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# Ranking of Job Applicants, On-the-job Search, and Persistent Unemployment<sup>\*</sup>

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We formulate an efficiency wage model with on-the-job search where wages depend on turnover and employers may use information on whether the searching worker is employed or unemployed as a hiring criterion. We show theoretically that such ranking of job applicants by employment status raises both the level and the persistence of unemployment and numerically that the effects may be substantial. More prevalent ranking in Europe compared to the US (because of more rigid wage structures etc.) could potentially help to explain the high and persistent unemployment in Europe.

Keywords: Efficiency wage, Turnover, Labour mobility, Persistence, Discrimination.

JEL classification: E24, J64.

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## 1. Introduction

When one compares European and US labour markets, several differences are apparent. Unemployment rates are much higher, turnover is much lower, and the adjustment back to equilibrium after a shock is much slower in Europe. While high unemployment may plausibly be blamed on unions and labour market rigidities and low turnover may be due to cultural differences, the last observation is especially intriguing. In several European countries, unemployment has remained high for a long time after it increased due to temporary cyclical shocks - a phenomenon usually called persistence or hysteresis. Adjustment costs and insider-outsider models can explain some persistence, but they can hardly generate the extreme persistence found in the data.

Generous unemployment benefits may make unemployed workers search less and make them less willing to take the jobs they can get. This can explain high unemployment, but seems less plausible as an explanation of the *persistence* of unemployment. While it is true that unemployment persists if some of those laid off due to a negative shock are slow to return to employment, this effect becomes progressively less important as those who became unemployed at the time of the shock find jobs. So this argument cannot explain a persistence of unemployment that is much larger than the average duration of unemployment for individual workers. Thus it seems hard to explain a very high persistence of unemployment focusing on the search behaviour of unemployed workers.<sup>1</sup>

Why is unemployment so persistent in Europe? In this paper we take a new look at this question, emphasizing two aspects of the labour market. The first is the importance of turnover for wage setting. The importance of voluntary turnover is well documented. Holmlund (1984) and Akerlof, Rose and Yellen (1988) report quit rates of around two percent per month for the US, Sweden and Japan, and Boeri (1999) finds that worker flows from one job to another constitute around 50 percent of all hiring in several European economies. Pissarides and Wadsworth (1994) report that around 5 percent of all employed workers in Britain search for a new job and according to Holmlund (1984) about 8 percent of employed workers in Sweden engage in job search during a year. Lane, Stevens and Burgess (1996) show that worker reallocation is two

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<sup>1</sup> This argument is made by Pissarides (1992) and Bean (1994). For example, Ljungqvist and Sargent (1998) assume that workers lose on average 40 percent of their human capital when they become unemployed, and that the replacement ratio is 70 percent. Still they get a very modest amount of persistence in their model; about 1/8 of the shock remains after two years. For a summary of the effects of unemployment insurance see Holmlund (1998).

to three times as great as job reallocation and labour turnover is procyclical because procyclical quits dominate counter-cyclical layoffs (Anderson and Meyer (1994)). McCormick (1988) shows that total separations depend strongly on the number of available vacancies. Survey evidence shows that firms care about turnover. Concerns about hiring and training costs, and loss of competence due to turnover, deter firms from wage cuts (Blinder and Choi (1990), Campbell and Kamlani (1997)).

The second starting point is the observation that unemployed workers are sometimes at a disadvantage in the competition for jobs because some employers prefer to hire already employed workers. Blau and Robins (1990) show that in the US, employed job searchers receive almost twice as many job offers as unemployed searchers with the same search effort. Winter-Ebmer (1991) finds that employment status is used as a screening device for productivity in Austria and Bewley (1999) and Agell and Lundborg (1999) find that a substantial fraction of employers in the US and Sweden view unemployment as a signal of lower productivity.

With search on the job, and costly turnover, the firm's optimal wage should depend on the probability that its employees find other jobs. If it becomes easier to find jobs, firms should raise wages to prevent costly turnover. If, in addition, unemployed workers do not compete for jobs on an equal basis with employed applicants, this makes it easier for employed workers to get the jobs they apply for, so firms should raise wages. In other words, we should expect an *interaction* between turnover, wage setting, and the disadvantage that unemployed workers have in the competition for jobs. More ranking of job applicants should raise wages and make unemployment higher and more persistent.

To formalize this intuition, we formulate a model where a fraction of all employed workers apply for new jobs while maintaining their current jobs. Whether a person applies for a new job or not depends on the wage offered by the current employer, wages elsewhere, and a stochastic job satisfaction factor associated with the current job. When setting wages, firms take the effects on turnover into account. Ranking is introduced by assuming that only employed applicants are hired to some jobs. Ranking increases the probability that an employed worker gets the job he applies for and this makes it optimal for firms to set higher wages. The result is both higher equilibrium unemployment and slower wage adjustment following a shock. High unemployment has only a weak effect on wages because unemployed workers do not compete well with those searching on the job.

Numerical simulations show that the quantitative effects of ranking may be substantial. We also use the model to interpret the different labour market outcomes in the US and Europe. Our simulations point to ranking of job applicants as a potentially important explanation of the high and persistent unemployment observed in many European labour markets.

Phelps (1972), Layard and Nickell (1986) and others<sup>2</sup> have suggested that unemployment persists because unemployed workers have difficulty competing for jobs, but there are few microeconomic formalizations of this idea. The insider bargaining model developed by Blanchard and Summers (1986), Gottfries and Horn (1987) and Drazen and Gottfries (1994) emphasizes the distinction between employed and unemployed workers, but can hardly generate the extreme amount of persistence found in the data.<sup>3</sup> Other related papers are Huizinga and Schiantarelli (1992), Gottfries and Westermarck (1998), and Pissarides (1992). Neither of these papers considers the interaction between on-the-job search, ranking, and wage-setting.<sup>4</sup>

The paper that is most closely related to ours is Blanchard and Diamond (1994). They examine how wages are affected if firms rank job applicants according to the length of unemployment. Wages are determined by Nash bargaining, with the expected utility of a recently laid off worker as threat point. Their result is that ranking affects wage dynamics but has only small effects in the long run. Our analysis differs in several ways. First, we replace Nash bargaining with an efficiency wage model with turnover between jobs. Second, we focus on the relation between employed and unemployed job applicants rather than ranking according to the length of unemployment. Third, while Blanchard and Diamond examine the effects on wages of exogenous movements in employment, both wages and employment are endogenous in our model, so we can solve for employment and calculate unemployment persistence.

