chosen one fails to allocate the object. We show that the seller-optimal mechanism takes the same form as in the case when there is commitment: The seller maximizes revenue by assigning, at $t = 1$, the good to the buyer with the highest virtual valuation if it is above a buyer-specific reserve price. If no trade takes place at $t = 1$, at $t = 2$, the seller assigns the object to the buyer with the highest posterior virtual valuation, provided that it is above the seller's value.

JEL classification: C72; D44; D82

Keywords: Mechanism design; Optimal auctions; Limited commitment

The classic works on auctions (Myerson, 1981; Riley and Samuelson, 1981) characterize the revenue-maximizing allocation mechanism for a risk-neutral seller who owns one object and faces a fixed number of buyers whose valuations are private information. An important assumption in these papers is that the seller commits to withdraw the item from the market if it is

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not sold. This commitment assumption is far-fetched and often not met in reality. Christie's in Chicago auctions bottles of wine that failed to sell in earlier auctions. The U.S. government re-auctions properties that fail to sell: Lumber tracts, oil tracts, and real estate are put up for a new auction if no bidder bids above the reserve price.[1] As Porter (1995) reports, 46.8 percent of the oil and gas tracts with rejected high bids were put up for a new auction. In March 2010, the FCC announced that in 2011, it would re-auction part of the 700 MHz wireless spectrum that failed to sell in 2009. The key issue is not only that commitment is often unrealistic, but, more importantly, that an auction that is desirable with commitment may lead to poor outcomes if there is limited commitment.

The durable-good monopolist literature was the first to study the effects of a seller's inability to commit to a given institution if it fails to realize all gains of trade (Bulow, 1982; Gul et al., 1986; Stokey, 1981). McAfee and Vincent (1997) study an auction setup in which the seller behaves sequentially rationally. The papers cited above restrict the procedures that the seller can employ (the seller chooses prices in the durable-goods papers and reservation prices in McAfee and Vincent, 1997 and in Liu et al., 2015)[2] and show that the seller's inability to commit reduces monopoly profits. Here, we maintain the assumption that the seller behaves sequentially rationally, but we allow the seller to choose any selling procedure (mechanism). Our goal is to determine which procedure maximizes revenue and to investigate the extent to which allowing for general mechanisms enables the seller to mitigate revenue loss due to the lack of commitment.

We consider the following scenario: There is a risk-neutral seller who owns a single object and faces I risk-neutral buyers. Valuations are private, independently distributed across buyers, and constant over time. The buyers and the seller interact for two periods and discount the future with the same discount factor. At the beginning of each period, the seller proposes a mechanism to sell the object. If the object is sold, the game ends; otherwise, the seller returns in the next period and offers a new mechanism. The game ends after two periods even if the object remains unsold.[3] We show that the optimal mechanism takes the same form as in the case when there is commitment: First- (or second-) price auctions with optimally chosen reserve prices are revenue-maximizing when buyers are ex-ante identical. When buyers' valuations are drawn from different distributions, the seller maximizes revenue by assigning the good to the buyer with the highest virtual valuation if it is above a buyer-specific reserve price. Reserve prices drop over time. How much the optimal reserve prices drop depends on the discount factor. Inability to commit is costly for the seller. The revenue loss is highest for intermediate values of the discount factor and when the number of buyers is small.

In the U.S., the FDIC runs a large number of auctions of distressed assets (real estate, in particular). Properties are auctioned off with reserve prices, and in a number of cases, the initial reserve price is too high and the property is sold later with a lower reserve.[4] In both the U.S. and Europe, fiscal crises have led to a surge in distressed assets for sale.[5] The amounts that financial institutions recover from these sales is very important for their future solvency and the health of

[1] These examples are also mentioned in McAfee and Vincent (1997).

[2] Other papers that study reserve price dynamics without commitment are Burguet and Skovics (1996), which examines cases of costly bidding, and Caillaud and Mezzetti (2004), which looks at sequential auctions of many identical units.

[3] The analysis of the case of $T = 2$ contains the most essential insights and can be carried out with less-burdensome notation. Section 6 presents an overview of the analysis of the case in which $2 < T < \infty$.

[4] See http://www.fdic.gov/buying/historical/index.html and McAfee et al. (2002), who thoroughly document this phenomenon.

[5] See Stovall and Tor (2011) or "Troubled European Assets Come to Market," in *The Wall Street Journal*, Feb. 5, 2013.