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Selling a dollar for more than a dollar? Evidence from online penny auctions[☆]

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ABSTRACT

Online penny auctions, emerged recently, are seen as an adaptation of the famous dollar auction and as "the evil stepchild of game theory and behavioral economics." In this paper, we use the complete bid and bidder history at such a website to show that penny auctions cannot sell a dollar for more than a dollar in the long run because of bidder learning across auctions and bidder heterogeneity in strategic sophistication. The website we study profited from a revolving door of new bidders but lost money to experienced bidders as a group because of the existence of experienced and strategically sophisticated bidders who profit from the website.

1. Introduction

Shubik (1971) famous dollar auction suggests the possibility of selling a dollar for more than a dollar. Can a firm adapt the dollar auction into a selling mechanism that sustains selling a dollar for more than a dollar over time? A new auction format recently emerged on the Internet, called the penny auction, might be seen as such an attempt. Penny auctions were described by Richard Thaler in the *New York Times* as a "diabolically inventive" adaptation of the dollar auction.[1] An article in the *Washington Post* asserts that penny auction is "the evil stepchild of game theory and behavioral economics" because it "fiendishly plays on every irrational impulse buyers have."[2] The primary purpose of this paper is to use the complete bid and bidder history at a major penny auction website to show that penny auctions cannot sell a dollar for more than a dollar in the long run.

Unlike eBay, penny auction websites sell products themselves, using rules similar to the following. First, a bidder must pay a small nonrefundable fee (e.g., \$0.75) to place a bid. A bid is an offer to buy the product at the current auction price. The auction price for any product is initially 0 and is increased by a fixed amount whenever a bid is placed. The increment is typically one penny, thus the name of penny auction. Second, the winner is the *last* bidder, the person whose bid is not followed by any other bid before a timer (e.g., of 30 s) expires. The timer is reset whenever a new bid is placed. The auction winner receives the product and pays the auction price. Consider an example in our data set. A bidder won an iPad auction after placing 70 bids, and the auction price was \$64.97. The winner paid a total cost of \$117.47 ($= 70 \times 0.75 + 64.97$) for the iPad, and the website's revenue was \$4937.72 ($= 6497 \times 0.75 + 64.97$)! A penny auction thus combines elements of an all-pay auction with a series of lotteries. Penny auctions are not a standard auction, in which the bidder who bids the

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[1] Richard H. Thaler, "Paying a Price for the Thrill of the Hunt," *New York Times*, November 15, 2009.

[2] Mark Gimein, "The Big Money: The Pennies Add Up at Swoopo.com," *Washington Post*, July 12, 2009.

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highest amount wins (Krishna, 2002, p. 29). The winner of a penny auction is often not the bidder who places the largest number of bids.

Central to our paper is the idea that no matter how effective an individual penny auction might be in exploiting bidder biases, it offers bidders immediate feedback on winning or losing so that losing bidders can quickly learn to stop participating. Consistent with this simple logic of individual rationality, we find that the website made positive profits, but its profits came from a revolving door of new bidders: the overwhelming majority of new bidders who joined the website on a given day played in only a few auctions, placed a small number of bids, lost some money, and then permanently left the site within a week or so. The website lost money to experienced bidders as a group: a very small percentage of bidders were experienced, but they won most of the auctions and earned substantial profits from the website. These findings suggest that penny auction websites cannot sustain excessive profits without attracting a revolving door of new customers who will lose money.[3]

The secondary purpose of our paper is to document and explain the observation that while experienced bidders as a group earned significant profits from the website, most experienced bidders actually lost money to the website. Our hypothesis is that not all experienced bidders in penny auctions are fully rational; they differ in their degree of strategic sophistication. We propose a measure of strategic sophistication and find evidence that experienced bidders' earnings are correlated with their strategic sophistication.

Our evidence comes from a nearly ideal bid-level data set collected from a major penny auction website (BigDeal.com). The data set covers all of the more than 22 million bids placed by more than 200,000 bidders in more than 100,000 auctions for a period of about 20 months, starting from the website's first day of operation to two days before the site's closure. The data set records the complete bid history of each bidder as well as the precise timing of each bid. We use a product's retail price at Amazon as an estimate of the product's market value. We define the auctioneer's profit as its revenue minus the market value of the products sold. Similarly, we define a bidder's profit or loss as the market value of the products she won minus her cost of bidding. Given these definitions, our conclusion that penny auctions cannot sustain selling a dollar for more than a dollar does not mean that penny auctions cannot sustain normal profits.

