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Journal of Economic Theory 161 (2016) 103–144

JOURNAL OF Economic Theory

www.elsevier.com/locate/jet

Information aggregation in a large multi-stage market game ☆

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Received 13 March 2015; final version received 3 November 2015; accepted 12 November 2015

Available online 2 December 2015

Abstract

A three-stage market-game mechanism is devised that is simple (actions are quantities and outcomes are determined by arithmetic operations that do not depend on details of the economy) and achieves efficiency in a two-divisible-good, pure-exchange setting with potential information-aggregation. After an entry stage, agents make offers which are provisional for all but a small, randomly selected group. Then, those offers are announced, and everyone else makes new offers with payoffs determined by a Shapley–Shubik market game. For a finite and large number of players, there exists an almost ex post efficient equilibrium. Conditions for uniqueness are also provided.

JEL classification: D82; D43

Keywords: Mechanism-design; Information-aggregation; Market-game; Efficiency

1. Introduction

There is a large literature—some of it theoretical (see below) and some of it experimental (see Axelrod et al., 2009)—that deals with settings in which there is dispersed and private information

☆ We are indebted to Jim Jordan for very helpful conversations at the inception of this work. We are also grateful for comments from two anonymous referees and the associate editor.
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http://dx.doi.org/10.1016/j.jet.2015.11.005
0022-0531/

that is valuable in the sense that better outcomes could be achieved if the private information is revealed. In such settings, the problem is to induce people to reveal what they know. This paper deals with a pure-exchange setting in which the challenge is to achieve ex post efficient allocations using a mechanism that is simple in two senses. The first is detail-freeness: the mechanism does not rely on specific information about the economy such as the functional form of agents' utilities or the way that private signals relate to the unobservable state (see Hurwicz et al., 1995). The second is that the participants' actions are low-dimensional and that there is a simple algorithm that computes the outcome for each profile of participants' actions. The mechanism we devise and analyze is a three-stage market-game (trading-post) mechanism. It is simple in those two senses and, as we show, achieves almost ex post efficiency when the finite number of agents is sufficiently large.

Some of the literature has focused solely on efficiency. Gul and Postlewaite (1992) and McLean and Postlewaite (2002) construct direct mechanisms that achieve almost ex post efficiency in environments that include ours as a special case. However, as is widely recognized, their direct mechanisms are not detail-free. Presumably, that is why McLean and Postlewaite (2002) (pages 2439 and 2441) do not regard their mechanism as suitable for actual use. Some of the literature has focused on both efficiency and simplicity under particular mechanisms. Reny and Perry (2006) and Vives (2011) study double-auction mechanisms and show that those mechanisms achieve ex post efficiency in special settings: Reny and Perry (2006) assumes unit demands, while Vives (2011) assumes quadratic utilities and normally distributed signals. However, except in such special cases, double auctions are not simple in terms of actions or the way the mechanism uses those actions. In order to achieve ex post efficiency in our setting, a general two-divisible-good setting, actions in a double auction would have to be general demand functions, which are not simple objects. Moreover, there is no simple algorithm that computes a market-clearing price in the double auction from arbitrary demand functions. Our mechanism, in contrast, has agents choosing one-dimensional actions and has outcomes produced using simple arithmetical operations (see, also, the remarks in Dubey et al., 1987, page 108).[1]

The environment we study is a (static) two-divisible-good, finite number-of-agents, pure-exchange setting in which there is a role for information aggregation. The information-preference structure is borrowed from Gul and Postlewaite (1992) and is closely to related to those in Reny and Perry (2006) and Vives (2011). There is an unobserved state-of-the-world, which in our case is drawn from a finite set, and there are private signals, also drawn from a finite set, that are informative about the state. The realized utility of an agent depends both on the state and on the private signal received. The state can be interpreted as a common taste (or quality) shock and the signal as an idiosyncratic taste (or quality) shock. In the language of *auction* theory, the model is a mixed *common-private value* setting. From a more general point of view, the presence of private signals makes it an *adverse-selection* model in the sense that after receiving a private signal, each agent knows something that others do not know. Finally, the setting has agents with endowments that are not under the direct control of the mechanism.

At stage-1, before learning their types, agents choose whether or not to participate when faced with a suitably small entry fee. Then the participating agents learn their types and enter stage-2. At stage-2, each agent names an offer as in most market-game mechanisms, but faces an

[1] Peck (2014) also obtains information aggregation and efficiency in a two-stage market game, but one with a finite set of large agents and a continuum of small agents. Ritzberger (forthcoming) studies a market game with limit orders and obtains competitive outcomes in a setting with "private values," but shows that his mechanism fails in settings with general aggregate uncertainty.