Wage growth and Job Mobility in the U.K. and Germany

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Abstract

This paper estimates the returns to tenure and experience in the United Kingdom and Germany using various methods to correct for heterogeneity and endogeneity biases. We show evidence that job mobility is higher in the UK than in Germany, and that job movers may be negatively selected in Germany and not in the UK. Our findings suggest that returns to tenure are close to zero in both countries and returns to experience are substantially higher in the UK than in Germany. According to our estimates, ten years of labor market experience are associated with average wage returns of around 70 percent in the UK and 30 percent in Germany. Separate estimates for different qualification groups show that in Germany, it is the group of workers with apprenticeship training that is driving the low returns to labor market experience. The underlying reason can be that the German Apprenticeship system may provide workers with general skills which accrue already at the starting of the post-apprenticeship wage, resulting in lower wage growth with post-apprenticeship labor market experience.

JEL Classification:

Keywords: returns to seniority, job mobility, asymmetric information.

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1. Introduction

This study uses worker-level data, the *British Household Panel Survey* and the *German Socio-Economic Panel* to compare the U.K. and Germany[1], in terms of the importance of tenure in the firm and experience in the labor market for the wage profile of workers. There has been an extensive debate on the measurement of the impact of seniority on wages. This has been the case because of the difficulties in eliminating estimation biases associated with individual and job-match heterogeneity and endogeneity of job mobility. We compare two countries with very different labor market institutions and patterns of job mobility. For example, while according to the OECD Employment Outlook (1999) the UK is among the countries with least restrictive employment protection legislation, Germany stands out for having relatively strict employment protection[2], along with France and Southern European countries. Moreover, unlike the UK, Germany has a tight corporatist labor market[3], which implies that even though there are no legal minimum wages in Germany, there are contractual wages per hour or month which are applied to all job categories, cover over 90 percent of the working population, and which are re-negotiated in most

[1] Because for Germany our data runs from 1984 to 1996, East Germany is excluded from our analysis.

[2] They report indicators of strictness of employment protection based on the regulations concerning firing, e.g., redundancy procedures, mandated pre-notification periods and severance payments, special requirements for collective dismissals and short-time work schemes.

[3] There are strong unions and employers' associations with autonomy to conclude collective agreements virtually on all matters of labor relations. The Federal Minister of Labor and Social Affairs estimates that, in 1990, the number of collective agreements in force was about 32000, encompassing almost all industries and services and about 90% of all employees (K.-L. Paque', 1993). Typically, these collective agreements fix contractual minima for wages and working conditions, and in practice virtually all organized employers offer the same wage and working conditions to union members and non-members alike.

instances on a yearly basis. In the UK, and the for the period under analysis (1991-1999) wages are much less regulated due to unions' weakened power[4] and the absence of minimum wages for most of the period[5]. These institutional disparities may play an important role in facilitating or hampering wage flexibility and job mobility. We show evidence that job mobility higher in the UK than in Germany and that job movers could be negatively selected in Germany and not in the UK. In our discussion of the results we suggest as possible explanations "stickier wages" in Germany (in models with employers' learning of workers' ability) and/or adverse selection of job movers in Germany due to low mobility in a context of asymmetric information between current and prospective employers about workers' ability. After correcting for most bias associated with job and individual heterogeneity, our findings suggest that returns to tenure are small in both countries and returns to experience are substantially higher in the UK than in Germany. According to our estimates, ten years of labor market experience are associated with average wage returns of 70 percent in the UK and 30 percent in Germany. Separate estimates for different qualification groups show that in Germany, it is the group of workers with apprenticeship training that drives down the returns to labor market experience in Germany. Our interpretation of this result is that much of the learning that seems to take place in the first few years in the UK labor market, is provided through the apprenticeship training in Germany. In fact, both the unskilled and the university graduates' returns to experience do not differ much between the two countries.

[4] Union membership declined from 33.3 in 1991 to 26.9 in 1998. In 1998 union coverage was around 7 percentage points higher than union membership (Bland, 1999).

[5] Wage councils were abolished in 1993. They covered around 2.5 million employees in retailing, clothing and hairdressing. Their scope was reduced by the Wages Act 1986, which exempted workers under 21 and restricted the Councils to setting a unique minimum hourly rate for all covered workers.

Our empirical section starts with the estimation of the very simple wage equation using OLS and instrumental variables methods which aim at correcting (at least partially) for some of the estimation bias. These estimation methods are the instrumental variable estimator suggested by Altonji and Shakotko (1987), Finnie's (1993) modification of the Altonji and Shakotko's estimator. A clear attraction of the methods we chose to re-visit in this paper is their simplicity and low data requirements. For this reason the Altonji and Shakotko (1987) instrumental variable estimator has also been used to study extensions of the standard wage model such as the returns to industry specific capital (Parent, 1999) and the impact of employer-provided training on wages (Parent, 2000), as well as to investigate the evolution of the wage premium for job seniority in the US (Marcotte, 1998).

This paper is organized as follows. Section 2 sets out the wage growth model and the estimation methods used. Section 3 describes the data. Section 4 provides descriptive statistics of job mobility, within and between jobs wage growth, and types of job separation. Section 5 presents the results, section 6 discusses them in light of the institutional differences between the two countries, and section 7 concludes.

2. Methods

2.1 The empirical model

The empirical analysis is based on the standard wage model described in Altonji and Shakotko (1987) and Topel (1991) in which workers wages depend on

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Minimum wages were re-introduced in the UK in April 1999, with a National Minimum

aggregate real wage growth, years of experience in the labor market and seniority with the firm.

$$W_{ijt} = \beta_0 \gamma_t + \beta_1 X_{ijt} + \beta_2 T_{ijt} + \varepsilon_{ijt} \qquad (1)$$

The dependent variable, W_{ijt}, is the log of the gross real hourly wage of individual i on job j at time t. γ_t is the time dummy, X_{ijt} is actual experience in the labor market and T_{ijt} is seniority with the current employer. β_0 is a parameter which captures aggregate wage growth, and the key parameters of interest, β_1 and β_2 give the partial effects of an additional year of experience or tenure on the wage. The empirical regression also includes individual controls and higher order terms of the tenure and experience variables.

The error term ε_{ijt} is decomposed in three orthogonal components, A_i, θ_{ij} and ν_{ijt} . The individual fixed effect A_i captures unmeasured differences in ability, the job-match effect θ_{ij} is fixed during the course of a job and allows for heterogeneity in the quality of the job matches, and the transitory component ν_{ijt} accounts for idiosyncratic shocks and measurement error:

$$\varepsilon_{ijt} = \theta_{ij} + A_i + \nu_{ijt} \qquad (2)$$

The wage equation in (1) can be re-written using (2):

$$W_{ijt} = \beta_0 \gamma_t + \beta_1 X_{ijt} + \beta_2 T_{ijt} + \theta_{ij} + A_i + \nu_{ijt} \qquad (3)$$

Wage.(Metcalf, 1999, EMIRE)

If the unobserved individual and job match effects are correlated with the variables of interest, then least squares estimates of β_1 and β_2 are likely to be biased. Economic theory gives us some guidance with respect to the likely signs of the correlation between each of the unobserved effects and years of tenure or experience.

Individuals with high unobserved ability are usually assumed to experience less layoffs and quits due to some inherent characteristic such as perseverance, motivation, or health status. This is usually assumed by analogy to the empirical positive relationship found between job tenure and other observable measures of ability such as education. In addition, employers' asymmetric learning about workers' ability may provide an explanation for more able individuals having longer job spells Schönberg (2002). If the firm has discretion with respect to whom lay off, the market infers that laid-off workers are of low ability. Wages offered by prospective employers reflect this expectation and high ability individuals face a disincentive to move jobs due to adverse selection. (Gibbons and Katz, 1991, Acemoglu and Pischke, 1998). These models predict that high ability workers are less likely to be laid off by current employers and, because of adverse selection, are also less likely to quit their jobs. For the above reasons, unobserved ability A_i is likely to be positively correlated with the tenure variable: $cov(T_{ijt}, A_i)>0$.

Since workers' experience is the result of successive decisions in and out of employment, if high ability individuals have indeed longer job spells, they are for this reason also likely to experience less unemployment spells throughout their lives[6], therefore accumulating more labor market experience than low ability individuals.

[6] Altonji and Shakotko (1987) and Topel (1991) both assume that both high wage and low wage workers have similar labor force attachments, but this assumption may be less adequate for European countries.

Experience in the labor market X_{ijt} therefore would be positively correlated with the individual fixed effect A_i [7]: $cov(X_{ijt}, A_i)>0$.

Tenure can also be positively correlated with the job-match effect θ_{ij} since workers may be less likely to quit high wage jobs. A "good match" is a worker-job pair with a high wage relatively to the distribution of wages the worker faces. Workers in good matches are less likely to receive a better offer than the current one and therefore are less likely to quit. In addition, if firms share the returns to a "good match", workers in jobs with a high θ_{ij} are also less likely to be laid off. The job match effect θ_{ij} may be for this reason positively correlated with years of tenure: $cov(T_{ijt}, \theta_{ij})>0$.

In addition, search theory and matching models predict a positive correlation between experience and the job match effect $cov(X_{ijt}, \theta_{ij})>0$, since job shopping over a career implies that the longer an individual spends in the labor market, the higher the probability of having received above average wage offers from a fixed wage distribution.

To assess how the covariance between the unobserved fixed components of the error term and tenure and experience can bias least squares results, consider the following auxiliary regressions:

$$A_i = b_1 X_{ijt} + b_2 T_{ijt} + \xi_{ijt} \qquad (4)$$

$$\theta_{ij} = c_1 X_{ijt} + c_2 T_{ijt} + \omega_{ijt} \qquad (5)$$

[7] Experience may also be positively correlated with the individual fixed effect if average workers' ability differs across cohorts. We assume however that average workers' ability is similar across different cohorts, conditional on experience, tenure and the other controls included in the empirical regression.

