IZA DP No. 27

Transition from School to Work: Search Time and Job Duration

Espen Bratberg
Oivind Anti Nilsen

December 1998

Transitions from school to work: Search time and job duration

Espen Bratberg
Øivind Anti Nilsen

Discussion Paper No. 27
December 1998

IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-201
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 27
December 1998

ABSTRACT

Transitions from school to work: Search time and job duration[a, b]

We consider the early labour market experience of young persons. Using a large data sample of Norwegian individuals finishing education in 1989-91, we analyse the transition from school to work and the duration of the first job. We allow the search duration, the accepted wage, and the job duration to be connected in a system of simultaneous equations which is estimated by maximum likelihood. The empirical evidence suggests that individuals with higher levels of schooling get jobs more quickly, and also have longer durations of their first jobs. Apprentices have shorter search periods and stay in their jobs longer than other individuals at the same educational level. Females appear to have lower reservation wages when entering the labour market (shorter search time and lower wages). They also stay in the first job longer than males do. The search duration and the accepted wage affect job duration positively, but the estimated covariance terms suggest unobserved factors working in the opposite direction.

JEL Classification: I21, J31, J64, C34, C41
Keywords: School-to-work transition, search time, wages, job duration

Espen Bratberg
Øivind Anti Nilsen
University of Bergen
Department of Economics
Fosswinckelsgt. 6
N-5007 Bergen
Norway
Tel.: +47 55 58 92 00
Fax: +47 55 58 92 10
email: oivind.nilsen@econ.uib.no

[a] The authors would like to thank Kjell Erik Lommerud and Alf Erling Risa for their comments. We have also benefited from the comments of participants at the European Commission Programme for Targeted Socio-Economic Research (TSER) meeting in Amsterdam, September 24-25, at the Norwegian Labour Market Economists' meeting in Åsgårdstrand, October 19-20, 1998, and at the Institute for the Study of Labour (IZA) in Bonn, November 10, 1998. Financial support by the EC/TSER Programme and the Norwegian Research Council is gratefully acknowledged.
[b] The data used in this paper were provided by The Norwegian Social Science Data Services (NSD). NSD is not responsible for the authors' analyses.

1. Introduction

In recent years, the authorities in most of the European countries have been concerned about the high incidence of unemployment among youths. The authorities in Norway have tried to attack youth unemployment from two angles: first, through policies aimed directly at the unemployed, through the benefit system and various training programs and second, by directing more resources into the educational system. The increased level of resources has been motivated by a wish to improve the quality of the educational system and to keep the younger cohorts at school instead of in the labour market. The strategy of increasing the resources allocated to education has been based on the understanding that younger and less experienced individuals have particular problems finding a permanent job.

Analysing the behaviour of school-leavers is important not only for evaluating policy options, but also for a general understanding of the youth labour markets. Youths experience major changes in their lives such as completing their education, getting their first permanent job, going through frequent job turnovers, building a family and becoming parents. All these factors will influence the early, as well as the prime-aged, labour market behaviour and success.

One of the questions we raise in this paper is whether the level of education affects the duration of spells of unemployment and employment. If there is competition for good quality jobs, we expect that individuals with a higher educational level will be more likely to get a job immediately after finishing their education. However, education may also increase the reservation wage of the individuals. If so, then the effect of longer education will be the opposite, i.e. it will increase the search period. In addition, a longer search period may be seen as an investment in getting a better job-match. By analysing the length of the search period and the length of the job-duration, we hope to shed some light on these opposite theories, and to see whether one of them is empirically dominant.

Using the job search/job matching theory, we may argue that search time adversely affects success in the labour market. The argument for such an effect is that longer unemployment durations may decrease the arrival rate of job offers, since longer unemployment duration could be interpreted as an adverse productivity signal, or as a signal of low human capital.[1] Together with the importance of the search period, we analyse how local unemployment affects the duration of different states in the labour market (search period and length of first job). A higher unemployment rate is likely to increase the search period and may

[1] See Flinn and Heckmann (1982) and Wolpin (1987) for empirical testing of structural models concerned with the effects of search period on the probability of finding a job.

also discipline the employed individuals to stick to their jobs, thus having a positive effect on the length of the first job.

The focus of interest in the job search literature is on unemployment duration and earnings, together with job duration. Search time and earnings, and search time and job duration, may be reasonable sets of equations to estimate simultaneously. However, a set consisting of wages and job duration may also be a proper set of equations, since there may be a trade-off between earnings and job security. A distinct feature of our contribution is the simultaneous focus on search time, hourly earnings and job. It is important to pay particular attention to the endogeneity between the search time, contracted wages, and the employment duration because unobserved heterogeneity may bias estimates of wages and job duration. In our approach we can also check whether there is "lagged duration dependence" affecting job durations, i.e. whether the time spent searching affects the time spent in the job, when the endogeneity of wages and search time is modelled.

Our data are taken from a Norwegian database that contains a wealth of information on a randomly selected 10% sample of the Norwegian population (the KIRUT database). In the study, 11658 school-leavers aged 16-33 were extracted from this database. The data set available allows us to measure the time of a completed education, and the start and end of each job for these individuals. In addition, there is information about family, income and other personal characteristics, as well as industrial codes and working hours information. We investigate school-leavers in the period from 1989-1991, a period of cyclical downturn, in which the educational system was used to combat increased youth unemployment.

The organisation of the paper is as follows. Section 2 provides a short review of the job search and job-match theory, together with a discussion of previous empirical findings. In Section 3, we give a brief description of some institutional features of the Norwegian educational system and the Norwegian labour market. The econometric model and estimation procedure are given in Section 4. A brief data description follows in Section 5 along with some summary statistics. In Section 6, we present our empirical results, while some concluding remarks are made in Section 7.

2. Previous research

The basic premise of the search theoretic framework is that agents have incomplete knowledge about the labour market.[2] Young and inexperienced workers have only limited information about firms, wages, working conditions, employment policies, and other important characteristics of potential jobs, together with the searchers' own skills and capabilities. Thus, they face substantial information costs. Likewise, employers have only limited information about job applicants.

The original contribution of search theory was in the analysis of unemployment duration. Search time may affect labour market success adversely. There are at least two reasons that the duration of unemployment can affect a worker's chance of getting a job. First, search activity may decline with the duration of unemployment.[3] However, the empirical evidence from Britain suggests that job search and job applicants do not fall off greatly with unemployment duration.[4] Second, there is the so-called stigma effect of unemployment (longer past spells of nonemployment cause longer future spells). The empirical evidence for the existence of the stigma effect of long unemployment is ambiguous. For instance, the findings of Lynch (1989) and Omori (1997) indicate that previous unemployment has a negative effect on later performance in the labour market. However, the empirical findings of Rosenthal (1994) and Gardecki and Neumark (1998) suggest that adult labour market career is unrelated to early nonemployment spell durations. Imbens and Lynch (1993) find that while workers appear to be scared by a long spell of unemployment, the damage seems to be reduced if they are unemployed in an area with high overall unemployment. Thus, individuals who experience nonemployment when proportionally fewer are nonemployed are more likely to have a longer search period.

There have also been several analyses of the job search behaviour of the employed (see for instance Burdett (1978a), Kahn and Low (1984), and Parsons (1991)). The evidence is that on-the-job search and wages (or distance between current wages and alternative wages) are negatively correlated.

Several empirical studies have analysed the school-to-work transition (e.g. Wolpin (1987), and Jensen and Westgaard-Nielsen (1987)). Eckstein and Wolpin (1995) investigate the duration to the first post-schooling full-time job and the accepted wage for that job within a search-matching-bargaining theoretic model. They find that the accepted wages decline with the duration of unemployment.

