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Matching markets under (in)complete information ☆

Lars Ehlers [a,*], Jordi Massó [b]

[a] *Département de Sciences Économiques and CIREQ, Université de Montréal, C.P. 6128 Succursale Centre-Ville, Montréal, Québec H3C 3J7, Canada*

[b] *Universitat Autònoma de Barcelona and Barcelona GSE, Departament d'Economia i Història Econòmica, Edifici B. Campus UAB, 08193 Cerdanyola del Vallès (Barcelona), Spain*

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Abstract

We introduce incomplete information to centralized many-to-one matching markets. This is important because in real life markets (i) any agent is uncertain about the other agents' true preferences and (ii) most entry-level matching is many-to-one (and not one-to-one). We show that given a common prior, a strategy profile is an ordinal Bayesian Nash equilibrium under incomplete information in a stable mechanism if and only if, for any true profile in the support of the common prior, the submitted profile is a Nash equilibrium under complete information in the direct preference revelation game induced by the stable mechanism.
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* Corresponding author.
E-mail addresses: lars.ehlers@umontreal.ca (L. Ehlers), jordi.masso@uab.es (J. Massó).

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1. Introduction

Centralized many-to-one matching markets operate as follows to match the agents from two sides, the firms (colleges, hospitals, schools, etc.) and the workers (students, medical interns, children, etc.): a centralized clearinghouse collects for each participant a ranked list of potential partners and matches via a mechanism firms and workers on the basis of the submitted ranked lists. In applications many of the successful mechanisms are stable.[1,2] The literature has considered stability of a matching (in the sense that all agents have to be matched to acceptable partners and no unmatched pair of a firm and a worker prefer each other rather than the proposed partners) to be its main characteristic in order to survive.[3] This is puzzling because there exists no stable mechanism which makes truth-telling a dominant strategy for all agents (Roth [24]). Therefore, an agent's (submitted) ranked lists of potential partners are not necessarily his true ones and the implemented matching may not be stable for the true profile. The literature has studied intensively Nash equilibria of direct preference revelation games induced by different stable mechanisms under complete information.[4]

We use the (ordinally) Bayesian approach in many-to-one matching markets by assuming that nature selects a preference profile according to a commonly known probability distribution on the set of profiles (a common prior).[5] Since matching markets require to report ranked lists and not their specific utility representations, we stick to the ordinal setting and assume that probability distributions are evaluated according to the first-order stochastic dominance criterion. Then, a strategy profile is an ordinal Bayesian Nash equilibrium (OBNE) if, for every von Neumann Morgenstern (vNM)-utility function of an agent's preference ordering (his type), the submitted ranked list maximizes his expected utility in the direct preference revelation game induced by the common prior and the mechanism.[6] For direct preference revelation games under incomplete information induced by a stable mechanism, our main result shows a link between Nash equilibria under complete information and OBNE under incomplete information. More precisely, Theorem 1 states that, given a common prior, a strategy profile is an OBNE under incomplete information in a stable mechanism if and only if for any profile in the support of the common prior, the submitted profile is a Nash equilibrium under complete information at the true profile in the direct preference revelation game induced by the stable mechanism.

[1] See Roth [25], Roth and Peranson [31], and Roth [30] for a careful description and analysis of the American entry-level medical market. Roth [29], Kesten [16], Ünver [36], and Ehlers [11] describe and analyze the equivalent UK markets.

[2] Chen and Sönmez [8], Ergin and Sönmez [13], and Abdulkadiroğlu, Che, and Yosuda [1] study the case of public schools in Boston, Abdulkadiroğlu and Sönmez [4] study the cases of public schools in Boston, Lee County (Florida), Minneapolis, and Seattle, and Abdulkadiroğlu, Pathak, and Roth [2,3] study the case of public high schools in New York City.

[3] See, for instance, Roth [25] and Niederle and Roth [21].

[4] See Dubins and Freedman [10], Roth [24,26,27], Gale and Sotomayor [15], Shin and Suh [34], Sönmez [35], Ma [17,18], and Alcalde [6].

[5] Roth [28] is the first paper studying strategic incentives generated by stable mechanisms under incomplete information. He shows that for particular vNM-utility representations of the ordinal preferences, Bayesian Nash equilibria under incomplete information may not satisfy appealing properties of Nash equilibria under complete information. Chakraborty, Citanna, and Ostrovsky [7] study two-sided matching markets with interdependent preferences.

[6] This notion was introduced by d'Aspremont and Peleg [5] who call it "ordinal Bayesian incentive-compatibility". Majumdar and Sen [20] use it to relax strategy-proofness in the Gibbard–Satterthwaite Theorem. Majumdar [19], Pais [22], and Ehlers and Massó [12] have already used this ordinal equilibrium notion in one-to-one matching markets.

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