According to (4) and (5) in a cross-section of individuals, both the individual and the job match effects can be correlated with years of seniority and labor market experience. Our model can now be re-written using (3), (4) and (5):

$$W_{ijt} = \beta_0\gamma_t + (\beta_1 + b_1 + c_1)X_{ijt} + (\beta + b_2 + c_2)T_{ijt} + \xi_{ijt} + \omega_{ijt} + v_{ijt} \qquad (6)$$

Least squares estimation of (6) is likely to produce biased estimates of returns to seniority and experience where:

$$\beta_1^{OLS} - \beta_1 = b_1 + c_1 \qquad (7)$$

$$\beta_2^{OLS} - \beta_2 = b_2 + c_2 \qquad (8)$$

Note that since A_i and θ_{ij} enter additively in the wage model (see (2)), the biases in (7) and (8) can be decomposed into the sum of a first component resulting from the association between the endogenous regressors and A_i and a second component resulting from the association between the endogenous regressors and θ_{ij}.

In order to assess the likely signs of the biases in (7) and (8) we use straightforward partitioned regression results applied to (4) and (5) to obtain explicit expressions for b_1, b_2, c_1 and c_2 in terms of the variances and covariances of the unobservable components and the variables of interest.

$$b_1 = \frac{Cov(X_{ijt}, A_i) - \gamma_{TX}Cov(T_{ijt}, A_i)}{Var(X_{ijt})\left[1 - (Corr(X_{ijt}, T_{ijt}))^2\right]} \qquad (9)$$

$$b_2 = \frac{Cov(T_{ijt}, A_i) - \gamma_{XT}Cov(X_{ijt}, A_i)}{Var(T_{ijt})\left[1 - (Corr(T_{ijt}, X_{ijt}))^2\right]} \qquad (10)$$

$$c_1 = \frac{Cov(X_{ijt}, \theta_{ij}) - \gamma_{TX}Cov(T_{ijt}, \theta_{ij})}{Var(X_{ijt})\left[1 - (Corr(X_{ijt}, T_{ijt}))^2\right]} \qquad (11)$$

$$c_2 = \frac{Cov(T_{ijt}, \theta_{ij}) - \gamma_{XT} Cov(X_{ijt}, \theta_{ij})}{Var(T_{ijt})\left[1 - (Corr(T_{ijt}, X_{ijt}))^2\right]} \qquad (12)$$

Where γ_{TX} is the coefficient from a regression of experience on tenure, and γ_{XT} the coefficient from a regression of tenure on experience. Starting with (9), it is clear that $cov(X_{ijt}, A_i) > 0$ is not a sufficient condition for $b_1 > 0$. The denominator in (9) is positive, but since tenure and experience are positively correlated ($\gamma_{TX} > 0$), we have that:

$$b_1 > 0 \qquad \text{if} \qquad Cov(X_{ijt}, A_i) > \gamma_{TX} Cov(T_{ijt}, A_i) \qquad (13)$$

In fact, Altonji and Williams (2003) have noted that if one assumes $Cov(X_{ijt}, A_i) = 0$, b_1 is negative since tenure and experience are positively correlated, and tenure and the individual fixed effect are also positively correlated. The intuition is the following. Returns to experience are identified from returns to tenure when workers change jobs, since during the course of a job, changes in tenure and experience are perfectly co-linear. If in a cross-section of workers, job duration and the individual fixed effects are positively correlated, low ability workers are over-represented among job movers. This could both overstate the estimated effect of job tenure on wages and understate the estimated effect of labor market experience on wages.

Conditions similar to (13) can be obtained for b_2, c_1 and c_2. We conclude that even if our assumptions about the covariances between the unobserved effects and tenure and experience being positive hold, the signs of the least squares returns to tenure and experience bias can not be determined. Put another way, both tenure and experience are likely to be positively correlated with A_i. However, because these

tenure and experience are positively correlated, the sign of the overall effect of A_i on the tenure and experience slopes is unclear. Similarly, even though both tenure and experience are likely to be positively correlated with the job match effect θ_{ij}, given that tenure and experience are positively correlated with each other, the overall signs of the effect of θ_{ij} on tenure and experience are ambiguous.

2.2 Altonji and Shakotko (A+S) Instrumental Variable procedure

The first method we use to correct for some of the potential biases described above is the one proposed by Altonji and Shakotko (1987). They follow an instrumental variable approach in which each of the tenure variables is instrumented with its deviations from *job means* DT_{ijt}. Let $\overline{T}_{ij}$ be the job mean of the tenure variable, then $DT_{ijt} = T_{ijt} - \overline{T}_{ij}$. The empirical section also includes higher order terms in tenure that are instrumented in the same way. If $\overline{T_{ijt}^{P}}$ is the job mean of a higher order term of the tenure variable, then $DT_{ijt}^{P} = T_{ijt}^{P} - \overline{T_{ijt}^{P}}$ is its deviation from the job mean. As these variables have zero average over each job, they are by construction orthogonal to the fixed individual and job match components. Hereafter we will call the estimation method of instrumenting tenure with its deviations from job means *IVten1*.

Experience cannot be instrumented with deviations from its job means as well, because deviations from job means of the linear terms of tenure and experience are perfectly collinear.

Applying *IVten1* to (6) may still produce biased estimates of returns to seniority and experience. Consider a variable $\hat{T}_{ijt}$ containing the predicted values of a

regression of tenure on its deviations from job means. Auxiliary regressions similar to those in (4) and (5) where tenure is replaced by $\hat{T}_{ijt}$ enable us to rewrite the second stage regression as:

$$W_{ijt} = \beta_0\gamma_t + (\beta_1 + b_1^{IVten1} + c_1^{IVten1})X_{ijt} + (\beta + b_2^{IVten1} + c_2^{IVten1})\hat{T}_{ijt} + \zeta_{ijt} \quad (14)$$

$$\beta_1^{IVten1} - \beta_1 = b_1^{IVten1} + c_1^{IVten1} \quad (15)$$

$$\beta_2^{IVten1} - \beta_2 = b_2^{IVten1} + c_2^{IVten1} \quad (16)$$

where b_1^{IVten1} and c_1^{IVten1} are the components of the bias in the returns to experience due to A_i and θ_{ij}:

$$b_1^{IVten1} = \frac{Cov(X_{ijt}, A_i)}{Var(X_{ijt})\left[1 - (Corr(X_{ijt}, \hat{T}_{ijt}))^2\right]} \quad (16)$$

$$c_1^{IVten1} = \frac{Cov(X_{ijt}, \theta_{ij})}{Var(X_{ijt})\left[1 - (Corr(X_{ijt}, \hat{T}_{ijt}))^2\right]} \quad (17)$$

Similarly, b_2^{IVten1} and c_2^{IVten1} are the components of the bias in the returns to tenure due to A_i and θ_{ij}:

$$b_2^{IVten1} = \frac{-\gamma_{X\hat{T}}Cov(X_{ijt}, A_i)}{Var(\hat{T}_{ijt})\left[1 - (Corr(\hat{T}_{ijt}, X_{ijt}))^2\right]} \quad (18)$$

$$c_2^{IVten1} = \frac{-\gamma_{X\hat{T}}Cov(X_{ijt}, \theta_{ij})}{Var(\hat{T}_{ijt})\left[1 - (Corr(\hat{T}_{ijt}, X_{ijt}))^2\right]} \quad (19)$$

The authors note that the remaining potential positive correlation between experience and the job match effect would not only bias the experience effect

upwards, but would also bias the tenure effect downwards: “Intuitively, the downward bias rises as a partial correction for the overstatement of the effect of additional labor market experience on wages during years in which the job remains the same” (p. 440). In addition, if returns to experience are also biased upwards due to the individual fixed effect being correlated with experience, this will reinforce the negative bias on the returns to tenure.

As an attempt to compare the relative importance of the individual and job heterogeneity bias in the two countries, in our empirical section we also use as an alternative instrumental variable for tenure its deviations from individual means. We call this instrumental variable estimator *IVten2*. Intuitively, while *IVten2* would represent an improvement over least squares since it produces an estimate of returns to tenure free from the bias due to the correlation between tenure and the individual fixed effect, *IVten1* produces an estimate of returns to tenure free from the bias due to the correlation between tenure and both the individual and job match effects. A comparison of least squares, *IVten1* and *IVten2*, could give an indication of the relative importance of individual and job match heterogeneity in the returns to tenure. Indirectly, this could give evidence of the relative importance of the correlation between ability and job duration, and job match quality and job duration in the two countries. Such evidence would not however be conclusive, as can be seen by comparing the expressions of the remaining biases in the returns to tenure and experience for *IVten2* with the ones for *IVten1* above (shown in appendix 3).

2.3 Finnie's extension of Altonji and Shakotko Instrumental Variable procedure

Finnie (1993) extends the IV-tenure estimator by instrumenting the tenure variables with their deviations from *job means* and the experience variables with their deviations from *individual means.* Let $\overline{Exp}_{ijt}$ and $\overline{Exp^P_{ijt}}$ be the individual means of the experience variables, then $DExp_{ijt} = Exp_{ijt} - \overline{Exp_i}$ and $DExp^P_{ijt} = Exp^P_{ijt} - \overline{Exp^P_i}$ are the deviations from their individual means. As this variables have zero average over each individual, they are by construction orthogonal to the individual fixed effect. Because tenure is instrumented with a variable that is uncorrelated with the individual and job match effects, and experience is instrumented with a variable that is uncorrelated with the individual fixed effect, we expect this estimator to be free from most bias. Experience instruments can still nevertheless be correlated with the job match component. Theory predicts a positive correlation between experience and the job match component. Thus, with this estimation method returns to experience can still be positively biased and returns to tenure negatively biased.