Schooling may be a way of sorting individuals according to their skills and abilities (Stiglitz (1975), and Burdett (1978b), in addition to a means of providing the students with knowledge. As we briefly discussed in the previous section, an increased level of education may

---

[2] See e.g. Mortensen (1986), Kiefer and Neumann (1989), and Devine and Kiefer (1991).
[3] Notably, the opposite effect may also be found. The reservation wage may decline if the cost of job search is expected to increase in the near future because unemployment benefits expire. That effect increases the escape rate from unemployment, cf Meyer (1990).
[4] See Chapter 5 in Layard, Nickell and Jackman (1991).

affect the length of the search period in both directions. Empirical analyses have revealed that the search time between school and working is shorter for those with higher levels of schooling (see for instance Eckstein and Wolpin (1995)). The correlation between education and the incidence of unemployment has been pointed out in much of the previous research. In addition, the correlation between education and the turnover or worker flow is also important for understanding the youth labour market. For the Norwegian labour market, Nilsen, Risa and Torstensen (1998) find that increased education increases the chances of staying employed, and correspondingly, decreases the probability of being unemployed.

In the empirical literature, structural as well as reduced form approaches have been used. In structural models, there are clear and unambiguous correspondences between the theoretic microeconomic model and the empirical model. The underlying structural parameters and functions in the job search model (for instance, the distribution of offered wages, the distribution of reservation wages, and the rate of arrival of job offers) cannot be identified in the latter approach. Instead, the focus is on the impact of relevant explanatory variables important to a reduced form hazard function. Since we do not have proper data for a structural model approach, we chose the reduced form approach. This allows us to utilise the very rich data set (the KIRUT database) to which we have access.

3. Institutional features of the Norwegian Education System and Labour Market

Norwegian children attend primary school for six years from the age of seven, and continue with three years in comprehensive school. There is very little specialising at this level. Upon completion of the nine years of compulsory education, pupils typically go on to upper secondary school immediately after finishing their primary education. In 1991, 95.1 percent of the pupils went from lower secondary to upper secondary school (Statistics Norway (1995)). In October 1977 there were approximately 157 000 pupils in upper secondary school (secondary general schools and vocational schools). The corresponding figure for 1995 was 210 000.[5] There are several areas of study in the upper secondary school, the most important distinction being between vocational and general orientations. The most general education lasts for three years and prepares the students for further studies at universities or other institutions of higher education. Compared to other countries, the number of apprenticeship

[5] Individuals on labour market programs are excluded. In 1995 the figure was 19 000.

positions is quite small.[6] Most university studies take between four and seven years. College educations such as nursing, primary school teaching, and engineering last three years. In 1997 there were roughly 172 000 students at universities and other institutions of higher education. The frequency of males and females in the secondary school is almost the same (information collected for 1995). However, at the graduate schools and the universities (below the Ph.D level), the fraction of females attending is higher. We should also note that females are underrepresented in apprenticeships and vocational training.

Figure 1 (see page 19) shows the labour force participation rates from 1980 to 1995 (percentages of the total number of persons in each group). The participation rate for young people aged 16-19 had a peak in the boom years of 1987-1988. We see a similar pattern for individuals aged 20-24 (and the total (16-74)). However, the strongest fluctuations are present for the youngest group. The development of the unemployment rates (percentages of the labour force) is given in Figure 2 (see page 19). After the boom period, the unemployment rate for the youngest group stays relatively constant at a high level. For individuals aged 20-24, we also see a significant growth in the unemployment rate. This picture is even clearer when we compare it to the total unemployment rate (age 16-74).

A recent survey of the Norwegian labour market situation in the period from the late '80s to 1995 is given in Torp (1996).

4. The econometric model

Motivation

We consider individuals who search for their first job and start to work, and follow them until they part from their jobs or are censored. It is natural to think of the transition from school to work using the same concepts as in studies of job search and unemployment duration. An individual who has finished school searches for jobs and eventually gets a job offer, which s/he accepts if the associated wage exceeds his/her reservation wage. The probability of leaving unemployment any day is thus the product of getting a job offer that day and the probability that the wage offer is above the reservation wage. In a continuous time representation, the exit or hazard rate out of unemployment (into employment) is this probability per time unit.

[6] A reform of the system of upper secondary education and training came into effect in 1994 (Reform-94). According to the new law, which is in effect for individuals who finished their primary education in the spring term of 1994 or later, everyone between 16 and 19 is entitled to three years of secondary education. Among the

The return to education is the wage premium associated with increasing the educational level. Clearly, the accepted wage is related to the reservation wage and hence, the employment hazard rate. Therefore, a wage equation must be estimated in a way that takes this dependence into account.

It may be argued that the accepted wage is an incomplete measure of the effect of education. To fully evaluate the returns to education, the labour market history over the full working life ought to be considered. With individual-level data, this is hardly feasible. However, the duration of the first job may supplement the information in a wage equation. A job can be terminated for several reasons: because the worker gets a better wage offer, because he is laid off, or because he (maybe temporarily) leaves the labour market, e.g. to raise children. The latter implies that gender differences may be expected, and also that job duration is not an unambiguous indicator of educational returns.

While not formalising a structural model, we shall treat the three measures of educational outcomes, job search duration, hourly wages, and job duration, as interrelated. A reduced form equation for search duration should include education and variables that affect the cost of search and hence the reservation wage, and also the probability of receiving an offer. The wage equation should include variables reflecting human capital and sectoral differences. Such variables must also be a part of an equation for job duration, in addition to the wage itself and variables that affect the demand for leisure. Furthermore, the time spent searching may affect this duration for at least two reasons: individuals who search longer may get a better match and hence stay longer in the job. On the other hand, employers may regard a long search period as a negative signal and be less prone to give the worker a permanent job.

Model specification

Denoting the time spent in some state as $T \sim G(t; \mathbf{x})$, where G is the c.d.f. of a density function g, and $\mathbf{x}$ is a vector of covariates, the hazard rate is defined as

$$l\,(t;\mathbf{x}) = \lim_{dt \to 0} \frac{\Pr\left(t \le T < t + dt \mid T \ge t, \mathbf{x}\right)}{dt} = \frac{g(t;\mathbf{x})}{1 - G(t;\mathbf{x})}$$

Models of job search and duration are usually cast in terms of the hazard rate. We use a regression-like approach, where the model is specified in terms of the duration distribution, more specifically as $T \sim G\left(t; \mathbf{x}'\hat{\mathbf{a}} + u\right)$. $\boldsymbol{\beta}$ is a vector of constants, and u is an unobserved

most important aims of the new law were improving the quality of the vocational training and increasing the stochastic term. In the present application, it is to be desired that the distribution is specified in a fashion that allows modelling simultaneous equations. The model must also allow for possible right censoring of the duration of the search period and of job duration.

Let $\mathbf{x}_s$, $\mathbf{x}_w$, and $\boldsymbol{\mu}_e$ denote vectors of regressors that affect duration of the search period, the wage, and job duration, respectively, with corresponding coefficient vectors $\boldsymbol{\beta}_s$, $\boldsymbol{\beta}_w$, and $\boldsymbol{\delta}_e$. We assume that the search period, the accepted wage, and the duration of the first job can be described by the following three equations.

