



The effect of production technology on trust and reciprocity in principal-agent relationships with team production



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ABSTRACT

We introduce differently sized teams, rather than a single worker, and three production technologies to an otherwise standard gift-exchange environment to study experimentally whether, and to what extent, ‘trust and reciprocity’ is affected. Moving to a team of workers introduces new motivations, such as free riding and coordination burden, that are likely to intensify with team size and the technology used by the firm. We find that the positive relationship between wages and effort, although affected, still holds; workers reduce their efforts when coordination for efficiency is more difficult using a particular production technology. Results also suggest that for any given technology, firms react to their relevant outcome (profitability) and not just to workers’ efforts.

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1. Introduction

There is a large experimental literature analyzing principal-agent problems with incomplete (or unenforceable) labor contracts. The most common environment studied consists of one firm which moves first and decides on the wage level, and then one worker responds by choosing an effort level that is transformed into the firm’s revenues via a given production technology.¹

Perhaps the most significant finding emerging from studying this setup with one firm and one worker is that the first mover, the principal, pays more than the minimum she has to, “trusting” that the second mover, the agent, will reciprocate, which he does, by exerting more effort than the dominant strategy prescribes.² However, in many labor relationships the principal-agent relationship is not one-to-one; rather, a principal is in charge of a team consisting of more than one worker.

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¹ See, for instance, Fehr et al. (1993), Fehr and Gächter (1998), Charness (2004), or Charness et al. (2004) for random-matching protocol and Gächter and Falk (2002) and Brown et al. (2004) for repeated interactions settings.

² Throughout the paper, we shall presume that the firm (manager) is female and the worker is male.

As trust and reciprocity comprise the foundation of cooperation in many economic environments where complete contracts are unenforceable, it is important to study the scope and limitations of previous findings in more general settings.

Recent analysis of the principal-agent problem with several workers has generated a growing experimental literature (which we will review in the next section).³ This paper examines whether, and to what extent, the *trust and reciprocity* found in the principal-agent relationship are affected when the principal is in charge of teamwork. The behavior of both the team members and the firm may also depend on the production technology, since it determines the outcome of the team and the profitability of the firm. Different technologies can induce different motivations resulting in different decisions of firms and workers. While with some production technologies the effort level provided by the worker has a direct effect on firm profits, with other technologies, the effect of individual effort levels on firm profits depends on the effort level provided by the other workers in the team. Consider, for example, a firm facing the *weakest link* environment, similar to an assembly line that moves only as fast as its slowest worker. In contrast, imagine a manager employing a team of computer programmers with similar skill levels to solve a programming problem. In this labor context, the most productive member may be the primary determinant of the team's productivity.⁴ Will firms and workers behave in the same way in both environments?

We study whether and how the production technology affects the behavior of both the firm and the workers and how it impacts performance in terms of efficiency, profits, and wages. We conducted an experiment where a team of four workers is matched with a (manager) firm. In the first stage, the firm offers a wage (not necessarily the same) to each worker; in the second stage, each worker chooses, without knowing the decisions of their coworkers, how much effort they will provide. We consider three different production functions that map a profile of effort levels to firm revenues. In the *Average (Minimum/Maximum)* production technology, the average (Minimum/Maximum) effort level provided by the workers determines the team's productivity and firm profits.

We find that despite the free rider motivation and coordination hurdle introduced by having a team of workers, *excess* cooperation, in terms of 'trust and reciprocity', although affected, still holds. Moreover, the positive relationship between wages and effort holds for all our production technologies. Our data also show that production technologies that magnify coordination hurdles, the *Maximum* and the *Minimum*, drive workers to provide lower effort levels than in the *Average* production technology. In other words, elevated coordination problems diminish the reciprocity of workers. This result suggests that different production technologies affect the final outcome not only through the implemented efforts, but also by affecting workers' individual performance.

Results also suggest that for any given technology, firms react to their relevant outcome (profitability) and not just to workers' efforts. We observe that the *Maximum* production technology leads firms to assign higher wage levels than do the other two technologies.

To test whether the effect of the production technology varies with team size, we vary the number of workers paired with a firm and run three additional treatments where firms are paired with two, rather than four, workers. With two workers, as with four, we find a positive relationship between effort and wages. However, smaller groups do not ease coordination between members, and do not reduce the free-rider problem. Results also show that production technologies that increase coordination hurdles, in this case only the *Maximum* technology, lead workers to provide lower effort levels than in the *Average* technology. This finding suggests that production technologies may generate significant differences in workers' behavior independently of group size. Comparing firm behavior across the six treatments, we find that, for a given production technology, increase in the labor force reduces the average wage level for the *Average* production technology and increases it for the *Maximum* one. Thus, our results suggest that team size will not affect workers' behavior, but it will influence firms' choices, depending on the production technology.

In sum, our study clearly shows that in an environment with teamwork, 'free riding' and coordination hurdles, both missing when there is only one worker, affect trust and reciprocity. The magnitude of this effect depends on the production technology.

The paper is organized as follows. Section 2 provides a brief literature discussion, and Section 3 explains the experimental design. The behavioral hypotheses are proposed in Section 4, we describe and discuss the results in Section 5, and Section 6 concludes.

2. Experimental literature on multi-worker gift exchange games

Previous literature on the principal-agent problem with several workers has mainly focused on horizontal fairness and the effect of social comparison among workers. Charness and Kuhn (2007) propose an experiment in which there are two workers (with high/low productivity) employed by the same firm. They find that although workers' effort choices are highly sensitive to their own wages, effort choice is not affected by the co-worker's wage. In the experiment proposed by Güth

³ From a theoretical point of view, the principal-agent problem with multiple workers has been abundantly studied in the literature. See, for instance, Holmstrom (1982), Harris and Holmstrom (1982), Frank (1984), Lazear (1989), Akerlof and Yellen (1990), Lawler (1990), Bewley (1999), Danziger and Katz (1997) or Charness and Kuhn (2007).

⁴ The Research Assessment Exercise in the UK shares some similarities. It is used to evaluate the quality of research undertaken in British higher education institutions. For this exercise, each department has to submit the publications of a selected number of their members for evaluation. Hence, the evaluation of the department depends on the performance of the most productive academics within the department.

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