The Importance of Literacy for Employment and Unemployment Duration

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Abstract. This study evaluates how literacy is related to unemployment and employment duration. We hypothesize that the effect of literacy may depend upon availability of other productivity signals. Models with heterogeneous effects of literacy are estimated for transitions from employment to unemployment and *vice versa* using unique survey and register data. The results show that for unemployed workers, literacy is as important as formal education and labour market experience. With respect to employment duration, education and labour market experience has no significant effect, but literacy significantly lowers the hazard rate into unemployment. The effects differ with respect to gender and cohabiting status.

Keywords: Labour Market Mobility; Unemployment and Employment Duration; Literacy; Human Capital;

JEL Codes: J24; J63; J64

1. Introduction

The aim of this study is to analyse the importance of literacy for employment and unemployment duration of workers, using a unique Danish data set combining survey data on test-based literacy scores with administrative register data on labour market transitions.

Recent decades have seen a shift in labour demand that favours skilled workers. This is likely to be caused at least partly by skill-biased international trade and skill-biased technological change. These changes have caused changing organizational structures on the labour market, away from the Tayloristic organization of firms towards more holistic organizations. Lindbeck & Snower (2000) develop a theoretical model showing that firms have incentives to change their organizational structure in this direction if technological changes involve task complementarities and puts increasing demands on workers' communicative abilities. OECD (1999) documents that such organizational changes are particularly widespread in the Danish labour market.

Today's organizational structures often involve concepts such as job rotation, quality circles and work teams, all of which increase the need for interpersonal communication, and therefore implicitly favour skills which facilitate such communication. An important part of communication is the ability to read and write. There is thus a distinct risk that a large group of workers will lose their jobs due to poor proficiency in this area and will have difficulty obtaining new employment in an ever changing labour market. This may have important policy implications in the sense that some groups of workers lacking literacy skills may need to improve these skills through post-education investment in further training, and public policy may play an important role by providing cheap efficient training opportunities.

Many studies of labour market transitions have included measures of the human capital of workers in the form of education and labour market experience. This study includes these measures but we also include measures of the literacy of workers: the ability to understand and use written information in order to achieve one's goals and to develop one's knowledge and possibilities. This may be considered a better measurement of the human capital of an individual than education and labour market experience, which are, to a greater extent, considered inputs to the production of human capital. However, an understanding of the separate roles literacy and education play for labour market transitions is important for how to target employment policies and for the assessment of the resources needed to help a group with poor literacy skills to establish themselves in the labour market.

This study improves upon research from different strands of literature. While an empirical link between literacy and labour market status has been established in literacy research, only measures of labour market status at a point in time have been used. To our knowledge, no previous studies have examined how literacy affects labour market transitions. This adds important information compared to previous research, because it allows for the distinction between inflow and duration in a given labour market state. A large part of the literacy literature has also been hampered by data limitations; either relying on self-reported literacy, or by being limited to certain population groups, immigrants in particular. This study measure up to the best of the existing literacy studies with respect to the use of test-based measures of literacy, the use of a national representative sample, and while causal effects of literacy are extremely difficult to isolate, some robustness towards endogeneity bias is obtained by controlling for parental education and parental labour market status during childhood and adolescence.

Moreover, in our discussion of the effect of literacy on labour market transitions, we try to integrate the literacy research with related labour market literature, including both theoretical and empirical results. This seems to be lacking in previous literacy research. Based on asymmetric information models, it is hypothesized that literacy may become more important as other signals are available. This variation in literacy effects is expected to be largest for unemployed. It is therefore examined how the effect of literacy varies among individuals with different characteristics.

The next section briefly describes previous research on the impact of human capital on labour market transitions. Section 3 contains a discussion of the importance literacy and human capital can be expected to have on mobility in the labour market. Section 4 describes the statistical model applied. A description of the data material used can be found in Section 5, and Section 6 contains the results of the empirical analyses. Section 7 concludes the analysis.

2. Previous evidence

Since labour market transitions are influenced by institutional settings, we start by summarizing previous findings specific to the Danish labour market in this section. Overall, the Danish labour market is characterised by a high rate of transitions between employment and unemployment, as demonstrated e.g. by Vejrup-Hansen (2000), Frederiksen & Westergaard-Nielsen (2001) and Mortensen (2002). This may, among other explanations, be due to a low degree of employment protection in combination with a high replacement rate for unemployed workers.

Jensen and Verner (1996) estimate duration models for the duration of unemployment and find that the likelihood of obtaining employment increases with the length of education. Rosholm (2001a) finds that the picture is not entirely monotonic with respect to length of education and that, in

general, education plays a greater role for young people. Rosholm (2001b) examines mobility into and out of three states: employment, unemployment, and non-participation in the labour market. He finds that education and labour market experience are essential to avoid dropping out of the labour market. Finally, Husted and Baadsgaard (1995) find that employed persons with a higher education have a lower unemployment risk, whereas the educational level of unemployed persons plays a minor role for their employment chances.

Bunzel *et al.* (2001) and Christensen *et al.* (2001) use a structural model to investigate the correlation between mobility in the labour market and wage formation.[1] Both find that the unemployment rate decreases monotonically with the level of education. Christensen *et al.* (2001) break down unemployment into a structural component (caused by high rates of unemployment benefits) and a frictional component, and find that both components decrease monotonically with the level of education.

There is thus a fair amount of evidence on the effect of education and labour market experience on labour turnover in the Danish labour market. This finding is much more general, as it has been found in most international studies as well, see e.g. Nickel (1979), Ashenfelter and Ham (1979) and Kiefer (1985) and more recent studies by e.g. Mincer (1991), Kettunen (1997) and Lauer (2003).

There also exist a number of studies on the impact literacy has on labour market outcomes. A common goal in this literature is to evaluate what happens to the effect of education when literacy measures are added as explanatory variables. This literature is of course sparse as literacy measures only are available in specifically designed surveys. In addition, a large part of the literature has

[1]See also Mortensen (2002).

focused on the impact of literacy on the labour market success for immigrants in particular (e.g. Rivera-Batiz, 1990; Chiswick and Miller, 1995), and finally, while there exist a number of studies examining the impact of literacy upon wages or income, studies examining the impact on other labour market outcomes are limited to studies of binomial indicators of labour-market attachment (e.g. Rivera-Batiz, 1992; Charette and Meng, 1998; Chiswick, Lee and Miller, 2003).

Results of studies that use the same data as the present study (SIALS) are presented in OECD (2000) and Jensen & Holm (2000), among others. In accordance with the international literature mentioned above, they show that those with poor literacy skills occupy a weak position in a labour market, characterised by great risk of unemployment, and they are more likely to receive transfer income and to have lower earnings.

Danes generally have a high level of literacy. Still, it is worth noting that 46 per cent of Danes between the ages of 16 and 66 have a prose literacy that can be described as inadequate compared to the demands that are made with regard to understanding and using information in written material (Jensen & Holm, 2000).

3. What correlations are expected with regard to literacy?

Green & Riddell (2001, 2003) note that proficiency in literacy can be considered direct measurements of an individual's human capital, that is, output-measurements, whereas education and labour market experience are indirect measures of the same, in the sense that they are considered inputs into the process by which human capital is produced. This view is also found in the classical literature on human capital, see for example Ben-Porath (1967). Of course, literacy is only a sub-measure of human capital, but it is likely to be a very central one in today's information

and knowledge society. Furthermore, since literacy captures very specific skills, it is likely that education and other human capital measures capture other skills required in the labour market.

But what explains the differences in transitions on the labour market between groups with different human capital? One very important factor is with no doubt imbalances in supply and demand of labour with given skills. There is some evidence of an increasing demand for well-educated workers in many western countries (e.g. Bound & Johnson, 1992; Jensen & Sørensen, 2001), and with rigid wage (as in Denmark) and supply adjustment processes, this will contribute to rigid skill-related unemployment differentials.