We denominate this instrumental variables estimator as *IVtenexp.* The explicit expressions for the biases in *IVtenexp* estimates are:

$$\hat{\beta}_1^{IVten\exp} - \beta_1 = b_1^{IVten\exp} + c_1^{IVten\exp} \tag{20}$$

$$\hat{\beta}_2^{IVten\exp} - \beta_2 = b_2^{IVten\exp} + c_2^{IVten\exp} \tag{21}$$

where $b_1^{IVten\exp}$, $b_2^{IVten\exp}$, $c_1^{IVten\exp}$ and $c_2^{IVten\exp}$ can be re-written as:

$$b_1^{IVten\exp} = 0 \tag{22}$$

$$b_2^{IVten\exp} = 0 \tag{23}$$

$$c_1^{IVten\exp} = \frac{Cov(\hat{X}_{ijt}, \theta_{ij})}{Var(\hat{X}_{ijt})\left[1-(Corr(\hat{X}_{ijt}, \hat{T}_{ijt}))^2\right]} \tag{24}$$

$$c_2^{IVten\exp} = \frac{-\gamma_{\hat{X}\hat{T}} Cov(\hat{X}_{ijt}, \theta_{ij})}{Var(\hat{T}_{ijt})\left[1-(Corr(\hat{T}_{ijt}, \hat{X}_{ijt}))^2\right]} \tag{25}$$

Both *IVten1* and *IVtenexp* give upward bounds to returns to experience and lower bounds to returns to tenure.

3. The Data

In this section we describe the two data sets used in this paper. Further details can be found in the appendix 1.C. This study uses the first 9 waves of the British Household Panel Survey (1991-1999) and the first 14 waves of the German Socio-Economic Panel (1984-1997).

3.1 The British Household Panel Survey

The BHPS was designed as an annual survey of all adult (16+) members of a nationally representative sample of more than 5,000 households, making a total of approximately 10,000 individual interviews. The same individuals are followed in the successive waves and, if they split-off from original households, all adult members of their new households are also interviewed. Children are interviewed once they reach the age of 16. Thus the sample should remain broadly representative of the population of Britain as it changes through the 1990s. However, in order to construct tenure and experience we need to use the retrospective data on past jobs collected in the second

and third waves (1992 and 1993). For this reason, we may not be able to include adults of newly formed households with members that split-off from the original households. We assume that this sample selection is random and does not affect the wage regressions as long as tenure and experience are included in the regressions.

At each wave the interviewees are asked to state the beginning date of the ongoing job spell, which is defined by a change of employer or a change of job within the same employer. Previous literature has focused on returns to tenure with the employer. We follow the same approach because promotions and job changes within the employer are likely to be associated with wage changes, and therefore must be considered as part of the same spell, for the purpose of the measurement of wage returns to job seniority. For this reason, the construction of both the tenure and experience variables require the use of the retrospective data on the labor market histories, for even if one chose to use potential experience instead of actual experience, this would be needed for the accurate construction of the variable "tenure with the employer".

When linking the job spell information in the various yearly questionnaires and the retrospective data collected in waves 2 and 3 one is confronted with the overlapping of more than one source of information for the same spell. Conflicting answers are resolved by giving priority to the information collected closest to the event occurrence. This is because recall error is likely to increase with the time elapsed between an event and the time of interview.

With the purpose of minimizing endogeneity and unobserved heterogeneity, our analysis restricts the sample to observations of non-self-employed white males

aged between 16 and 60 with jobs in the private sector. Self-employed wages may be misreported and loosely related with the individual productivity, non-white and female wages may suffer from discrimination, and the latter are also likely to be highly affected by endogenous labor force participation. By restricting the age interval, we avoid individuals without strong labor force attachments. We exclude the public sector where wages are regulated and may not reflect accumulation of human capital and worker productivity increases.

The earnings variable used is real hourly wage. Nominal hourly wage is obtained by first dividing the current job usual gross monthly pay by 4.33 to obtain weekly wage and then by weekly hours, to obtain hourly wage. Weekly hours is the sum of the number of hours normally worked per week and the number of overtime hours in normal week. The nominal hourly wage is then deflated with the Retail Prices Index[9] to obtain real hourly wages. Wage outliers were dropped.

Some of the analysis in the next sections the will divide workers into three skill groups: *unskilled*, *medium skilled* and *university graduates*. For the UK data the unskilled include those which report the following qualifications: no qualifications, other qualifications, apprenticeship, CSE, commercial qualifications, no O levels. The medium skilled include those with O levels or equivalent, nursing qualifications, teaching qualifications and A- levels. Finally, the university graduates are those with a higher degree, a first degree, or other higher qualification.

[9] Monthly values are averaged for each year with 1991 as base year. Source: Economic Trends, Annual Supplement, 1998, Office for National Statistics.

3.2 The German Socio-Economic Panel

The GSOEP started in 1984 as an yearly longitudinal survey of 4298 private households[10] and around 9000 individuals in the Federal Republic of Germany (FRG). Although from 1990 data is also collected for the German Democratic Republic (GDR), we restrict our analysis to the FRG since the GDR labor market is likely to behave very differently. Similar to the BHPS, in the GSOEP all household members are interviewed individually from the age of 16. In principle, all persons who took part in the very first wave of the survey as well as their children whenever born, are surveyed in the following years whether or not they remain in the household. Third persons moving into an existing GSOEP household are also followed-up. For the same reasons stated in section 3.1, the analysis is restricted to observations of non-self-employed white males aged between 16 and 60 with jobs in the private sector.

The number of years of labor market experience is constructed in two stages. The first stage uses the yearly biographical scheme containing employment information from the age of 16 to the first wave of the panel to construct total experience at the entry of the panel. Both part-time and full-time spells are taken into account. The second stage uses the calendar available for each wave listing all labor market activities for each month in the year preceding the interview. This information is added to the information computed in the first stage to construct experience at each wave. The tenure variable is constructed from the information about the exact year and month the individual has started current job (i.e., the employment spell with the current employer), up to the time of interview.

[10] These numbers are for the GSOEP sub-sample A - "Residents in the FRG", 95% scientific-use version.

Wages are computed by dividing reported gross earnings in the month before the interview by the number of hours worked for pay.

For the German data, given the apprenticeship system, the three skill groups considered are the following: workers with no apprenticeship training and no university – the *unskilled*, workers with apprenticeship training but no university degree – the *medium skilled* or *apprenticeship trainees*, and workers with university degree – the *university graduates* (See appendix 1.C for more details).

3.3 Sample statistics

Columns 1 and 3 of

Table 1 show the mean sample characteristics for the two full samples. There is a high degree of similarity between the two data sets. The average age is 37 in the UK and 39 in Germany and the mean experience is 20 years in the UK and 19 in Germany. When constructing labor market experience in Germany we did not include the apprenticeship training period, hence the larger age-experience gap in Germany than in the UK. Average tenure is two years longer in Germany than in the UK. The remaining columns present the summary statistics for the differenced sub-samples used in the first stage of Topel 2-stage model. Workers in the differenced sub-samples are older, more experienced and have been in their current jobs longer.

Table 1: Summary Statistics - Mean sample characteristics for white males

	U. K. - BHPS		Germany - GSOEP	
	Full sample	Topel differenced sample	Full sample	Topel differenced sample
	1	2	3	4
Hours worked per week	39.8	39.8	40.8	40.7
	(6.7)	(5.9)	(6.2)	(5.7)
Tenure (years)	8.2	9.8	10.0	11.8
	(7.9)	(7.9)	(9.5)	(9.4)
Experience (years)	19.6	21.2	18.9	21.0
	(11.6)	(11.1)	(12.0)	(11.5)
Percent married	63.8	68.3	74.9	80.2
Number of observations	7073	4572	12302	8818
Number of individuals	1502	1079	2209	1673
Number of jobs	2259	1345	3053	1993
Number of waves	9	8	14	13

Note: Standard errors in parenthesis

4. Descriptive statistics

4.1 Wage growth: total, within jobs and between jobs

Figure 1 depicts the average yearly wage growth in both data sets for the years available[11]. Wage growth between two adjacent years is computed by averaging the difference in the log of real hourly wage for all individuals observed in both periods. This does not necessarily coincide with total wage growth across all individuals, since it does not include those that enter and exit the panel[12]. In the years 1984-97, the real gross hourly wages in the German sample grew on average 3.23 per year and in the period 1991-99 the real gross hourly wages in the UK sample grew on average 2.87

[11] Nominal wages were deflated with the retail price index for each country. All figures and tables use real wages.

[12] Wage growth between 1984 and 1985 in Germany may be excessively low since unlike the other years where 80 to 95 percent of interviews take place between February and April, in 1984 by May only 50 percent of the interviews had taken place, and the remaining took place between May and September. Measurement error in yearly wage growth is therefore likely to be higher between 1984 and 1985. We expect the time dummies in our regression analysis to pick the potential downward bias.

per year. However, during the years for which there is data for the two countries – 1991 to 1997, the yearly wage growth was very similar in the two data sets (2.81 in Germany against 2.58 in the UK).

Figure 2 shows the yearly average wage growth within and between jobs. The between jobs wage growth is much more volatile than the within jobs wage growth. This is probably related with the differences in the causes for separation during periods of low and high wage growth. It is a well known fact that one of the characteristics of recessionary years is the increase in the number of laid-off workers. Conversely, during periods of higher wage growth when it is easier for workers to find jobs, there should be a higher share of voluntary moves. Volatility is however likely to be exacerbated by the reduced number of individuals changing jobs each year[13].