(1) $$\ln t_s = \min\left(\mathbf{x}_s'\boldsymbol{\beta}_s + u_1, \ln \tau_s\right)$$

(2) $$\ln w = \mathbf{x}_w'\boldsymbol{\beta}_w + \eta \ln t_s + u_2$$

(3) $$\ln t_e = \min(\boldsymbol{\mu}_e'\boldsymbol{\delta}_e + \gamma \ln t_s + \alpha \ln w + u_3, \ln \tau_e),$$

where τ_s and τ_e are the censoring times of search duration and job duration, respectively, and

$$\begin{pmatrix} u_1 \\ u_2 \\ u_3 \end{pmatrix} \sim N(\mathbf{0}, \Sigma), \text{where } \Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_2^2 & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_3^2 \end{pmatrix}.$$

The assumption of joint normality implies that the marginal distributions of t_s, w, and t_e are lognormal[7]. Note that ln$w$ and lnt_e are only observed when lnt_s is not censored. Therefore, unless σ_{12} and σ_{13} are zero, neither (2) nor (3) can be estimated consistently without taking into account the ”sample selection” due to this truncation.

Estimation

The system (1) - (3) may be estimated by maximum likelihood. We note that with our assumptions, equations (1) and (3) are censored regression (Tobit) equations, and it is possible to draw on previous results regarding simultaneous equations with censoring. It is assumed that the equations are properly identified.

The likelihood function may be derived[8] by recognising the three possible combinations of censoring. Firstly, t_s may be censored, in which case neither t_e nor the wage is observed. Secondly, t_s may be observed without censoring, while t_e is censored. Finally, it may be the case that neither t_s nor t_e is censored.

---

number of pupils taking vocational education up to a third of the cohort size.

[7] Belzil (1995) uses a similar approach when estimating unemployment duration and employment duration in a simultaneous equations system.

[8] Lee (1992) derives the likelihood function for a model corresponding to our equations (1) and (3) (with left censoring). Because *w*, when observed, is not censored, the introduction of equation (2) is fairly straightforward and does not necessitate multivariate integration.

The likelihood contribution of an individual who is censored at t_s is simply

$$\text{(4)} \qquad \Pr(t_{si} \geq t) = \Phi\left(\frac{\mathbf{x_{si}}'\boldsymbol{\beta}_s - \ln t_s}{\sigma_1}\right)$$

where $\Phi(.)$ denotes the c.d.f. of the standard normal distribution.

In the case where t_s is observed without censoring, but t_e is censored, the contribution is $\Pr(t_{ei} \geq t_e, w_i, t_{si}) = \int_{t_e}^{\infty} f(\ln t_{ei}, \ln w_i, \ln t_{si}) d \ln t_{ei}$. The joint p.d.f. $f(.)$ can be written as the conditional distribution of $\ln t_e$ times the joint marginal distribution of $\ln w$ and $\ln t_s$, which is bivariate normal. Define

$\mathbf{\Sigma}_{11} = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{pmatrix}$, $\quad \mathbf{\Sigma}_{12} = \begin{pmatrix} \sigma_{13} \\ \sigma_{23} \end{pmatrix}$, $\quad \mathbf{\Sigma}_{21} = \mathbf{\Sigma}_{12}'$, $\quad \mathbf{z} = \begin{pmatrix} \ln t_s - \mathbf{x_s}'\boldsymbol{\beta}_\mathbf{s} \\ \ln w - \eta \ln t_s - \mathbf{x}_w'\boldsymbol{\beta}_\mathbf{w} \end{pmatrix}$, and $\sigma_{3\cdot 12}^2 = \sigma_3^2 - \mathbf{\Sigma}_{21}\mathbf{\Sigma}_{11}^{-1}\mathbf{\Sigma}_{12}$, the conditional variance of u_3.

Then, using the rule for conditioning in the multivariate normal distribution,

$$\text{(5)} \qquad \begin{aligned} \Pr(t_{ei} \geq t_e, w_i, t_{si}) &= \Pr(t_{ei} \geq t_e \mid w_i, t_{si}) \times f_{\ln w_i, \ln t_{si}}(\ln w_i, \ln t_{si}) \\ &= \Phi\left(\frac{\mathbf{x_{ei}}'\boldsymbol{\beta}_e - \ln t_e + \mathbf{\Sigma}_{21}\mathbf{\Sigma}_{11}^{-1}\mathbf{z}_i}{\sigma_{3\cdot 12}}\right) \times (2\pi)^{-1} \left|\mathbf{\Sigma}_{11}\right|^{-\frac{1}{2}} \exp\left\{-\tfrac{1}{2}\mathbf{z}_i'\mathbf{\Sigma}_{11}^{-1}\mathbf{z}_i\right\} \end{aligned}$$

where $\mathbf{x_{ei}}'\boldsymbol{\beta}_\mathbf{e} \equiv \boldsymbol{\mu}_e'\boldsymbol{\delta}_{ei} + \gamma \ln t_{si} + \alpha \ln w_i$.

If neither of the durations is censored, the likelihood contribution is given by the joint density of $\ln t_s$, $\ln w$, and $\ln t_e$,

$$\text{(6)} \qquad f(\ln t_{si}, \ln w_i, \ln t_{ei}) = (2\pi)^{-\frac{3}{2}} \left|\mathbf{\Sigma}\right|^{-\frac{1}{2}} \exp\left\{-\tfrac{1}{2}(\mathbf{z}_i', \ln t_{ei} - \mathbf{x}_{ei}'\boldsymbol{\beta}_e)\mathbf{\Sigma}^{-1}(\mathbf{z}_i', \ln t_{ei} - \mathbf{x}_{ei}'\boldsymbol{\beta}_e)'\right\}.$$

By taking natural logarithms of (4) - (6) and summing over individuals, we get the log-likelihood function as

$$L(\boldsymbol{\beta}_s, \boldsymbol{\beta}_w, \boldsymbol{\beta}_e, \Sigma) = \sum_{t_{si} \geq t_s} \ln\left[\Phi\left(\frac{\mathbf{x}_{si}'\boldsymbol{\beta}_s - \ln t_s}{s_1}\right)\right]$$

$$(7) \qquad + \sum_{t_{si} < t_s, t_{ei} \geq t_e} \left\{ \ln\left[\Phi\left(\frac{\mathbf{x}_{ei}'\boldsymbol{\beta}_e - \ln(t_e) + \boldsymbol{\Sigma}_{21}\boldsymbol{\Sigma}_{11}^{-1}\mathbf{z}_i}{s_{3\cdot12}}\right)\right] - \ln(2p) - \tfrac{1}{2}\ln\left(\left|\boldsymbol{\Sigma}_{11}\right|\right) - \tfrac{1}{2}\mathbf{z}_i'\boldsymbol{\Sigma}_{11}^{-1}\mathbf{z}_i \right\}$$

$$- \sum_{t_{si} < t_s, t_{ei} < t_e} \tfrac{1}{2}\left[3\ln(2p) + \ln\left(\left|\boldsymbol{\Sigma}\right|\right) + (\mathbf{z}_i', \ln t_{ei} - \mathbf{x}_{ei}'\boldsymbol{\beta}_e)\boldsymbol{\Sigma}^{-1}(\mathbf{z}_i', \ln t_{ei} - \mathbf{x}_{ei}'\boldsymbol{\beta}_e)'\right].$$

Finally, we note that the system is recursive, and that if $s_{23} = 0$, equation (3) may be estimated independently of equation (2) – but not of equation (1). In that case, the likelihood reduces to the one in Lee (1992). If $s_{13} = s_{23} = 0$, equation (3) can be estimated alone. Equations (1) and (2) are reduced to a sample selection model with Tobit censoring rule (or Tobit type 3 model), for which several estimation procedures exist. This restricted model may also be used to perform a likelihood ratio test of H_0: $s_{13} = s_{23} = 0$.

5. Data

The analysis uses data from the KIRUT database, which contains detailed individual information on socio-economic background, labour market participation, and social insurance payments for a random 10% sample of the Norwegian population aged 16-67.[9] The information, obtained from several public registers, is organised in an event-oriented fashion. Currently, the database contains data for the period from 1989 – 1994.

