



Competitive on-the-job search [☆]



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ABSTRACT

The paper proposes a model of on-the-job search and industry dynamics in which search is directed. Firms permanently differ in productivity levels, their production function features constant returns to scale, and search costs are convex in search intensity. Wages are determined in a competitive manner, as firms advertise wage contracts (expected discounted incomes) so as to balance wage costs and search costs (queue length). Firms are assumed to sort out their coordination problems with their employees in such a way that the on-the-job search behavior of workers maximizes the match surplus. Our model has several novel features. First, it is close in spirit to the competitive model, with a tractable and unique equilibrium, and is therefore useful for empirical testing. Second, on-the-job search is an efficient response to firm heterogeneities and convex search costs. Third, the equilibrium leans towards a job ladder, where unemployed workers apply to low-productivity firms offering low wages, and then gradually move on to more productive, higher-paying firms. With a continuum of firm types, the job ladder is strict, in the sense that there is a one-to-one correspondence between the productivity of the current employer and that of the firms she searches for. The paper also contributes methodologically, as the existence proof requires a version of Schauder's fixed point theorem that is not commonly used by economists. Finally, our model offers different implications for the dynamics of job-to-job transitions than existing models of random search.

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1. Introduction

There is broad evidence that job-to-job transitions play an important role in the labour market. The last decade has witnessed a growing literature modeling and estimating firm dynamics, job-to-job and unemployment-to-employment transitions, as well as wage distributions. This literature is broadly coherent with the DMP (Diamond, Mortensen, Pissarides) search paradigm. Most of these contributions (notably [Mortensen and Pissarides, 1994](#)) assume that search is random, and firms cannot use wages as an instrument for fast recruiting.

In the present paper we set up and analyze a model of directed search with identical workers and large and (ex post) heterogeneous firms. In competitive search equilibrium, firms advertise wages and workers choose optimally which firms to

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apply to. On-the-job search is efficient, in the sense that workers' search behavior maximizes the joint income of workers and firms. We obtain a tractable model of on-the-job search, which delivers an efficient allocation of resources, and in which on-the-job search is an optimal response to search frictions and heterogeneous firms.

The equilibrium leans towards a job ladder, where unemployed workers search for low-productivity firms offering low wages, and then gradually advance to higher paid jobs. Productive firms pay higher wages and grow faster than less productive firms. The economic logic underlying the job ladder is that workers with low current wages are the most eager to get a job quickly, while the productive firms are the most eager to get workers quickly. If one side of the market matches quickly, it follows from the matching function that the other side matches slowly. Hence, efficiency requires that the most eager workers (the unemployed) search for the least eager firms (low-productivity firms), while the least eager workers (employed in the second most productive firm) search for the most eager firms (the most productive ones).

In the first part of the paper, we only allow for a finite number of firm types. In the resulting equilibrium, worker search is not completely ordered, in the sense that workers employed in the same firms may search for firms with different productivities. Furthermore, when the number of firm types increases, no clear convergence pattern emerges. We therefore extend the model and allow for a continuum of firm types. In the resulting equilibrium there is a one-to-one correspondence between the productivity of a worker's current employer and of the productivity of the firm she is searching for. Unemployed workers randomize over an interval of low productivity firms.

Our proof of existence of an equilibrium for continuous types relies on Schauders fixed point theorem. We do not employ the commonly used version found in [Stockey and Lucas \(1989\)](#), which requires equicontinuity. Instead we define equilibrium in terms of distribution functions, the distribution of workers over firms and the distribution of applications. Since Helly's selection theorem ensures that distribution functions form a compact and convex set (in the set of all functions on the unit interval), we can apply Schauder's fixed theorem in its general topological formulation. This approach may be of broader interest, since it circumvents the technical complication of equicontinuity and makes Schauders fixed point theorem applicable to a larger class of equilibrium models.

The paper also delivers a method for mapping, continuously, the set of all distribution functions (which may be discontinuous) into a set of continuous distribution functions. As equilibrium in search models (and other models as well) often can be characterized by distribution functions, we believe that our methods may be useful in many applications.

Our model is consistent with some stylized facts regarding job-to-job movements: 1) productivity differences across firms are large and persistent and different productivity level across firms coexist in the labor market, 2) on-the-job search is prevalent and worker flows between firms are large, and 3) more productive firms are larger and pay higher wages than less productive firms. In addition, our model gives rise to empirical predictions that differ substantially from those of existing models of on-the-job search. For instance, the [Burdett and Mortensen \(1998\)](#) model predicts a weak relationship between the wage before the job switch and the distribution of wages after the job switch. More specifically, the wage after successful on-the-job search is a draw from the wage offer distribution truncated at the wage in the previous job. According to our model, workers employed in firms offering relatively high wages (i.e., have high productivity) search for jobs that offer strictly higher wages than do workers employed in firms offering lower wages initially, and thus different workers face different distributions.

There is a substantial literature on job-to-job movements. First, [Davis and Haltiwanger \(1999\)](#) show that job-to-job flows are huge. [Lentz and Mortensen \(2005\)](#) find that reallocation of workers from low- to high productivity firms are important for economic growth. [Postel-Vinay and Robin \(2002\)](#) were among the first to structurally estimating a search model with on-the-job search. Other recent papers on on-the-job search include [Lentz and Mortensen \(2008, 2012\)](#), [Bagger and Lentz \(2014\)](#), [Bagger et al. \(2013\)](#), [Lise and Robin \(2013\)](#), and [Lamadon et al. \(2013\)](#). We deliver an alternative framework, based on directed search, suitable for empirical analysis.

There exist papers with directed on-the-job search. [Moen and Rosen \(2004\)](#) analyze human capital investments in the presence of on-the-job search. [Shi \(2009\)](#) and [Menzio and Shi \(2010, 2011\)](#) study directed on-the-job search. These models have similar structure to our theory in terms of employment contracts, but there are fundamental differences. Most importantly, in these papers firms are identical and differences in productivity are much specific. Furthermore, as firms are identical in the search phase, the equilibrium in Menzio and Shi is block recursive, essentially implying that a zero profit condition applies in all submarkets.

Our key motivating factor is that productivity difference across firms are large and persistent ([Lentz and Mortensen, 2008](#)). Hence, the model should capture this fact. In our model firms productivity are indeed permanently heterogeneous. After sinking a cost K , firms draw productivity y_i and will keep this productivity until they exit the market. Hence a zero profit condition only applies *ex ante*, not when firms are searching for workers. This dramatically changes the nature of equilibrium and breaks the block recursivity of [Menzio and Shi \(2011\)](#). [Delacroix and Shi \(2006\)](#) analyze an urn-ball model of the labor market with on-the-job search, and show that equilibrium is characterized by a job ladder. Again it is assumed that firms are identical. Furthermore, on-the-job search is inefficient, and solely caused by imperfect contracting between workers and firms. Our modeling of firms are similar to that of [Kaas and Kircher \(2013\)](#), but they do not allow for on-the-job search. Finally, our paper is related to [Mortensen and Wright \(2002\)](#), who analyze competitive search equilibrium when workers differ in income during unemployment. Some preliminary results are in [Garibaldi and Moen \(2010\)](#), where we solve a simple equilibrium model with on the job search and two permanently different productivity levels.

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