While between jobs wage growth is clearly above within jobs wage growth in Germany, this is only true in the UK in the second half of the nineties. For both Germany and the UK, however, the overall average of between jobs wage growth (5.66 and 3.25) is higher than within jobs wage growth (3.23 and 2.82). Figure 3 plots within and between jobs wage growth by experience interval. For both countries between jobs wage growth is higher than within jobs wage growth in the first 10 to 15 years of workers' careers. After that, wage gains at job changes fall below within jobs wage growth becoming negative towards the end of individuals' careers. This is consistent with decreasing marginal returns to job search.

shows that British workers hold on average more jobs during their careers than German workers. The difference between the two countries is likely to be even larger than the one depicted, because we are not accounting for the number of short job spells between interviews, which is likely to be higher in the UK. Figure 5 graphs the percentage of job-to-job transitions and job transitions with an unemployment spell between jobs on the total number of individuals observed in paid employment in two consecutive waves by age 5-year interval. Unemployment is defined differently

in the two data sets. While in the UK individuals report their own perception of their labor market status, in Germany they are asked whether they are registered as unemployed. Because of this disparity, the figures also show the percentage of job-to-job transitions with an intermediate non-labor market spell. For Germany the gap between the share of transitions with unemployment and the share transitions with a non-labor market spell is larger than for the UK. This is consistent with a more stringent definition of unemployment status in the German data. In both countries both job-to-job transitions and transitions with interruptions decline with age. This is consistent with decreasing marginal returns from search. These graphs are consistent with higher job mobility in the UK than in Germany since the occurrence of both types of transitions is higher in the former than in the latter for all age categories. However, the difference between the occurrence of job-to-job transitions in the UK and Germany is much stronger than the difference in transitions with a non-employment spell. This is suggestive of a stronger role for voluntary job changes in the UK than in Germany.

5. Results

5.1 Returns to tenure and experience

Table 2 A. and B. show the coefficients and cumulative returns to tenure and experience in the two countries using the four estimation methods described: OLS, *IVten1*, *IVten2* and *IVtenexp*. All regressions use fourth degree polynomials in tenure

[13] In the German sample each year between 40 and 60 individuals are observed in a different job from the previous year, while in the BHPS sample we observe between 60 and 80 job changes in two

and experience to allow for non-linear returns. Columns 1 and 5 of Table 2.B. show that according to OLS estimates ten years of tenure are associated with a 9.1 percent wage increase in the UK and an 8 percent wage increase in Germany. These values are considerably smaller than typical estimates with US data (Topel 1991, Altonji and Shakotko, 1987, Altonji and Williams, 1997). Columns 2 and 6 show that when tenure is instrumented with its deviations from job means, the returns to 10 years of tenure decline to 6.1 percent in the UK and to 2.2 percent in Germany, and loose statistical significance. This suggests that the correlation between tenure and the individual and job match effects generate a positive but small bias in the returns to tenure estimated by OLS. Taken at face value, the difference between the least squares and the *IVten1* estimates of the tenure effect would suggest that this bias would be larger in Germany than in the UK. Columns 3 and 6 show the results of instrumenting tenure with deviations from the individual means. For the UK this estimator gives very close tenure effects to the ones estimated with least squares (and also very close experience effects). Since IVten1 produces an estimate of returns to tenure free from the bias due to the correlation between tenure and both the individual and job match effects this would be consistent with the low importance of heterogeneity bias in the UK. The fact that in the UK the IVten1 estimates of the tenure effect are lower than the ones given by IVten2 would also suggest that least squares would be positively biased due to job match heterogeneity. However, as discussed in section 2 (and shown in the appendix 3) the differences between these estimates are only suggestive of such interpretation, but offer no proof of that. For Germany, IVten2 and IVten1 estimates of the tenure effect are both lower than least squares estimates and very similar to each other

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consecutive years.

(returns to experience are higher than least squares and also very similar to each other). This would be consistent with least squares having a positive bias mainly due to individual heterogeneity and not due to the job match heterogeneity. In other words, the evidence given by the differences in the least squares, *IVten1* and *IVten2* estimates would be consistent with more able workers having longer job durations in Germany and jobs with better matches lasting longer in the UK.

As it has been pointed out before, because experience may be correlated with the individual and job error components, returns to experience are likely to be biased, which may in turn bias returns to tenure. Columns 4 and 8 show that when both tenure and experience are instrumented, *IVtenexp*, returns to tenure in both countries are lower than with any of the previous estimators. In addition returns to experience are somewhat higher than with the previous estimators both for the UK and Germany, and standard errors are also higher. Given that both *IVten1* and *IVtenexp* give upward bounds to returns to experience and lower bounds to returns to tenure, we favor *IVten1*.

The lower panels of table 2.A and 2.B point to higher returns to experience in the UK than in Germany according to the four estimation methods. According to our preferred method *IVten1*, for the UK, the first year in the labor market yields a return of roughly 9 percent, and by the 10th year in the labor market the resulting average cumulative return is roughly 70 percent. The marginal returns decrease with experience and the following 10 years generate another 20 percentage points wage gain. In Germany, *IVten1* estimates a return to the first year in the labor market of 3.6 percent, the first 10 years yield a cumulative wage gain of roughly 30 percent, and the first 20 years yield a 42 percent wage gain.

5.2 Cumulative returns to tenure and experience by skill group

In this section we investigate whether the returns to job seniority and general labor market experience differ by skill group. Table 3 and Table 4 display the returns to tenure and experience by qualification group for the UK and Germany. These results were obtained by interacting qualification dummies for the medium skilled and university graduates with the tenure and experience polynomials. Results are shown for OLS, *IVten1* and *IVtenexp*. The various estimation methods differ in roughly the same way for each qualification group as for the whole sample of workers. For both countries and all skill groups *IVten1* estimates show lower tenure effects than least squares, though *IVten1* standard errors are in most cases too large to enable strong conclusions. In addition, with the exception of the university graduates in the UK, *IVten1* offers a higher lower bound to the returns to tenure and a lower upper bound to the returns to experience than the *IVtenexp*.

For the UK, *IVten1* estimates of the returns to ten years of tenure are 7 percent for the unskilled, zero for the medium qualified and 8 percent for the university graduates. For Germany, *IVten1* estimates of the returns to tenure are -4.4 (with a standard error of 8.3) percent for the unskilled, 3.5 for workers with apprenticeship training and zero for university graduates. However, none of these estimates are significantly different from zero.

For the UK, returns to experience rise moderately with skill category. According to the *IVten1* estimates returns to 10 years of experience are 61 percent for

the unskilled, 74 percent for workers with medium skills and approximately 80 percent for university graduates.

For Germany the main difference among the three education groups' returns to experience is that for workers who went through apprenticeship training (Table 4) returns to experience are substantially lower than for the other groups (less than 20 percent to ten years estimated by IVten1). The IVten1 estimate of returns to ten years of tenure for the unskilled is 62.8 percent which is remarkably similar to the returns to experience of the same skill group in the UK, and the university graduates have between 40 and 65 percent cumulative wage returns to ten years of experience.

5.3 Negative selection of job movers

The comparison of the returns to tenure and experience given by the estimation methods considered showed evidence consistent with more able individuals having longer job durations in Germany but not in the UK. If this was the case, this would imply that job movers were negatively selected in Germany, but not in the UK. We conduct a similar exercise to Dustmann and Meghir (2001) by looking at how wages vary with the number of jobs held, in order to look for evidence of negative selection of job movers in any of the two countries. Table 6.A shows the results for Germany of regressing the log wage on job number dummies, an age polynomial and year dummies. The last two columns show that for the whole sample, wages do not increase with the number of jobs, and if anything they decrease with the number of jobs. In fact most coefficients are negative, though only a few are significantly different from zero at 1 percent significance level. The results for university graduates (columns 5 and 6) and workers with apprenticeship training (columns 3 and 4) do not

differ much from the ones for the whole sample. For unskilled workers (columns 1 and 2), however, positive coefficients suggest that the number of jobs are positively associated with higher wages, though most coefficients are not significantly different from zero.

How can wages decrease with the number of jobs conditional on age and aggregate wage growth if wage growth between jobs is on average higher than within jobs (as shown before)? One possible explanation would be if individuals who change jobs are of lower unobservable ability. If individuals who have a large number of jobs conditional on age are of lower ability, their wages are likely to be lower than those of "stayers". This would explain why in spite of wage gains at job changes, wages seem to decrease with the number of jobs. One way of testing this is to run the same regressions with individual fixed effects: after controlling for individual fixed effects, wages should increase with the number of jobs. Columns 7 and 8 of Table .B confirm this hypothesis. Overall, wages increase steadily with the number of jobs (wages at the 8^{th} and subsequent jobs are on average 20% higher than the wage at the first job). Columns 1 to 6 break the analysis by qualification group. University graduates' wages increase significantly with the job number, unskilled workers wage gains seem substantially higher than the ones given by OLS estimates, and workers with apprenticeship training have now positive wage coefficients, though most are not significantly different from zero. This confirms that our previous finding of negative selection of job movers in the GSOEP[14] applies to all skill groups.

Table 5 (parts A and B) shows the results for the United Kingdom which are in sharp contrast with the ones described above. Least squares estimates show evidence

[14] Dustmann and Meghir (2001) obtain similar evidence using the German Social Security records (IAB data) for the years 1975-1995.

of positive wages gains for up to three jobs, with an eventual decline suggested by the negative coefficient for 7 and more jobs. The unskilled workers seem to be the ones with positive wages gains, since for the more qualified groups' only the coefficient for job number 2 is significantly different from zero. With fixed effects on the full sample, the signs of job number dummies become negative and insignificantly different from zero. The major difference between fixed effects estimations and OLS is that most wage coefficients for the unskilled become negative and insignificantly different from zero, suggesting positive selection of job movers among the unskilled. On the overall there seems to be no evidence of negative selection among job movers in the UK. We have showed that in both countries between jobs wage growth is higher than within jobs wage growth only in the first 10 to 15 years of workers' careers. In addition, if negative selection of job movers is due to asymmetric information between current and prospective employers, it is likely to take place in the beginning of workers' careers when their past job history is less informative of their ability. We therefore also looked at the relationship between wages and the number of jobs for the first 13 years of workers' careers. Table 7.A and 7.B shows the results for the UK. Again, they do not provide evidence of negative selection o job movers. Table 8.A and 8.B shows results for Germany for workers with no more than 13 years of labor market experience. The pattern of results is very similar to the one for the full sample, and the evidence of negative selection of job movers is at least as strong as for the full sample, since now the contrast between OLS and fixed effect estimates is even larger. We could find no evidence of negative selection of job movers in the UK in any of the periods. (one could argue that there is at most a very modest suggestion of negative selection among university graduates since wage gains at job changes are somewhat

higher with fixed effects than with OLS), and if anything, results point to some positive selection among unskilled job movers.