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<sup>2</sup> See references in Machin and Manning (1999).

<sup>3</sup> In univariate models of unemployment, the coefficient on lagged unemployment is close to unity for many European countries (see Appendix 2). The Blanchard and Summers (1986) version of the insider bargaining model generates hysteresis, which is an extreme form of persistence, but only because they make very special assumptions concerning union preferences etc. - see the discussion in Blanchard (1991) or Bean (1994).

<sup>4</sup> Pissarides (1992) assumes that long-term unemployment leads to the loss of skills. Firms cannot distinguish long-term and short-term unemployed, so all job seekers have the same chance to get a job. Unemployment is persistent because long-term unemployment implies a deterioration of the average quality of unemployed workers, which makes it less profitable for firms to create vacancies. Thus the mechanisms are quite different from those considered here. Pissarides (1994) introduces on-the-job search into an equilibrium search-matching model, but the interaction with ranking is not explored.

Also, our *results* differ from those of Blanchard and Diamond: ranking has substantial effects not only on the dynamics, but also on the long run levels of wages and employment.<sup>5</sup>

In the next section we briefly explain and motivate our definition of ranking. In Section 3 we present the model and analyze the wage, search and employment decisions, and in Section 4 we examine the level and persistence of unemployment in a symmetric equilibrium. The quantitative effects of ranking are studied in Section 5 and in Section 6 we use the model to discuss potential explanations for the observed differences between European and the US labour markets. We end the paper with a short discussion of key assumptions in the model.

## 2. Why Ranking?

In the analysis below, ranking means that employers sometimes, when choosing between applicants for a particular job, prefer to hire someone who has a job rather than an unemployed worker. We assume that firms rank applicants in this way for some jobs. This definition of ranking raises an important question. Why do firms sometimes prefer to hire already employed applicants?

A natural argument is that the perceived productivity of an unemployed worker may be lower than that of an employed worker because workers lose human capital in unemployment.<sup>6</sup> In the formal model, it is enough that unemployed workers are perceived to be slightly less productive to justify ranking, provided that the wage is the same. Then, as long as there are employed applicants available, unemployed workers will not be hired and the lower productivity is never observed. Equivalently, the training cost may be slightly higher for unemployed workers.

Another possibility is that there are a small number of workers among the unemployed, who are unemployable, but this can only be observed after hiring and training, in which case the worker is fired. If the firm hires an unemployed worker, it runs a small risk that it will pay the training cost in vain and this will be equivalent to a slightly higher hiring cost for *all* unemployed workers. Again, firms will rationally discriminate unemployed workers.

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<sup>5</sup> Two recent papers by Tranaes (2001) and Kugler and Saint-Paul (2003) both study models with turnover where unemployment is taken as a negative signal, but neither derive the implications for wage adjustment and unemployment persistence, which is a main focus of our paper.

<sup>6</sup> See Edin and Gustavsson (2001) for evidence of skill depreciation during unemployment.

All these arguments can be criticized, however, by arguing that the firm could offer different wages for the different groups, each wage corresponding to the expected productivity (net of hiring cost) of a worker in that group. Thus there must be some rigidity in the wage structure that prevents firms from differentiating wages according perceived productivity differences. It seems to be important for firms to have a “company wage policy” which the workers perceive as fair. Unions tend to insist on “equal pay for equal work”, and this prevents wage differentiation based on productivity differences which are not easily observed by workers. Bishop (1987), Campbell and Kamlani (1997) and Bewley (1999) report evidence that wages tend to be equalized for a given type of job. We will not try to explain such wage equalization in the present paper, but we take it as a fact of life. Our purpose is to analyse the *implications* of ranking for aggregate wages and employment.<sup>7</sup>

### 3. Wage, Search, and Hiring Decisions

The model formalizes the idea that job-to-job flows are substantial and firms consider the effects on turnover when they set wages.<sup>8</sup> There are many monopolistic firms and many workers per firm. Labour supply is inelastic: all workers want to work an exogenously given time at the prevailing wage and the labour force per firm is constant and normalized to one. Variables indexed  $i$  refer to an individual firm while variables without index  $i$  are aggregates (averages). The sequence of events in each period is the following:

- i) At the beginning of the period, some of the employed workers leave employment and enter the pool of unemployment. The fraction leaving employment,  $s$ , is exogenously given and represents workers quitting or being laid off for personal reasons etc.<sup>9</sup>
- ii) Monopolistic firms set wages and prices  $w_t^i, p_t^i$ .

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<sup>7</sup> What is important is not that all workers are paid the same wage, but that wage differentials do not fully reflect productivity differentials. Also, we do not allow payments for jobs and bonding arrangements. See Gottfries and Sjöström (2000) and Eriksson (2003) for theoretical analysis of these issues.

<sup>8</sup> The model developed below is a dynamic version of the turnover model with ranking. The turnover version of efficiency wages was developed by Stiglitz (1974), Schlicht (1978) and Salop (1979).

<sup>9</sup> We assume that workers need not quit their current job in order to look for another job, and that those who quit into unemployment do this for other reasons. This assumption is in line with evidence that unemployed workers spend a rather small fraction of their time on job search, so often it is possible – even advantageous – to remain employed while searching for a new job. See Chapter 8 in Layard, Nickell and Jackman (1991) for a review of the evidence.

- iii) Remaining employed workers decide whether to apply for a new job or not. The fraction of employed workers applying for new jobs is denoted  $S_t^i$ . All unemployed workers also apply and each job applicant submits one application to a randomly chosen firm.<sup>10</sup>
- iv) Each firm receives the applications, observes an aggregate demand shock,  $m_t$ , and employs  $n_t^i$  workers. Only employed applicants are hired to some jobs.

Some workers change jobs and are replaced immediately.

We now describe the model and analyze the decisions made by firms and workers, starting with the last stage.

#### *Stage IV: Hiring and Job-to-job Flows*

At stage iv, wages and prices are predetermined. Because of monopolistic competition, price exceeds marginal cost, so firms simply hire the number of workers required to satisfy demand. Ranking means that firms prefer to hire employed applicants. To prevent complete discrimination of the unemployed, and in line with empirical evidence, we assume that ranking applies only to a fraction  $r$  of the job openings in a given period.<sup>11</sup> We assume that there are always enough employed job applicants to fill the jobs, so only employed applicants are hired to those jobs.