For the purpose of this study, a datafile from Statistics Norway containing detailed individual level information on completed educations (including the month of completion) was merged with KIRUT. Our sample includes individuals born between 1954 and 1976 who completed education between January 1989 and September 1991. The sampled individuals are observed until the end of 1994. We define "school-leavers" as individuals who finished an education before October 1991, and for whom no other finished courses of education were recorded after that (until September 1994). Students who had two or more completed courses of education with a time-span between them of at least four years were also defined as potential

[9] KIRUT is a Norwegian acronym which roughly translates to "Clients into and through the Social Insurance System". The data were provided by The National Insurance Administration, The Directorate of Labour, and Statistics Norway.

school leavers, if the first course of education was finished before October 1991. Because we are mainly interested in the transition to and duration of the first job, we also excluded individuals more than five years older than the "normal" completion age of an education. We are left with a sample of 11658 individuals with completed educations. For these individuals, we constructed a search time (or joblessness) variable measuring the time from completing school until employment, assuming that school leavers are also job searchers.

Employment records were taken from the employers' register.[10] We define the first "real" job as the first job after a completed education, given that the employment record lasts three months or longer and that the weekly number of working-hours is 20 or more (37.5 is the standard weekly hours). Subsequent records less than two months apart are nested within the first job spell.

Because the completed educations in our sample are spread over more than two and a half years, we had to choose a common length of the individual search periods before censoring. We chose 80 weeks, the maximum length for which an individual may receive unemployment benefits. Thus the longest job duration we are able to measure for an individual who finished his education by September 1991, and who was unemployed for 80 weeks, is 90 weeks. Hence job spells are censored at 90 weeks.

The construction of the wage variable and some further details on data management are described in Appendix 1. For variable definitions, the reader is referred to Table 1 (see page 20). Note that in the search time equation, we do not use an individual's actual age at the time of completing education, but the deviation of actual age from the "normal" age for someone who follows the standard progress. Where appropriate, the variables are measured at different points of time according to which equation they are used in. The family-relevant variables are included in the duration equations, but not in the wage equation, as it is believed that they may affect the individual's decision to accept an offer, but not the market wage.[11] Similarly, being non-Scandinavian is assumed to (possibly) affect the probability of a job offer and hence the search period, but not the wage when other factors are controlled for. Other identifying variables are the industry dummies, apprenticeship, experience, the unemployment rate, and unemployment insurance. Educational level is assumed to (possibly) affect the wage, as well as the duration equations. The industry dummies control for the fact that the educational level differs across industries. Moreover, the type of contracts and turnover rates may vary

[10] Employers are obliged to report all new employees who are expected to stay in the job for at least three days to this register.

[11] E.g. Dolton and Makepeace (1987) find a pattern which suggests that female labour market participation is conditioned by marital status and the presence of a child, while earnings, given participation, do not depend on marital status.

between sectors.

Summary statistics for the full sample, the individuals getting a job (t_s uncensored) and individuals not getting a job before being censored (t_s censored) are given in Table 2 (see page 21). We find that 53 percent of the full sample is censored at 80 weeks. This may seem disproportional, and could be caused by some misreporting to the employers' register. It could also be that we have failed to pick up some new educations and erroneously count individuals who continue their education as school-leavers.[12] Conscripts may also contribute to the high incidence of censoring, because we have no information on individuals doing their military service. The fact that the incidence of censoring is larger among males (56.3%) than among females (50.4%) may support this notion. Finally, our criteria for defining a "real" job may be too strict and imply a large share of the school-leavers are classified as job searchers even if they have some part time job over a longer period. Still, our estimates should be consistent given our definition.[13]

Comparing the shares of the different educational levels among the uncensored and the censored group in Table 2, we find evidence that education decreases the probability of being censored. To more completely appreciate the effect of education on search time duration, wages, and job duration, we next turn to the estimation results.

6. Empirical Results

Maximum likelihood estimates of the system (1)-(3) are given in Table 3 (see page 22). Starting with the effects of education on the search period, the main impression is that our findings here roughly correspond to those in other empirical studies. The education category coefficients are monotonically decreasing and significant, implying that the time taken to find a job is shorter for those with higher levels of schooling. Individuals in the highest educational category have 17.4 days shorter search periods than the least educated individuals.[14] Furthermore, we see that apprentices get a job relatively quicly after completing their education. They also tend to stay longer in their first job, compared to individuals with other types of education at the same educational level. There are several possible reasons for this. First, uncertainty and information asymmetries are lower for apprentices if they start to work in the firm where they received their training. In addition, if an apprentice leaves the firm where he received his training, a portion of

[12] However, the sample has also been checked against a KIRUT-variable which indicates whether the individual was under education the current year.
[13] However, varying the first-job criteria does not affect the number of censored observations significantly.
[14] Exp(1.416 + 1.443) = 17.4. This figure is modest, but still the effect of education is large as compared to the other estimates.

the acquired human capital and firm specific skills is lost.[15] Thus, apprentices have incentives to stay in the firms where they were trained.

Turning to the wage equation, the size of the education dummies is monotonically increasing, except for the primary school only (ED9) category. The coefficient on (ED9) is, however, not significant[16], and it seems safe to conclude that more education does increase wages. The importance of education is less clear in the job duration equation. It is slightly surprising that only the ED1315 coefficient is significant and positive.[17] One possible explanation might be that in this category we find groups such as teachers and nurses. It seems reasonable that the probability that the first job is a good match is higher for such groups than for those with less specialised educations.

Females have shorter search periods, lower wages and longer job durations than males. These two findings are consistent with the notion that female labour force entrants have a lower reservation wage than men. In part, this may be explained by the Norwegian maternity leave system, which is quite generous, but which requires a minimum of 10 months' paid work previous to giving birth for eligibility.[18] Females who plan to have a child may therefore accept lower paid jobs. The fact that the first job lasts longer for women than for men is consistent with a lower degree of on the job search, but this may also in part be explained by the strong protection against dismissals during maternity leaves. On the other hand, the NKIDS variable has a negative (but insignificant) effect on job duration. However, the number of children is measured at the beginning of the job spell and therefore contains no information on whether a woman bears a child during her first job-spell. Spouse income reduces the duration of the first job. This result may be explained as a labour-free income effect, if females quit to leave the labour market (but we do not model the destination of quitters). Somewhat more speculatively, this pattern may be an effect of assortative mating and the fact that the flow of job offers is better for individuals married to high-income spouses, due to access to better jobs through the spouse's network.

Non-Scandinavian citizenship increases the time needed to get a job. This could be

[15] It is hard to get reliable documentation of the quit-rate (the share of the apprentices who chose to change employer after the final journeymen's tests are passed). The general opinion, at least in The Council of Vocational Training (*Rådet for fagopplæring i arbeidslivet*), is that firms have looked upon apprentices as an important way of recruiting skilled workers and that most of the apprentices stay in the firm after their training contracts are finished. There seems also to be a general understanding that the quit rate will increase after Reform-94 (see footnote 6), since the use of apprentices is meant to be an integrated part of the educational system.

[16] This result should be interpreted with care, since only 7 out of 57 individuals in the ED9 group get a job before they are right-censored.

[17] Less precision in the estimates of equation (3) may also be due to the fact that 61% of the job durations are censored at 90 weeks.

[18] The maternity leave compensation in the analysed period was 100% of work income for 42 weeks or 80% for 52 weeks. This comes in addition to the universal child benefit.

discrimination due to asymmetric information about non-Scandinavians' skills and abilities. Being older than the expected age when completing education also reduces the search period. One reason may be higher search intensity, but it could also be that some employers prefer slightly older job applicants. In equation (2), age affects the wage positively. Usually the motivation for including age in wage equations is to account for human capital. Even though education is among the regressors here, it is reasonable that some of the positive effect of age is because age, by necessity, is positively correlated with education in a sample of first-job entrants. The negative effect of age on job duration is harder to explain, but possibly older individuals have better prospects of other jobs and therefore leave the first one sooner.