In addition to a traditional supply-demand based explanation for skill-related unemployment differentials, high unemployment can be a limiting factor for the options of the individual job seeker, and a person's level of human capital can contribute to reduce these limitations (Ashenfelter and Ham, 1979). This may happen in several ways. Two strands of theories are mentioned here, both of which highlight the importance of limited information. The first is based on search theory while the second is based on theories of asymmetric information and signalling.

In the search theoretic framework, human capital may affect labour market transitions in various ways. First of all, the higher skilled may have a larger labour market, both because they may search for jobs at their own skill level and at levels below, but also because they often tend to search in larger geographical regions. The former is supported by analyses of Belgian data in Cockx & Dejemeppe (2001). Human capital can also influence the level of information and, thus, the effectiveness of job search. Interpreted in a standard search framework, human capital may increase search effectiveness, the rate at which job offers are received, and shift the wage-offer distribution

to the right, all leading to, *ceteris paribus*, shorter unemployment duration (e.g. Mincer, 1991; Kettunen, 1997). However, in the search model framework, human capital may also increase the reservation wage, leading *ceteris paribus* to longer unemployment duration. Longer unemployment duration for the more skilled may also arise because hiring and training costs are often higher for the more skilled (Nickel, 1979).

For the same reasons (i.e. good qualifications and high training costs) those with more human capital may also find it easier to keep their jobs. There are of course other factors that may play a role in the transition from employment to unemployment. The duration of the period of employment is affected by, among other things, seniority in a given position, which may be determined by employment and wage contracts (Jovanovic, 1979a, 1979b). Seniority is affected by the amount of firm-specific training. If general human capital and firm specific training are complements, this will induce a positive correlation between human capital measures and employment duration (Kiefer, 1985).

The explanations mentioned hitherto assume that skills perfectly observable. Essential to the understanding of the specific role literacy plays with respect to labour market transitions is however, that job matches between employers and workers are encumbered with asymmetric information. Employers can only to a limited extent observe specific capabilities (such as literacy) of the individual job seeker, while they have more information on the capabilities of their own workers (or they will obtain this knowledge in keeping with the increase in seniority, Jovanovic, 1979a). Therefore, signalling may be important especially for the unemployed. The most commonly mentioned signal is education as suggested by Spence (1973). In various related models, years of labour market experience, lay-offs and other indicators of individual labour market career have been

suggested as potential signals or screening devices (e.g. Stiglitz, 1975; Gibbons and Katz, 1991; Farber and Gibbons, 1996). More generally, in situations where there is reason to believe that education is not a good signal (as e.g. discussed in Streb, 2002, because taste for education differ), employers may want to gather additional information. This may include individual labour market histories but also individual traits such as marital status and number of children. Marital status has, for instance, a robust relationship with earnings for men, whereas the relationship is less clear for women (Ribar, 2004). When it is difficult to separate able from less able workers by the information at hand, an obvious way of doing so is by examination of applicants.

Based on the discussion above, we would thus hypothesize that for the transition from unemployment to employment, those with more literacy should be able to find jobs faster than those with lower levels of literacy. However, literacy may not be easily observed by potential employers, so we would expect this relation to be quite weak because we also include other factors related to human capital, which are easier to observe by the potential employer. Moreover, we would expect literacy to play a role particularly for groups where other signals of productivity are not available, that is, for the less educated, those with little working experience, and e.g. singles. For such workers, potential employers might want to try to obtain information on literacy.

For transitions out of employment, we would expect literacy to be important for all groups, since it should affect productivity in most types of jobs available in the information society and a current employer is likely to have reasonable accurate information on literacy level.

As education and working experience affects the production of human capital, thus literacy, and as they all may be affected by unobserved ability components, we would expect the importance of

other human capital factors, notably education and working experience, to decline when literacy is introduced as an additional explanatory variable in the model of employment duration.

4. Econometric model

The labour market transitions into and out of unemployment and employment is best analysed using duration models, see for instance Lancaster (1990).

The present study uses a piecewise constant proportional hazard model (PCPH) which allows for a flexible type of duration dependence. The model is specified in terms of the hazard function, which is the instantaneous rate of ending a spell of a given type at *t*, given that it is not concluded before time *t*. The hazard rate in the PCPH model, conditional on observed explanatory variables, *x*, is given by:

$$\theta(t \mid x) = \exp(x'\gamma + \sum_{i=1}^{M} \lambda_i 1(c_{i-1} \le t < c_i)),$$
$$c_0 = 0, c_M = \infty, \quad c_0 < c_1 < ... < c_M$$

where the $c_i, i=1,\ldots,M$ denote the cut points of the piecewise constant baseline hazard function. For given values of the regressors, the parameters λ_i thus describe the level of the hazard function at durations of length between c_{i-1} and c_i. Upon the analysis of transitions from state *j* to state *k*, a spell that ends with a transition to a state other than *k* will be treated as though they were right-censored at the time of the transition. Let *d* be an indicator that the spell is not right-censored. Since the density can be written as the hazard rate times the survival function, the likelihood function becomes:

$$L = \prod_i f(t_i \mid x_i)^{d_i} S(t_i \mid x_i)^{1-d_i} = \prod_i \theta(t_i \mid x_i)^{d_i} S(t_i \mid x_i)$$

where $S(t \mid x)$ denotes the survival function. In the case of the PCPH, the survival function is given by:

$$S(t \mid x) = \exp\left[-\exp(x'\gamma)\left(\sum_{j=1}^{m} (c_j - c_{j-1}) \exp(\lambda_j) + (t - c_m)\exp(\lambda_{m+1}) \right) \right]$$

where *m* is determined by: $c_m < t \leq c_{m+1}$.

Unobserved heterogeneity is taken into account by using a discrete mixture distribution with two points of support. The unobserved component is assumed to be individual rather than spell specific, which is known to improve empirical identification.

The potential endogeneity of literacy is not addressed explicitly in this study, although we do try to push the interpretation of the results in the direction of a causal relation. The reasons behind the neglect of this issue are fourfold: First, we believe that the delimitation of the sample (see below) to those aged 25 or above implies that major educational activities have been initiated such that the order of magnitude of literacy for any given worker in the sample is already determined at this age. Second, we are not looking at individuals who have decided not to enter the labour market, that is, individuals who have chosen to invest little in literacy because they want to stay at home. Third, we do control for parental education and parental attachment to the labour force while growing up. Fourth, a more pragmatic reason is that we have no valid instrument available to correct for the

potential endogeneity of literacy. Finally, we are not aware of any studies where the potential endogeneity of literacy has been accounted for.

5. Data

The data for this study consist of the Danish part of the Second International Adult Literacy Survey (SIALS) data set, which is a survey data set with measurements of literacy of individuals, combined with longitudinal data constructed from register data from Statistics Denmark (see Jensen and Holm, 2000). The register data is from a 10% random sample of the Danish population older than 14. The individuals surveyed in the SIALS data were randomly chosen from this register data sample.

The Danish SIALS data set comprises 3,026 persons between the ages of 16 and 66. The competency measured in SIALS is literacy, which is measured using three so-called "domains": prose literacy, mathematical literacy and document comprehension. Prose literacy is for instance defined as "…the knowledge and skills required to understand and use information from texts such as newspapers … and passages of fiction" (OECD, 2000). All three domains are tested via more than 30 questions, which are found to be relevant in the context of daily life, e.g. reading of manuals, declarations of contents and understanding invoices. The answers are scored such that the final measures range from 0 to 500. OECD defines a level of 276 as adequate compared to the demands that are made with regard to understanding written information in modern society (OECD, 2000).