6. Discussion of results

In this section we discuss the various findings of the preceding section. In terms of returns to tenure, our estimates point to low average returns to tenure in both countries. If these estimates are unbiased, this implies that either the component of workers' skills that is not transferable across employers is unimportant, or that workers do not share the returns to this training in the form of increasing wages. Unfortunately, since our estimates could not correct for the potential upward bias in the experience effect due to its possible positive correlation with accumulation of search capital, our estimates of the tenure effect may still be downward biased.

Average returns to labor market experience are, according to our results, markedly higher in the UK than in Germany. The estimates by skill group suggest that at least some of this difference is likely to be due to higher "entry wages" for workers who have been through apprenticeship training, since this group of workers' returns to experience estimates are substantially lower than the other two. Workers who undergo the apprenticeship training are known to receive general or transferable skills (Acemoglu and Pischke, 1999), and their productivity and corresponding wage may increase less since their first work period after the apprenticeship training, simply because much of the learning is concentrated during the apprenticeship period. In fact, for all other qualification groups in Germany and all qualification groups in the UK, returns to experience have a very steep slope during the first few years. Estimated

returns to experience among unskilled workers are similar in the two countries, but returns to experience among university graduates seem to be somewhat higher in the UK than in Germany.

By exploring the differences between OLS and IV results, we found some evidence consistent with "more able" workers having longer job durations in Germany, but not in the UK. We discuss two models that could explain why "more able" workers experience longer job tenures, or, in other words, why "less able" workers are laid off more often or have more incentives to quit.

A possible source of negative selection of job movers consistent with our wage model is the presence of "sticky wages". In a context of learning with sticky wages, where in a first stage the employer's information about workers' ability is imperfect, sticky wages may imply that the firm is forced to layoff workers' whose productivity turns out to be "too low"[15]. An assumption behind this model is that both current employers and prospective employers learn about the worker's ability after a job spell.

It is reasonable to accept that individual real wages of German workers may be stickier than those of British workers. Although nominal wage rigidity probably holds in the two countries, British employers may have more discretion with respect to individual wage increases and promotions than German employers who face wage tariffs for different occupations and industries which are often renegotiated on a yearly basis. This model would imply that less able workers would be laid off more often but would not have more incentives to quit.

[15] See Dustmann and Schönberg (2002) for a model where the presence of union wages leads firms to lay off workers with productivity below the union wage, once workers' ability is revealed. Their model's main aim is to explain why firms pay for general training within the German Apprenticeship System.

An alternative possible source of negative selection of job movers is asymmetric information between the current and prospective employers about workers' ability, as mentioned in section 2.1 (Schönberg (2002) suggests that asymmetric information may result in an ability bias in the estimation of returns to job tenure). In a context of asymmetric information, adverse selection is less important the higher the job mobility (Acemoglu and Pischke, 1998). The higher the job mobility, the lower the expected difference in the average ability of job stayers and job movers. Since job mobility is higher in the UK than in Germany, if negative selection is due to asymmetric information, it should be stronger in Germany than in the UK. In the context of asymmetric information less able workers would be laid off more often and would also face less disincentives to quit.

7. Conclusions

In this study we compare the returns to tenure and experience in the UK and Germany using least squares, instrumental variables estimations and the Topel (1991) 2-stage method. Our results show that returns to tenure are low in both countries. Returns to experience are higher in the UK than in Germany. We estimate that 10 years of job seniority generate a wage return of 6 percent in the UK, and 2 percent in Germany. Returns to 10 years of experience are around 70 percent in the UK and 30 percent in Germany.

We also estimate separate regressions for three different qualification groups. We find that workers who went through the apprenticeship training system in Germany have substantially lower returns to labor market experience than all other

groups. This suggests that a large part of difference between the two countries' returns to experience can be attributed to the apprenticeship training. Workers with these qualifications probably receive a relatively high entry wage in their first employment spell after apprenticeship, to reflect the productivity gains associated with the acquisition of skills during the apprenticeship period.

The differences between OLS and IV estimates show some evidence consistent with stronger heterogeneity biases in Germany than in the UK. These are interpreted as being suggestive of negative selection of job movers in terms of unobserved ability in Germany. Finally, we point out that the institutional differences between the two countries may be the source behind the differences in the selection of jobs movers in Germany. It can both be driven by wage tariffs in Germany (in models of imperfect information about the workers' ability with "sticky wages") or by stronger adverse selection of job movers in Germany induced by the lower job mobility in a context of asymmetric information between current and prospective employers about workers' ability.

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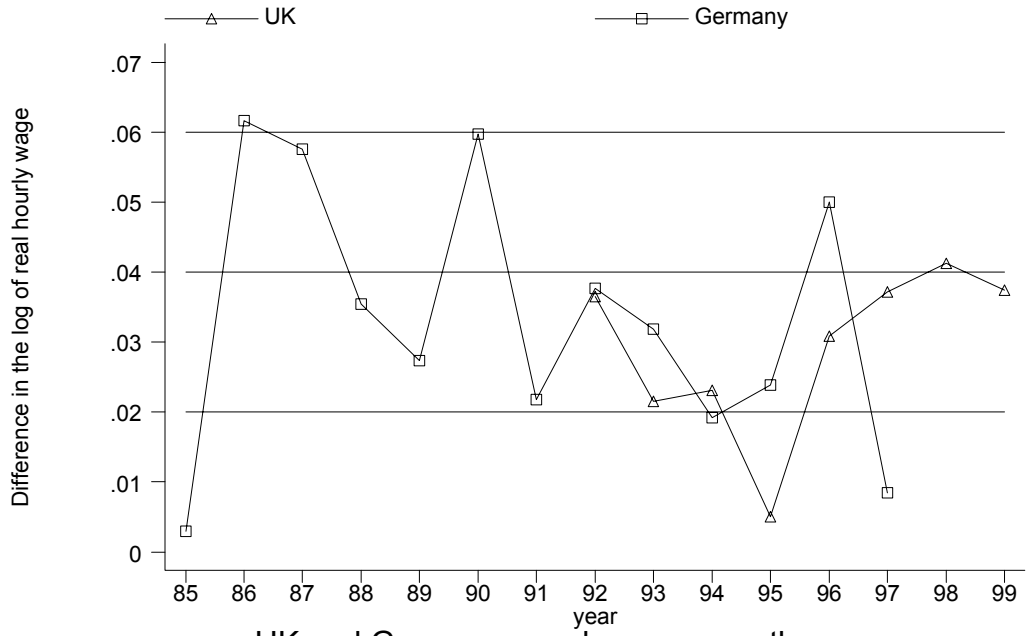
Figure 1



