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# The duration of unemployment as a signal

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**Abstract**

A model is studied in which the unemployment duration of job applicants affects firms' hiring decisions. The equilibrium wage offered to applicants is decreasing in their unemployment duration. A fraction of the workers whose unemployment spell exceeds a critical length withdraws from the labor market.

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## 1. Introduction

Frequently, firms are unable to accurately determine whether job applicants meet their skill requirements without incurring considerable costs. Firms thus have an incentive to use any signal which can help them in their recruitment decisions. In this respect, information on the length of the job applicants' unemployment spells is useful, because this information is easily available, and because workers with long unemployment spells are typically less employable than workers with shorter spells, as workers who meet the job requirements of a high proportion of firms are likely to leave unemployment relatively quickly.

The model presented in this paper focuses on this signaling role of unemployment duration. Although, in the model, the productivity of a given worker is unaffected by unemployment, the signaling role of the unemployment duration implies that, in equilibrium, the wage offered to jobless workers is decreasing in the length of their unemployment spell. If the wage falls sufficiently low for long unemployment spells, then a fraction of the jobless (and possibly all jobless) stop searching for jobs once they reach a critical unemployment duration. This critical duration is positively related to market sector productivity. The model is consistent with empirical

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evidence that the reservation wage of the jobless, the intensity of job search and the probability of leaving unemployment are decreasing in the unemployment duration. [1]

## 2. The model

### *2.1. Preferences, technology and the information structure*

The model assumes a continuum of workers and free entry of firms. There are two types of workers, denoted A and B. The probability that a random type A worker meets the skill requirements of a random firm (this probability will be denoted by $p^A$) is greater than the corresponding probability for a type B worker ($p^B$), i.e. $p^A > p^B$. This is the only difference between the two types. Regardless of his type, the output of a worker in a given firm is $y > 0$ per period if the worker meets that firm's skill requirements and output is zero otherwise. A firm only hires a worker if that worker meets its skill requirements. A jobless worker has a non-market productivity which equals $\omega < y$. Time is continuous. For an exogenous reason (death) workers withdraw from the labor force at the rate $z > 0$ (i.e. the probability that a given worker dies during a short time interval of length $\Delta$ is $z\Delta$). There is a continual inflow of new workers into the economy and the size and the composition (between type A and type B workers) of the total labor force is constant. All workers are born jobless.

A firm can costlessly determine the length of the unemployment spell of a given worker. In addition, it can accurately determine the skills of an unemployed worker, but only by interviewing (testing) the worker. A firm bears a cost $c > 0$ for each interview which it conducts.

Firms which are willing to employ duration $\tau$ jobless announce the wage at which they accept to hire these workers, conditional on the outcome of an interview. All employment contracts are signed for the life time of the worker and the wage rate is constant over the entire employment period.

Workers face an exogenous constraint on the number of job applications which they can make. At any given point in time, an exogenous random mechanism determines which workers can make a job application at that instant. It is assumed that, with probability $\Delta$, a worker gets the opportunity to make a job application during a short time interval of length $\Delta$. Hence a jobless worker has the opportunity to make one job application, on average, per period of unit length.

Workers do not know which firms require the specific skills which they possess. Hence they randomly apply for jobs at firms offering to pay the highest wage rate to workers with their duration. In what follows, $w(\tau)$ denotes the highest wage rate offered to the duration $\tau$ jobless.

Workers and firms are risk neutral and they use a constant discount factor $i$. For a firm, the expected present value of the profits from employing a worker at a salary $w$ is $(y - w)/(z + i)$ (recall that $z$ is the death rate of the workers). Hence the expected gain for a firm from interviewing a worker with unemployment duration $\tau$ is $\pi(\tau)(y - w(\tau))/(z + i) - c$, where $\pi(\tau)$ is the probability that the worker meets the skill requirements of the firm.

[1] See Kasper (1967), Kiefer and Neumann (1979), Layard et al. (1991) and Nickell (1979). Work by Lockwood (1991), Berkovitch (1988), Viswanath (1989) and Blanchard and Diamond (1990) has also studied models in which firms condition their hiring decisions on the length of the unemployment spells of job applicants. The present model was developed independently of that work [see Kollmann (1986)]. The present paper seems closest to Lockwood (1991), who also considers a model with a cut-off unemployment duration, but numerical simulations suggest that in that model the critical duration is countercyclical, i.e. *decreasing* in labor productivity (also, the wage does not depend on the unemployment duration).

