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Stability with one-sided incomplete information

Sushil Bikhchandani

UCLA Anderson School of Management, Los Angeles, CA 90095-1481, United States

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Abstract

Two notions of stability, ex ante stability and Bayesian stability, are investigated in a matching model with non-transferrable utility, interdependent preferences, and one-sided incomplete information. Ex ante stable matching-outcomes are unblocked for every belief on the blocking partner's type while Bayesian stable matching-outcomes are unblocked with respect to prior beliefs. Ex ante stability is a minimal requirement. Bayesian stability is a more selective desideratum with sound efficiency properties.

JEL classification: C78; D47; D82

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1. Introduction

The concept of stability in two-sided matching markets was introduced in a seminal paper by Gale and Shapley (1962). A matching is stable if there does not exist a blocking pair, i.e., no two agents prefer each other to their respective partners in the matching. In this model, agents do not have any private information that might affect their own preferences or the preferences of other agents. Much of the subsequent literature also assumes complete information – see Roth and Sotomayor (1990).

At least some private information is present in most matching markets. Surgeons at a hospital do not know the operating skill of an applicant to its surgical internship program; this is revealed only after the applicant is hired. A firm has an imprecise estimate about a potential employee's

E-mail address: sbikhcha@anderson.ucla.edu.

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productivity, based on his experience and training; the firm learns the worker's productivity only after employment. Similarly, standardized test scores, grades, and reference letters provide only partial information about the academic ability of a college applicant. Thus, it is important to investigate matching markets where these is incomplete information.

In this paper, I explore two notions of stability under one-sided incomplete information in a matching model in which workers are matched with firms.[1] Utility is non-transferrable (NTU) and side payments between workers and firms are not possible. Agents have interdependent preferences in the sense that the utility of an agent depends on the type of the agent it is matched with. Workers have private information about their types whereas firms' types are common knowledge. Once a matching occurs, the type of a worker is revealed to the firm it is matched with. The utility function of each agent increases in his own type and the type of its matched partner.

A *matching outcome* is a matching together with the types of workers.[2] Because a matching may be stable at one set of worker types but not at another, a matching outcome is the appropriate object of stability. The focus is on restrictions imposed on the set of matching outcomes by two notions of stability under incomplete information: *ex ante stability* and *Bayesian stability*. These are defined by the absence of one of two forms of blocking: *blocks for all admissible worker types* and *Bayesian blocks*, respectively. Stable matching-outcomes, once established, are never blocked by any coalition of workers and firms. How stable matching-outcomes might arise is not addressed in this paper.

Bayesian stability is investigated under the assumption that workers' types are independently and identically distributed. A distributional assumption is not necessary for ex ante stability.

Ex ante stability adapts to a NTU model, a definition of stability under one-sided incomplete information introduced by Liu et al. (2014) in a matching model with transferrable utility (TU) and side payments. A firm j participates in a block with a worker i only if j is better off with all *admissible types* of i, i.e., with all types of worker i that are better off in the contemplated block. Under this definition of blocking, it is common knowledge between the pair (i, j) that each is better off in the block. Matching outcomes that are unblocked for all admissible worker-types are ex ante stable.

A matching outcome is Bayesian stable if it is not Bayesian blocked. A firm j participates in a Bayesian block with worker i if j's expected utility in the block is greater than its utility in the current matching. The firm's expectation is taken over all admissible types of its blocking partner (worker i). Thus, Bayesian blocking is a weaker requirement than blocking for all admissible types. Consequently, Bayesian stable matching-outcomes are a subset of ex ante stable matching-outcomes.

In each of the two notions of stability, the absence of a block to a matching outcome implies that certain states of nature (i.e., vector of worker types) did not occur. Elimination of these states of nature from consideration opens up the possibility of other potential blocks; if these other possible blocks do not transpire, then the implication is that some other states of nature did not occur. Thus, the continued persistence of a matching outcome leads to a recursive decrease in the set of possible states of nature. If a matching endures, it becomes common knowledge among agents that the types of workers are such that there are no blocking opportunities; such matching outcomes are stable. Liu et al. (2014) point out that this is similar in spirit to Holmstrom and Myerson (1983)'s notion of durable mechanisms.

[1] While the model is of one-to-one matching, it is easily generalized to a many-to-one matching model under the assumption that each firm has responsive preferences.

[2] Firms' types are common knowledge and remain fixed throughout the analysis.