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Team production in competitive labor markets with adverse selection ☆

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ABSTRACT

Team production is a frequent feature of modern organizations. Combined with team incentives, team production can create externalities among workers, since their utility upon accepting a contract depends on their team's performance and therefore on their colleagues' productivity. We study the effects of such externalities in a competitive labor market if workers have private information on their productivity. We find that in any competitive equilibrium there must be Pareto-efficient separation of workers according to their productivity. We further find that externalities facilitate equilibrium existence, where under a particular condition on workers' indifference curves even arbitrarily small externalities guarantee equilibrium existence.

1. Introduction

Many modern firms employ innovative human resource management practices that include team production, team incentives, and profit sharing (Ichniowski and Shaw, 2003). Team production often comprises many tasks, all of which must be well executed for a team to be successful. A worker's productivity then depends on the productivity of his team colleagues. In particular, a worker will be less productive if matched with less productive co-workers.[1] Combined with team incentives, team production implies that the utility a worker gets upon accepting a job depends on the characteristics of his

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[1] Kremer (1993) illustrates this complementarity in production by an extreme but illuminating example: the explosion of the space shuttle Challenger in 1986, which happened because one single component, the O-ring, malfunctioned. Further examples of "O-ring production functions" are discussed in Dalmazzo (2002), Fabel (2004), and Jones (2011).

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colleagues. This stands in contrast to standard job market signaling and screening models that assume that the utility a worker gets upon accepting an employment contract depends exclusively on the terms of the contract and the worker's own productivity.[2]

Despite the practical and theoretical relevance of the subject, no paper has yet analyzed how team production – and the thereby arising externalities among workers – affect competitive labor markets if workers have private information on their productivity.[3] To fill this gap we investigate a screening version of Spence's (1973) job market signaling model while introducing a simple externality between workers. In our model, firms compete for workers. Employment contracts specify wages and some task requirements, where a worker's costs of complying with the task requirements depends on his productivity. By combining wages and task requirements, firms can thus screen workers according to their productivity. Contrary to the standard framework, a worker's utility upon accepting a contract does not only depend on his productivity and the contract, but also on the average productivity of the co-workers in his chosen firm.

We show that whenever there exists a competitive equilibrium, then firms make zero profit, workers are separated according to their productivity, and the inefficient task requirement needed for separation is minimized. More intriguingly, we prove that externalities among workers facilitate equilibrium existence, where under a particular condition on workers' indifference curves in contract space, arbitrarily small externalities guarantee existence. Since Rothschild and Stiglitz (1976) it is known that in the standard framework there does not exist a competitive equilibrium in pure strategies if the fraction of low-productivity workers is sufficiently small.[4] The reason is that any competitive equilibrium must be a separating equilibrium in which high-productivity workers face the minimum task requirement needed to ensure separation from low-productivity workers. This minimum task requirement – and thus the inefficiency arising from private information – does not depend on the fraction of low-productivity workers. If the fraction of low-productivity workers is sufficiently small, the separating equilibrium can therefore be destroyed by a Pareto-dominating pooling contract that specifies a zero task requirement and sets wages so as to make a small positive profit when accepted by all workers. Because pooling is ruled out in equilibrium, there exists no competitive equilibrium.

These arguments no longer hold in the case of externalities among workers. The reason is that externalities entail that market entrants offering a pooling contract might not be able to attract high-productivity workers: given that none of the other high-productivity workers accepts the new contract, each high-productivity worker finds it optimal not to accept the contract, as he would otherwise work with low-productivity colleagues, which he dislikes. Since the pooling contract makes losses when attracting only low-productivity workers, market entry is unprofitable. Hence, a competitive equilibrium exists. The externality creates a coordination problem among workers, and selecting the right equilibrium response to market entry ensures equilibrium existence.

The above result suggests that the externality has to be sufficiently large to ensure equilibrium existence. We show that this is not true if some firms offer “latent contracts.” Such latent contracts are not accepted by any workers in equilibrium, but they turn out to be very useful to deter market entry. Because these latent contracts are offered by firms that only employ low-productivity workers, high-productivity workers do not accept them in equilibrium, since they would otherwise suffer from being matched with only low-productivity colleagues. Low-productivity workers never find these latent contracts attractive, because wages are too low to compensate them for the high task requirement. Given this situation, consider market entry of a firm that wants to attract both low-productivity and high-productivity workers. If this new firm indeed manages to attract all low-productivity workers, then this unintentionally renders previously latent contracts appealing to high-productivity workers, because accepting such a contract no longer has the drawback of being matched with low-productivity colleagues. Since latent contracts thus make it more difficult for market entrants to attract high-productivity workers, they can render profitable market entry impossible. In fact, we can show that under a particular condition on workers' indifference curves in contract space – more productive colleagues make changes in wages relatively more influential on workers' utility than changes in the task requirement – the supremum utility that high-productivity workers can get from accepting a previously latent contract after market entry is infinitely large, even if the externality is arbitrarily small. Equilibrium existence is in this case guaranteed, since latent contracts ensure that market entrants can never attract high-productivity workers without making losses. In contrast to the argument in the previous paragraph, coordination problems are no longer part of the story: for all equilibrium contract choices, the new firm always attracts all low-productivity workers, and all high-productivity workers accept a previously latent contract.

2. Related literature

Our paper complements the large existing literature on adverse selection. We distinguish between papers that focus on team production, equilibrium existence, externalities and coordination, and latent contracts.

[2] The discussed externalities among workers also arise naturally in partnerships that employ profit sharing. Partnerships with profit sharing are very common in many industries, including law, accounting, investment banking, management consulting, or medicine. See for example Hansmann (1996), Farrell and Scotchmer (1988), and Encinosa et al. (2007). In these industries, the quality of potential partners is likely to play an important role in employment choices.

[3] We provide a detailed overview of the related literature in Section 2.

[4] We also focus on pure strategies in this model and prove equilibrium existence for this case. For an analysis of mixed strategy equilibria in models of adverse selection see Dasgupta and Maskin (1986a, 1986b) and Rosenthal and Weiss (1984).