The labour market history data files are constructed from extracts of various registers maintained by Statistics Denmark. At the time when this research project was initiated labour market histories

were available for the period 1985-2000. A detailed description of the construction of the labour market histories can be found in the Appendix. The labour market history files contain spells spent in a large number of labour market states, measured with monthly precision. These labour market states are then combined to form the following four more general states: Unemployment, employment, ordinary education, and other states. This grouping of the state space is exhaustive and mutually exclusive.

The unemployment state only comprises those who are registered with the Danish Public Employment Service, including persons participating in active labour market programs[2]. An employment spell may include jobs with different employers as long as there are no intervening periods in other states. The state ”other” covers e.g. people on leave of absence[3], transitional allowance, early retirement, social assistance (outside the public employment service, that is, for individuals who are categorized ‘not employable’), sickness benefits and other states outside the labour force. The states are combined to connected spells, described by a start month in a given state and the duration of the spell in that state until the person changes state or the observation period ends. Periods outside employment of less than three months where the worker returns to the same employer are considered temporary dismissal. Two employment spells with the same employer, interrupted by a period of less than three months, are, therefore, considered a single

[2] All unemployed have a right to participate in an active labour market program after a certain period of unemployment. Programs consist of direct (temporary) job creation schemes, subsidized employment, job search assistance, classroom and vocational training programs, and some formal education programs.

[3] Treating on leave as a separate state might give rise to the concern that long unemployment spells are broken up in several short spells. There is, however, little room for this suspicion as only around 5% of the unemployment spells ends with a transition to a leave scheme, and only 0.2% of the employment spells ends with a transition to leave schemes.

employment spell. This modification is made because previous research has shown that temporary layoffs are widely used in Denmark, and that those temporarily laid off differ in their search behaviour from other unemployed workers (Jensen & Westergaard-Nielsen, 1990; Jensen & Svarer, 2003).

To avoid length-biased sampling from spells that are initiated before the beginning of the sampling period (Lancaster, 1990), we use a flow sample with spells that start in 1994 or later. The year 1994 is chosen so that the time of measurement of literacy (1998) is reasonably close to the period under review.

Only individuals over the age of 25 are considered. This removes a large part of temporary employment, which takes place during courses of education, where the importance of literacy is expected to differ compared to a post-graduation situation. With the mentioned restrictions the selected data contains 1,741 employment spells and 1,533 unemployment spells.

The register data connected to these spells include the most common individual socio-economic and demographic variables obtained on an annual basis. These are age, gender, an indicator for the presence of children aged 0-2, an indicator for being married or cohabiting (couple), educational level (basic school (the reference group), vocational education, medium education, and long education), actual working experience (calculated from mandatory employment related pension contributions), cumulative unemployment and employment duration during the past three years before the current spell, the number of distinct unemployment and employment spells experienced by each individual during the past three years before the current spell, and the state occupied immediately before the current spell (for employment spells, the possibilities are unemployment,

education, and outside the labour force the reference group; for unemployment spells, the possibilities are employment, education, and outside the labour force – the reference group). Finally, in the estimations we also have indicators for the starting year of the current spell, the reference being 1994. In the estimations, the educational groups medium and long education have been collapsed into one group, denoted higher education.

A few remarks on drawbacks of the data are in order: It is not possible to separately identify quits from layoffs in the data. This may be important, since those with poor literacy skills are more likely to experience involuntary dismissal, e.g. because they possess fewer of the competencies valued by the employer. At the same time, those with high literacy skills may choose voluntary unemployment for brief periods of time provided they have a new job lined up. Finally, the data unfortunately contains only few spell-specific variables, so that we cannot, for example, control for the position or wage of current or previous employment, or other variables that convey important information regarding the quality of a job-match.

6. Empirical results

The importance of each of the three measures of literacy (prose, document and mathematical literacy) for mobility has been examined in preliminary analyses. It is found that they have the same qualitative importance, but the quantitative importance to mobility is slightly larger for prose literacy than for the two other literacy measures. When all three literacy measures are included simultaneously in the model, prose literacy also dominates mathematical literacy and document literacy. This is noteworthy since poor prose literacy is more frequent in Denmark than poor performance with respect to the other two literacy measures (Jensen & Holm, 2000). Thus, in the

following we focus on prose literacy[4], referring to it just as literacy. Table 1 contains descriptive statistics for the employment and unemployment spells and the explanatory variables used in the duration models.

Table 1. Descriptive statistics for employment and unemployment spells.

	Employment spells			Unemployment spells		
	Mean	Std.err	Range	Mean	Std.err	Range
Duration (days)	606	655	30-2541	257	316	1-2431
Literacy	277	37	139-370	272	37,5	139-359
Age	36.6651	9.6407	25-64	38.0776	10.0284	25-64
High school						
Vocational education	0.4273	0.4948		0.4318	0.4955	
Short advanced	0.0758	0.2648		0.0770	0.2666	
Advanced	0.0643	0.2454		0.0444	0.2060	
Labour market experience (years)	10.3989	7.9135	0-37	11.0789	8.1165	0-37
Man	0.4739	0.4995		0.4540	0.4980	
Cohabiting	0.6157	0.4866		0.6295	0.4831	
Children 0-2 years	0.1200	0.3300		0.1400	0.3400	
Father missing	0.3912	0.4881		0.3907	0.4881	
Father vocational	0.3642	0.4813		0.3601	0.4802	
Father short advanced	0.0333	0.1795		0.0300	0.1707	
Father advanced	0.1379	0.3448		0.1370	0.3439	
Father worker	0.6536	0.4759		0.6608	0.4736	
Father self-employed	0.2912	0.4545		0.2786	0.4484	
Past unemployment duration[a]	4.2620	3.4554	0-10.5	3.5765	3.2911	0-10.2
Past employment duration[a]	4.4013	3.2867	0-10.2	5.527	3.7319	0-10.5
Past unemployment periods[a]	1.4124	1.1808	0-7	1.0294	1.1094	0-6
Past employment periods[a]	1.0367	1.0943	0-6	1.2681	1.2387	0-6
From employment				0.7684	0.4220	
From unemployment	0.7398	0.4389				
From education	0.0999	0.3000		0.0528	0.2238	
Number of spells	1,741			1,533		

[4] The three measures are closely correlated (the correlation between prose and mathematical literacy is 0.86, and the correlation between prose and document literacy is 0.92) and a principal component analysis shows that 93% of the variation of the three domains can be explained by one principal component that is fundamentally an average of the three. If the average of the three literacy measurements is included, the results are equivalent to those that include prose literacy only.

Note: Employment includes temporary lay-offs. Unemployment includes periods in active labour market programs. The range is given by the minimum and maximum value of the variables. Literacy and variables referring to father's education and occupation are from SIALS. "Father missing" means missing information for parental variables.

[a] Past duration (in months) and number of periods during 3 years prior to current unemployment spell.

Table 1 shows that employment spells last on average 606 days, i.e. a bit more than 1½ years, and that unemployment spells last on average 257 days, i.e. slightly more than 8.5 months. Unemployment duration is about twice as large in this sample as is normally found, but that is mainly because temporary layoffs, which make up about 40 percent of all unemployment spells and are typically quite short, are included as part of employment spells.

It is apparent that the average level for literacy is slightly higher for persons in employment than for the unemployed, and that the unemployed are slightly older and have more years of working experience[5] than those who are employed. It is quite remarkable that the mean literacy level, around 275, is the level that OECD has defined as a minimum necessary to be reasonably able to meet the demands in current society (OECD, 2000). It is also apparent that slightly fewer among the unemployed persons have a medium-long or long education than among the employed.