As will be explained below, we consider a symmetric equilibrium where all firms set the same wage and hire the same number of workers. Let  $a_t$  be the probability that an employed job searcher finds a job. Then the fraction of employed workers changing jobs is  $S_t a_t$  and the number of previously employed workers quitting to take another job is  $S_t a_t (1 - s) n_{t-1}$ . Firms hire the number of workers they wish to employ minus the workers who remain from last period, taking into account exogenous and endogenous separations, so hiring is  $n_t - (1 - s)(1 - S_t a_t) n_{t-1}$ . Searchers consist of both unemployed workers,  $1 - (1 - s) n_{t-1}$ , and employed workers searching on-the-job  $(1 - s) S_t n_{t-1}$ . We assume that workers do not know for which jobs ranking is applied but send in their applications at random. The probability that an employed searcher gets a job is:

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<sup>10</sup> Whether workers send in one or more applications is less important, but “search intensity” is assumed to be the same for all searchers. Endogenous search intensity would make the model more complicated (see the discussion in the final section).

<sup>11</sup> We may imagine that some firms always rank, but job applicants do not know this, or that some personnel managers rank. Formally, firms are indifferent between ranking and not ranking in the model.



$$a_t = r \frac{n_t - (1-s)(1-S_t a_t)n_{t-1}}{(1-s)S_t n_{t-1}} + (1-r) \frac{n_t - (1-s)(1-S_t a_t)n_{t-1}}{1 - (1-s)n_{t-1} + (1-s)S_t n_{t-1}}. \quad (1)$$

With probability  $r$  the worker applies for a job where only employed searchers are hired and in this case the probability to get a job is hiring divided by the number of employed searchers per firm.<sup>12</sup> With probability  $1-r$  the worker applies for a job where there is no ranking and in this case the probability to get a job is hiring divided by the total number of searchers per firm. Solving for  $a_t$  we get:

$$a_t = \frac{(n_t - (1-s)n_{t-1})(r - (r-S_t)(1-s)n_{t-1})}{(1 - (1-s)n_{t-1})(1-s)S_t(1-r)n_{t-1}}. \quad (2)$$

We see that  $a_t$  is higher if employment is growing and if more firms rank applicants.

### *Stage III: On-the job Search*

At stage III, every worker who remains employed has to decide whether to look for a new job or not. We assume that each worker employed at the beginning of a period draws a number  $\nu$  that determines his job satisfaction from working at his present job in the current period.<sup>13</sup> If an individual worker in firm  $i$  has drawn the number  $\hat{\nu}$ , his utility from staying this period is  $\hat{w}_i^j$ . This number is drawn from a random distribution with cumulative distribution function  $G(\nu)$  which is unimodal with mean  $\bar{\nu}$  and lower support  $\tilde{\nu}$ . To keep the model simple, we assume that every worker makes a new independent draw from  $G(\nu)$  every period.<sup>14</sup> The firm does not observe job satisfaction and sets the same wage for all workers. A worker who switches jobs

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<sup>12</sup> For this equation to make sense there must be more employed job applicants than jobs. In case of a very large positive demand shock, employment in period  $t$  could potentially be so large that there are not enough employed job applicants. To keep the model simple, we disregard this possibility in our theoretical analysis, and check that the inequality is fulfilled for the parameter values and shocks of reasonable magnitude in our numerical simulations below.

<sup>13</sup> Akerlof, Rose and Yellen (1988) emphasize that both wages and non-pecuniary factors influence quit decisions.

<sup>14</sup> The assumption that the gain from switching jobs is purely temporary is made to generate turnover in a simple way. Of course, we would expect “job satisfaction”  $\nu$  to be serially correlated. Allowing for persistence in job satisfaction would make the analysis very complicated because different workers’ would have different levels of job satisfaction and this would affect their propensity to search for jobs. Thus the state of the model would include the distribution of workers across different levels of job satisfaction.

finds out the level of job satisfaction in the new job only after he has taken it. When all other firms set wage  $w_t$  the expected utility from a randomly chosen new job is assumed to be  $\lambda E(v w_t)$ , where  $\lambda$  reflects costs of switching jobs:  $0 < \lambda < 1$ .

There are no costs associated with on-the-job search, so a worker who has drawn  $\hat{v}$  will search for a new job if  $\lambda \bar{v} w_t > \hat{v} w_t^i$ . We assume that the lower support on  $v$  is such that workers never prefer to quit into unemployment. Note that if wages are the same, most workers prefer to stay at the job they have. These assumptions imply that the fraction of workers in firm  $i$  that apply for a new job is

$$S_t^i = Z(w_t^i / w_t) \equiv G(\lambda \bar{v} w_t / w_t^i), \quad (3)$$

where  $Z$  is decreasing and convex when the relative wage is near unity.<sup>15</sup> Note that because there is no cost of search, the decision to search does not depend on the chance to get a job. All searching workers apply for one job each period and submit their applications randomly, so the fraction of workers in firm  $i$  who take a new job is  $Z(w_t^i / w_t) a_t$ .

#### *Stage II: Wage- and Price-setting*

Every worker produces one unit of the good,  $q_t^i = n_t^i$ , and demand for the firm's product is a constant-elastic function of the firm's relative price and aggregate demand:  $q_t^i = (p_t^i / p_t)^{-\eta} m_t / p_t$ . The stochastic "money supply"  $m_t$  represents shocks to aggregate demand. Firms set prices and wages before they observe  $m_t$ .<sup>16</sup>

Labour turnover is costly. For every worker the firm hires, it incurs a hiring cost equal to  $c$  times the average wage,  $w_t$ . We assume that voluntary quits are sufficiently large so that all employment adjustments can be made by variations in

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<sup>15</sup> For a very low relative wage, most workers leave the firm and  $Z$  is concave but this region will not be relevant in equilibrium.

