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Unravelling in two-sided matching markets and similarity of preferences

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ABSTRACT

This paper investigates the causes and welfare consequences of unravelling in two-sided matching markets. It shows that similarity of preferences is an important factor driving unravelling. In particular, it shows that under the ex-post stable mechanism (the mechanism that the literature focuses on), unravelling is more likely to occur when participants have more similar preferences. It also shows that any Pareto-optimal mechanism must prevent unravelling, and that the ex-post stable mechanism is Pareto-optimal if and only if it prevents unravelling.

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1. Introduction

Hiring policy is one of the most important determinants of a firm's success. The hiring process calls for collecting information in order to choose the best individual from among the candidates. In certain markets, however, firms hire workers long before all the pertinent information is available. For instance, in the market for hospital interns before 1945, appointments were made even as early as two years before students' graduation and the actual start of the job (Roth, 1984, 2003). A similar situation still exists in the market for federal court clerks (Avery et al., 2001; Haruvy et al., 2006).[2] This phenomenon of contracting long before the job begins and before relevant information is available, is called *unravelling*. Those early matches often turn out to be inefficient when the job starts.

Unravelling has been recognized as a serious problem in numerous markets.[3] Measures designed to preclude this phenomenon (such as centralized clearinghouses and enforcement of uniform hiring dates) have not always been successful. Unravelling prevails in certain markets because some employers see a better chance to hire their most preferred candidates when they contract early than when they wait. Meanwhile, other markets for entry-level professionals appear never to have experienced unravelling, including markets for new professors in finance, economics and biology. Studying what factors

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[2] According to Haruvy et al. (2006), "63% of responding judges said that they had completed their clerkship hiring [for jobs beginning in 2002] by the end of January, 2000, in contrast to only 17% who had completed their hiring by January the previous year."

[3] Examples include entry-level law and medical markets, postseason college football bowls, and fraternity and sorority rushes. For a more extensive list, see Roth and Xing (1994).

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lead to unravelling in some markets but not in others is necessary for designing better measures to prevent unravelling in markets prone to it.

Much of the existing research focuses on stability as the key to understanding unravelling. A matching is ex-post stable if every agent prefers his match to being unmatched, and if there is no blocking pair, that is, a worker and a firm that both strictly prefer each other to their assigned partners. Roth (1991) and Kagel and Roth (2000) argue that ex-post stable matching implemented upon arrival of pertinent information should preclude early contracting under uncertainty. This argument — known as the "stability hypothesis" (Roth, 1991) — is based mainly on the observation that implementing ex-post stable matching through a clearinghouse[4] stopped unravelling in the US and UK medical markets. However, some clearinghouses with an ex-post stable algorithm have failed to stop unravelling. Examples include the US gastroenterology market, whose clearinghouse was abandoned in 1996 (Niederle and Roth, 2003) and the Canadian market for new lawyers, where a large number of firms contract with students a year before graduation despite a clearinghouse (Roth and Xing, 1994). Roth and Xing (1994) also offer theoretical examples of unravelling even when ex-post stable matching is expected upon the arrival of pertinent information. There is no consensus, however, what drives those examples — what are the reasons for the stability hypothesis to fail; that is, for a clearinghouse with ex-post stable algorithm to unravel.[5]

Despite extensive discussion in the economics literature, we have only limited understanding of why unravelling occurs in some markets but not in others. And the basic question of what are the potentials and limitations of mechanisms designed for markets where unravelling is possible remains largely unexplored. This paper investigates both issues: the causes of unravelling and mechanism design. The existing literature on unravelling had not considered the relevance of similarity of preferences. This paper shows that the similarity of preferences is an important factor contributing to unravelling. The more similar are firms' preferences, the more unravelling will occur in the market. This provides a reason for the stability hypothesis to fail: high similarity of preferences may cause an ex-post stable matching mechanism to unravel. This paper also shows that unravelling leads to a loss in welfare, and a mechanism must preclude unravelling to be Pareto-optimal. Moreover, for any market, there exists a Pareto-optimal mechanism, which does not unravel. In markets where ex-post stable mechanism unravels, there exist unstable mechanisms that do not unravel, Pareto-improve on the ex-post stable mechanism and achieve Pareto-optimal outcome.

This paper examines a two-sided matching market populated by firms on one side and workers on the other. The agents on each side are heterogeneous and they have preferences over agents on the other side of the market. Their aim is to match with the best possible agent on the other side. Workers' preferences over firms are identical: all workers agree on which firm is the best firm, the next-to-best or the worst firm. Firms, however, may have different preferences over the workers. The similarity of firms' preferences over workers is a comparative statics parameter; two extreme cases are independent and identical preferences, although intermediate levels of similarity are also explored. There are two periods. Firms and workers can contract in either period, but firms only learn their preferences in the second period. The firms and workers who contract in the first period exit the market. The agents who remain in the second period participate in a mechanism that produces a matching between them. In this model, contracting during the first period, before firms have learned their preferences, constitutes unravelling. Such early contracting takes place when a firm makes an offer during the first period and the offer is accepted.[6] This happens when contracting under uncertainty yields a higher expected payoff, for both the firm and the worker, than the expected matching in the second period.

The first part of the paper investigates unravelling when the mechanism in the second period is assumed to produce the ex-post stable matching. In the environment considered here there always exists a unique ex-post stable matching. It is obtained by matching the best firm with its most preferred worker, next-best firm with its most preferred worker from among the remaining ones, etc. The focus of this part of the paper is to analyze how the nature of equilibria changes with similarity of firms' preferences, under the ex-post stable mechanism. In particular, sequential equilibria in pure strategies are explored. It is shown that the nature of these equilibria depends crucially on the level of similarity: unravelling occurs only in markets where firms' preferences are sufficiently similar. And more firms contract early in equilibrium as preferences become more similar.

With very similar preferences, many firms are likely to prefer the same workers. Once the information about rankings arrives and the ex-post stable matching is implemented by the mechanism, the best firms are matched with workers preferred by most firms, and worse firms are very likely to be matched with workers they rank low. Even before firms know the actual rankings, they are aware that once that information is available, all firms will compete for the same workers. Amid such competition, worse firms may have a better chance to hire their top candidates if they contract before rankings are known. Contracting so early presents some risk: the firm may end up with an even worse candidate. But there

[4] In a clearinghouse, firms and workers submit their preferences, and a matching among all participants is produced by an algorithm.

[5] The stability hypothesis is not the only explanation of unravelling in the literature. Other factors contributing to unravelling are congestion (Roth and Xing, 1997), exploding offers (Niederle and Roth, 2004), shocks in supply and demand (McKinney et al., 2005). In Damiano et al. (2005), early contracting is the result of costly search. Li and Rosen (1998), Li and Suen (2000) and Suen (2000) point to workers' risk aversion as the main cause of the phenomenon. This paper analyzes another — previously unexplored — factor contributing to unravelling: similarity of preference.

Although risk aversion plays an important role and may be an additional cause of early contracting, it is not a necessary condition for the phenomenon. The model in this paper assumes risk neutrality in order to distinguish incentives to unravel driven by similarity of preferences from those attributable to risk aversion.

[6] All offers made in the first period expire by the end of that period. Such offers are sometimes referred to as "exploding offers." Niederle and Roth (2004) show that exploding offers are necessary for unravelling to occur.

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