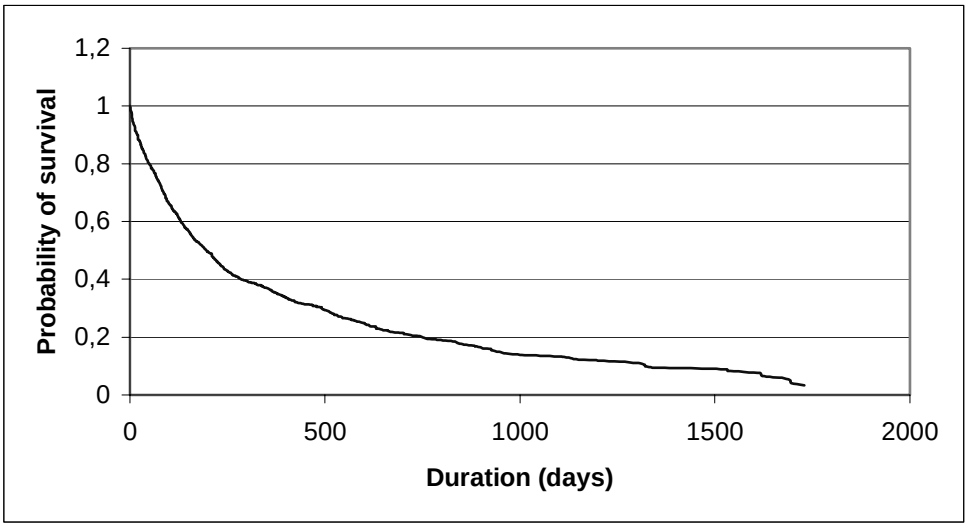
For the sake of comparison, we have calculated mean literacy levels for people in education and outside the labour market. These figures show a far greater difference in literacy: persons who are undertaking education have a higher level of literacy, while persons outside the labour market clearly have poorer literacy skills than both the employed and the unemployed. This is largely in agreement with previous findings conducted with other labour market data (cf. Jensen & Holm, 2000).

[5] Note that working experience here denotes actual working experience, calculated from mandatory employment related pension contributions.

In order to shed light on transition patterns out of unemployment and into employment, Figure 1 shows Kaplan-Meier estimates of the survival function of the unemployment spells. Figure 1 shows that approximately half of the unemployed have found work after 200 days of unemployment. Only 1 per cent of them are still unemployed after almost 5 years of unemployment (1750 days).

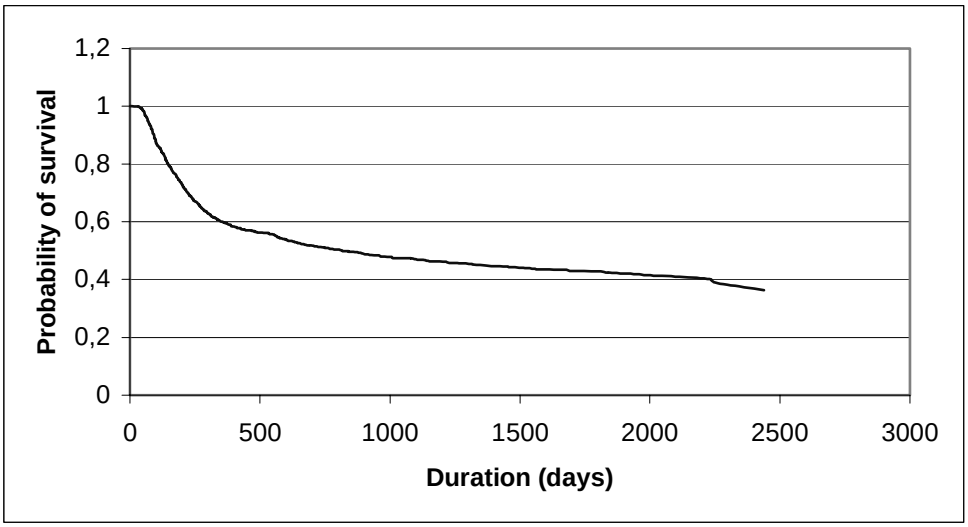
The Kaplan-Meier survivor function for employment spells ending in unemployment is shown in Figure 2. Half of those who begin an employment spell after 1994 are still employed after approximately 2.25 years (820 days), and the level of departure into unemployment stabilises after a couple of years. Thus, there is a large share of workers that end their employment spell quickly. This is due to the flow sampling scheme, which samples from the inflow rather than the stock of employed workers. This is not a problem, since the sample is intended to be representative of the inflow into employment.

Figure 1: Survival function for unemployment spells ending with employment.



Note: Only spells begun after 1994 are included. The figure shows the share of unemployment spells (registered with the Danish Public Employment Service), that after a given number of days do not end in employment.

Figure 2: Survival function for employment spells ending with unemployment.



Note: Only spells begun after 1994 are included. The figure shows the share of employment spells that do not end in unemployment after a given number of days.

Duration analyses

The model takes into account that some individuals are more mobile than others, regardless of their level of literacy and education, by including control variables for the cumulative unemployment duration and the number of unemployment spells in the previous three years. Furthermore, for the estimates of the duration of unemployment, a dummy variable for the previous spell being an employment spell is included in the model. This is done in order to take into account these persons' stronger connection to the labour market and for the reason that such persons may have found their new jobs while still being employed in their old jobs (thus, the unemployment spell can, to a greater extent, be voluntary). We also control for gender, whether living in a couple[6], having children aged 0-2, level of education, years of labour market experience and the education and occupational status

[6] Cohabiting couples includes both married, cohabiting couples of equal sex (formally registered as a couple), cohabiting couples with a common child and cohabiting couples of different sex without children, who are not related, with less than 15 years of age difference and where no other adults are living in the household.

of their fathers. Occupational status refers to the status possessed by the father during the longest period while the individuals were growing up.

We first ran the duration model with all variables interacted with literacy, with a 4^{th} order polynomial function of literacy, and with a number of other specifications in order to find the best specification with respect to the way to enter literacy into the model. It turned out that – for both employment and unemployment duration – the best model is one where literacy is interacted with gender and marital status. Hence, in the tables below, this will be the case for most of the results presented therein.

The importance of literacy to the employment prospects of the unemployed

Table 2 contains the results for the hazard rate from unemployment to employment. The table contains four different specifications, the first one does not include literacy, the second includes literacy linearly, the third includes literacy interacted with gender and cohabiting status, while the fourth allows for unobserved heterogeneity by a discrete (two point) mixture distribution.

The parameters from the piecewise constant baseline hazard are not shown. It allows for eleven different levels and is therefore rather flexible. It generally shows a pattern of negative duration dependence within the first year of unemployment, after which it tends to stabilize.[7]

The remaining coefficients show how the hazard rate into employment varies with the explanatory variables. A positive coefficient implies that a larger value of the variable is associated with an

[7] Results regarding the baseline hazard rates as well as with the mathematical and document literacy measures are available upon request from the corresponding author.

Table 2. Duration models for unemployment spells with transitions to employment.