A jobless worker with duration $\tau$ does not want to get a job unless $w(\tau) \geq \omega$ holds. Hence, no duration $\tau$ jobless is hired unless $\pi(\tau)(y-\omega)/(z+i) - c \geq 0$, i.e. unless

$$\pi(\tau) \geq c(z+i)/(y-\omega) \equiv \pi^{\min} . \tag{1}$$

Let $\Pi(\tau)$ denote the value of $\pi(\tau)$ which obtains in an economy in which all jobless workers with durations $\tau' \leq \tau$ use every opportunity to make job applications. We have

$$\Pi(\tau) = \{ap^{A} \exp(-p^{A}\tau) + (1-a)p^{B} \exp(-p^{B}\tau)\} / \{a \exp(-p^{A}\tau) + (1-a) \exp(-p^{B}\tau)\} , \tag{2}$$

where $a$ is the proportion of type A workers among the newborn workers. [2] $p^{A} \neq p^{B}$ implies that $\Pi(\tau)$ is decreasing in $\tau$ [note that $\lim_{\tau \to \infty} \Pi(\tau) = p^{B}$].

It will be assumed that

$$p^{B} < \pi^{\min} < \Pi(0) . \tag{3}$$

$p^{B} < \pi^{\min}$ implies that if there only existed type B workers in this economy, then no worker would ever be interviewed. Condition (3) guarantees that there exists an unemployment duration $\tau^*$ such that

$$\Pi(\tau^*) = \pi^{\min} . \tag{4}$$

*2.2. Equilibrium*

When (3) holds, than all jobless workers whose unemployment spells are shorter than $\tau^*$ use every opportunity to make job applications [the proofs of this and the following statements are presented in the working paper version of this paper (Kollmann (1993)]. Hence, for a firm, the probability that a random job applicant with unemployment duration $\tau < \tau^*$ meets its skill requirements equals $\pi(\tau) = \Pi(\tau)$. Free entry of firms ensures that the expected gain to firms from interviewing workers with durations $\tau < \tau^*$ is zero, i.e. $\Pi(\tau)(y - w(\tau))/(z+i) - c = 0$ holds for $\tau < \tau^*$. As $\Pi(\tau)$ is decreasing in $\tau$, this implies that $w(\tau)$ (and hence also the reservation wage of jobless workers) is decreasing in $\tau$ (for $\tau < \tau^*$). The intuition for this is simple: type A workers tend to find jobs more rapidly than type B workers; hence a firm that interviews workers with short unemployment spells is more likely to find workers who meet its skill requirements than a firm that interviews workers with longer unemployment spells. Therefore, the wage rate consistent with zero expected gains from interviewing workers is lower for workers with longer unemployment spells.

$w(\tau)$ approaches the non-market sector productivity $\omega$ and $\pi(\tau)$ approaches $\pi^{\min}$ as the unemployment duration approaches $\tau^*$. Figure 1 plots the wage schedule $w(\tau)$ [the figure assumes $w(\tau) = \omega$ for $\tau \geq \tau^*$; see the discussion below] and it also illustrates the determination of the critical duration, $\tau^*$.

In equilibrium, it has to be the case that a positive fraction of the jobless whose unemployment duration exceeds $\tau^*$ stop applying for jobs. To see why this is so, assume that none of these

[2] Let $A(\tau)$ [$B(\tau)$] be the measure of type A (B) jobless with duration $\tau$. We have $\Pi(\tau) = (p^{A}A(\tau) + p^{B}B(\tau))/(A(\tau) + B(\tau))$. When type $j$ workers use every opportunity for job applications, then the proportion of type $j$ workers who find a job or who die during a time span of length $\Delta$ is $(z + p^{j})\Delta$. Hence $A(\tau) = A(0) \exp(-(z + p^{A})\tau)$, $B(\tau) = B(0) \exp(-(z + p^{B})\tau))$ holds when workers with durations $\tau' \leq \tau$ use every opportunity to make job applications.