Given the conventional wisdom that unemployment insurance is associated with longer unemployment duration, it is somewhat surprising that the estimated coefficient on unemployment benefits level is negative, implying a negative elasticity of 0.365.[19] However, one should bear in mind the universal nature of unemployment insurance in Norway, and the fact that the variable only mirrors previous earnings.[20] School leavers with higher previous earnings (due to part time jobs, working during vacations etc.) may have more labour market experience, and hence a higher probability of getting a job offer.[21] In addition, individuals may have had higher earnings because of higher endowments of human resources. These individuals permanently have higher probabilities of getting a job offer.

A high local unemployment rate, not surprisingly, increases the search time but has a negative effect on the length of the first job. The first result is probably due to a lower rate of job-offers in periods of recession. The second one is consistent with there being a higher risk of losing the job when unemployment rises. The signs of the industry dummies in the wage equation are mostly as expected, giving some evidence that wages are higher in the manufacturing industry (the base category). In the job duration equation, only the SALES dummy is significant (and positive), indicating that workers in this sector are more likely to stay in their first job than workers in the manufacturing sector. Knowing that variation in demand in and between various sectors is significant, we had expected more effects of the industry

[19] See Atkinson and Micklewright (1991) for a critical survey of the existing literature on unemployment benefits and labour market transitions. Hernæs and Strøm (1996), in a Norwegian study, find that the benefit level increases the unemployment duration for individuals without previous spells of unemployment.

[20] UI is compulsory and regulated by law. The earnings requirement is 0.75*G* the previous year or on average the last three years, where *G* is the basic counting unit in the National Insurance System – NOK 34000 in 1990. For incomes between 0.75 and 6*G*, the replacement rate is 0.62. Eligible individuals must report at the local employment agency and be available for new placement.

[21] The dummy D^{UI} is difficult to interpret. It is included because we code LN(UI) as 0 for individuals without entitlement, but cannot be interpreted as "the effect of being ineligible" when both variables are included. If LN(UI) is left out of equation (1), it turns out that the coefficient on D^{UI} changes sign from negative to positive, indicating that non-eligibles have longer search periods.

dummies.

The time spent searching might affect the wage in two opposite ways. On the one hand, there is the adverse productivity signal effect and the stigma effect. On the other hand, there is the probability of having a better job match when the search period is increased. It turns out there is no direct effect at all – the estimated coefficient of lnt_s is not significant in the wage equation. However, the positive covariance term between the two equations (s_{12}) indicates that there are unobservable factors which increase the search period (maybe by increasing the reservation wage) and which also have a positive influence on the accepted wage.

We noted in Section 4 that if $s_{23} = 0$, equation (3) could be estimated separately from equation (2). From the reported results, we see that this is not the case: there is a negative correlation in the error terms. The s_{13} –term is also negative, and we reject a joint hypothesis of $s_{13} = s_{23} = 0$ by Wald and Likelihood ratio tests. We therefore conclude that the results are in favour of estimating the system simultaneously, and that estimating equations (2) and (3) independently of equation (1) would yield biased results.

The effect of search duration on job duration in equation (3) is positive, indicating "lagged duration dependence". This may indicate that a longer search period improves the match, and this would be consistent with the positive coefficient on the wage variable. On the other hand, there are unobserved factors acting in the opposite direction (s_{13} and s_{23} are both negative). If we interpret this unobserved factor as "ambition", this would mean that the most ambitious individuals get higher wages after a longer search period ($s_{12} > 0$), but also that they stay for a shorter period in the job associated with this high wage (s_{13} and s_{23} negative). This could be because they want to move on to even better jobs, or because the employers find that their productivity does not merit their high wages and they get laid off.

In Appendix 2, we report results from estimating equations (1) and (3) alone. Interestingly, it turns out that this misspecified model gives a *negative* effect of wage on job duration. We also experimented with estimating only equations (1) and (2) together, and achieved results very similar to those in Table 3.

7. Concluding remarks

In this study, we have analysed the early labour market experience of young persons finishing education. We took into consideration that the search duration, hourly earnings, and the job duration are connected in a system of simultaneous equations.

The empirical evidence suggests that education is important for getting a job quickly, and that it also has a positive wage effect. In addition, individuals with a higher level of education have a longer first job duration. These findings may provide support for the clearly stated policy of the Norwegian authorities of increasing resources to education as an important strategy in combating youth unemployment. There are certain qualifications to this statement. It is a generic problem when studying the “returns to education” that the education variables may suffer from endogeneity problems, potentially leading to an upward bias in the estimated effects of education. Furthermore, even though the effect of education is positive at the individual level, this is not necessary true at a more aggregate level. Increased education may also have a more limited effect on the overall re-employment probability due to job competition, if the main consequence of increasing young people’s educational level is to change individuals' positions in the queue of job seekers.

Apprentices seem to have a shorter search time relative to individuals with other types of education at the same educational level. They also tend to stay longer in their first job. This finding may be interpreted as a positive argument for the reform of the upper secondary school that took place in 1994 (Reform-94), where the goal was to increase the number of individuals taking vocational education. However, again it may be the case that an increased number of individuals taking vocational education will increase the job competition among these individuals, thus reducing the overall effect of this effort.

The local unemployment rate affects the duration of the search period, as well as job duration, significantly. These findings may indicate that business cycles are important and that unemployment affects the success of youths in the labour market negatively. However, it is not clear that the negative impact of unemployment on current labour market success will remain once the economy picks up again. International studies on this topic are ambiguous.

We also find the gender differences interesting. The evidence suggests that females have lower reservation wages when entering the labour market (shorter search time and lower wages). They also stay in their first job longer than males do.

The system approach was especially important when estimating the duration of the first job. Failing to control for the endogeneity of wages and the previous period of job search would lead to the erroneous conclusion that the higher the wage, the sooner an individual will separate from his first job.

REFERENCES

Atkinson AB, Micklewright J (1991) Unemployment Compensation and Labor Market Transitions: A Critical Review, *Journal of Economic Literature* 29(4), Dec., pg 1679-1727.

Belzil C (1995) Unemployment Insurance and Unemployment over Time: An Analysis with Event History Data, *Review of Economics and Statistics* 77(1), Febr., pg 113-26.

Burdett K (1978a) A Theory of Employee Job Search and Quit Rates, *American Economic Review* 68(1), March, pg 212-20.

Burdett K (1978b) The Testing and Sorting Functions of Higher Education, *Journal of Public Economics* 10(1), Aug., pg. 117-22.

Devine TJ, Kiefer NM (1991) *Empirical labor economics: The search approach*, Oxford University Press, Oxford.

Dolton PJ, Makepeace GH (1987) Marital Status, Child Rearing and Earnings Differentials in the Graduate Labour Market, Economic Journal 97(388), Dec., pg. 897-922.

Eckstein Z, Wolpin KI (1995) Duration to First Job and the Return to Schooling: Estimates from a Search-Matching Model, *Review of Economic Studies* 62(2), April, pg 263-86.

Flinn C, Heckman J (1982) New Methods for Analyzing Structural Models of Labor Force Dynamics, *Journal of Econometrics* 18(1), Jan., pg. 115-68.

Gardecki R, Neumark D (1998) Order from Chaos? The Effects of Early Labor Market Experiences on Adult Labor Market Outcomes, *Industrial and Labor Relations Review* 51(2), Jan., pg. 299-322.

