

Risk aversion and optimal reserve prices in first- and second-price auctions[☆]

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Abstract

We analyze the effects of buyer and seller risk aversion in first- and second-price auctions in the classic setting of symmetric and independent private values. We show that the seller's optimal reserve price decreases in his own risk aversion, and more so in the first-price auction. The reserve price also decreases in the buyers' risk aversion in the first-price auction. Thus, greater risk aversion increases ex post efficiency in both auctions – especially that of the first-price auction. At the interim stage, the first-price auction is preferred by all buyer types in a lower interval, as well as by the seller.

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1. Introduction

Much of the literature that compares the effects of risk aversion across auctions assumes each auction has the same, exogenously determined reserve price. The predominant example is the comparison of a first-price auction (FPA) to a second-price auction (SPA) with the same reserve price, in a symmetric independent private values setting.³ The well-known result in this case is that risk averse bidders bid more in the FPA than they do in the SPA.⁴

However, the reserve price in most real auctions is set by the seller. To the extent that it influences bidding behavior and depends on the type of auction, the endogeneity of the reserve price should be taken into account. In particular, the comparative statics of the optimal reserve price are of direct interest because they bear on ex post efficiency. Lowering the reserve price decreases the probability of the inefficient event in which no sale occurs because the maximum value of the bidders exceeds the seller's value but not the reserve price.

This paper focuses on the effects of buyer and seller risk aversion on the seller's optimal reserve price in standard first- and second-price auctions. Sharp results are obtained by restricting attention to the otherwise simplest setting, that of symmetric and independent private values. Our main results are Theorems 1–3.

Theorem 1 establishes that if the seller and/or the buyers are risk averse, then the seller sets a lower reserve price in the FPA than in the SPA. This is in contrast to when all parties are risk neutral, in which case the revenue equivalence theorem implies that the seller's optimal reserve price is the same in both auctions. Risk aversion thus makes the FPA more ex post efficient than the SPA. The result hinges on how the FPA equilibrium bid function is affected by a marginal increase in the reserve price. Risk averse bidders increase their bids less than do risk neutral bidders, and a risk averse seller values the increase in the bids of the high bidders relatively less than does a risk neutral seller because of diminishing marginal utility. Both forces lower the seller's marginal incentive to raise the reserve price.

Theorem 2 establishes that in either auction, a more risk averse seller sets a lower reserve price. Thus, the more risk averse the seller, the more ex post efficient are both auctions. The intuition is straightforward: a more risk averse seller values more (on the margin) a decrease in the risk of not selling the object. The proof, however, is surprisingly intricate.⁵

Theorem 3 establishes that in two fairly general cases, the seller sets a lower reserve price in the FPA if the bidders are more risk averse. (Bidder risk aversion does not affect the SPA equilibrium.) In case (a) the reverse hazard rate function of the bidders' values is decreasing, and either the more risk averse or the less risk averse group of bidders (or both) exhibit nonincreasing absolute risk aversion. In case (b) the more risk averse bidders are strictly more risk averse, in the sense that the minimum of their Arrow–Pratt measure of risk aversion exceeds the maximum of that of the less risk averse buyers. In either case the rate at which the FPA bid function increases in the reserve price is smaller when the bidders are more risk averse. This gives the seller less incentive to raise the reserve price. This effect is stronger if the seller is also risk averse, as then the fact that more risk averse bidders bid higher than less risk averse bidders implies that

³ We use the term FPA for both the first-price sealed-bid auction and the strategically equivalent Dutch (descending) auction. We use the term SPA for both the second-price sealed-bid (Vickrey) auction and the “button” model of the English ascending-bid auction, as they have the same dominant strategy equilibria in our private values setting [15].

⁴ This and related results are established, e.g., in [1,2,4,6,7,10,12,13,15,19,20].

⁵ Theorem 3 in [22] is our Theorem 2 for the case of risk neutral bidders (and a more general information structure). Our proof takes a different approach.

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