Design and Analysis of Trading Processes

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Project Overview

Markets facilitate economic transactions, so do contractual agreements, auction and bargaining procedures. This project is devoted to the analysis and design of these trading processes. Several suggested areas of focus are listed below. Students are welcome to do theoretical or empirical projects as well as develop own ideas in the broad fields of game theory and applied microeconomics.

Auctions

In brief, the suggested directions for research in auction theory fall into four broad categories: efficient auctions in the interdependent values settings; auctions with active seller's participation; dynamic ads auctions (such as Google's and Yahoo's); auction design for privatization and procurement in Russia. There are plenty of other hot topics in this area, among them analysis of collusive behavior in auctions and static and dynamic auctions with anonymous bidders (such as eBay). Also, some data is available for empirical research.

Constrained-Efficient Auctions. Designing mechanisms that aggregate players' private information and reach efficient allocations at the end of the play is one of the central problems of applied mechanism design. The structure and dimensionality of players information matters. In environments where private information is interdependent —a value of one player may depend on the information of the others— achieving efficiency is a non-trivial task. Dasgupta & Maskin (2000) and Jehiel & Moldovanu (2001) show that if the player's information is multidimensional, achieving full efficiency is generically impossible, as no mechanism (game) can offer sufficient incentives for the players to (fully) reveal their private information.

What is the second-best mechanism —a mechanism that achieves maximum of efficiency subject to all (information-driven) incentive constraints is a general open problem. Identifying relevant conditions on the players' information for simple second-best mechanisms; designing such simple auctions that implement the second-best; comprehensive analysis of special cases such as two-bidder and/or two-signals auctions and two-signals bilateral trade problem; and, of course, finding the solution in general multi-dimensional signals interdependent value settings would constitute a significant contribution in this line of research.

Efficient auctions for divisible goods in interdependent values settings. For the most part, auctions for divisible goods such as electricity, oil, financial instruments are studies in private values settings or in symmetric settings with some common component and plenty of bidders. Consider a situation in which there are a few "big" bidders. The information some of these bidders possess may be important for determining the values of the other bidders. The design of mechanisms that allow for such information to be revealed in bidding and that result in an efficient allocation is an open problem. Sales of oil and gas contracts, electricity and pollution markets, even some treasury auctions are potential applications.

Auctions with active sellers. With notable exception of double auctions, auction theory typically has the seller/auctioneer in a passive role. Even when the seller is free to choose any mechanism she wants, she is not considered to be an active participant in the actual format she chooses. At the most, the seller is able to set a reserve price. Studying mechanisms in which the seller can be an active participant is both theoretically and practically relevant. Izmalkov (2004) shows that the seller can reach the optimal auction revenue if she actively participates in the English auction even in asymmetric settings. Many real-life auctions, notably in industrial procurement and real estate, have flexible allocation rules and a possibility for the seller to set such rules for each specific auction. For instance, the seller can decide which of the bids to accept after the bids are submitted. The accepted bid need not be the highest bid if the seller has some preferences over who she would like to win or over other components of the submitted bid such as financing of it. Balestrieri (2008) constructs a dynamic mechanism, a modified English auction, in which the sellers makes repeated individualized offers, and which allows the seller with such preferences to achieve the common knowledge optimal revenue no matter what are her initial preferences over the bidders. This is a completely open area for research, with a lot of interesting directions. When it is that the seller wants to be active? How much she stands to gain? What are the strategies available to the bidders to defend themselves against such an opportunistic seller? Does anonymity of bidders help?

Online advertising auctions. The bulk of Google's and Yahoo's revenue is generated from their internet advertisement business. Roughly, each time a person searches, depending on the content of his search query, a few business links may pop up at the top or on the right of the page. Certainly the top advertising position is more valuable and businesses are willing to pay to be listed higher. Edelman, Ostrovsky & Schwarz (2007) and Athey & Ellison (2008) are two recent papers on the subject. While these papers "covered a lot of ground" many interesting questions remain. For instance, many businesses are likely to care about who else is listed with them, and this has not been considered so far. What makes these auctions unique and fascinating is that they are much more than auctions: in fact, Google, Yahoo (and, more generally, Microsoft, eBay, and to some extent amazon.com, expedia.com, and many others) design and implement online marketplaces. Understanding what objectives to pursue and how to realize them matters.

Analysis and design of auctions and markets in Russia. Many different auctions are conducted and could be conducted in Russia, but the comprehensive analysis of them is virtually absent (often because of the lack of data).[1] In addition to the standard interests in conducting such analyses, the main question is whether, given the objective (of efficiency or revenue maximization), these auctions are properly designed. Also, as one can "naturally" expect that some sort of collusive actions may be present in such auctions, an interesting topic is identification of collusive practices in some of Russian auctions. (See Porter (2005).)