Han A, Hausman JA (1990) Flexible Parametric Estimation of Duration and Competing Risk Models, *Journal of Applied Econometrics*, 5, pg. 1-28.

Hernæs E, Strøm S (1996) Heterogeneity and Unemployment Duration, *Labour*, 10, pg. 269-96

Imbens G, Lynch LM (1993) Re-employment Probabilities Over the Business Cycle, *NBER Working Paper* 4585, Cambridge, MA .

Jensen P, Westergard-Nielsen NC (1987) A Search Model Applied to the Transition from Education to Work, *Review of Economic Studies* 54(3), July, pages 461-72.

Kahn LM, Low SA (1984) An Empirical Model of Employed Search, Unemployed Search, and Nonsearch, *Journal of Human Resources* 19(1), Winter, pg. 104-17.

Kiefer NM, Neumann GR (1989) *Search models and applied labor economics*, Cambridge University Press, New York.

Layard R, Nickell S, Jackman R (1991) *Unemployment*, Oxford University Press, Oxford.

Lee BJ (1992) A nested Tobit analysis for a sequentially censored regression model, *Economics Letters* 38, pg. 269-273.

Lynch LM (1989) The Youth Labor Market in the Eighties: Determinants of Re-employment Probabilities for Young Men and Women, *Review of Economics and Statistics* 71(1), Febr., pg. 37-45.

Meyer BD (1990) Unemployment Insurance and Unemployment Spells, *Econometrica*, 58, pg. 757-782.

Mortensen DT (1986) Job search and labor market analysis, In Ashenfelter OC, Layard R (ed) *Handbook of Labor Economics*, North Holland, Amsterdam.

Nilsen ØA, Risa AE, Torstensen A (1998) Staying or Leaving: Transitions from Work among Norwegian Youths, mimeo, Department of Economics, University of Bergen, Norway.

Omori Y (1997) Stigma Effects of Nonemployment, *Economic Inquiry* 35(2), April, pg. 394-416.

Prentice RL, Gloeckler LA (1978) Regression Analysis of Grouped Survival Data with application to Breast Cancer Data, *Biometrics*, 34, pg. 57-67.

Parsons DO (1991) The Job Search Behavior of Employed Youth, *Review of Economics and Statistics* 73(4), November, pg. 597-604.

Rosenthal L (1994) Labour Market Transitions following Redundancy: An Approach with Time-Varying Variables, *Applied Economics* 26(4), April, pg. 409-16.

Statistics Norway (1995), *Statistical Yearbook 1995*, Statistics Norway, Oslo.

Stiglitz JE (1975) The Theory of "Screening," Education, and the Distribution of Income, *American Economic Review* 65(3), June, pg 283-300.

Torp H (1996) Unemployment in Norway, In Wadensjö E (ed) *The Nordic labour markets in the 1990's*, Elsevier Science B.V., Amsterdam, The Netherlands.

Wolpin KI (1987) Estimating a Structural Search Model: The Transition from School to Work *Econometrica* 55(4), pg. 801-17.

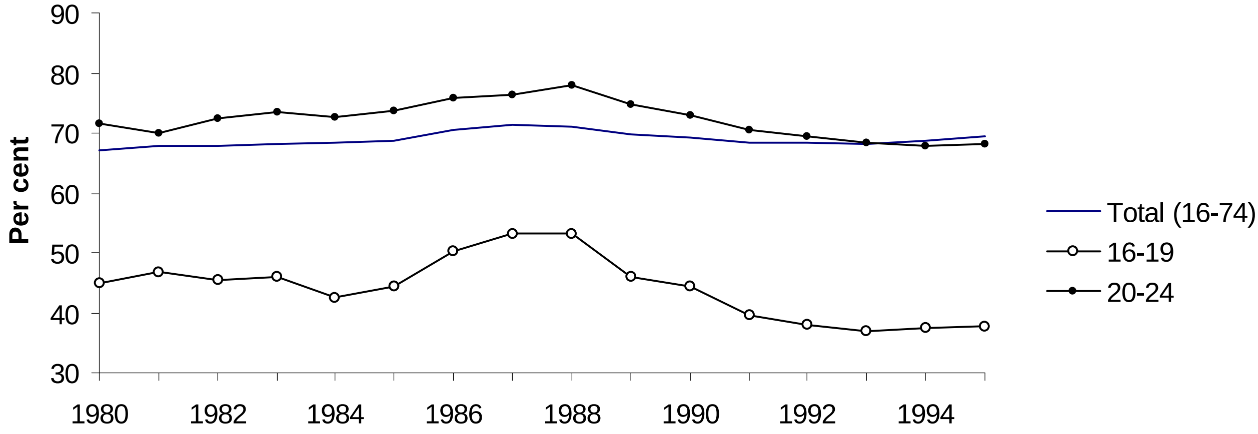

Figure 1 Labour force participation rates

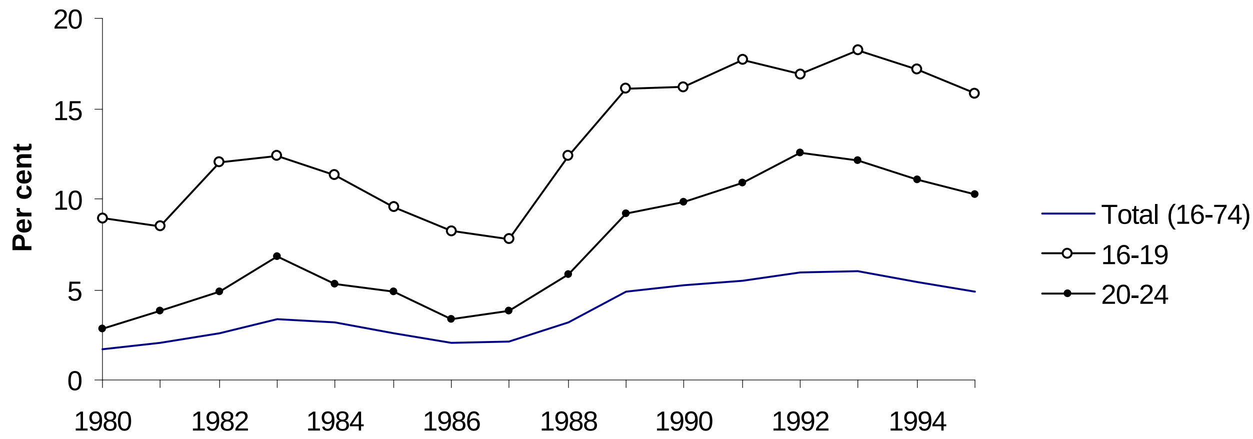

Figure 2 Unemployment rates (LFS)

Table 1 Variable definitions

Variable	Equation	Definition
LN(WAGE)	3	Natural log of hourly wage – endogenous (see Data appendix for calculation method)
MARRIED	1, 3	Dummy indicating marriage when completing education (eq. (1))/beginning first job (eq. (3))
SPINC	1, 3	Spouse income in 1990 NOK (same dating as MARRIED variable)
NKIDS	1, 3	#children below age 11 (same dating as MARRIED variable)
NONSCAND	1	Dummy indicating citizen of non-Scandinavian country
AGEDIFF	1	Deviation of age when completing education from expected age
AGE	2, 3	Eq. (2): age (years) when completing education Eq. (3): age (years) when beginning first job
ED9	1, 2, 3	Education at lower secondary level (≤ 9 years)
ED10-12		Education at upper secondary level (10 – 12 years) (Reference group)
ED13-15	1, 2, 3	Education at college/university level I (13-15 years)
ED16	1, 2, 3	Education at university level II (≥ 16 years)
APPRENTICE	1, 2, 3	Dummy indicating apprenticeship
EXPERIENCE	2	# years with income above minimum level for obtaining pensions rights
LN(UI)	1	Natural log of unemployment benefits (calculated on basis of previous earnings data)
D^{UI}	1	Dummy indicating non-eligibility for unemployment benefits
AGRIC/ MANUF/ SALES/ FINAN/ PUBLIC	2, 3	Dummies indicating sector of employment (based on industrial codes) Base category: manufacturing
UNEMP	1, 3	Eq. (1) Local unemployment rate in month education was completed Eq. (3) Local unemployment rate in month when beginning first job

