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# Recursive contracts, firm longevity, and rat races: An experimental analysis



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## ABSTRACT

This paper reports the results from a laboratory experiment which investigates the structure of contracts that emerge in overlapping-generation firms where future ownership is a prerequisite of employment. Workers in the young generation are offered employment contracts designed by the firms' owners who belong to the old generation. When old, employed workers are granted ownership rights as long as the firm continues to operate. In line with theoretical predictions, the results indicate that as firm longevity increases, the recursive nature of the contracts leads to a rat race characterized by low wages, high effort levels, and rent dissipation. These results have important implications for the optimal management of long-lived firms such as partnerships.

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## 1. Introduction

Many firms are ongoing organizations made up of individuals who join when young and leave when old. In such firms, young workers often move on to executive roles at a later stage of their career. As executive roles typically entitle individuals to a share of the firm's profits, a young worker's decision to join a firm may depend not only on the current rewards, but also the prospect of future rents that might arise through internal promotion (e.g., Baker et al., 1994a, 1994b; Ferrall, 1996; Landers et al., 1996).

Contracts in such organizations are recursive. The contracts that young workers are willing to accept today depend on the expected value of owning the firm in the future, which in turn depends on the contract that they will be able to impose on the next generation of workers if promoted. The recursive nature of the contracts implies that factors that affect the expected value of owning the firm in the future, such as the expected longevity of the firm, may play a critical role in determining the contracts that will emerge in equilibrium.

This paper reports the results from a laboratory experiment investigating the structure and efficiency of contracts that may emerge in overlapping-generation (OLG) firms where future ownership is a prerequisite of employment. A typical example of such organizations are partnerships where the ownership of non-fungible assets (e.g., corporate skills,

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reputation) is eventually passed vertically within the firm—from the older to the younger generation.<sup>1</sup> A few empirical studies have provided evidence that new workers in partnerships tend to work long hours for relatively low salaries (e.g., Ferrall, 1996; Landers et al., 1996). This finding suggests that recursive contracting can lead to rat races.<sup>2</sup>

The advantage of using a laboratory experiment to address our research question is that we are able to focus our attention on the role of recursive contracting and exclude other forces that may affect the efficiency of contracts in OLG firms. For example, one cannot rule out the possibility that the rat races reported in the aforementioned empirical studies are due to adverse selection or moral hazard.<sup>3</sup>

As a theoretical framework for our experiment, we present a model based on Bardsley and Sherstyuk (2006). In particular, we present a simplified version of their model with homogeneous agents and complete information, which is amenable for testing in the laboratory.<sup>4</sup> In the model presented in Section 2, firm owners — members of the older generation — design the contracts offered to the young generation of workers. Workers who accept contracts will become owners of their firm as long as the firm continues operating. In this environment, the expected value of owning a firm depends on the firm's longevity, which is determined by the probability that the firm continues operating in the future.<sup>5</sup>

The model reveals that when the expected value of owning the firm is high, the unique subgame-perfect equilibrium is a rat race characterized by inefficiently high levels of effort and the dissipation of firm rents.<sup>6</sup> The reason for this inefficiency is the inability of owners to write inter-generational contracts. Since the next (unborn) generation of workers is not privy to the original contract, the recursive structure implicitly includes a third party in the negotiation whose interests are not represented and whose actions are non-contractible. The additional rents offered from the next generation induce workers to accept lower wages or exert higher effort than they would in a single-period firm. Once wages are reduced to zero, owners offer contracts with inefficiently high levels of effort that workers are willing to accept. The model thus suggests a negative relationship between the expected longevity of a firm and efficiency.

We explore the relationship between firm longevity and efficiency using an OLG labor-market experiment. Subjects take on the roles of firm owners and potential workers. Owners make offers to potential workers specifying a wage and a level of effort that they must exert if they accept the contract. Effort is enforceable. Workers who accept an employment contract become owners in the next period if the firm continues to operate. The probability that the firm continues to operate is our treatment variable. In particular, we consider two experimental treatments that differ in the expected longevity of firms. In the first treatment (*Efficient*), firm longevity is expected to be short and the model predicts an efficient outcome. In the second treatment (*Rat-Race*), firm longevity is expected to be longer and the theoretical prediction is a rat race.

The results from our laboratory experiment are consistent with the theoretical predictions. In the *Efficient* treatment, contracts converge to the efficient effort level and the corresponding wage level. Wages act as the primary contracting instrument. In contrast, in the *Rat-Race* treatment, markets converge to a rat-race equilibrium with inefficiently high levels of effort, low wages, and high inequality in earnings between owners and workers. The convergence of the theoretical predictions in both treatments is notable given the complexity of the decision problem, the presence of high payoff inequality, and the fact that contracts in the early periods of the experiment are efficient and fair (i.e., they equalize the earnings of owners and workers) in both treatments.

To the best of our knowledge, our experiment is the first to document the emergence of rat races in a laboratory environment. In addition, the paper contributes to the literature on OLG experiments by being the first to study contract design in OLG firms. Previously, an OLG structure has mainly been used to test macroeconomic theories.<sup>7</sup> A few exceptions are Aliprantis and Plott (1992), Offerman et al. (2001), and Chermak and Krause (2002), who study competitive equilibria, cooperation, and environmental issues, respectively, using OLG experiments. We are also not aware of any empirical evidence linking rat races to firm longevity.

Our findings suggest that recursive contracts may help to understand behavior observed in many organizations. The closest example of the organizations in our design is legal firms and management-consulting companies where junior

<sup>1</sup> Partnerships with such features are common in many fields including law, accounting, investment banking, management consulting, advertising, and some branches of medicine.

<sup>2</sup> In fact, all the empirical studies we found on rat races use data from partnerships. In economics, the term rat race is typically used to describe situations in which an individual is enticed to overwork, and where rents from this work are dissipated.

<sup>3</sup> Akerlof (1976) was the first to show that rat races may emerge if workers' abilities are unobservable to the employer. See also Stiglitz (1975), Miyazaki (1975), Landers et al. (1996), and Andersson (2002) for models with adverse selection. In these models, workers may work inefficiently long hours to signal their higher ability. Models with moral hazard emphasize that promotion tournaments, used to provide workers with incentives not to shirk, may result in inefficiently high effort levels. See, for example, Gibbons and Murphy (1992), Ferrall (1996), Holmstrom (1999), and Baker et al. (2006).

<sup>4</sup> Bardsley and Sherstyuk (2006) develop a more general model than the one considered here with heterogeneous agents and adverse selection. The probability of being promoted is a choice variable in their model and one of the instruments that the firm can use to screen workers. In our framework, we assume that workers are promoted automatically as long as the firm survives to the next period. We treat firm longevity as an exogenous variable and focus on how it affects optimal contract design.

<sup>5</sup> As we explain in Section 2, an increase in firm longevity can also be interpreted as an increase in the probability that a worker is promoted or a decrease in the discounting of future rents. We relate the discounting of future rents to firm longevity as it is more amenable to experimental testing.

<sup>6</sup> Rebitzer and Taylor (2007) also use an OLG framework to explore the organizational structure of firms. They model the emergence of "up-or-out" promotion contests in large law firms and argue that the "up-or-out" promotion structure enables firms to prevent attorneys from grabbing and leaving the firm with key client relationships. The existence of a steady state is asserted in their model while our paper contains a proof of the existence of a unique subgame-perfect equilibrium.

<sup>7</sup> For a survey, see Duffy (2008).

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