<sup>16</sup> In this section we assume that the wage can be changed at the beginning of every period (month). In Appendix 1 we generalize this to the case when the wage is set for  $N$  periods. There are no overlapping contracts. As is well known, overlapping contracts may generate persistence, but we want to examine how much persistence we get in the model without this additional source of persistence. For an explanation of nominal wage rigidity see Gottfries (1992).

hiring.<sup>17</sup> Then, the number of workers hired is  $n_t^i - (1-s)(1-Z(w_t^i/w_t)a_t)n_{t-1}^i$ . The firm has discount factor  $\beta$  and sets wage  $w_t^i$  and price  $p_t^i$  to maximize:

$$E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} \left\{ (p_{\tau}^i - w_{\tau}^i) n_{\tau}^i - c w_{\tau} [n_{\tau}^i - (1-s)(1-Z(w_{\tau}^i/w_{\tau})a_{\tau})n_{\tau-1}^i] \right\} \quad (4)$$

where  $n_{\tau}^i = (p_{\tau}^i / p_{\tau})^{-\eta} m_{\tau} / p_{\tau}$  and where  $E_t$  is used to denote expectations conditional on whatever information firms have when they set wages and prices for period  $t$ . The individual firm takes  $a_t, p_t$  and  $w_t$  as given and the first order conditions for period  $t$  are:

$$w_t^i : E_t \left\{ -n_t^i - c(1-s)Z'(w_t^i/w_t)a_t n_{t-1}^i \right\} = 0, \quad (5)$$

$$p_t^i : E_t \left\{ (1-\eta)n_t^i + (w_t^i + c w_t - \beta c w_{t+1}(1-s)(1-Z(w_{t+1}^i/w_{t+1})a_{t+1}))\eta \frac{n_t^i}{p_t^i} \right\} = 0. \quad (6)$$

The first condition says that the direct cost of a marginal wage increase equals the reduction in turnover costs associated with a higher wage. The optimal wage depends on the average wage level,  $w_t$ , the hiring cost,  $c$ , and how easy it is to get a job,  $a_t$ .

The pricing decision is complicated by the fact that the marginal cost includes not only the wage and hiring cost this period, but also the reduction of hiring costs the next period if a worker is hired today rather than the next period. The probability that a worker, who is hired today, remains next period depends on the labour market situation the next period. Thus, the firm faces a dynamic optimization problem in its price/employment decision. Fortunately, it is not necessary to solve this dynamic optimization problem to find equilibrium employment, however.

#### 4. The Level and Persistence of Unemployment

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<sup>17</sup> This assumption simplifies the analysis because firms always hire some workers. Without it,  $a_t$ , would sometimes hit the zero lower bound and there would be layoffs. This would complicate the model, but it should not fundamentally alter the conclusions. After a once and for all unexpected shock that throws some workers out of jobs, the dynamic adjustment will still be governed by the same equations.

Since we are interested in aggregate employment, we consider a symmetric equilibrium where all firms enter with the same employment and set the same wage. Then on-the-job search is constant,  $S_t = Z(1) = S$ , and we have from equation (5):

$$E_t[n_t] = \Omega(1-s)n_{t-1}E_t[a_t], \quad (7)$$

where  $\Omega \equiv -cZ'(1) > 0$ .  $\Omega$  is a measure of the upward wage pressure arising because of turnover costs. We assume that  $\Omega(1-s) > 1$ . Substituting (2) into (7), we can determine expected employment as a function of employment in the previous period:

$$E_t[n_t] = f(n_{t-1}) \equiv \frac{\Omega(1-s)n_{t-1}[r - (1-s)(r-S)n_{t-1}]}{\Omega[r - (1-s)(r-S)n_{t-1}] - (1 - (1-s)n_{t-1})S(1-r)}. \quad (8)$$

#### *The Long Run Level of Unemployment*

Setting  $E_t[n_t] = n_{t-1} = n^{ss}$  we can find the steady state employment rate to which the economy would converge if there were no shocks:

$$n^{ss} = \frac{S(1-r) - s\Omega r}{(1-s)[s\Omega(S-r) + (1-r)S]}. \quad (9)$$

For the steady state level of employment to be positive we assume that  $r/(1-r) < S/(s\Omega)$ . This inequality gives a limit to how much ranking our model can take. That  $r$  cannot be too large is most evident if we consider the extreme case when employers hire almost only employed workers. Then employed job searchers have a very good chance to get a job even if there is massive unemployment, so firms raise wages, very few unemployed workers are hired, and employment falls to zero.

To find out how ranking affects the level of employment we differentiate (9) with respect to  $r$  and simplify:

$$\frac{dn^{ss}}{dr} = -\frac{1}{1-s} \frac{(S + s\Omega)s\Omega S}{[s\Omega(S-r) + (1-r)S]^2} < 0. \quad (10)$$

More ranking makes it easier for employed job searchers to get jobs, so firms raise wages and employment falls.<sup>18</sup>

#### *The Persistence of Unemployment*

To get a dynamic equation for employment, note that  $n_t = m_t / p_t$ , so taking expectations we get  $E_t(n_t) = E_t(m_t) / p_t$  and, using (8):

$$n_t = f(n_{t-1}) \frac{m_t}{E_t(m_t)}. \quad (11)$$

)

Because of wage and price rigidity, unexpected shocks to the money supply affect employment, and once employment has changed, this will affect wages and employment in subsequent periods. As a measure of persistence from one period (month) to the next we use the derivative of the function  $f$  evaluated at the steady state level of employment (this equation is written out explicitly in Appendix 1):

$$\rho_m \equiv f'(n^{ss}). \quad (12)$$

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This derivative is positive for reasonable values for the parameters. To understand why employment depends positively on employment in the previous period, imagine that  $m$  falls permanently and unexpectedly starting from the long run equilibrium. This happens after wages and prices have been fixed, so employment falls. In the next period, firms cut their wages, but not so much that employment immediately returns to its steady state value. The reason is that if wages would immediately fall by the same fraction as  $m$ , there would be a large increase in employment, many vacancies, and high turnover. Foreseeing this, each individual firm would have an incentive to cut the wage less than the others in order to reduce turnover. Therefore, the equilibrium solution

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<sup>18</sup> If  $\Omega$  and  $r$  are sufficiently low we get a corner solution with full employment. This can be seen by setting  $\Omega = 1/(1-s)$  and  $r=0$  in equation (9).

must be that wages fall by less than the initial decrease in nominal demand, and employment remains low for some periods after the negative shock.<sup>19</sup>

How does ranking affect the persistence of unemployment? In Appendix 1 we show that ranking increases persistence:

$$\frac{d\rho_m}{dr} > 0. \quad (13)$$

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The intuition behind this result can be understood by relating to the explanation for persistence given above. After a negative shock, the wage will not fall immediately to the new steady state level because, if it did, there would be a relatively large number of vacancies and excessive turnover. Thus wages adjust slowly although the level of unemployment is high. Ranking reinforces this mechanism. When an employed worker has priority for some jobs, his chance to get a job depends less on the stock of unemployment and more on the number of vacancies. When unemployed workers cannot compete well for the jobs, a large stock of unemployment has a weak effect on wages. This slows down wage and employment adjustment after a demand shock.

