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Information revelation in auctions with common and private values ☆

Xu Tan

Department of Economics, University of Washington, Seattle, WA 98195, USA

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ABSTRACT

We explore the incentives to reveal verifiable private information when there are both common and private components to agents' valuations and when private information is held in both dimensions. When agents observe only one signal, they have no incentive to reveal the signal because such a revelation would negate their information advantage. However, when agents observe multiple signals, they may be incentivized to reveal certain signals that could lower their opponents' bids and thereby result in a higher profit from other signals. This paper shows that there exists an equilibrium with revelation of common-value signals in standard auctions, which is an efficient equilibrium that maximizes the social welfare and could provide the seller with a higher profit than a situation with no information revelation.

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1. Introduction

In many auctions, bidders hold idiosyncratic information that consists of both common-value and private-value signals. On the one hand, private values play a role when agents are heterogeneous. For example, in oil tract auctions, firms care not only about the quantity of oil but also about their private costs involved in extracting the oil from the tract.[1] On the other hand, common values are important when an item can be resold. For instance, in the housing market, buyers have private preferences for a particular house, and they also care about the future price (common value) of the house.

This paper explores the incentives for revelation of verifiable information[2] in auctions featuring the presence of both common-value and private-value signals. Consider the example of an oil tract auction by the government in which an insider bidder knows the oil quantity in the tract whereas an outsider bidder does not. Each bidder also knows the extraction cost that is unique and private to him/herself. In such a multi-dimensional signal setting, is it in the insider's interest to credibly reveal information about the oil quantity? How do both the social welfare and the seller's profit change with this revelation?

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E-mail address: tanxu@uw.edu.

[1] A similar example is the sale of timber-harvesting contracts studied by Pesendorfer and Swinkels (2000).

[2] This paper focuses on revelation with verifiable evidence: Agents must provide evidence when revealing a signal such that they can truthfully reveal a signal or hide it, but they cannot lie about the signal.

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As opposed to the information revelation incentives – or the lack thereof – in auctions with single-dimensional signals (single-dimensional auctions for short), there are incentives to reveal common-value information in auctions with multi-dimensional signals. Because bidders earn positive rents from their private information, sharing the only signal in single-dimensional auctions leads to a loss of information advantage, an effect that is widely studied in single-dimensional auction settings (Milgrom and Weber, 1982b; Klemperer, 1999). As a result, bidders in single-dimensional auctions are not typically incentivized to reveal information. However, agents in auctions with two-dimensional signals may be able to profit from revealing one dimension of their signals. For instance, in the aforementioned oil tract example, suppose that the insider knows that the oil reserve is small and that he has an extremely low extraction cost. If the insider shares the quantity information, it could make the outsider submit a lower bid, thereby increasing the insider's likelihood of winning the auction or allowing him to pay a lower price for the tract. In turn, this will boost the insider's payoff based on his low private cost of extraction. We generalize this intuition as follows: When there are two-dimensional signals, bidders may be incentivized to reveal one of the signals to lower opponents' bids and earn a higher profit from the other signal.

When bidders can choose to reveal verifiable common-value signals, we find pre-communication to be indispensable in modeling multi-dimensional auctions. Recent studies have shown that multi-dimensional auction models have several prediction challenges, such as the non-existence of equilibria (Jackson, 2009) and the loss of full efficiency (Pesendorfer and Swinkels, 2000; Goeree and Offerman, 2003). Unlike the one-to-one monotone equilibrium bidding strategy[3] in single-dimensional auctions, the bidding strategy in two-dimensional auctions consists of a two-to-one mapping with a monotonicity that is not naturally defined.[4] Thus, the equilibrium is more difficult or even impossible to achieve. The lack of monotonicity also results in the loss of full efficiency because there is no guarantee that the winner has the highest value.

A different set of predictions can be obtained with the introduction of pre-communication in multi-dimensional auction settings under the condition of verifiable information revelation. First, an equilibrium exists where agents fully reveal their common-value signals, the auction is reduced to a pure private-value setting, and bidders resort to the monotone bidding strategy. Second, there is no efficiency loss in this equilibrium because the highest bid comes from the bidder with the highest value. Finally, the seller may also prefer information revelation because it increases the seller's profit by reducing agents' information rents.

In addition, this model predicts a shift in information-collecting behavior among agents. Agents are typically motivated to overtly collect signals to display their information advantage (Milgrom and Weber, 1982b), but they have no incentive to do so if the common-value signals will be fully revealed after a costly overt collection. However, these agents may wish to covertly acquire certain signals to gain an information advantage.

1.1. Related literature

This paper is related to the literature on the strategic communication of verifiable signals and to the literature on information revelation in auctions. We briefly review highlights of the relevant literature below.

The communication model of hard information and its unraveling argument are introduced by Milgrom (1981) and Grossman (1981).[5] Okuno-Fujiwara et al. (1990) provide sufficient conditions for the full revelation of multiple signals, which is recently greatly generalized by Hagenbach et al. (2014). The intuition for unraveling and full disclosure relies on the existence of a worst-case type such that if a hidden signal is believed to be this worst-case type, then agents are incentivized to reveal their signals. We share a similar intuition when constructing incentives for revelation in auctions. In particular, if the hidden common-value signal is believed to be of high value, bidders may have incentives to reveal low common-value signals.

However, information revelation in auctions is not as common as it is in other contexts. A large auction literature emphasizes the benefit of private information (e.g., Milgrom and Weber, 1982b; Klemperer, 1999); therefore, bidders do not profit from revealing signals in single-dimensional auctions even when such signals are verifiable (Kovenock et al., 2010). As a result, the focus is on the seller's information revelation (Milgrom and Weber, 1982b). As the most relevant study in the previous literature to our paper, Benoit and Dubra (2006) demonstrate that bidders are incentivized to reveal common-value signals when their private values are commonly known and asymmetric. In their example with two bidders, the bidder with higher private value can increase his/her profit by revealing the common-value signal, particularly when the signal indicates low common value. Our results extend Benoit and Dubra (2006) to auctions with two-dimensional signals. By revealing the common-value signal, agents could increase their information rent from the private-value signal.[6]

[3] Monotonicity generally means that bidding strategies are monotone in signals.

[4] For instance, the realization of a low private value and a high common value is not comparable to another realization of a high private value and a low common value.

[5] Subsequent investigations of this subject include Milgrom and Roberts (1986), Shin (1994) and Lipman and Seppi (1995), among others (see Milgrom, 2008 for a more recent discussion).

[6] A technical difference between the two papers is that in their general theorems 1 and 2, Benoit and Dubra (2006) directly impose restrictions on the equilibrium payoffs in the auction stage to simplify the analysis and obtain more general predictions. In our paper, we do not impose such restrictions but instead focus on three popular types of auctions: first-price, second-price, and all-pay auctions.

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