Applications of Mechanism Design with Full Privacy and No Trust.

Privacy of information is clearly a human desideratum, stemming from possible effects of any information revealed by current actions on future interactions. Somewhat surprisingly, it has received virtually no attention in Microeconomic Theory literature. In part this can be explained by the fact that most of mechanisms obtained as solutions (to a variety of problems in auctions, contract theory, bargaining, market design, voting, etc.) are idealistic in relying on assistance of a mediator. Such a mediator collects reports from the players and selects an outcome. In essence, in settings with incomplete information —when private information does matter— privacy is substituted by the trust in mediator, often by an explicit assumption on the ability of the mediator to commit to the mechanism. As long as the mediator is trusted with correctly processing collected reports so as to obtain and reveal the outcome and nothing more, the mechanism obtains the perfect privacy —only the minimal unavoidable information is revealed— the outcome. But, can we really trust the mediators? Are trusted mediators readily available?

Izmalkov, Lepinski & Micali (2008) demonstrate that any finite mediated normal-form mechanism can be (perfectly) implemented by an *unmediated* extensive-form mechanism with a public mediator so that: (1) the two mechanisms are strategy equivalent — their normal forms are isomorphic, and thus solutions of the games generated by these mechanisms are the same; (2) the two mechanisms are privacy equivalent — players learn exactly the same information during and after the play of each mechanism provided they use equivalent strategies; and (3) the public mediator only performs the public actions, so that everyone can verify that he is acting properly, and never learns any information that should remain private.

Dynamic Contracting. As in auctions, in contract theory many models are centered on one specific player called the principal. Optimal contracting is a problem of finding the contract that maximizes the principal's payoff. In static contracting models —in which, an interaction between the principal and agents, while possibly in stages, leads to payoffs, that realize only once— the Revelation Principle is the main solution tool. In dynamic models —in which payoffs and possibly the information of the players realize multiple times— the Revelation Principle often fails. The reason is that the principal may find it optimal to

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[1]The data on Russian Oil and Gas Fields auctions can be found at http://econ.la.psu.edu/CAPCP/RussianData/index.html.

"abuse" the information she receives from agents in earlier stages of the game. This greatly complicates the analysis but also is a source of many interesting effects and models (e.g. the Ratchet effect). The above work implies that one can apply the Revelation Principle without loss of any generality, as one does not need to associate the principal with the mediator implementing the first- or second- best contracts. One can assume that a universally trusted mediator exists, who also receives, if necessary, some message from the principal, and implements the best mechanism for the principal. Then, such a mediator can be dispensed with, for instance, by asking the principal to perform all the public actions, and without affecting any incentives of the agents. To what extent this observation affects the current literature remains to be investigated.

Commitment. In both auction and contract theory, the auctioneers and the principals, respectively, are assumed to be able to commit to the mechanisms or, more generally, incentive schemes they choose. What happens if this assumption does not hold? Studying the implications of limited commitment is of independent interest by itself as, clearly, it is an important practical issue, and there are several possible definitions of commitment one can investigate. One specific problem is that the auctioneer, once she learns some information about the bidders, may choose to abandon the current mechanism and start another.

One approach in resolving this problem is to define commitment on the space of outcomes directly as follows. For any specific outcome, ask the auctioneer (the principal) if she is ready to make that outcome final. If she is, she can commit to such an outcome (say sell the good to player 1 at a price of 10), if she is not, then she cannot. Such a definition leads to a commitment function, which can be evaluated in parallel with the outcome function. Then, for instance, if it evaluates to 0 meaning that the final outcome is such that the auctioneer cannot commit to it, the actual outcome and private information of the bidders contained in it are not disclosed. What are the implications of such an approach? What is the proper way to model commitment? (Also see Vartiainen (2002).)

Contracting on Mechanisms

Hart & Moore (1999) and Maskin & Tirole (1999) laid down the foundations for the incomplete contracts two competing theories. Roughly, the literature developed by considering simple, realistic, but rather ad hoc restrictions on the types of contracts the agents can write on the one side, and by investigating what contracts are implementable depending on the nature of observable, but not verifiable, information and restrictions on mechanisms to be used, such as no-renegotiation rules, on the other side. An interesting avenue of research, that falls somewhat in between these two directions, is to consider what the agents can achieve by contractually restricting the set of mechanisms to be used tomorrow in the case of disagreement. In practice, the contracts often have explicit "mechanisms" clauses, such as requiring the parties to go to the arbitrator. For instance, rather then specify today that one agent will have the right tomorrow to buy certain goods/services at a certain price or that it is optimal to allocate ownership to one of the agents to induce proper investment

levels, one can instead let the agents to write down a specific trading procedure that they can use tomorrow to split the realized surplus.

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