European Economic Review 64 (2013) 98–110

Contents lists available at ScienceDirect

European Economic Review

journal homepage: www.elsevier.com/locate/eer

Handicaps in incomplete information all-pay auctions with a diverse set of bidders

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ARTICLE INFO

Article history:
Received 25 September 2012
Accepted 27 August 2013
Available online 5 September 2013

JEL classification:
C72
D44
D82

Keywords:
All-pay auctions
Asymmetric auctions
Contests
Handicaps
Preferential treatment

ABSTRACT

In many contests, a subset of contestants is granted preferential treatment which is presumably intended to be advantageous. Examples include affirmative action and biased procurement policies. In this paper, however, I show that some of the supposed beneficiaries may in fact become worse off when the favored group is diverse. The reason is that the other favored contestants become more aggressive, which may outweigh the advantage that is gained over contestants who are handicapped. The contest is modeled as an incomplete-information all-pay auction in which contestants have heterogenous and possibly non-linear cost functions.

1. Introduction

There are many examples of contests in which a subset of contestants receive either "preferential treatment" or a "handicap". On the labor market, affirmative action may influence which job applicant wins the prize, in this case the job. The same is true in the contest to win admission into university. Internal applicants are sometimes given preference over external applicants when a firm seeks to fill a senior position. In public procurement, domestic firms may be given preferential treatment over foreign firms, and so on.

In all these examples it is a *diverse* group of contestants who are favored. Affirmative action applies to individuals with different backgrounds, internal applicants for senior positions are likely to be heterogeneous, and domestic firms may have different technologies. Another feature of the examples is that the prize is not awarded based on the identities of the contestants alone, but also on the qualifications of the contestants in question. The investment in these qualifications – obtaining an education before applying for a job, preparing for the SAT, working hard to prove one's worth to the company, or building up expertise prior to seeking a procurement contract – may entail very significant costs. Importantly, the size of this investment is endogenous; it is likely to depend on the perceived strength of the competition and on whether the contestant is given preferential treatment. Since a given contestant may not have complete information regarding the skills, costs, or preferences of his rivals, asymmetric information may also play a role in determining the magnitude of a contestant's investment.

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http://dx.doi.org/10.1016/j.euroecorev.2013.08.007

The objective of this paper is to contribute to the public debate on preferential treatment by examining its consequences in contests that are characterized precisely by both *within-group diversity* and *incomplete information*. I will show that the combination of these two features may, somewhat perversely, produce outcomes that are arguably opposite of what intuition would suggest. Specifically, the main result is that if the group of contestants who is given preferential treatment (modeled as a handicap to their common rival) is diverse, a subset of them may participate less often, win less often, and overall be worse off when preferential treatment is introduced. Thus, the current paper serves as a note of caution; rather than "leveling the playing field", preferential treatment may, in principle, increase the severity of the problems or inequalities it perhaps intends to minimize. Given that preferential treatment is often implicitly or explicitly justified by a desire to level the playing field, it seems worthwhile to point out that, at least theoretically, preferential treatment does not automatically have the desired effect.

The contest is modeled as a deterministic contest or all-pay auction. Thus, the paper is related to the literature on incomplete information auctions with heterogenous participants. However, for technical reasons, most theoretical papers on asymmetric auctions assume that there are exactly two heterogeneous bidders. For instance, Amann and Leininger (1996) study two-bidder all-pay auctions. Clearly, since the purpose of this paper is to consider a setting with two groups, at least one of which is diverse, a model with only two bidders is not adequate.

The effects of preferential treatment have of course also been studied empirically e.g. in the context of procurement auctions, resource auctions, and university admissions. However, empirical work on asymmetric auctions typically make assumptions that force many-bidder auctions to resemble two-bidder auctions. In an influential paper, Krasnokutskaya and Seim (2011) study highway procurement auctions in which small businesses are given preferential treatment. Thus, bidders are divided into two groups, depending on their size. Importantly, it is assumed that there is no observable diversity within groups. The same assumption is made in Athey et al. (2013) for timber auctions. One may wonder if it is innocent to abstract away from within-group diversity.

In a similar vein, motivated by affirmative action in university admissions, Hickman (2011) considers a theoretical model of all-pay auctions with incomplete information and bidders who belong to one of two different groups, but with no within-group diversity.[1] Hickman's (2013) empirical analysis of the issue, again using an all-pay auction, also assumes there are two different groups (minorities and non-minorities), with no observable within-group diversity. Consider now Fryer and Torelli's (2010) examination of the potentially complicated relationship between social status (popularity) and academic achievement among whites and non-whites. While there is a positive relationship between popularity and academic achievement among whites, the relationship is inversely U shaped among non-whites. More to the point, Fryer and Torelli (2010) demonstrate that within the "group" of non-whites, there is a marked difference between the black and Hispanic populations; academic performance is punished starting at a much lower level of achievement among Hispanics. This suggests that the non-monetary costs of academic achievement is not identical for all non-whites. One may now wonder about the potential effects of a hypothetical policy that gives preferential treatment to non-whites on the labour market or in university admissions, but ignores the diversity within that group. In this respect, the current paper is of policy relevance because the main result implies that some minority groups may benefit at the expense of not only the whites but also of other minority groups.

In this paper, I take a first step toward a more general analysis of comparative statics in all-pay auctions with more than two bidders (or more than two homogeneous groups of bidders).[2] The methodological insight of the paper is quite simply that results from two-bidder auctions may, at least sometimes, be utilized to inform the analysis of many-bidder auctions, even when equilibrium cannot be characterized in the latter setting. Specifically, the set-up of the problem is engineered to minimize the complications from having several bidders. Hence, the reaction to preferential treatment in an auction with two bidders is used to infer the main result. The economic insight is equally simple, but no less important, namely that the number and the *composition* of bidders matter for comparative statics. Quite apart from the specific results of the paper, the broader implication is thus to call for more research on many-bidder all-pay auctions.

For some intuition of the main result, consider a contest with a "strong", a "weak", and a "very weak" bidder, and assume that the strong bidder is handicapped. As a consequence, the two weaker bidders have less to fear from the strong bidder. However, that does not necessarily mean that they will work less hard. In fact, the "weak" bidder may push his newfound advantage by investing more aggressively. From the point of view of the "very weak" bidder, one rival has become less of a threat, but the other more of a threat. I show, under fairly mild assumptions, that the very weak bidder would be less likely to win the prize with a small bid when the strong bidder is handicapped. The second step is to show that there are cost structures for which a monotonic equilibrium exists in which the very weak bidder wins the prize with probability zero and earns zero payoff, but that such an equilibrium does not exist without the handicap.[3] The cost function of the very weak

[1] Hickman's (2011) model is made tractable by the assumption that there is a continuum of bidders and prizes. In contrast, there is a finite number of bidders and a single prize in the current paper.

[2] Recently, Parreiras and Rubinchik (2010) have examined all-pay auctions with more than two bidders. They point out that the addition of more bidders gives rise to several technical complications that are absent in two-bidder models. For instance, strategies may be discontinuous. However, they do not examine the consequences of changes to the contest design, i.e. they are not concerned with comparative statics.

[3] Conditions under which the former is the unique equilibrium are also presented. To the best of my knowledge, these results represent the first uniqueness results in many-bidder all-pay auctions with incomplete information.