UK and Germany: yearly wage growth

Figure 2

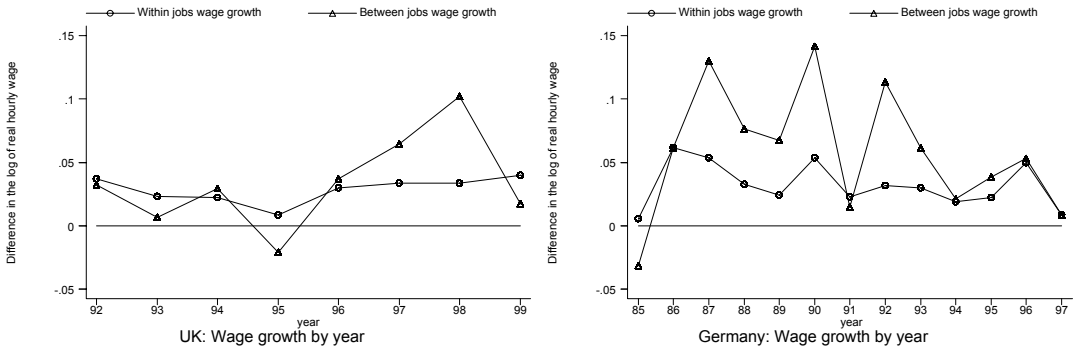


Figure 3

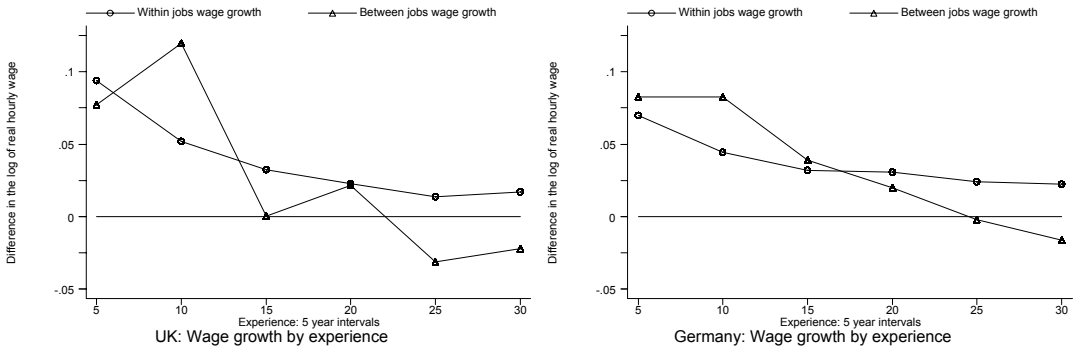
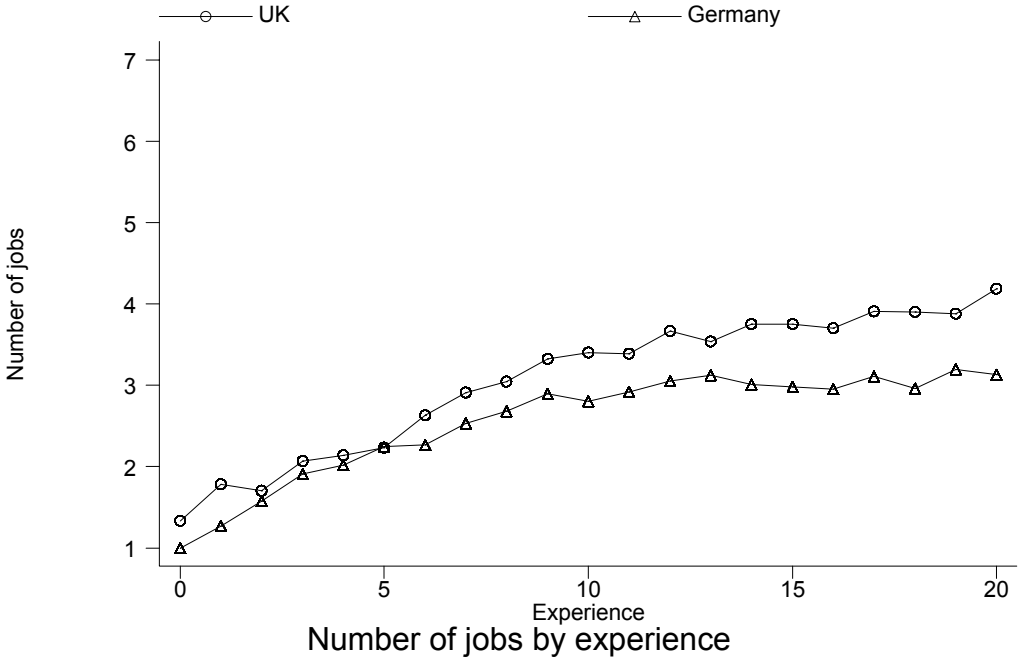
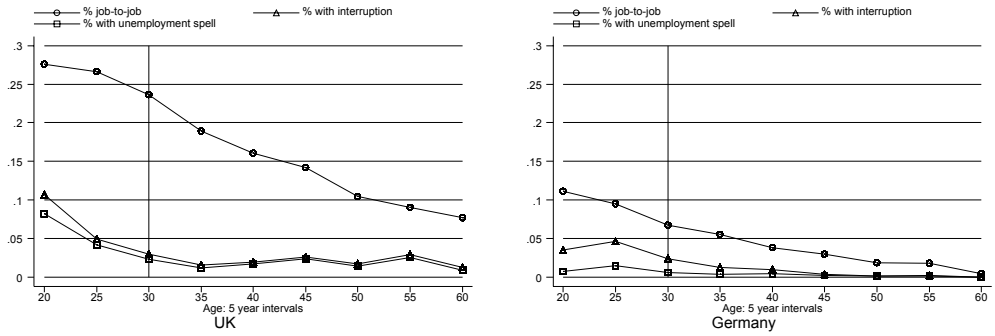


Figure 4



Number of jobs by experience

Figure 5: Type of transition between two waves of employment



Appendix 1.B Tables

Table 2: Returns to tenure and experience - OLS, IV and 2-Stage method
A. Coefficients

	UK				Germany			
	OLS	IVten1	IVten2	IVtenexp	OLS	IVten1	IVten2	IVtenexp
	1	2	3	4	5	6	7	8
Tenure	0.0116	0.0142	0.0135	0.0150	0.0136	0.0038	0.0061	-0.0013
	(0.0053)*	(0.0104)	(0.0083)	(0.0102)	(0.0034)**	(0.0051)	(0.0045)	(0.0051)
Tenure ^{2}x10	-0.0040	-0.0129	-0.0083	-0.0164	-0.0094	-0.0030	-0.0064	-0.0019
	(0.0065)	(0.0140)	(0.0120)	(0.0141)	(0.0042)*	(0.0062)	(0.0057)	(0.0061)
Tenure ^{3}x100	0.0014	0.0054	0.0040	0.0066	0.0040	0.0017	0.0028	0.0012
	(0.0028)	(0.0065)	(0.0058)	(0.0065)	(0.0018)*	(0.0026)	(0.0025)	(0.0026)
Tenure ^{4}x1000	-0.0002	-0.0007	-0.0006	-0.0008	-0.0005	-0.0002	-0.0003	-0.0001
	(0.0004)	(0.006)	(0.0009)	(0.006)	(0.0003)*	(0.0004)	(0.0003)	(0.0004)
Experience	0.0885	0.0904	0.0886	0.0856	0.0345	0.0369	0.0357	0.0472
	(0.0062)**	(0.0071)**	(0.0066)**	(0.0132)**	(0.0039)**	(0.0044)**	(0.0043)**	(0.0063)**
Experience^{2}x10	-0.0452	-0.0454	-0.0450	-0.0374	-0.0110	-0.0105	-0.0093	-0.0160
	(0.0050)**	(0.0056)**	(0.0053)**	(0.0111)**	(0.0032)**	(0.0036)**	(0.0035)**	(0.0052)**
Experience^{3}x100	0.0096	0.0097	0.0095	0.0075	0.0005	0.0001	-0.0001	0.0020
	(0.0015)**	(0.0017)**	(0.0016)**	(0.0036)*	(0.001)	(0.0011)	(0.0011)	(0.0017)
Experience^{4}x1000	0.0008	-0.0008	-0.0007	-0.0006	0.0001	0.0001	0.0020	0.0001
	(0.0002)**	(0.0002)**	(0.0002)**	(0.0004)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
P-value (tenure)	24.85	0.83	5.70	0.71	58.44	1.53	1.96	1.14
P-value (exp.)	143.25	89.01	111.75	23.56	104.59	73.10	86.46	46.60
N. obsv.	7073	7073	7073	7073	12302	12302	12302	12302
R2	0.3012	0.2985	0.3008	0.2880	0.4004	0.3979	0.3966	0.3864

Note: All regressions include marital status, 2 qualification dummies and year dummies. Standard errors in parenthesis.
**- Significant at 1 percent level; *- Significant at 5 percent level.

B.: Cumulative returns to tenure and experience - OLS, IV and 2-Stage estimations

	UK				Germany			
	OLS	IVten1	IVten2	IVtenexp	OLS	IVten1	IVten2	IVtenexp
	1	2	3	4	5	6	7	8
1 year ten	0.0113	0.0131	0.0128	0.0135	0.0128	0.0035	0.0055	-0.0015
	(0.0047)	(0.0093)	(0.0073)	(0.0091)	(0.0031)	(0.0046)	(0.0041)	(0.0046)
5 years ten	0.0508	0.0461	0.0525	0.0425	0.0506	0.0134	0.0179	-0.0097
	(0.0149)	(0.0290)	(0.0217)	(0.0269)	(0.0098)	(0.0157)	(0.0131)	(0.0149)
10 years ten	0.0911	0.0611	0.0888	0.0442	0.0803	0.0224	0.0222	-0.0211
	(0.0168)	(0.0371)	(0.0252)	(0.0297)	(0.0114)	(0.0228)	(0.0172)	(0.0196)
15 years ten	0.1253	0.0683	0.1244	0.0358	0.1067	0.0352	0.0268	-0.0280
	(0.0166)	(0.0485)	(0.0301)	(0.0347)	(0.0118)	(0.0311)	(0.0214)	(0.0239)
1 year exp	0.0877	0.0898	0.0879	0.0854	0.0340	0.0366	0.0354	0.0467
	(0.0063)**	(0.0072)**	(0.0067)**	(0.0132)**	(0.0038)	(0.0042)	(0.0041)	(0.0061)
5 years exp	0.4065	0.4192	0.4079	0.4101	0.1566	0.1721	0.1678	0.2196
	(0.0296)**	(0.0344)**	(0.0314)**	(0.0629)**	(0.0152)	(0.0173)	(0.0167)	(0.0259)
10 years exp	0.6856	0.7141	0.6889	0.7353	0.2718	0.3067	0.3022	0.3932
	(0.0473)**	(0.0571)**	(0.0505)**	(0.1076)**	(0.0221)	(0.0266)	(0.0249)	(0.0408)
15 years exp	0.8191	0.8623	0.8230	0.9449	0.3374	0.3913	0.3901	0.5107
	(0.0519)**	(0.0664)**	(0.0562)**	(0.1348)**	(0.0237)	(0.0317)	(0.0281)	(0.0484)
20 years exp	0.8472	0.9020	0.8496	1.0530	0.3553	0.4238	0.4279	0.5738
	(0.0500)**	(0.0697)**	(0.0555)**	(0.1541)**	(0.0230)	(0.0364)	(0.0298)	(0.0527)

Note: *Log-wage returns* to *k* years of tenure (experience) with $k=1,5,10,15,20$ is the cross-product of the row vector of the tenure (experience) polynomial coefficients with a column vector of the form (k, k^2, k^3, k^4). Values presented are the *wage returns* and are obtained by applying an exponential transformation to the log wage returns minus 1. Standard errors are the square root of a 1st order Taylor approximation of the corresponding variance.