It should be emphasised that the effect of ranking is not a mechanical effect that arises because employed job searchers take some of the available jobs. Every job switcher leaves a job which is immediately filled, so the number of jobs available for unemployed workers is not directly affected by on-the-job search or ranking. In fact, it is readily verified that  $a''$  is equal to  $(n_t - (1-s)n_{t-1})/(1 - (1-s)n_{t-1})$  - independent of  $r$  and  $S$  for given employment. The effect of ranking on unemployment is due to its effect on turnover, wages, and labour demand.<sup>20</sup>

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<sup>19</sup> Huizinga and Schiantarelli (1992) and Gottfries and Westermarck (1998) make a similar argument but do not consider on-the-job search or ranking.

<sup>20</sup> Burgess (1993) and Anderson and Burgess (2000) discuss congestion effects of on-the job search taking the number of job openings as exogenous. For other references, see Pissarides (2000). Note, though, that e. g. Pissarides (1994, 2000) use the word persistence to mean that unemployment *responds slowly to shocks*. We refer to the fact that unemployment *returns slowly to equilibrium* after a temporary (cyclical) shock.

### Prices and Wages

We have solved for employment without using the first order condition with respect to the price. This was possible because the model is recursive so that we can find expected employment in a period without considering what happens in the product market. This is analogous to static models where the natural rate of unemployment is independent of the position of the aggregate demand curve. Unexpected demand shocks do affect employment, however, because of short-term wage and price stickiness.

To see the relation between wages, prices and employment more clearly, we evaluate (6) in a symmetric equilibrium:

$$1 - \eta + (1 + c)\eta \frac{w_t}{p_t} - \beta c(1 - s)\eta \frac{E_t(w_{t+1}(1 - Sa_{t+1}))}{p_t} - \beta c(1 - s)\eta \kappa_t = 0, \quad (14)$$

where  $\kappa_t$  is the conditional covariance between  $w_{t+1}(1 - Sa_{t+1})$  and  $n_t$  divided by  $p_t E_t(n_t)$ .<sup>21</sup> Solving for the real wage we get what may be called a “quasi labour demand curve” or a “price setting curve”, i. e. the real wage that is consistent with price setting:

$$\frac{w_t}{p_t} = \frac{\eta - 1 + \beta c(1 - s)\eta \kappa_t}{(1 + c)\eta - \beta c(1 - s)\eta E_t((1 - Sa_{t+1})w_{t+1} / w_t)}. \quad (15)$$

- Figure 1 about here -

In Figure 1 we have drawn this price-setting (PS) curve downward-sloping but this is not important for the argument.<sup>22</sup> The wage setting (WS) curve corresponding to equation (8) is vertical: wages are set so that expected employment equals  $f(n_{t-1})$ .<sup>23</sup>

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<sup>21</sup> Recall that wages and prices are set simultaneously before the stochastic demand variable  $m_t$  is observed. In equilibrium, firms realize that all firms are setting the same wages and prices.

<sup>22</sup> We have drawn the price setting curve downward sloping because the expectation in the denominator depends on current employment. If current employment is high, wages are expected to rise and employment to fall. Thus  $E_t(w_{t+1} / w_t)$  is high and  $E_t(a_{t+1})$  is low.

<sup>23</sup> Alternatively, in the price-output space the equation for the aggregate demand curve is  $q_t = m_t - p_t$  and the equation for the aggregate supply curve is  $p_t = E_t(m_t) / f(q_{t-1})$ .

Firms' expectations about the future affect price markups and real wages, but not employment.<sup>24</sup>

## 5. Quantitative Effects of Ranking

Having showed analytically that ranking reduces the level of employment and raises persistence we now ask whether these effects are quantitatively important. To answer this question we take the period to be one month and choose the following numbers for the fundamental parameters:  $s = 0.01$ ,  $S = 0.03$ ,  $\Omega = 4$ . These numbers are in the range of parameter values "fitted" to the US and European labour markets in Section 6 below. Yearly persistence is calculated as  $\rho = \rho_m^{12}$ . Table 1 shows what happens to

unemployment and persistence as we increase the fraction of jobs for which ranking occurs from zero to 40 percent. Without ranking there is some persistence. Ranking has large effects on both the *level* and the *persistence* of unemployment. If ranking is applied for 30 percent of the jobs, unemployment increases more than three times and also it becomes much more persistent.

- Table 1 about here -

Why do we find much larger long run effects than Blanchard and Diamond (1994)? Our interpretation is the following. Blanchard and Diamond assume that the wage is set according to the Nash bargaining solution where the "threat point" is taken to be the situation if the employed worker was to become unemployed.<sup>25</sup> In their model, ranking has two competing effects on the threat point utility. If an employed worker were to become unemployed, his chance to find a new job soon would be much better since he would be "first in line" for new jobs, but on the other hand he runs a small risk of becoming long-term unemployed himself, and then he will be worse off by ranking. The simulations made by Blanchard and Diamond show that unless workers are very myopic these two effects almost cancel and the net effect of ranking on the wage is small.<sup>26</sup>

In our model the worker can continue to work at his old job if he does not get the job he applies for. Since employed job-searchers do not risk becoming long-term

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<sup>24</sup> From (7) and (15) we see that  $r$  does not affect the long run levels of  $a$  and  $w/p$ . Hence the profit share does not depend on  $r$ .  $\Omega$  and  $s$  do affect  $w/p$ , but by a very indirect channel.

<sup>25</sup> See Gottfries and Westermarck (1998) for a criticism of this way of modeling wage bargaining.

<sup>26</sup> Similar results have been obtained in other models; see Machin and Manning (1999).



unemployed the second effect does not appear. Therefore, ranking has an unambiguous and strong effect on the long run levels of wages and employment.

### *Effects of Individual Parameters*

In Table 2 we report the effect on unemployment and persistence as we vary one parameter at the time, starting from a baseline case where 25 percent of the firms rank applicants.

- Table 2 about here -

In order to understand the effects of changes in the parameters, it is important to realize that employment is determined by labour demand, so if employment falls, it is because nominal wages increase, and conversely. Since wages depend on the chance to get a job, we can infer what happens to employment by considering how the chance to get a job is affected by the parameter change for a given level of employment.

A higher exogenous *flow into unemployment* ( $s$ ) implies that for a given level of employment there will be more job openings, it will be easier for job applicants to get jobs. Firms therefore raise wages, unemployment increases, and persistence also increases. An increase in *on-the-job search* ( $S$ ) means that there are more applicants for jobs, particularly for the ranking jobs, so the chance to get a job falls, firms reduce wages, employment increases, and there is less persistence.<sup>27</sup> An increase in *wage pressure* ( $\Omega$ ) obviously raises wages and leads to higher unemployment. It also makes unemployment more persistent. *Ranking* ( $r$ ) has the same qualitative effect as wage pressure, but from Table 2 we see that ranking has a relatively stronger effect on persistence. Intuitively, an increase in  $r$  not only raises the probability that employed job-searchers find jobs, but also makes this probability depend more on the number of job openings and less on the unemployment rate.