	No literacy		With Literacy		With Interactions		With heterogeneity	
	Estimate	Std.err	Estimate	Std.err	Estimate	Std.err	Estimate	Std.err
Literacy[b]			-0.0099	0.0940				
Literacy, single men[b]					0.2581	0.2060	0.2600	0.2089
Literacy, cohabiting men[b]					**-0.4678**	0.1507	**-0.4847**	0.1541
Literacy, single women[b]					0.2902	0.2329	0.2964	0.2320
Literacy, cohabiting women[b]					0.2835	0.1698	0.2943	0.1728
Age	0.0414	0.0356	0.0414	0.0356	0.0367	0.0357	0.0389	0.0366
Age^2[c]	-0.0083	0.0043	-0.0083	0.0043	-0.0076	0.0043	-0.0079	0.0044
Experience	0.0239	0.0157	0.0239	0.0157	0.0253	0.0157	0.0250	0.0161
Experience^2[c]	-0.0032	0.0051	-0.0032	0.0051	-0.0039	0.0051	-0.0038	0.0053
Child 0-2	**-0.3842**	0.1416	**-0.3846**	0.1416	**-0.3943**	0.1423	**-0.4205**	0.1492
Man	**0.2232**	0.1063	**0.2217**	0.1071	0.3638	0.8381	0.3809	0.8387
Cohabiting	0.0826	0.0963	0.0821	0.0965	0.1184	0.7812	0.0984	0.7649
Cohabiting man	0.1629	0.1357	0.1640	0.1361	**2.0510**	1.0318	**2.1260**	1.0288
Man with child 0-2	0.2836	0.1977	0.2835	0.1978	0.3029	0.1980	0.3337	0.2052
Past unemployment duration[a]	-0.0368	0.0201	-0.0367	0.0200	-0.0385	0.0202	-0.0366	0.0209
Past unemployment periods[a]	0.0733	0.0488	0.0730	0.0489	0.0784	0.0490	0.0816	0.0502
Past employment duration[a]	0.0224	0.0200	0.0224	0.0199	0.0208	0.0201	0.0240	0.0209
Past employment periods[a]	0.0825	0.0479	0.0827	0.0479	0.0732	0.0480	0.0741	0.0491
From employment	**0.5341**	0.1266	**0.5339**	0.1267	**0.5358**	0.1271	**0.5350**	0.1308
Duration, last employment spell	**-0.0201**	0.0041	**-0.0201**	0.0041	**-0.0200**	0.0041	**-0.0206**	0.0043
From education	**0.7180**	0.2005	**0.7184**	0.2005	**0.7481**	0.2018	0.7690	0.2071
Duration, last education spell	0.0043	0.0188	0.0043	0.0188	-0.0004	0.0192	0.0005	0.0196
High School	0.1321	0.1266	0.1360	0.1317	0.1018	0.1327	0.0968	0.1357
Vocational education	**0.2150**	0.0757	**0.2167**	0.0774	**0.2078**	0.0776	**0.2056**	0.0793
Short advanced	0.2241	0.1345	0.2269	0.1372	0.2174	0.1374	0.2092	0.1411
Advanced	0.1695	0.1650	0.1732	0.1692	0.0922	0.1712	0.0776	0.1763
Father missing	-0.0364	0.1338	-0.0348	0.1264	-0.0014	0.1357	0.0003	0.1277
Father vocational	0.0239	0.1350	0.0258	0.1272	0.0456	0.1366	0.0545	0.1296
Father short	-0.1406	0.2156	-0.1365	0.2121	-0.0766	0.2181	-0.0802	0.2165
Father advanced	0.0059	0.1704	0.0095	0.1518	-0.0126	0.1667	-0.0102	0.1544
Father worker	**0.3112**	0.1538	0.3119	0.1539	0.2816	0.1543	0.3087	0.1603
Father self-employed	0.2590	0.1587	0.2598	0.1588	0.2398	0.1593	0.2737	0.1658
Start year 1995	0.0547	0.1099	0.0550	0.1099	0.0378	0.1100	0.0363	0.1123
Start year 1996	**0.2264**	0.1065	**0.2268**	0.1065	0.1869	0.1069	0.1933	0.1088
Start year 1997	**0.2285**	0.1087	**0.2290**	0.1087	0.1710	0.1098	0.1770	0.1119
Start year 1998	**0.3159**	0.1191	**0.3162**	0.1190	**0.3243**	0.1192	**0.3375**	0.1217
Start year 1999	**0.2531**	0.1134	**0.2533**	0.1135	**0.2427**	0.1136	**0.2440**	0.1164
Start year 2000	-0.1343	0.1462	-0.1339	0.1462	-0.1484	0.1463	-0.1691	0.1530
α							**-3.2232**	0.4505
ln(P1)-ln(1-P1)							**-1.8125**	0.7830
LogL	-7,008.00		-7,007.00		-7,001.85		-7,000.71	
LR test, compared to model before:			0.01		12.30		2.29	
			(1 d.f.)		(3 d.f.)		(2 d.f.)	
AIC 2(lnL-p)	-13,928.01		-13,926.00		-13,908.70		-13,907.42	

Notes: The estimations are based on 1,533 observations. Coefficients in bold are significant on a 5% level. α is the

point of support in the heterogeneity distribution, and ln(P1)-ln(1-P1) is its log-odds probability. LR test is a likelihood ratio test that compares likelihoods with the model just before. The degrees of freddom are given below. AIC is Akaikes information criterion.

[a] Past duration (in months) and number of periods during 3 years prior to current unemployment spell.

[b] Coefficient multiplied by 100.

[C] Coefficient multiplied by 10.

increase in the hazard rate and a reduction in the expected duration of unemployment until a transition to employment.

Looking across the four sets of estimates, it is apparent that the effect of most variables is fairly constant. Younger, men, and in particular men with children less than 3 years of age, persons with short previous unemployment duration, and those entering unemployment from employment or education (as opposed to entering from outside the labour force,) have shorter unemployment spells. While father's education is insignificant, those who grew up with a working or self-employed father have shorter unemployment durations. Of particular interest, we note that those with more working experience and the more educated also have shorter unemployment periods. Increasing working experience by one standard deviation (8.1 years) above the mean (11.1 years) raises the hazard rate from unemployment to employment by approximately 15%. Individuals with a vocational education, a short advanced or an advanced degree have hazard rates, which are around 18-25% higher than for those without a qualifying education. The effects of short advanced and advanced education are, however, not significant.

The second set of estimates includes literacy linearly. It shows that the effect of literacy is small and insignificant and that controlling for literacy does not alter the impact of labour market experience

and education on unemployment duration. The third set of results contains interactions between literacy, and gender and cohabitation status. The results show that more literacy increases the exit rate from unemployment for women and for single men, while for cohabiting men, we find the opposite result.[8] Thus the hazard rate from unemployment to employment is 11% higher if literacy increases by a standard deviation (37 points, see table 1) for women or single men, while it is 16% lower in the same case for cohabiting men. On the other hand, cohabiting men already have a very high exit rate from unemployment in this specification. Interpreted within a signalling model as discussed above, this suggests that for men, living in a couple sends a very strong signal in the labour market. It may be that the importance of the 'cohabitation signal' tends to decrease with the human capital embodied in the person, because then other signals become more important. Such a phenomenon could potentially explain the negative relation between literacy and the exit rate from unemployment for men living in couples.

We emphasize that when literacy is included in the model, the effect of a high school or advanced degree decreases quite a bit. This is however not the case for the effect of a vocational or a short advanced education, nor of labour market experience. In fact, the impact of working experience tends to become more important when literacy enters the model.

The fourth set of estimates controls for unobserved heterogeneity. This is done using a discrete mixing distribution as in Heckman & Singer (1984), although we restrict the distribution to be with only two points of support. One point of support is normalized to zero, and it is seen that the other, α, is significantly different from this. Even though the Akaike information criterion suggests that these estimates are preferred to those without unobserved heterogeneity, both the likelihood and

[8] In table 4 we show that imposing the restriction that the coefficient to literacy is identical for women and single men, the coefficient to literacy becomes statistically significant. Therefore, we treat it as significant in Table 2 as well.

Table 3. Duration models for employment spells with transitions to unemployment.