Table 3: Cumulative returns to tenure and experience by qualification – UK

	Unskilled			Medium qualified			University graduates		
	OLS	*IVten1*	*IVtenexp*	OLS	*IVten1*	*IVtenexp*	OLS	*IVten1*	*IVtenexp*
	1	2	3	4	5	6	7	8	9
1 year ten	0.0135	0.0212	0.0190	0.0228	0.0076	0.0073	-0.0054	0.0082	0.0107
	(0.0090)	(0.0205)	(0.0186)	(0.0083)**	(0.0159)	(0.0150)	(0.0084)	(0.0161)	(0.0150)
10 years ten	0.0870	0.0691	0.0398	0.0742	0.0042	-0.0172	0.1055	0.0818	0.0885
	(0.0341)*	(0.0936)	(0.0621)	(0.0268)**	(0.0672)	(0.0490)	(0.0273)**	(0.0655)	(0.0471)
15 years ten	0.1140	0.0438	-0.0011	0.0728	-0.0043	-0.0480	0.1880	0.1114	0.1095
	(0.0326)**	(0.1181)	(0.0724)	(0.0260)**	(0.0929)	(0.0596)	(0.0283)**	(0.0826)	(0.0535)
1 year exp	0.0787	0.0791	0.0775	0.0809	0.0819	0.0679	0.1164	0.1150	0.1068
	(0.0167)**	(0.0193)**	(0.0336)*	(0.0094)**	(0.0117)**	(0.0181)**	(0.0120)**	(0.0136)**	(0.0268)**
10 years exp	0.5794	0.6133	0.6712	0.7069	0.7419	0.6681	0.7808	0.7951	0.7195
	(0.1176)**	(0.1507)**	(0.2593)*	(0.0701)**	(0.0948)**	(0.1381)**	(0.0832)**	(0.1000)**	(0.2077)**
20 years exp	0.6964	0.7834	1.0033	1.0283	1.1043	1.1154	0.7702	0.8234	0.7722
	(0.1185)**	(0.1873)**	(0.3271)**	(0.0772)**	(0.1375)**	(0.2004)**	(0.0742)**	(0.1031)**	(0.2507)**
N. obsv.	7073	7073	7073	7073	7073	7073	7073	7073	7073
R2	0.3136	0.2903	0.279	0.3136	0.2903	0.279	0.3136	0.2903	0.279

Note: *Log-wage returns* to *k* years of tenure (experience) with *k=1,5,10,15,20* is the cross-product of the row vector of the tenure (experience) polynomial coefficients with a column vector of the form *(k, k^2, k^3, k^4)*. Values presented are the *wage returns* and are obtained by applying an exponential transformation to the log wage returns minus 1. Standard errors are the square root of a 1st order Taylor approximation of the corresponding variance.

Table 4: Cumulative returns to tenure and experience by qualification – Germany

	Unskilled			Apprenticeship training			University graduates		
	OLS	*IVten1*	*IVtenexp*	OLS	*IVten1*	*IVtenexp*	OLS	*IVten1*	*IVtenexp*
	1	2	3	4	5	6	7	8	9
1 year ten	-0.0107	-0.0204	-0.0247	0.0140	0.0088	0.0043	0.0211	-0.0154	-0.0174
	(0.0082)	(0.0148)	(0.0137)	(0.0036)**	(0.0055)	(0.0053)	(0.0097)*	(0.0147)	(0.0142)
10 years ten	-0.0263	-0.0446	-0.1199	0.0939	0.0353	-0.0022	0.1032	0.0036	-0.0329
	(0.0313)	(0.0828)	(0.0548)*	(0.0133)**	(0.0276)	(0.0227)	(0.0320)**	(0.0837)	(0.0555)
15 years ten	0.0088	-0.0090	-0.1279	0.1216	0.0423	-0.0108	0.1132	0.0465	-0.0268
	(0.0340)	(0.1118)	(0.0649)*	(0.0135)**	(0.0375)	(0.0275)	(0.0353)**	(0.1465)	(0.0737)
1 year exp	0.0989	0.1030	0.0901	0.0174	0.0190	0.0312	0.0586	0.0781	0.0859
	(0.0111)**	(0.0131)**	(0.0184)**	(0.0045)**	(0.0049)**	(0.0071)**	(0.0137)**	(0.0169)**	(0.0211)**
10 years exp	0.6024	0.6281	0.6838	0.1694	0.1978	0.2846	0.4557	0.5803	0.6451
	(0.0692)**	(0.0984)**	(0.1231)**	(0.0250)**	(0.0298)**	(0.0457)**	(0.0664)**	(0.0971)**	(0.1289)**
20 years exp	0.5505	0.5870	0.8509	0.2506	0.3121	0.4452	0.6228	0.7544	0.8925
	(0.0652)**	(0.1496)**	(0.1499)**	(0.0258)**	(0.0402)**	(0.0593)**	(0.0680)**	(0.2075)**	(0.1833)**
N. obsv.	12302	12302	12302	12302	12302	12302	12302	12302	12302
R2	0.4063	0.4027	0.3904	0.4063	0.4027	0.3904	0.4063	0.4027	0.3904

Note: *Log-wage returns* to *k* years of tenure (experience) with *k=1,5,10,15,20* is the cross-product of the row vector of the tenure (experience) polynomial coefficients with a column vector of the form (k, k^2, k^3, k^4). Values presented are the *wage returns* and are obtained by applying an exponential transformation to the log wage returns minus 1. Standard errors are the square root of a 1st order Taylor approximation of the corresponding variance.

Table 5: Wages and job number in the UK

A. OLS

Job Number	Unskilled		Medium Educated		Univ. Graduates		Total	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
2	0.122	4.03	0.046	2.14	0.063	2.14	0.074	4.46
3	0.108	3.21	0.033	1.40	0.018	0.67	0.079	4.53
4	0.050	1.52	0.033	1.50	0.055	1.51	0.049	2.65
5	0.081	2.42	-0.025	-1.08	0.001	-0.27	0.006	0.13
6	0.091	2.17	0.062	1.85	-0.114	-2.85	0.019	1.06
7+	0.058	1.95	0.005	0.19	-0.163	-5.06	-0.043	-2.44
N. Observ.	1818		2495		2403		6716	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. For comparison with the German data in these regressions we restrict the data to workers who had no more than 10 years of labor market experience at the time of the first wave.

B. Fixed Effects

Job Number	Unskilled		Medium Educated		Univ. Graduates		Total	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
2	-0.070	-1.73	-0.013	-0.50	0.109	3.15	-0.008	-0.52
3	-0.102	-1.93	0.005	0.19	0.136	2.99	0.000	-0.04
4	-0.015	-0.21	0.018	0.29	0.096	1.78	-0.007	-0.35
5	0.041	0.36	-0.011	-0.13	0.019	0.13	-0.039	-1.43
6	-0.017	-0.61	0.079	1.43	0.039	0.66	-0.024	-0.72
7+	0.129	1.34	-0.038	-0.18	0.103	0.33	-0.022	-1.20
N. Observ.	1818		2495		2403		6716	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. For comparison with the German data in these regressions we restrict the data to workers who had no more than 10 years of labor market experience at the time of the first wave.

Table 6: Wages and job number in Germany

A. OLS

Job Number	Low Education		Medium Education		High education		Total	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
2	0.075	2.130	-0.037	-2.460	-0.017	-0.680	-0.031	-2.220
3	0.138	3.350	-0.028	-1.620	-0.045	-1.260	-0.045	-2.710
4	0.160	2.270	0.008	0.380	-0.001	-0.010	-0.006	-0.280
5	0.069	0.940	-0.044	-1.650	-0.012	-0.280	-0.017	-0.690
6	0.265	1.950	-0.038	-1.030	0.299	3.590	0.005	0.130
7	0.254	0.770	-0.146	-2.860	-0.034	-0.380	-0.105	-2.020
8+	-0.032	-0.390	-0.170	-4.430	0.028	0.400	-0.167	-4.640
N. Observ.	550		2430		760		3740	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. The sample used is smaller because number of jobs can only be computed for workers who entered the labor market not more than 10 years before the first wave.

B. Fixed Effects

Job Number	Low Education		Medium Education		High education		Total	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
2	0.146	3.310	0.033	1.350	0.071	2.540	0.100	5.720
3	0.152	2.750	0.033	1.110	0.094	2.630	0.106	4.800
4	0.303	3.730	0.017	0.470	0.240	5.240	0.120	4.370
5	0.497	4.530	0.078	1.820	0.247	4.740	0.187	5.570
6	0.622	3.610	0.033	0.600	0.305	3.900	0.157	3.500
7	0.802	2.390	0.040	0.540	0.210	2.230	0.155	2.510
8+	(dropped)		0.109	1.430	(dropped)		0.202	2.950
N. Observ.	550		2430		760		3740	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. The sample used is smaller because number of jobs can only be computed for workers who entered the labor market not more than 10 years before the first wave.

Table 7: Wages and job number in the UK during the first 13 years in the labor market

A. OLS

Job Number	Unskilled		Medium Educated		Univ. Graduates		Total	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
2	-0.026	-0.59	0.036	1.36	0.104	2.98	0.046	2.26
3	-0.067	-1.29	0.023	0.71	0.087	2.24	0.032	1.35
4	0.012	0.22	0.007	0.20	0.022	0.45	-0.025	-0.91
5	-0.081	-1.39	-0.007	-0.18	-0.023	-0.48	-0.050	-1.77
6	-0.138	-1.39	0.078	1.56	-0.020	-0.29	0.000	0.01
7+	0.111	1.59	0.041	0.77	-0.047	-0.70	-0.002	-0.06
N. Observ.	405		1054		891		2350	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. For comparison with the German data in these regressions we restrict the data to workers who had no more than 10 years of labor market experience at the time of the first wave.

A. Fixed Effects

Job Number	Unskilled		Medium Educated		Univ. Graduates		Total	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
2	-0.056	-1.04	0.012	0.39	0.108	2.65	0.011	0.49
3	-0.147	-1.89	0.060	1.39	0.117	2.06	0.013	0.41
4	-0.099	-0.98	0.142	2.42	0.111	1.59	0.038	0.96
5	0.014	0.12	0.146	2.10	0.093	1.13	0.049	1.06
6	-0.109	-0.78	0.256	3.28	0.124	1.25	0.089	1.62
7+	0.003	0.02	0.162	1.82	0.203	1.86	0.065	1.04
N. Observ.	405		1054		891		2350	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. For comparison with the German data in these regressions we restrict the data to workers who had no more than 10 years of labor market experience at the time of the first wave.