Four papers on penny auctions (Augenblick, 2011; Hinnosaar, 2010; Platt et al., 2010; and Byers et al., 2010) appeared before our paper. All four papers use data from Swoopo, the first penny auction website, and find that Swoopo made excessive profits during the sample periods they study. These papers' explanations for the observed excessive profits are very different from ours. Platt et al. (2010), which has been published as Platt et al. (2013), emphasize bidders' risk-loving preference. Their evidence is based on auction-level data (e.g., the number of bids in an auction), and they do not study bid- or bidder-level data. Byers et al. (2010) propose bidder asymmetry as a potential explanation for excessive profits, but they do not offer empirical evidence. Augenblick (2011) emphasizes the sunk cost fallacy as the explanation for overbidding at Swoopo. He notes that most of the bidders in his sample play in a small number of auctions and place a small number of bids, but he does not study the timing of bidder entry and exit, which is critical for observing whether there is a revolving door of new bidders. It is also unclear whether inexperienced bidders in his sample lost money and whether experienced bidders made money. Hinnosaar (2010) deals largely with a technical issue in modeling penny auctions.

These alternative explanations (risk-loving preferences, bidder asymmetry, and the sunk cost fallacy) imply that penny auctions may sustain excessive profits even in the long run. Our findings, however, suggest that penny auctions may generate excessive profits in the short run but not in the long run. Indeed, Swoopo, BigDeal, and many other penny auction websites have come and gone. We do find that a small number of experienced bidders consistently lose money over time; such bidders may have risk-loving preferences (Platt et al., 2010) or they may derive utility from the mere act of bidding in penny auctions.

Two papers on penny auctions (Caldara, 2012; Goodman, 2012) appeared after our paper. Caldara (2012) conducts lab experiments to study penny auctions, and his lab findings support our conclusion that penny auction websites profit from a revolving door of new bidders. He concludes (p. 32) that "excessive revenues will only last as long as [penny] auction websites can attract new, inexperienced bidders." Goodman (2012) is similar to Augenblick (2011) but focuses on the role of reputation in penny auctions.

Our paper contributes to the behavioral industrial organization literature that focuses on how profit-maximizing firms exploit consumer biases. See sections of Ellison (2006) and DellaVigna (2009) for reviews of the literature and DellaVigna and Malmendier (2006) for an excellent example. Our findings suggest that market experience can limit overbidding, at least in auctions with clear feedback, and that firms' ability to exploit consumer biases is constrained by consumer learning.[4] Our findings also suggest that when firms exploit inexperienced bidders, they may be exposed to the risk of being exploited by experienced and sophisticated players.

Our paper also relates to the behavioral game theory literature (e.g., Camerer, 2003; Crawford et al., 2013), which uses principles of behavior economics to study strategic interactions and finds that subjects in experimental games often have limited and heterogeneous strategic sophistication. An emerging literature uses the behavioral game theory approach to study strategic interactions in field settings (Brown et al., 2012; Goldfarb and Xiao, 2011; Goldfarb and Yang, 2009). These studies often measure players' strategic sophistication as in level-k/cognitive hierarchy models (e.g., Camerer et al., 2004; Costa-Gomes and Crawford, 2006). Because penny auctions are a complicated dynamic game, we cannot measure players' strategic sophistication in the same way. Our measure is specific to penny auctions. Nonetheless, our paper provides evidence that player heterogeneity in strategic sophistication is important for understanding penny auctions, a large-scale game in the field. Other than Caldara (2012), previous studies on penny auctions did not cite the behavior game theory literature.

Our paper relates further to the large literature on online auctions. See Bajari and Hortaçsu (2004) for a review of the literature and Einav et al. (2015) for a recent example. In particular, our paper is related to empirical studies of overbidding in auctions (e.g., Malmendier and Lee, 2011). Finally, our paper is related to a few recent studies of nonstandard auction formats. Raviv and Virag (2009) and Houba et al. (2011) study the lowest unique bid auction, and Ostling et al. (2011) study the lowest unique positive integer game.

[3] This feature is shared somewhat by Ponzi schemes. We are not suggesting that penny auctions are Ponzi schemes or necessarily scams.

[4] See List (2003) for evidence that market experiences may eliminate some forms of market anomalies.