	No literacy		With Literacy		With Interactions		With heterogeneity	
	Estimate	Std.err	Estimate	Std.err	Estimate	Std.err	Estimate	Std.err
Literacy[b]			**-0.3394**	0.1132				
Literacy, single men[b]					**-1.0033**	0.2328	**-1.2684**	0.3185
Literacy, cohabiting men[b]					-0.2426	0.1693	-0.3318	0.2312
Literacy, single women[b]					-0.3826	0.2710	-0.5058	0.3330
Literacy, cohabiting women[b]					-0.1016	0.1778	-0.1571	0.2220
Age	-0.0003	0.0389	0.0039	0.0387	0.0073	0.0392	0.0162	0.0499
Age^2[c]	0.0023	0.0047	0.0015	0.0047	0.0012	0.0047	0.0007	0.0060
Experience	0.0002	0.0188	-0.0008	0.0188	-0.0021	0.0190	-0.0127	0.0239
Experience^2[c]	-0.0047	0.0064	-0.0041	0.0064	-0.0053	0.0065	-0.0034	0.0079
Child 0-2	-0.1017	0.1612	-0.1119	0.1610	-0.1478	0.1620	-0.1642	0.2032
Man	0.0339	0.1198	0.0123	0.1208	1.6771	0.9456	2.0321	1.2169
Cohabiting	-0.1692	0.1061	-0.1748	0.1062	-0.9391	0.8691	-1.1600	1.0806
Cohabiting man	0.1236	0.151	0.0991	0.1513	-1.1479	1.1301	-1.4398	1.4720
Man with child 0-2	-0.3432	0.2403	-0.3572	0.2404	-0.3462	0.2410	-0.4925	0.2993
Past unemployment duration[a]	0.1396	0.0239	**0.1351**	0.0239	**0.1349**	0.0239	**0.1617**	0.0309
Past unemployment periods[a]	0.0795	0.0585	0.0876	0.0588	0.0927	0.0591	0.1079	0.0760
Past employment duration[a]	0.0201	0.0224	0.0167	0.0225	0.0209	0.0225	0.0130	0.0281
Past employment periods[a]	0.0750	0.0549	0.0721	0.0553	0.0628	0.0556	0.0892	0.0710
From unemployment	0.6514	0.1557	**0.6356**	0.1555	**0.6364**	0.1551	**0.8043**	0.1953
Duration, last unemployment spell	-0.0160	0.0129	-0.0141	0.0127	-0.0135	0.0127	-0.0203	0.0171
From education	-0.6930	0.3533	-0.6744	0.3534	-0.6664	0.3532	-0.6335	0.3717
Duration, last education spell	0.0819	0.0322	**0.0810**	0.0321	**0.0810**	0.0315	**0.0821**	0.0341
High School	-0.1038	0.1563	0.0351	0.1630	0.0364	0.1636	0.068	0.2063
Vocational education	-0.0999	0.0854	-0.0357	0.0884	-0.0587	0.0886	-0.0160	0.1138
Short advanced	-0.2885	0.1574	-0.1848	0.1620	-0.2065	0.162	-0.1281	0.2155
Advanced	-0.5171	0.1818	-0.3605	0.1899	-0.3589	0.1903	-0.3496	0.2391
Father missing	-0.0470	0.1377	-0.0179	0.1351	-0.0046	0.1351	0.0283	0.1831
Father vocational	0.0245	0.1445	0.0838	0.1414	0.1058	0.1415	0.1421	0.1886
Father short	0.2783	0.2269	0.4067	0.2290	0.4062	0.2305	0.5710	0.3052
Father advanced	0.2194	0.1714	0.3093	0.1716	0.3189	0.1715	**0.4686**	0.2259
Father worker	-0.1512	0.1563	-0.1342	0.1566	-0.1275	0.1572	-0.2162	0.2145
Father self-employed	-0.2189	0.1656	-0.2027	0.1661	-0.2033	0.1666	-0.2986	0.2258
Start year 1995	-0.1679	0.1207	-0.1684	0.1206	-0.1528	0.1208	-0.1979	0.1593
Start year 1996	-0.0865	0.1183	-0.0876	0.1184	-0.0717	0.1185	-0.0435	0.1572
Start year 1997	-0.1449	0.1219	-0.1389	0.1219	-0.1386	0.1221	-0.1875	0.1579
Start year 1998	-0.1805	0.1279	-0.1789	0.1277	-0.1732	0.1279	-0.2548	0.1652
Start year 1999	-0.1497	0.1241	-0.1403	0.1241	-0.1259	0.1242	-0.1983	0.1585
Start year 2000	-0.0657	0.1713	-0.073	0.1712	-0.0773	0.1713	-0.1091	0.1987
a							**-1.8116**	0.3070
ln(P1)-ln(1-P1)							**2.5872**	0.4885
LogL	-6,191.39		-6,186.97		-6,181.50		-6,175.93	
LR test, compared to model before:			8.83		10.95		11.13	
			(1 d.f.)		(3 d.f.)		(2 d.f.)	
AIC 2(lnL-p)	-12,470.78		-12,463.95		-12,459.00		-12,451.86	

Note: Based on 1741 observations. See notes for Table 2.

parameters estimates are hardly altered.

The importance of literacy to the unemployment risk of the employed

Table 3 presents the results for the hazard rate from employment to unemployment. The parameters in the piecewise constant baseline hazard (not shown) reveals an increasing hazard during the first two months of an employment spell, after which it declines fairly monotonically. This is also a standard finding in the literature.

As for unemployment duration, four different sets of estimates are presented in the table. Even though the estimates vary more across specifications than was the case for unemployment duration, there are some similarities. Those with more unemployment in the previous three years are more likely to have shorter employment spells, whereas previous periods of employment are of no significant importance to the risk of unemployment. Quite surprisingly, years of labour market experience does not significantly affect the risk of becoming unemployed either.[9] The unemployment risk varies in a more monotonic way with length of education than the employment chances did for the unemployed. The education effects are all insignificant though. Significant education effects are obtained by collapsing different education groups. This is e.g. the case when short advanced and advanced are collapsed and literacy is excluded. We keep the finer groups however, such that a potential literacy effect is not just capturing these educational differences. When we do not control for literacy, those with an advanced education have a lower unemployment risk: the hazard rate into unemployment is 18% lower than for those without an education. When literacy is included in the analysis the effect of advanced education decreases to 12%. The second

[9] This result does not change if we leave out the quadratic term for experience.

sets of estimates show that literacy is significant. An increase in literacy of one standard deviation, 37 points, lowers the exit rate from employment to unemployment by 12%.

Introducing interactions between literacy, and gender and cohabiting status, we find that literacy does only have a significant impact for single men, where more literacy leads to a large decline in the exit rate from employment. In fact, a 37 points increase in literacy is associated with a 37.5% lower exit rate from employment. Once again, it would appear that cohabiting status for men is a strong signal of high productivity and/or stability, but in this case it is not statistically significant. Also, single men tend to be those who have the least stable employment relations although this coefficient is not significant either.

The fourth set of estimates shows that unobserved heterogeneity is an important part of the model and, when allowed for, some of the coefficients change markedly. Among these the literacy effects, which increase by almost 50%. Using the Akaike information criterion, this model is preferred to the one without unobserved heterogeneity[10].

These results may be masking the effect of literacy on employment and unemployment duration for two reasons. First of all, previous labour market status may affect literacy measured in 1998. To gain some robustness against this scenario, we estimated the models with interactions between literacy and cohabiting status for spells that started in 1998 or later. This reduces the sample to less than the half. However, with one exception it produces literacy coefficients of the same sign and more or less of the same order of magnitude as with the larger sample. The exception is for single women, where we find a negative, but insignificant effect of literacy on unemployment duration.

[10] The model with unobserved heterogeneity is also preferred if we apply the Lindsay-criterion (Lindsay, 1983). Moreover, adding more points of support does not improve the fit.

Second, it may be that some of the impact of literacy is masked by the inclusion of other sets of explanatory variables. For example, if literacy affects current unemployment and employment spells, then it may also have affected the duration of these spells in the past. Hence, inclusion of the labour market history may mask some of the effects of literacy. To investigate this issue, we have estimated models without labour market history, and without education and labour market experience. The coefficients to literacy interacted with gender and cohabitation status are reported in Table 4 below. As unobserved heterogeneity did not affect the estimates for transitions from unemployment to employment, the additional estimations for these transitions are without unobserved heterogeneity, whereas we allow for unobserved heterogeneity for the transitions from employment to unemployment. Note that the rows are not in equal order for the unemployment and employment estimations. The rows are ordered to accommodate the restriction in the last column.