Table 8: Wages and job number in Germany during the first 13 years in the labor market

A. OLS

Job Number	Low Education		Medium Education		High education		Total	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
2	0.093	2.180	-0.034	-2.020	-0.037	-1.380	-0.054	-3.610
3	0.117	2.470	-0.037	-1.930	-0.078	-2.080	-0.089	-5.030
4	0.164	2.080	-0.008	-0.340	-0.034	-0.710	-0.058	-2.610
5	0.061	0.740	-0.049	-1.580	-0.083	-1.690	-0.062	-2.180
6	0.260	1.840	-0.046	-1.220	0.212	2.450	-0.048	-1.240
7	0.232	0.680	-0.129	-2.200	-0.065	-0.720	-0.105	-1.860
8+	-0.046	-0.510	-0.275	-5.860	0.019	0.220	-0.275	-6.570
N. Observ.	432		1942		656		3030	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. The sample used is smaller because number of jobs can only be computed for workers who entered the labor market not more than 10 years before the first wave.

B. Fixed effects

Job Number	Low Education		Medium Education		High education		Total	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
2	0.171	3.170	0.047	1.710	0.056	2.070	0.117	6.000
3	0.159	2.280	0.055	1.630	0.074	2.090	0.118	4.790
4	0.308	3.030	0.036	0.900	0.228	4.750	0.127	4.100
5	0.505	3.850	0.084	1.730	0.191	3.440	0.183	4.800
6	0.648	3.280	0.067	1.140	0.265	3.460	0.168	3.450
7	0.819	2.210	0.081	0.990	0.135	1.440	0.157	2.310
8+	(dropped)		0.194	2.080	(dropped)		0.239	2.770
N. Observ.	432		1942		656		3030	

Note: Coefficients shown for the regression of log-wages on job number dummies. Separate regressions for each education group. The regression for the total of workers includes medium and high education dummies. All regressions include third order age polynomial and year dummies. Job one dummy and year one dummy are omitted. The sample used is smaller because number of jobs can only be computed for workers who entered the labor market not more than 10 years before the first wave.

Appendix 2: Bias in the *IVten2* estimator

In the empirical section we use as an instrumental variable for tenure its deviations from individual means. We call this instrumental variable estimator *IVten2*. If $\widetilde{T}_{ijt}$ is the predicted value of the first stage, where tenure is regressed on its deviations from the individual mean, then the biases in the returns to tenure and experience are given by the expressions below:

$$W_{ijt} = \beta_0\gamma_t + (\beta_1 + b_1^{IVten2} + c_1^{IVten2})X_{ijt} + (\beta_2 + b_2^{IVten2} + c_2^{IVten2})\widetilde{T}_{ijt} + \zeta_{ijt} \quad (1)$$

$$\beta_1^{IVten2} - \beta_1 = b_1^{IVten2} + c_1^{IVten2} \quad (2)$$

$$\beta_2^{IVten2} - \beta_2 = b_2^{IVten2} + c_2^{IVten2} \quad (3)$$

Bias in the returns to tenure:

$$b_2^{IVten2} = \frac{-\gamma_{X\widetilde{T}}Cov(X_{ijt}, A_i)}{Var(\widetilde{T}_{ijt})\left[1-(Corr(\widetilde{T}_{ijt}, X_{ijt}))^2\right]} \quad (4)$$

$$c_2^{IVten2} = \frac{Cov(\widetilde{T}_{ijt}, \theta_{ij}) - \gamma_{X\widetilde{T}}Cov(X_{ijt}, \theta_{ij})}{Var(\widetilde{T}_{ijt})\left[1-(Corr(\widetilde{T}_{ijt}, X_{ijt}))^2\right]} \quad (5)$$

Recall that the bias in the returns to tenure from *IVten1* can be written as:

$$\beta_2^{IVten1} - \beta_2 = b_2^{IVten1} + c_2^{IVten1} \quad (6)$$

$$b_2^{IVten1} = \frac{-\gamma_{X\hat{T}} Cov(X_{ijt}, A_i)}{Var(\hat{T}_{ijt})\left[1-(Corr(\hat{T}_{ijt}, X_{ijt}))^2\right]} \tag{7}$$

$$c_2^{IVten1} = \frac{-\gamma_{X\hat{T}} Cov(X_{ijt}, \theta_{ij})}{Var(\hat{T}_{ijt})\left[1-(Corr(\hat{T}_{ijt}, X_{ijt}))^2\right]} \tag{8}$$

From (4), (5), (7) and (8) it is clear that if

$$\frac{-\gamma_{X\hat{T}}}{Var(\hat{T}_{ijt})\left[1-(Corr(\hat{T}_{ijt}, X_{ijt}))^2\right]} = \frac{-\gamma_{X\widetilde{T}}}{Var(\widetilde{T}_{ijt})\left[1-(Corr(\widetilde{T}_{ijt}, X_{ijt}))^2\right]} \tag{9}$$

$$\text{then} \quad \beta_2^{IVten2} - \beta_2^{IVten1} = \frac{Cov(\widetilde{T}_{ijt}, \theta_{ij})}{Var(\widetilde{T}_{ijt})\left[1-(Corr(\widetilde{T}_{ijt}, X_{ijt}))^2\right]} \tag{10}$$

One could therefore assess the importance of the association between match quality and job duration by comparing the estimates given by *IVten1* and *IVten2*. However, without further assumptions we can only state that the larger the association between job match quality and job duration, the higher the probability that $\beta_2^{IVten2} > \beta_2^{IVten1}$.

Intuitively, it is true that *IVten1* produces an estimate of returns to tenure free from the bias due to the correlation between tenure and both the individual and job match effects while *IVten2* produces an estimate of returns to tenure only free from the bias due to the correlation between tenure and the individual fixed effect. However returns to tenure are also biased due to the correlation between experience and the individual and the job match components, and the magnitude of this bias depends on the association between experience and $\widetilde{T}_{ijt}$ or $\hat{T}_{ijt}$. For this reason one can not establish that the bias in β_2^{IVten2} is larger than the bias in β_2^{IVten1}.

Appendix 3: The data

British Household Panel Survey

Tenure: is the total number of years in which the individual works for the same employer. It is constructed for all individuals that are in paid employment. It is not constructed for self-employed, since these are excluded from the sample. Individuals are asked to give the starting date of the job spell, and not the spell with employer[16]. For example, if the individual is promoted, the date collected is the date of promotion. In order to track down the starting date with the present employer, we go back as many spells as there are jobs changes with the same employer, which involves using the information of the inter-wave history files and the retrospective data in many instances. We therefore add the time spent in the various spells within the same employer in order to compute tenure with the employer. When linking the job spell information in the various yearly questionnaires and the retrospective data collected in waves 2 and 3 one is confronted with the overlapping of more than one source of information for the same spell, or part of it. Conflicting answers are resolved by giving priority to the information collected closest to the event occurrence. This is because recall error is likely to increase with the time elapsed between

[16] Question Text: "What was the date you started working in your present position? If you have been promoted or changed grades, please give me the date of that change. Otherwise please give me the date when you started doing the job you are doing now for your present employer."

an event and the time of interview. In addition, in some cases in two consecutive waves although the job starting date given in the later wave takes place before the previous wave interview, the discrepancy between the two start dates makes it clear that they refer to two different job spells. We therefore also adopted the following rule: if the starting date of a given spell occurs just before the previous wave interview date (i.e., during the previous year) and it is more than 1 year apart from the starting date recorded in the previous interview, then it is assumed that this spell started just after the previous wave interview.

Experience: sums the individual's time spent in paid employment or as a self-employed since leaving full time education. Similar to the tenure variable, it combines the information from the various yearly questionnaires and the retrospective data collected in waves 2 and 3.

Skills: The skill variable is constructed from the information on the individuals' highest educational qualification. We classified workers into three skill groups as follows. *Unskilled:* No qualifications, other qualifications, apprenticeship, CSE, commercial qualifications, no O levels. *Medium skilled:* O levels or equivalent, nursing qualifications, teaching qualifications, A levels. *University Graduates:* Higher degree, 1st Degree, other higher.

Wage: Nominal hourly wage is obtained by first dividing the current job usual gross monthly pay by 4.33 to obtain weekly wage and then by weekly hours. Weekly hours are the sum of the number of hours normally worked per week and the number of overtime hours in normal week. The nominal hourly wage is then deflated with the Retail Prices Index[17] to obtain real hourly wages.

German Socio-Economic Panel

Tenure: The variable tenure in the job was constructed using the information about the exact year and month the individual has started current job, up to the time of interview. This variable was rounded to the nearest year.

Experience: The number of years of labor market experience is constructed in two stages. The first stage uses the yearly biographical scheme containing employment information from the age of 16 to the first wave of the panel to construct total experience at the entry of the panel. Both part-time and full-time spells are taken into account. The second stage uses the calendar available for each wave listing all labor market activities for each month in the year preceding the interview. This information is added to the information computed in the first stage to construct experience at each wave. This variable was rounded to the nearest year.

[17] Monthly values are averaged for each year with 1991 as base year. Source: Economic Trends, Annual Supplement, 1998, Office for National Statistics.

Skills: Given the apprenticeship training system in Germany, workers are divided workers into those with no apprenticeship training and no university degree – *Unskilled*, those with apprenticeship training – *Medium skilled or apprenticeship trainees*, and those with a university degree – *University graduates*.

Wage: Real hourly wage was constructed using the information on the reported gross earnings in the month preceding the interview. These excluded any additional payments, e.g., holiday money or back-pay and included money earned for overtime. This amount was divided by 4.33 to obtain weekly wage and then by weekly hours. Weekly hours are a derived variable with the actual number of hours worked per week. This is based on the information given at the question: *And how much on average does your actual working week amount to, with possible overtime?* Gross nominal hourly wages were deflated by the German consumer price index.