

# Incentives in decentralized random matching markets

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## Abstract

Decentralized markets are modeled by means of a sequential game where, starting from any matching situation, firms are randomly given the opportunity to make job offers. In this random context, we prove the existence of ordinal subgame perfect equilibria where firms act according to a list of preferences. Moreover, every such equilibrium preserves stability for a particular profile of preferences. In particular, when firms best reply by acting truthfully, every equilibrium outcome is stable for the true preferences. Conversely, when the initial matching is the empty matching, every stable matching can be reached as the outcome of an ordinal equilibrium play of the game.

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## 1. Introduction

The study of centralized markets has been privileged in the two-sided matching literature. The introduction of centralized matching procedures in markets that experienced certain kinds of failures is partially responsible for such dedication. In fact, a number of markets—for physicians, lawyers, dentists, and osteopaths, among others—have adopted central clearinghouses after periods of uncontrolled unraveling of appointment dates and chaotic recontracting.<sup>1</sup> These markets now work by having each agent of the two sides of the market submit a rank ordered preference list of acceptable matches to the central clearinghouse, which then produces a matching by

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<sup>1</sup> See Roth and Xing (1994) and Niederle and Roth (2003).

processing all the preference lists according to an algorithm. Roth (1984a, 1991) showed that the algorithms used in most of the successful clearinghouses roughly follow the lines of Gale and Shapley's deferred acceptance algorithm (Gale and Shapley, 1962). This procedure generates a matching of workers to positions that is stable in terms of the submitted preferences in the sense that no worker and firm that are not matched to each other would prefer to be so matched.<sup>2</sup>

In contrast, decentralized markets have received relatively little attention.<sup>3</sup> The exact set of rules that governs a centralized market, making it particularly amenable to analysis, is no longer present when matching is organized in a decentralized way. Namely, decentralized decision making in complex environments may introduce randomness in the order in which job offers are made. The speed of the mail, the telephone network, or the internal structure of firms making some react faster than others determine the success in establishing communication with the desired workers. Moreover, decentralized markets involve different strategic issues from those of centralized markets. In fact, when a clearinghouse exists, agents must simply decide what preference lists to submit to the matchmaker, after which the match is created. However, in a decentralized market agents do not submit lists; instead, they can decide, after each interview or telephone call what to do next. The size of the strategy space is thus extremely large and, together with the underlying uncertainty, has precluded analysis by means of standard matching tools.

The purpose of this paper is to apply the extremely simple marriage model to the study of decentralized labor markets. In this model, agents' preferences are ordinal in nature. Hence, we merely take for granted their ability to order the potential working partners, without assuming that they are capable of giving cardinal content to their preferences.<sup>4</sup> The starting point of the analysis is any matching situation, providing a framework to the study of both entry-level and senior level markets. The matching process is then modeled as an extensive form game, where firms sequentially offer their positions. The inherently uncertain features of the market are modeled as chance moves that determine the order of play: at each moment in time, any firm—even if already matched—is randomly selected and given the opportunity to offer its position to a worker. This worker compares it with any offer he may be holding and rejects one, while (temporarily) holding the other, pending the possible arrival of even better offers. We assume that, once rejected, the firm is not willing to propose to the same worker again, but it may obviously offer its position to a different worker when given the opportunity to act.

There are different options when it comes to modeling the functioning of a decentralized labor market. A fundamental feature is that an agent's strategy does not necessarily comply with a list of preferences. In this model, for instance, a worker may entertain the strategy of accepting the first proposal received and rejecting all subsequent proposals, which is not consistent with a list of preferences for different orders of proposals. This, together with the fact that the initial matching is not, necessarily, the empty matching, where every agent is unmatched, assures that the process we describe cannot be reduced to a mere implementation of Gale and Shapley's algorithm. Moreover, chance moves introduce uncertainty in which matchings are achieved: it may happen that starting with the same initial matching, different plays of the game yield different outcomes for the same strategy profile.<sup>5</sup> This contrasts with two other papers aimed at modeling decentralized labor markets: Blum et al. (1997), which studies the vacancy chain problem and where chance

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<sup>2</sup> See Roth and Sotomayor (1990) for a comprehensive study of two-sided matching markets.

<sup>3</sup> There are notable exceptions, namely Blum et al. (1997), Haeringer and Wooders (2004), Roth and Vate (1991), Roth and Xing (1997), among others.

<sup>4</sup> It follows that monetary transfers are embodied in agents' preferences, i.e., there is more to a job than just a salary.

<sup>5</sup> See Example 1 below for illustration.

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