The fourth model is similar to the third set of results in Tables 2 and the fourth set of results in table 3. Beginning with the first model, education, working experience, and recent labour market history variables are left out of the model. In this specification, literacy has a significantly positive effect on the exit rate out of unemployment for cohabiting women, while it is significantly negative for cohabiting men. Including education and labour market experience in model 2 and 3 does not alter these results, except that education unbalances the effect a bit between men and women. When labour market history is included in model 4 literacy becomes insignificant for cohabiting women.

Table 4. Literacy effects when other labour market variables are included sequentially.

	Model 1 age, gender, children, cohabiting status, parental info + time dummies + interactions	**Model 2** Model 1 + education dummies	**Model 3** Model 2 + experience and experience squared	**Model 4** Model 3 + 8 recent labour market history variables	**Model 5** Model 4 with restriction
Transitions out of unemployment:					
Literacy, cohabiting men[b]	**-0.4876**	**-0.5633**	**-0.558**	**-0.4678**	**-0.4678**
	(0.1448)	(0.1498)	(0.1512)	(0.1507)	(0.1505)
Literacy, single men[b]	0.1537	0.0910	0.1240	0.2581	
	(0.1974)	(0.2037)	(0.2060)	(0.2060)	
Literacy, single women[b]	0.3488	0.2730	0.2767	0.2902	**0.2773**
	(0.2285)	(0.2315)	(0.2320)	(0.2329)	**(0.1250)**
Literacy, cohabiting women[b]	**0.4408**	**0.3663**	**0.3706**	0.2835	
	(0.1609)	(0.1663)	(0.1694)	(0.1698)	
LR, model vs model(-1)		1.11	12.75	112.38	0.01
		(4 d.f.)	(2 d.f.)	(8 d.f.)	(2 d.f.)
Transitions out of employment:					
Literacy, single men[b]	**-1.4855**	**-1.3987**	**-1.6275**	**-1.2684**	**-1.267**
	(0.2418)	(0.2485)	(0.2899)	(0.3185)	(0.3188)
Literacy, cohabiting men[b]	**-0.5875**	**-0.4863**	**-0.4516**	-0.3318	
	(0.2017)	(0.2084)	(0.2067)	(0.2312)	
Literacy, single women[b]	**-0.7904**	**-0.6242**	**-0.6206**	-0.5058	-0.2817
	(0.3030)	(0.3128)	(0.3205)	(0.3330)	(0.1571)
Literacy, cohabiting women[b]	**-0.4229**	-0.3100	-0.1708	-0.1571	
	(0.2046)	(0.2097)	(0.2201)	(0.2220)	
LR, model vs model(-1)		6.50	22.90	251.61	0.82
		(4 d.f.)	(2 d.f.)	(8 d.f.)	(2 d.f.)

Note: Standard errors in parentheses. LR test row has degrees of freedom in parentheses. See notes to Table 2.

Still, testing for the equality of the coefficient to literacy for women and single men, we find that the coefficient is indeed the same and imposing this restriction, it is statistically significant.

The bottom part of the table shows similar results for transitions from employment to unemployment. It shows that literacy is significant for all interactions between gender and cohabiting status when education, experience and labour market history is not controlled for. However, once again, when past labour market history is controlled for, literacy becomes

insignificant for all but the single men. We cannot reject that the literacy coefficient is the same for women and cohabiting men (model 5), but it is not significantly different from zero.

Since the result for cohabiting men's transitions from unemployment is so different from other results, we elaborate a bit further upon it. In particular, we pursue the idea that the effect of literacy depends upon availability of other signals. We do this by splitting up cohabiting status into three: married and other cohabitants (see footnote 6) and singles and interact these further with other low-signal variables. The results are shown in table 5 with results from table 4 once more repeated. In model 6, we split up cohabitant status into married and other cohabitants. It shows that the negative effect solely occurs for married men, not for other cohabitants. Furthermore, the effect of being married is much larger than the effect of being other cohabiting. Within the signalling story this makes sense, since formal marriage is easier to use as a signal than other types of cohabitation. The result is in line with the previous stated hypothesis that the strong value of the marriage signal decreases when human capital (literacy) increases, i.e. when other signals become more important. In model 7 the literacy-cohabiting variables are interacted with the dummy for having small children. We tried other interactions, but they did not provide sizeable nor significant effects. The results show that the negative impact of literacy occurs for married men without small children. Again, having no small children is a valuable signal in itself for men (see table 2), and therefore the result can be explained by the same scenario as above, that the value of marriage and no small children decreases when human capital increases.

Table 5. Additional results on literacy effect for unemployed.

		Model 4 From table 4		**Model 6** Model 4 with couple divided to married, cohabiting		**Model 7** Model 6 with interactions for married men + restrictions
Transition out of unemployment:	Estimate	Std.err	Estimate	Std.err	Estimate	Std.err
Literacy, married man	**-0.4949**	0.1542	**-0.7335**	0.1888	**-0.9563**	0.215
Literacy, cohabiting man			-0.0629	0.2361	0.1306	0.2943
Literacy, married woman	0.2913	0.177	0.3085	0.1996		
Literacy, cohabiting woman			0.2441	0.3069	**0.2984**	0.1309
Literacy, single man	0.2624	0.2094	0.2834	0.2062		
Literacy, single woman	0.2998	0.2448	0.313	0.2354		
Literacy, married man, child 0-2					**1.0203**	0.4799
Literacy, cohabiting man, child 0-2					-0.5553	0.4878
Literacy, women or single man, child 0-2					-0.0457	0.3928
LogL	-7,000.2		-6,997.5		-6,988.6	
LR, model vs model(-1)			5.33		17.84	
			(4 d.f)		(7 d.f.)	

Notes: LR test row has degrees of freedom in parentheses. See notes to Table 2.

Discussion and Conclusion

We have shown that literacy is at least as important as both formal education and years of working experience for the employment chances of the unemployed. For cohabiting men, the relation is the inverse of the expected, but this may be a spurious result induced by the productivity signal of cohabitation becoming less important as human capital (literacy) increases. Further pursuing this idea, this type of spurious relation is even more pronounced for formally married men without small children. With respect to the unemployment risk of the employed, education and labour market experience has only a modest effect, while literacy has a large protective effect for both women and men. Excluding other productivity signals (not cohabitation, though) we find that more literacy is associated with more stable employment relations for all groups (although the result is not quite significant for cohabiting women).

The size of the effect of literacy is considerable. Increasing literacy by one standard deviation raises the hazard from unemployment to employment by 11% for women and single men and lowers the hazard from employment to unemployment by 12% overall and by 37.5% specifically for single men. These effects are at the very least comparable in size to the effects of education and labour market experience.

Altogether, our results confirm the expectation that literacy matters for both employment and unemployment duration, and that it may in fact be at least as relevant to include in analyses of labour market transitions as standard human capital measures such as education and labour market experience.

It appears that literacy matters more for the employed than for the unemployed, at least if we take into account the results reported in Table 4. This is in accordance with our a priori expectations.

We did expect to find an effect of literacy for unemployed singles. However, the effect is equally strong for cohabiting women, while for cohabiting men the relation was the opposite of the expected. This is already discussed above, but the results warrant further research.

The implications of the study are that a strategy of investing in post education training might improve the labour market situation, both with respect to increasing employment duration and lowering unemployment duration, of trained individuals. To the extent that positive externalities are involved, government subsidies to such policies could be advocated.

Appendix

Construction of labour market histories

This appendix describes the main principles for the establishment of monthly labour market states and coherent labour market spells. The appendix is from Arendt et al. (2004) and is reproduced here for the sake of completeness.