### *Medium Term Wage Contracts*

In the numerical simulations above, we took the period to be one month and we assumed that wages were changed every month. In practice wages are changed less frequently. Since wage contracts themselves contribute to persistence, it is important to

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<sup>27</sup> It may appear counterintuitive that more on-the-job search implies lower unemployment. Won't employed job searchers take jobs, which would otherwise be given to unemployed workers? In our model, this is not true because every job switcher leaves a new job opening, which is filled immediately. If there was some delay in filling jobs, more job search would imply that more jobs were vacant, but this should be a small effect.

compare these two sources of persistence and to examine the interaction between them.<sup>28</sup> Table 3 shows yearly persistence ( $\rho$ ) when wage contracts extend for 1, 12 or 24 months for different levels of ranking.<sup>29</sup> As expected, persistence increases, but the effect is fairly modest compared to the effect of ranking. With  $r$  equal to 0.3, the speed of adjustment of employment is so low that medium term wage contracts add very little to persistence.<sup>30</sup>

- Table 3 about here -

## 6. A Tentative Explanation of the Differences between Europe and the US

An interesting question is whether the mechanisms discussed above could potentially explain the observed differences between European and US labour markets. To answer this question we investigate what the values of the fundamental parameters have to be if the model is to reproduce key labour market statistics for each of the labour markets in the US, Germany and France.<sup>31</sup> Our purpose here is not to test the model, but simply to ask whether the mechanisms discussed here could *potentially* explain the dramatic differences that we see between labour markets in different countries.

We take the period to be one month and the length of wage contracts to be 12 months in all three countries. There are four fundamental parameters in the model: the fraction of employed workers leaving to unemployment in each period,  $s$ , the fraction of employed workers that apply for a new job each period,  $S$ , wage pressure,  $\Omega$ , and the fraction of jobs for which firms rank applicants,  $r$ . While  $s$  can be measured reasonably well we lack direct measures of the other parameters. However, we do have estimates of the following three empirical magnitudes: the fraction of employed workers changing jobs,  $Sa$ , the fraction of the workforce that is unemployed,  $u$ , and the persistence of unemployment,  $\rho$ . Estimates of these magnitudes obtained by Blanchard and Diamond (1990), Burda and Wyplosz (1994), Boeri (1999) and others are reported

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<sup>28</sup> Also, the importance of unexpected shocks is much greater when wages are fixed for longer periods.

<sup>29</sup> Parameters  $s$ ,  $S$  and  $\Omega$  are set as before. See Appendix 1 for derivation.

<sup>30</sup> We consider wage contracts that fix one wage for the whole contract period. In practice, union contracts that extend beyond one year typically specify one wage for each year and hence they are less rigid than the 24 months wage contract considered here. The one-year wage contract seems most relevant.

<sup>31</sup> We think of Germany and France as examples of European economies with high and persistent unemployment. We choose not to look at the Scandinavian countries since centralized or coordinated wage setting differs in fundamental ways.

in the first part of Table 4. Obviously, the exact numbers can be questioned, but our simulations are only meant to illustrate the importance of various mechanisms.

In all three countries, the flow between jobs is of the same order of magnitude as the flow into (and out of) unemployment but the flows in Europe are much smaller - between one quarter and half the rates observed for the US. Unemployment is higher and much more persistent in Europe. We now ask the following question: are there plausible values of the fundamental parameters  $S$ ,  $\Omega$ , and  $r$  such that  $Sa$ ,  $u$  and  $\rho$  match the empirical estimates? Since we have three free parameters and three observable magnitudes, we can just identify the values of the fundamental parameters using the steady state equations in our model. The implied values for  $S$ ,  $\Omega$  and  $r$  are presented in the second part of Table 4. At the bottom of the table we also report the implied chances for employed and unemployed job-searchers to get a job in steady state. We see that the observed smaller worker flows, higher unemployment rates and higher persistence in Europe can be “explained” by a combination of less on-the-job search, higher wage pressure, and more ranking in Europe compared to the US.<sup>32</sup>

- Table 4 about here -

Why do we get this result? Consider the difference between the US and France! First,  $s$  is lower in France and since job-to-job flows are much smaller in France, it seems reasonable that there is also less on the job search in France. But simulations with the model show that these lower turnover rates by themselves should imply *lower* unemployment and *less* persistence compared to the US. Thus, we have to find the explanation for the high and persistent unemployment in Europe among the other two factors: wage pressure and ranking. Both these factors tend to raise the level and the persistence of unemployment, but as we saw in Table 2, ranking has a relatively stronger effect on persistence.<sup>33</sup> This is why the simulation points to more prevalent ranking as a potential explanation of the much higher persistence observed in Europe.

Is this reasonable? Unfortunately, the wage pressure ( $\Omega$ ) and ranking ( $r$ ) parameters do not have any obvious empirical counterparts. We did not allow for union bargaining in our model, but since unions tend to raise wages we can, informally, think

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<sup>32</sup> Our assumption that there are enough employed job searchers is fulfilled for all countries. For France, 1.2 percent of the jobs are filled every period and 2.9 percent of the employed workers search on the job. This leaves room for a 1.7 percent unexpected increase in employment within a month without running out of employed applicants to the ranking jobs.

<sup>33</sup> Put differently, if we increase wage pressure only until unemployment reaches the level observed for France, we get less persistence than what we observe empirically.

of them as a factor that adds to wage pressure in this model. Thus a high value of  $\Omega$  may be due to strong unions in Europe.<sup>34</sup> As concerns ranking,  $r$ , it is not easy to measure, but in our view, there are good reasons to expect more ranking in Europe. First, it is easier to fire a worker in the US compared to most European countries. This should make US firms more willing to take the risk and hire a worker of uncertain quality. Second, wages structures are likely to be more rigid in Europe. Unions typically tend to compress wage distributions, especially within groups with similar jobs and qualifications, and insist on wage differentials being based on objective and verifiable criteria: “equal pay for equal work”.<sup>35</sup> Thus it seems likely that employers in Europe find it more difficult to differentiate wages according to perceived productivity differentials compared to the US, where unions are nonexistent in most sectors. Consistent with this view, there is evidence that workers who are laid off in Europe get a smaller wage reduction compared to the previous job compared to US workers *if* they get a new job.<sup>36</sup> Of course, their chance to get a new job is much smaller.