Notes:
Equation (1): Duration of search period
Equation (2): Wage equation
Equation (3): Job duration

Table 2 Descriptive statistics

	Full sample (N=11658)		T_S uncensored (N=5440)		T_S censored (N=6218)	
		SE	Mean		Mean	SE
T_S	386.555	214.502	188.305	157.830	560.000	0.000
LN(T_S)	5.601	1.079	4.771	1.096	6.328	0.000
WAGE			106.096	75.788		
LNWAGE	4.553	0.523	4.520	0.504		
FEMALE	0.503		0.534		0.475	
MARRIED (ed. compl.)	0.047		0.062		0.034	
MARRIED (jobstart)			0.071			
SPINC (ed. compl.)	5014.89	30643.71	6761.25	35054.91	3487.1	26089.1
- if married	107076.4	95585.71	109142.9	93190.45	103744.1	99463.07
SPINC (jobstart)			7929.13	37408.80		
- if married			113964.8	90878.97		
NKIDS (ed. compl.)	0.055	0.246	0.042	0.221	0.067	0.265
NKIDS (jobstart)			0.052	0.249		
NONSCAND	0.013		0.009		0.017	
AGEDIFF	1.068	1.610	1.218	1.658	0.938	1.555
AGE (ed.compl.)	20.331	2.501	20.984	2.790	19.759	2.054
AGE (jobstart)			21.413	2.781		
ED9	0.005		0.001		0.008	
ED10-12	0.784		0.693		0.864	
ED13-15	0.181		0.256		0.115	
ED16	0.030		0.049		0.012	
APPRENTICE	0.172		0.187		0.159	
EXPERIENCE	1.034	1.557	1.422	1.736	0.695	1.290
UI (All)	334.284	450.048	423.914	476.861	255.868	409.456
(UI>0)	781.92	351.76	801.00	357.20	755.81	342.56
LN(UI) (All)	2.814	3.266	3.496	3.310	2.217	3.107
(UI>0)	6.582	0.380	6.607	0.380	6.549	0.377
D^{UI}	0.572		0.471		0.661	
AGRIC			0.026			
MANUF			0.273			
SALES			0.276			
FINAN			0.062			
PUBLIC			0.363			
UNEMP (ed. compl.)	5.833	2.387	5.710	2.487	5.940	2.291
UNEMP (jobstart)			5.943	2.421		

Table 3 Maximum likelihood estimates of simultaneous equations model
Coefficients and asymptotic standard errors

	EQ (1): LN(T_S)		EQ (2): LN(WAGE)		EQ (3): LN(T_E)	
	Coeff	SE	Coeff	SE	Coeff	SE
CONSTANT	8.941[c]	0.579	1.445[c]	0.496	1.791[c]	1.918
Endogenous variables						
LN(T_S)			-0.032	0.031	0.316[c]	0.112
LN(WAGE)					1.146[c]	0.405
Family/individual background						
FEMALE	-0.392[c]	0.041	-0.136[c]	0.018	0.481[c]	0.091
MARRIED	-0.488[c]	0.129			0.199[a]	0.121
SPINC	9.35E-07	8.42E-07			-1.59E-06[b]	7.41E-07
NKIDS	0.952[c]	0.096			-0.256[b]	0.109
NONSCAND	0.540[c]	0.179				
Human capital						
AGEDIFF	-0.053[c]	0.015				
AGE			0.296[c]	0.036	-0.269[b]	0.134
AGESQRD			-0.006[c]	0.001	0.007[b]	0.003
ED9	1.416[c]	0.380	0.252	0.179	-0.669	0.544
ED13-15	-1.031[c]	0.055	0.071[b]	0.036	0.531[c]	0.103
ED16	-1.443[c]	0.110	0.267[c]	0.059	0.244	0.170
APPRENTICE	-0.434[c]	0.056	-0.017	0.023	0.230[c]	0.073
EXPERIENCE			0.042[c]	0.006		
Unemployment insurance						
LN(UI)	-0.365[c]	0.089				
D^{UI}	-2.030[c]	0.573				
Industry and unemployment						
AGRIC			-0.033	0.040	-0.183	0.116
SALES			-0.107[c]	0.017	0.162[c]	0.068
FINAN			-0.023	0.028	0.042	0.088
PUBLIC			-0.046[c]	0.018	-0.024	0.058
UNEMP	0.037[c]	0.008			-0.022[c]	0.008
Variance and covariance terms						
σ_j^2, j = 1, 2, 3	3.370[c]	0.072	0.231[c]	0.020	1.804[c]	0.442
σ_{12}	0.322[c]	0.102				
σ_{23}			-0.362[c]	0.123		
σ_{13}					-1.08[c]	0.418
Censored	6218/11658				3323/5440	

[a]Significant, 10% level [b]Significant, 5% level [c]Significant, 1% level
Number of observations: 11658
Loglikelihood: -23269.62
LR model test (against model without covariates): 2850(χ^2_{43})
Wald test of H_0: $\sigma_{13} = \sigma_{23} = 0$: 8.74 (p = 0.01)
LR test of H_0: $\sigma_{13} = \sigma_{23} = 0$: 12.33 (p =0.002)

Appendix 1 Data management

In this appendix we provide certain details on the treatment of data that were left out in the main text.

Defining school-leavers

We have left individuals registered as taking longer courses of study out of the sample, if these studies were to be completed after 3 years. However, in working with the data, we found a large proportion of individuals who finished an educational program even though the variable containing information on whether an individual is registered as a student or not (the current education variable) indicated no ongoing education. As we are more confident regarding the information on completed education, in cases with a hit on the current education variable, without an corresponding record on the completion variable, the individual was left out of the sample.

Construction of the wage variable

Hourly wage was based on a categorical variable defining the number of hours per week (30 hours or more, 20-29 hours, and 4-19 hours), the duration of a job, and the total income of all the jobs of an individual. We assumed that the three categories correspond to 37.5 hours (the standard working hours per week), 25 hours (2/3 of full time), or 15 hours (40% of full time). From the employers' register, we obtained the starting and terminal dates of jobs. We measured the duration of a job as a fraction of a job lasting one year, multiplied by the weekly hours, and summed over all employment records over the year. Thus we arrived at an estimate of the number of hours worked that year. We then divided the income by the total number of hours to get a measure of the hourly wage.

Education and industry

Information regarding education was based on a datafile containing the month of completion and a 3-digit code describing level and field. The educational level dummies were based on the first digit in this code. We also included a dummy for vocational education – based on all three digits. There may be some inaccuracies, because the full code for vocational educations with 6 digits was not available.

The industry dummies were based on the industrial ISIC-code in the employers' register. The categories were defined as follows (ISIC-codes in parentheses):

- AGRIC (11-13)
- MANUF (21-29, 31-39, 41-42, 50, "undefined")
- SALES (61-63, 71-72, 92, 95)
- FINAN (81-83)
- PUBLIC (91, 93-94)

To supplement the descriptive statistics in Table 4, Table A1.1 shows educational level by gender, and also by industry for those who got a job. The most well educated individuals were found in finance and the public sector, while individuals recruited to agriculture and sales were at the other end of the scale.