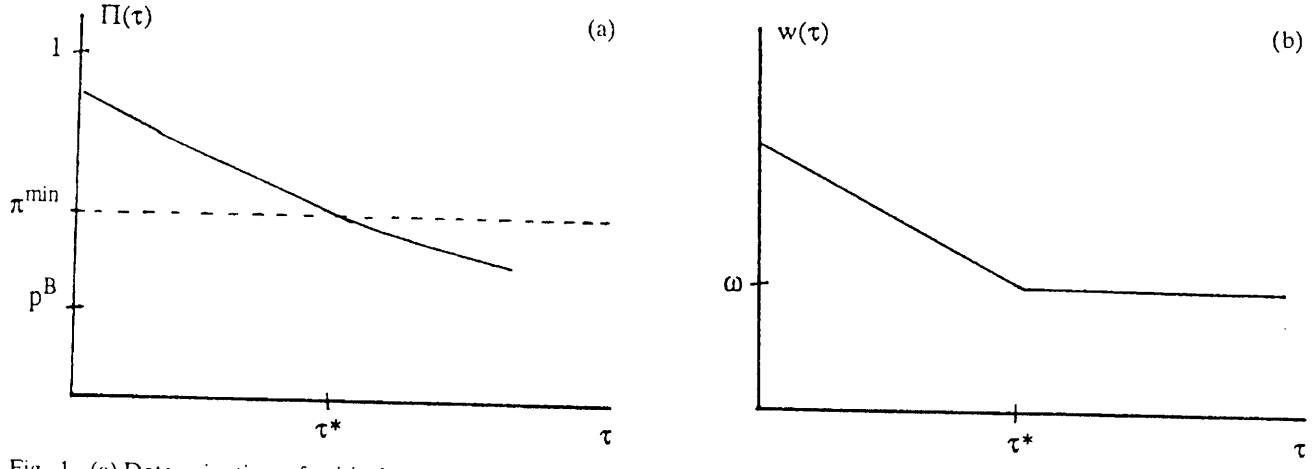


Fig. 1. (a) Determination of critical unemployment duration $\tau^*$ [see (4)]. (b) Wage rate.

jobless withdrew from the job market; $\pi(\tau)$ would then be driven below $\pi^{min}$ and $w(\tau)$ would fall below $\omega$ for $\tau > \tau^*$, and thus it would not be optimal for the long-term jobless to continue searching for jobs.

In this sense, the model captures the empirical finding that the intensity of job search and the probability of switching from unemployment to employment are smaller for the long-term unemployed than for workers with short unemployment spells.

However, the model does not uniquely pin down the behavior of the jobless workers with durations $\tau \geq \tau^*$. One possibility is that $w(\tau) = \omega$ holds for $\tau \geq \tau^*$, [3] which implies that jobless workers with these durations are indifferent between applying for jobs and not applying. Hence one possible equilibrium is that all jobless with durations $\tau \geq \tau^*$ withdraw from the job market. However, there exist other equilibria in which fractions of both types of jobless workers with durations $\tau \geq \tau^*$ stay in the job market [the fractions have to satisfy the restriction that $\pi(\tau) \geq \pi^{min}$ holds for $\tau \geq \tau^*$, because otherwise firms would not be willing to interview job applicants with these durations].

If we, realistically, assumed that the market sector productivity of a jobless worker is negatively related to $\tau$, then all jobless exceeding a critical duration would withdraw from the job market (this would be the case, even if the negative relation between $y$ and $\tau$ were very weak). Hence the symmetric equilibrium in which all workers with durations $\tau \geq \tau^*$ withdraw from the market seems to be the most appealing equilibrium.

We see from (1) and (4) that an increase in the market sector productivity $y$ raises the critical duration $\tau^*$. Because the model does not uniquely pin down the behavior of the jobless for $\tau \geq \tau^*$, it does not yield a definite relation between $y$ and total employment; however, it is easy to see that if all workers with durations $\tau \geq \tau^*$ withdraw from the job market, then unambiguously employment rises when $y$ increases. [4]

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[3] It can be shown that, in equilibrium, $w(\tau) \leq \omega$ has to hold for all $\tau \geq \tau^*$.

[4] Kollmann (1986) provides a detailed analysis of the dynamic effects of productivity shocks in the model.

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