## 7. Discussion

Our main purpose has been to show that ranking is a potential reason for high and persistent unemployment. If unemployed workers cannot compete well for the jobs, unemployment will have a weak effect on wages, unemployment will be high, and the return to equilibrium will be slow.

Our model emphasizes the demand side of the labour market. There is excess supply in the labour market and there are no matching frictions which prevent firms from immediately hiring the workers they want; unemployed workers are ready to take any job they can get. Presumably, we could add some frictions without overturning the conclusions, but it is essential to our argument that hiring firms typically face a *choice*

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<sup>34</sup> Gottfries and Westermarck (1998) develop a wage bargaining model where the union wage turns out to be equal to the “efficiency wage” times a “union markup factor”. This has approximately the same effect as an increase in  $\Omega$  in the present model. Unfortunately, the dynamic nature of the present model makes explicit treatment of bargaining technically complicated.

<sup>35</sup> This role of unions is strongly emphasized by Freeman and Medoff (1984); see also Freeman (1982). For more general evidence that unions tend to equalize wages for their members, see Zweimuller and Barth (1994), Blau and Kahn (1996, 1999), Hibbs and Locking (2000). Westermarck (1999) develops a union formation model where unions tend to compress wage differentials.

<sup>36</sup> Classical papers are Gibbons and Katz (1991) and Jacobson, Lalonde, and Sullivan (1993). Burda and Mertens (2001) review the evidence and report evidence for Germany. See also Grund (1999) and Bender et al. (1999).

between several job applicants, some of whom are employed. We view this as a realistic feature of the model.

Quits into unemployment are taken as exogenous and search is modelled in a very simple way. There are no costs of search, so unemployed workers always search and employed workers always search if they would like to change jobs. Searchers always take the jobs they are offered. Since both quits into unemployment and search by unemployed workers are taken as exogenous, unemployment benefits do not matter. With endogenous quits and search decisions by unemployed workers, there would be a role for unemployment benefits affecting unemployment.<sup>37</sup> The model would become much more complicated because of the forward-looking aspects of quits and search.<sup>38</sup> It is not clear how persistence would be affected, however.

We did not explain why some firms prefer to hire employed job applicants. Instead, our purpose was to examine the consequences of such behaviour. The questionnaire studies quoted in the introduction suggest that ranking occurs, but to find out whether it is really important, we need more direct evidence on the hiring strategies of firms and the magnitude and effectiveness of on-the-job search. If our model of the labour market has any relevance, on-the-job search and ranking are very under-researched areas of labour economics.

## Appendix 1: Derivation of Selected Expressions

*Effect of ranking on persistence:* Inserting (2) in (7) we get:

$$E[n_t] = \Omega \frac{(E_t(n_t) - (1-s)n_{t-1})(r - r(1-s)n_{t-1} + (1-s)Sn_{t-1})}{(1 - (1-s)n_{t-1})S(1-r)}.$$

Implicit differentiation of this expression and some simplification gives us:

$$\rho_m \equiv \left. \frac{dE_t(n_t)}{dn_{t-1}} \right|_{n=n^{SS}} = \frac{\Psi - s(1-s)Sn^{SS}}{\Psi},$$

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<sup>37</sup> Several empirical studies find statistically significant effects of benefits on exit rates from unemployment, but in most cases the effect is small; see Layard, Nickell and Jackman (1991) and Holmlund (1998) for reviews.

<sup>38</sup> See Ljungqvist and Sargent (1995) for a model with endogenous quits.

where  $\Psi = (1-s)(r(1-(1-s)n^{ss}) + (1-s)Sn^{ss})(1-(1-s)n^{ss})$ . Differentiating with respect to  $r$  we get:

$$\frac{d\rho_m}{dr} = \frac{1}{\Psi^2} \left[ -\Psi s(1-s)S \frac{dn^{ss}}{dr} + s(1-s)Sn^{ss} \frac{d\Psi}{dr} \right].$$

It is easily verified that  $\Psi$  and  $d\Psi/dr$  are both positive. Since we have shown that  $dn^{ss}/dr$  is negative, this means that  $d\rho_m/dr$  must be positive.

*Medium Term Wage Contracts:* For concreteness, let the period (t) be one month and assume that wages are changed in January each year ( $N=12$ ). To avoid some technical complications, we assume that the firm has to choose one employment level for the whole year after it has observed the shock for the current year, but turnover occurs throughout the year. For simplicity we ignore discounting within the year. Now the efficiency wage condition corresponding to (5) becomes:

$$E_T(Nn_T^i) = -(1-s)cZ'(w_T^i/w_T)E_T(a_{1T}n_{T-1}^i + (N-1)a_{2T}n_T^i),$$

where  $T$  is a time index for years,  $E_T$  denotes the expectation conditional on information available when firms set wages for year  $T$ ,  $a_{1T}$  is the probability to get a job in the first period of the wage contract (in January) and  $a_{2T}$  is the probability to get a job in the remaining periods (February-December). Considering a symmetric equilibrium, defining  $\Omega$  as before, and using (2) we get:

$$NE_T(n_T) = \Omega(1-s)E_T\left(\frac{n_T - (1-s)n_{T-1}(r - (1-s)(r-S)n_{T-1})}{(1 - (1-s)n_{T-1})(1-s)S(1-r)} + \right.$$

$$\left. (N-1)\frac{sn_T(r - (1-s)(r-S)n_T)}{(1 - (1-s)n_T)(1-s)S(1-r)}\right) \approx \Omega(1-s)\frac{E_T(n_T) - (1-s)n_{T-1}(r - (1-s)(r-S)n_{T-1})}{(1 - (1-s)n_{T-1})(1-s)S(1-r)} +$$

$$\Omega(1-s)(N-1)\left[H(E_T(n_T)) + \frac{H''(E_T(n_T))}{2}\sigma^2\right]$$

where  $H(x) \equiv [sx(r - (1 - s)(r - S)x)] / [(1 - (1 - s)x)(1 - s)S(1 - r)]$ . Here we have used a Taylor approximation to the function  $H(x)$ ,  $H''(x)$  denotes the second order derivative,  $\sigma^2$  denotes the variance of employment and we have disregarded terms involving higher moments of the distribution.