Table A1.1. ***Average years of schooling (no. of obs.), by gender and by industry.***

***Full Sample* (11658 obs.)**	**Females**	**Males**
Total	12.0 (5861)	11.8(5797)

Ts uncensored (5440 obs.)	**Females**	**Males**
AGRIC	11.4 (37)	11.2 (103)
MANUF	12.0 (370)	11.6 (1117)
SALES	11.4 (894)	11.7 (608)
FINAC	12.7 (189)	13.7 (148)
PUBLIC	13.3 (1415)	13.6 (559)
Total	(2905)	(2535)

Appendix 2 Equations (1) and (3) estimated separately

The results reported in Section 6 are in favour of estimating equations (1)-(3) simultaneously. In order to get some hold of the impact of simultaneity, we also estimated the duration equations separately. Keeping to the assumption that t_s and t_e are lognormally distributed, this amounts to estimating logt_s and logt_e by ordinary Tobit.

In order to assess, roughly, the impact of distributional assumptions, we also estimated the equations using the proportional hazard model:

$$l(t;\mathbf{x}) = \quad (\ )$$

$l_0\ t$ is the baseline hazard. The model may be estimated "semiparametrically" by conditioning out $l_0(t)$, or by choosing a flexible functional form for the baseline hazard. The first method is known as Cox's partial likelihood estimator. For the latter, the most used methods are those suggested by Prentice and Gloeckler (1978) and Han and Hausman (1990). Here we use the Han and Hausman estimator, which is very easy to implement. It is assumed that

$$\ln \int_0^{t_i} l(u;\mathbf{x}_i)du = \mathbf{x}_i{}'\hat{\mathbf{a}} + e_i\,,$$

where e is extreme value distributed. Letting

$$\ln \int_0^{t} l_0(u)du = d_t \text{ for time intervals } t = 1,...,T,$$

the model can be estimated by discretising the duration variable according to the time intervals and using ordered logit to estimate $\boldsymbol{\beta}$. In this application, the ordered logit cutpoints are the logs of the period specific integrated baseline hazards.

We report lognormal, partial likelihood (Cox) and ordered logit (Han and Hausman) estimates in Table A2.1[22] The baseline hazard estimates in the Han/Hausman model are not reported. In what follows, we only compare roughly to the results reported in the main text.

The lognormal estimates of equation (1) are very similar to the ones we obtained from the simultaneous equations system, with the possible exception of the coefficient on D^{UI} – but even that one falls within a 95% confidence interval of the original estimate. The estimate of s_1^2 is almost identical.[23] This similarity is to be expected, as the system is triangular, and there are no endogenous variables on the right-hand side in equation (1).[24] We also note that the semiparametric estimates come quite close to the lognormal ones and the ones reported in the text, especially the Han/Hausman results are very similar. Even though results from different parametrisations are not directly comparable, this suggests that as regards equation (1), the results are not very sensitive to distributional assumptions.

Equation (3) contains two endogenous r.h.s variables, and is also affected by sample selection due to the censoring in equation (1). The estimates presented here are thus expected to differ from the results in Table 3, and they do. In particular, we note that the sign

---

[22] In the Cox model, the parametrization is in $\boldsymbol{\beta}^* = -\boldsymbol{\beta}$. Consequently, the results must be multiplied by –1 to be compared to the Han/Hausman estimates.

[23] Note that the estimate reported in the Table A2.1 is of s_1.

[24] We also estimated (1) and (2) simultaneously, assuming joint normality. The results – not reported here – were almost identical to the ones in the text.

of the wage effect is reversed: it is now estimated negative. The coefficient on lnt_s is still positive and significant, but it is biased downwards. Most of the other estimates are quite different, too. Exceptions are the effect of being in the ED13-15 group (the only significant education dummy), and the family relevant variables, where the lognormal specification yields estimates similar to the simultaneous equations model. In this case, there are larger differences between the lognormal and the semi-parametric estimates, but the negative effect of wages remains. Thus, the most important lesson from this exercise is that failing to control for the endogeneity of wages and the previous period of job search would lead to the erroneous conclusion that that the higher the wage is, the sooner the individual will separate from his/her first job.

Table A2.1 ***Lognormal and proportional hazard estimates of search time and job duration (estimated separately)***

	$LN(T_S)$ (N=11658)						$LN(T_E)$ (N=5440)					
	Lognormal		Cox		Han/Hausman		Lognormal		Cox		Han/Hausman	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE
CONST	8.016[c]	0.520					6.259[c]	1.031				
$LN(T_S)$							0.054[c]	0.016	-0.070[c]	0.021	0.092[c]	0.026
LNWAGE							-0.135[c]	0.036	0.154[c]	0.048	-0.218[c]	0.059
FEMALE	-0.385[c]	0.041	0.293[c]	0.029	-0.396[c]	0.038	0.232[c]	0.038	-0.340[c]	0.050	0.386[c]	0.062
MARRIED	-0.490[c]	0.134	0.287[c]	0.082	-0.498[c]	0.124	0.129	0.112	-0.240	0.167	0.241	0.191
SPINC	7.5E-7	8.9E-7	-4.2E-7	5.3E-7	8.02E-7	8.23E-7	-1.52E-6[b]	7.26E-7	2.56E-6[b]	1.07E-6	-2.74E-6[b]	1.22E-6
NKIDS	0.979[c]	0.092	-0.698[c]	0.070	0.925[c]	0.088	-0.120	0.079	0.196[a]	0.106	-0.211[a]	0.128
NON-SCAND	0.607[c]	0.185	-0.482[c]	0.146	0.607[c]	0.178						
AGEDIFF	-0.068[c]	0.014	0.054[c]	0.009	-0.065[c]	0.013						
AGE							-0.006	0.096	0.113	0.137	-0.040	0.162
AGE^2							0.002	0.002	-0.005	0.003	0.003	0.004
ED9	1.411[c]	0.380	-1.189[c]	0.379	1.358[c]	0.406	-0.070	0.436	0.109	0.502	-0.132	0.676
ED13-15	-1.044[c]	0.055	0.726[c]	0.037	-0.999[c]	0.051	0.440[c]	0.061	-0.606[c]	0.086	0.730[c]	0.101
ED16	-1.446[c]	0.110	1.042[c]	0.068	-1.408[c]	0.100	0.287[b]	0.125	-0.336[a]	0.176	0.461[b]	0.207
APPR-ENTICE	-0.452[c]	0.056	0.358[c]	0.039	-0.437[c]	0.051	0.134[b]	0.048	-0.189[c]	0.062	0.220[c]	0.078
LN(UI)	-0.221[c]	0.080	0.102[b]	0.051	-0.189[c]	0.073						
D^{UI}	-1.093[b]	0.519	0.405	0.335	-0.899[a]	0.474						
AGRIC							-0.228[b]	0.103	0.312[c]	0.121	-0.385[b]	0.163
SALES							0.023	0.048	-0.026	0.061	0.047	0.077
FINAN							0.014	0.080	0.016	0.107	0.020	0.131
PUBLIC							-0.085[a]	0.050	0.191[b]	0.065	-0.164[b]	0.080
UNEMP	0.037[c]	0.008	-0.023[c]	0.006	0.033[c]	0.008	-0.017[b]	0.007	0.022[b]	0.009	-0.028[b]	0.011
σ	1.836	0.020					1.061	0.019				
Loglik.	-14918.8		-48813.6		-22428.1		-5013.2		-17545.8		-9581.9	

[a]Significant, 10% level [b]Significant, 5% level [c]Significant, 1% level

Note: Cox estimates must be multiplied by –1 for comparison to Han/Hausman estimates