Establishment of monthly states

A detailed labour market state is determined for each person for each month. These are then combined to make up the overall states. The order of priority in which the detailed states are determined is established based on the reliability and accuracy of the information on the various states. The order of priority is important because a person can, in the course of a month, be in more than one state. For instance, a person can be on social assistance benefits for one part of a month and outside the labour force for another part of a month. If the social assistance state is established before the "outside the labour force" state, the person will be allocated the state of social assistance benefits for the entire month. The unemployed (e.g. persons who are registered with the Danish Public Employment Service or are eligible for social assistance benefits) are the only ones for which we have data on how many days of unemployment they had in a month. This is utilised in connection with assessing the duration of the various spells. The determination of the monthly states for each person is carried out as follows.

1. First, unemployment months (i.e. months where the person is registered with AF) are divided into unemployment on social assistance benefits and unemployment on unemployment benefits. Social assistance benefits months for persons who have only received supplementary benefits from the

social assistance system are redefined so that such persons are not counted as social assistance benefits recipients.

2. Then unemployment (in the named order of priority) is established for those who qualify for unemployment and social assistance benefits, subsidised employment, other local authority activation schemes, retirement, transitional allowance, leave of absence schemes, various types of activation schemes for those who qualify for unemployment benefits, recipients of sickness benefits and social assistance benefits (except for subsidised employment and unemployment for those registered with AF).

3. Next, unemployment of up to 35 days (equalling five weeks of holiday) falling during an activation or leave of absence period is re-specified as activation and leave of absence, respectively. Furthermore, unemployment of up to one month in duration immediately following an activation spell is re-specified as activation (again because the person may actually be on holiday).

4. Since there can be problems with the accuracy of the registration of social assistance benefits recipients, months with unspecified states that are between months on social assistance benefits are redefined as months on social assistance benefits. This fills in the gaps of one month's duration between social assistance spells.

5. The above states are distributed based on information at the monthly level. Thereafter, the months where a person is in a course of education or in employment are determined based on information at the annual level. Education months are established based on information on courses of education in progress (as of 1 October) and on the highest level of education completed. When a course of education is commenced, it is assumed to commence in September. When a course of education is concluded, it is assumed to conclude in June.

6. Months in employment are determined based on information on annual Danish Labour Market Supplementary Pension (ATP) payments, which are registered in the variable ATPSUM, that is,

only ATP payments regarding employment conditions are considered. If a person is employed by and receives pay from a company (and receives a pay subsidy from the local authority or AF system) there are ATP payments registered in ATPSUM. If, on the other hand, the person receives an allowance directly from their local authority, but no pay from their employer, any ATP payments are *not* registered in ATPSUM. The calculation of employment spells takes into account the fact that the following types of subsidized employment result in ATP payments which are registered in ATPSUM: local authority job training and flexible jobs, AF job training, AF individual job training, special activation jobs (*puljejob*) and job rotation appointments. If a person has been employed in one of these schemes for e.g. two months in the course of the year, the person's ATPSUM will record two months' less of ordinary employment than if the person had not been employed under these schemes. The distribution of the registered ATP amounts for the year according to the number of months in ordinary employment takes into account whether the person is employed full-time or part-time.

7. If a person has full ATP payments for a year, she is assumed to be in employment even though she is registered as in a course of education.

8. If the number of months with unspecified states is less than or equal to the number of months the person should have been in employment according to the ATP payments, the person is assumed to be in employment for these months. If the number of months with unspecified states is greater than the number of months the person should have been in employment according to the ATP payments, the person is assumed to be in employment for the first unspecified months of the year.

9. If the person is registered as self-employed or as an assisting spouse, the person is assumed to be in employment for the months with an unspecified state.

10. If the person, according to the annual figures for labour market attachment, belongs to the group of "others outside the labour force" or is retired, these states are allocated to unspecified months.

11. Finally, a few other corrections are made. Among them, periods on sickness benefits that follow a period of unemployment are respecified as unemployment. Similarly, leave of absence and activation following unemployment are redefined as unemployment. For the very first employment spells (in 1985), ANSAAR (the year of appointment at the workplace where the person works in November) is used to estimate how long the employment state has lasted. Finally, periods of one or two months in duration with unspecified states are attributed to the same state as in the previous month.

Table A1 shows an overview of the detailed states and Table A2 shows how they are related to the overall states.

Table A1: Survey of the detailed monthly labour market states

State	Meaning
0	Unspecified
10	Unemployment on unemployment benefits
11	Unemployment on unemployment benefits, previous month on sickness benefits
12	Unemployment on unemployment benefits, previous month on leave of absence
15	Unemployment on social assistance benefits (kis)
16	Unemployment on social assistance benefits (kis), previous month on sickness benefits
17	Unemployment on social assistance benefits (kis), previous month on leave of absence
	Types of retirement
21	Transitional allowance

22,221	Early retirement
23	Disability pension
24,241	State pension
	Leave of absence schemes
31	Childcare leave
32	Sabbatical leave
33	Study leave
	Types of activation
41	AF job training (private sector) and special activation jobs (*puljejob*)
42	AF job training (public sector), individual job training and job rotation appointments
43	AF education, in general
431	AF education, adult vocational training centre (AMU)
432	AF education, adult day school
433	AF education, adult education centre (VCU) + other county authorities
44	Study leave as unemployed
45	Start-up allowance
46	Enterprise allowance
47	AF activation of young people through education
48	AF activation through education
49	Local authority activation, other
50	Social assistance benefits outside KIS
51	Local authority job training and flexible jobs
52	Specially arranged local authority courses of education
53	Study leave following social assistance benefits
54	Individual local authority job training and voluntary unpaid work

60	Sickness benefits
70	Employment
71	Self-employed
72	Assisting spouse
73	Remaining employment, distributed from January
74	Employment, previous period on sickness benefits
-7,75	Temporary dismissal
76	Employment, previous period on leave of absence
80	Education
81	Working on Advanced Leaving Examination of the *Folkeskole* (primary and lower secondary school)
90	Outside the labour force
91	Outside the labour force, distributed to adjacent months

Table A2: The overall states and their correlation with the detailed states

Overall state	Meaning of overall state	Detailed state
1	Unemployed (registered with AF)	10,11,12,41,42,43,431,432,433,44,45,47,48
2	Employed	70,71,72,73,74,75,76,77,78,79,-7
3	Other, education, social assistance benefits (not registered with AF), sickness benefits, outside the labour force incl. retirement and leave of absence	All others

Monthly distributed states and coherent periods

After having determined for each person a detailed labour market spell in each month, these are grouped into overall states. The monthly states are then gathered to form continuous labour market

spells, each of which is characterised by a state and the duration of the state (measured in number of days, with one month equalling 30 days). The construction of these spells utilises, as mentioned, the information available for unemployment (but not for other states) on number of days of unemployment for each month. Thus, the data is corrected for the duration of the unemployment spell based on the information on the number of days of unemployment in the first and last months of an unemployment spell. The duration of the other spells is determined based on the number of months in the state and, if the spell falls immediately prior to or following an unemployment spell, also based on information on the duration of this unemployment spell. Because the states of unemployment (on social assistance benefits and unemployment benefits, respectively) are determined at an early stage in the calculations to establish the monthly states (cf. above), a person may have been in another state for a number of days in the months that have been allocated as an unemployment state. This is adjusted for by utilising the information on the duration of unemployment for the month in question.[11]

For each spell, variables are also established for the duration and frequency of previous spells in the three years immediately prior to the start of the spell in question. These variables are used as explanatory variables in the statistical analyses.

[11] For a person who is unemployed for a given month, but not for the previous and succeeding months, 30 minus the number of days the person was unemployed for the month in question is allocated equally to the previous and succeeding states. If a person is unemployed for two months or more in succession, 30 minus the number of days the person was unemployed in the month in question are allocated to the previous state from the first month. For the last month a person is unemployed, the surplus days are allocated to the succeeding state.

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