## Appendix 2: Data

### *The flow into unemployment (s):*

For the US economy we use values from Blanchard and Diamond (1990). The data are Abowd-Zellner adjusted gross flow series, which are seasonally adjusted data from CPS studies. The data set covers the period January 1968 to May 1986 and gives us monthly figures. The flow to/from unemployment averages 1.4 million per month. To get this in fractional form we divide it with the average stock of employment taken from the CPS, which is 93.2 million. The result is a flow from employment to unemployment equal to 1.5 percent of employment. For the continental European economies we use data from Layard, Nickell and Jackman (1991) based on OECD sources. These data measure the total inflow into unemployment so it includes flows from out-of-the labour force into unemployment but it also excludes workers who flow in and out of unemployment very quickly. For Germany they report an inflow rate into unemployment of 0.4 percent monthly for the period 1986-88. For France the corresponding flow is 0.6 percent.

*The flow from job-to-job (Sa):* Data on this flow is generally of lower quality compared to data for the flows discussed above. Since there do not exist any direct studies of this flow we instead have to rely on approximations from other data. This is often done by using series of separations and new hires.

For the US economy we continue to use Blanchard and Diamond (1990) as our data source. They conclude that job-to-job movements represent 60 percent of quits in the manufacturing sector from 1968-88. Furthermore, they approximate quits to 0.401 million out of 19.739 million employed workers for the period 1968-81. This implies a fraction of job-to-job movements of 0.012. This figure is confirmed by Akerlof, Rose and Yellen (1988) who report a monthly quit rate from 1948-81 of around 2 percent. For the continental European economies we have had some problems obtaining accurate data. We have found two principal data sources; Burda and Wyplosz (1994) report data for 1987 from national statistics and Boeri (1999) who report data from the year 1992. Boeri gets his data by taking the annual hiring rate and subtracting all

annual inflows into employment from unemployment and inactivity to obtain an employment to employment flow. For Germany, Burda and Wyplosz report a job-to-job flow of 0.0797 million per month implying a fraction of  $0.0797 / 27.070 = 0.003$ . For France the corresponding figures are 0.0358 million and  $0.0358 / 15.685 = 0.002$ . These are extremely small numbers compared to the US. Boeri, on the other hand, reports corresponding flow rates of 0.0095 for Germany and 0.0073 for France. This means that around 60 percent of all hiring in Germany as well as 50 percent of hiring in France are job-to-job flows. Although the figures cover different time periods it is puzzling that they diverge so markedly.<sup>39</sup> In the simulation we assume that 50 percent of hiring in both Germany and France is job-to-job flows and thus we assign the same numerical value to the job-to-job flow as to the flow from unemployment to employment, i.e. 0.004 for Germany and 0.006 for France.

*Unemployment rate ( $u$ ):* For the US we use the above mentioned average stocks from the CPS for the time period 1968-86 of 93.2 million employed and 6.5 million unemployed workers. This gives us an unemployment rate of 0.07. For the European economies OECD (1999) reports an average unemployment rate between 1986-96 of 8 percent for Germany and 10.6 percent for France.

*Persistence ( $\rho$ ):* Different authors use very different techniques to estimate persistence and this means that it is difficult to compare different studies. Some studies estimate persistence in simple autoregressive models while some newer studies use the unobserved components (UC) technique. All studies conclude that persistence is higher in the European labour markets. Two similar studies using standard econometrics are Blanchard and Summers (1986) and Alogoskoufis and Manning (1988).<sup>40</sup> The former estimate the persistence of unemployment with yearly data for a number of countries including a time trend and their estimates of  $\rho$  are 0.36 for the US, 0.94 for Germany and 1.04 for France. The second study, also with a time trend included, report estimates for the US 0.48, Germany 0.94 and France 1.04. In our calibration below we set  $\rho$  to 0.36 for the US and 0.80 for Germany and France. This means that we follow Blanchard-Summers but adjust the European values downwards. We do this partly because  $\rho$  may easily be overestimated if there are long-term structural changes

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<sup>39</sup> A potential explanation for the difference can be the fact that Boeri uses measures consisting of point-in-time observations that are 12 months apart and therefore does not take into account events occurring within the 12-month period between observations. This can lead to an overstatement of job-to-job flows.

<sup>40</sup> An alternative way of estimating persistence is used in Assarsson and Jansson (1998) and Jaeger and Parkinson (1994)



affecting the natural rate of unemployment, and partly to avoid pushing the model to very extreme values.

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Table 1  
The Effect of Ranking on the Level and Persistence of Unemployment

	$u$	$\rho$
$r=0.0$	0.029	0.03
$r=0.1$	0.040	0.10
$r=0.2$	0.061	0.30
$r=0.3$	0.108	0.64
$r=0.4$	0.370	0.96

Table 2  
Effects of a 20% increase in each parameter in an economy with ranking.

	$s$	$S$	$\Omega$	$r$	$u$	$\rho$
<b>Baseline case</b>	<b>0.010</b>	<b>0.030</b>	<b>4.00</b>	<b>0.25</b>	<b>0.078</b>	<b>0.45</b>
$s$ increases	<b>0.012</b>	0.030	4.00	0.25	0.110	0.56
$S$ increases	0.010	<b>0.036</b>	4.00	0.25	0.069	0.36
$\Omega$ increases	0.010	0.030	<b>4.80</b>	0.25	0.112	0.62
$r$ increases	0.010	0.030	4.00	<b>0.30</b>	0.109	0.64

Table 3  
Yearly persistence ( $\rho$ ) with one-month, one-year and two-year wage contracts

	$N=1$	$N=12$	$N=24$
$r=0.0$	0.03	0.19	0.32
$r=0.1$	0.10	0.28	0.41
$r=0.2$	0.30	0.44	0.53
$r=0.3$	0.64	0.69	0.72
$r=0.4$	0.96	0.96	0.96

Table 4  
Observable magnitudes and implied values for the parameters

	Parameter	US 1968-86	Germany 1986-88	France 1986-88
<i>Empirical estimates:</i>				
Separations to unemployment	s	0.015	0.004	0.006
Job-to-job flow	Sa	0.012	0.004	0.006
Unemployment rate	u	0.07	0.08	0.106
Persistence	$\rho$	0.36	0.80	0.80
<i>Fitted parameter values:</i>				
On-the-job search	S	0.042	0.025	0.029
Wage pressure	$\Omega$	3.540	6.174	4.855
Ranking	r	0.185	0.364	0.383
<i>Implied chance to get a job:</i>				
Probability if employed	a	0.29	0.16	0.21
Probability if unemployed	a <sup>u</sup>	0.17	0.04	0.05

Note: See Appendix 2 for definitions and sources.

Figure 1. Employment and the real wage.

