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Asymmetric Wheat Auctions with Resale and Partially Divisible Bidding Objects

Ruoran Chen^a, Simin Huang^{a,*}^a*Department of Industrial Engineering, Tsinghua University, Beijing, China, 100084***Abstract**

This study examines asymmetric wheat auctions, with an object that is indivisible at the bidding stage, but divisible at the resale stage. Two bidders compete on auction. One is a large-sized miller, who can process the object being auctioned, and the other is a small-sized miller, who can only process part of the object. We show that this auction has a monotone equilibrium, and that the seller's expected revenue in the second-price auction is strictly larger than that in the first-price auction. Moreover, we develop a threshold as a criterion for the small-sized miller's speculating behavior on auction.

Keywords:

Asymmetric auctions, resale, monotone equilibrium, partially divisible

1. Introduction

In this study, we examine asymmetric wheat auctions with resale, where the wheat is sold as a single indivisible object on auction, and then becomes divisible at the resale stage. We use the term “partially divisible” to describe this kind of object, because the object is divisible itself but constrained to be indivisible during the bidding. Such objects exist widely in commodity auctions in developing countries, such as India, China, Pakistan, and so on. For example, in China, the government keeps wheat reservation inventories, and sells part of the wheat reservation periodically by means of wheat auctions. The government decides and announces the quantity of wheat for sale at each auction. Wheat millers with different capacities and demands participate in the wheat auctions. After the auction, the winning bidder has an opportunity to resell a portion of the wheat to other bidders. In the bidding stage, the quantity of the wheat is predetermined, and the wheat is traded as an indivisible object. However, in the resale stage, the bidder can divide the wheat and sell only a part of it in order to maximize his overall payoff.

We consider an auction in which two bidders participate. One is a large-sized miller (L), who has sufficient capacity to process all the wheat on auction. The other is a small-sized miller (S), whose capacity is less than the quantity of wheat on auction. Intuitively, both bidders are motivated to participate in the post-auction trading. From the viewpoint of L, S may bid less owing to his limited capacity, even if S's unit valuation is high. Therefore, L has an opportunity to increase his payoff by selling part

of the wheat to S. Then, S can increase his payoff by selling the wheat that he does not have the capacity to process.

Auctions with resale have been explored widely in recent studies. Gupta and Lebrun [5] study the equilibrium of an asymmetric first-price auction, with resale and bidding disclosures. Haile [8] discusses the resale possibilities in a symmetric auction setting. Zhoucheng Zheng [15] studies the sell-optimal auction design when the resale stages are included. Garratt and Tröger [3] focus on speculating behavior in auctions with resale, and Garratt et al. [4] study the collusion caused by resale in a second-price auction. Pagnozzi [11] models the resale stage of an asymmetric auction as a bargaining problem.

Hafalir and Krishna [6] study asymmetric auctions with resale, and compare the first-price and second-price formats. They consider incomplete information in the resale stage, and discuss different resale mechanisms. Then, Hafalir and Krishna [7] study the seller's revenue and allocation efficiency of asymmetric auctions with resale. Cheng and Tan [1] demonstrate the equivalence between an asymmetric common value auction and a private value auction with resale. Lebrun [9] constructs a behavioral equilibrium for the case in which the bids are fully disclosed. Virág [13] extends the auction setting to a multi-bidder case, and Virág [14] studies the effects of the reserve price in auctions with resale. Tan and Xing [12] consider a different auction setting, with both private value bidders and common value bidders.

Compared to the existing literature, this study considers an object that is indivisible in the bidding stage, but divisible in the resale stage. Moreover, this type of auction is different to a multi-object auction. For example, Filiz-Ozbay et al. [2] study multi-object auctions with resale, under both the Vickrey format and the simultaneous second-price format.

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