What determines wage differentials across the EU?

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Abstract

We analyse determinants of the wage differentials observed between the UK and nine European countries using the European Community Household Panel (ECHP). The empirical decomposition is based on a proportional hazards model. The approach based on rank invariant estimators is borrowed from the literature on failure time data. Donald et al. (2000) pioneered this approach. Behr and Pötter (2006) improved their estimation method by using a marginal likelihood for the regression part of the model and a completely nonparametric estimator for the underlying distribution function. By means of natural splines we allow for nonlinear regression effects. Using this approach we isolate three different underlying forces for wage differentials: differences in skills, differences in prices for skills and differences in the returns-to-skill functions.

1 Introduction

In this paper, we analyse the differences in wage distributions between the UK and nine European countries in 2001. The data base is the European Community Household Panel (ECHP).

In recent research on labour markets, international comparative studies have been fruitfully exploited to highlight variations in labour market institutions, skill endowments and wage distributions (Blau and Kahn 1996 and 2003). Differences in wage distributions between the US and Canada have been studied by DiNardo and Lemieux (1997) and by Donald, Green and Paarsch (2000). Beaudry and Green (2003) analysed differences between the US and Germany focusing on changes in relative capital endowments.

We apply the approach suggested by Behr and Pötter (2006) which extends the pioneering approach of Donald et al. (2000). The decomposition of wage differences is based on a proportional hazards model for wages using a marginal likelihood for the regression part of the model. This allows to dispense with the arbitrary grouping of observations used by Donald et al. (2000), Fortin and Lemieux (1998), and DiNardo et al. (1996). Moreover, we use a general additive model based on splines for the effects of covariates which can capture any nonlinearities. Splines are generally more stable than the traditional use of polynomials.

This approach can also be compared to quantile regression methods popularised by Martins and Pereira (2004), Machado and Mata's (2005) and others. In most of this literature, linear parametrisation of the quantile function are used. In contrast, the proportional hazards model implies a somewhat more complicated dependence on covariates and on a non-parametric component that nevertheless can be easily estimated (Dabrowska 2005).

The paper is structured as follows. In Section 2, we outline the decomposition approach based on the proportional hazards model. The data base is described briefly in Section 3. Section 4 contains an extensive descriptive analysis. In section 5 we provide the results of the decomposition analysis. Section 6 concludes.

2 A proportional hazards model for wage data

Juhn et al. (1991) and Fortin and Lemieux (1998) have argued persuasively that since changes in wage structure tend to have the same impact on all workers earning the same wage, measures of wage structure effects should only depend on the position of a worker in a given wage distribution. Moreover, the position within a wage distribution may be assumed to depend on the workers skill level. This would follow from a human capital model in which wages (in equilibrium) are equal to marginal productivity that reflects skill levels.

Thus observed wages result from skills by means of a return-to-skills function

$$W = \Lambda^{-1}(r^*) \tag{1}$$

which should be strictly monotone in the amount of skills r^*. Hence, persons having higher skills will receive a higher wage compared to persons having lower skills and persons with lower skills will receive a lower wage than better skilled persons will irrespective of the wage structure.

A change of wage structure should only be reflected in a change of the function Λ^{-1} while a change in the distribution of skills should only be reflected in a change in the distribution of r^*. Disentangling the effect of wage structure from that of amounts of skill thus means to distinguish effects on the function Λ^{-1} from those on the distribution of r^*, the amount of skills.

Proportional hazards models are an obvious choice to model this distinction between wage structure and amount of skill structure since they naturally allow to specify Λ^{-1} and r^* separately.

To specify the proportional hazards model let the probability that a person has at least wage w be given by the complementary distribution function

$$S(w \mid x) := \Pr(W > w|x) =: 1 - F(w \mid x)$$

where $F(w \mid x)$ denotes the conditional cdf of W. A convenient model for the influence of covariates x on the complementary distribution function is

$$S(w \mid x; \beta) = S_0(w)^{r(x;\beta)}, \quad 0 < r(x; \beta) < \infty, \; r(0; \beta) = 1 \tag{2}$$

For an arbitrary, fixed complementary distribution function $S_0(.)$, this family of distributions is referred to proportional hazards model. $S_0(w)$ is the baseline complementary distribution function, i.e. $S(w \mid x; \beta)$ evaluated at $x' = (0, 0, \ldots, 0)$. $r(x; \beta)$ is often called the relative risk function.

A suitable choice of $r(x; \beta)$ is the exponential form

$$r(x; \beta) = e^{x'\beta} \tag{3}$$

which ensures $r(x; \beta) > 0$. The normalisation $r(0; \beta) = 1$ is achieved by excluding a constant term.

Let $\Lambda(w \mid x; \beta)$ denote the negative logarithm of the complementary distribution function $\Lambda(w \mid x; \beta) := -\ln S(w \mid x; \beta)$. In the context of duration analysis, the function $\Lambda(w \mid x; \beta)$ is called the integrated hazard function. The complementary distribution function can be expressed as

$$S(w \mid x; \beta) = e^{-\Lambda(w \mid x; \beta)}$$

so that with $\Lambda_0(w) := -\ln S_0(w)$ we have

$$S(w \mid x; \beta) = \exp\left(-\Lambda(w \mid x; \beta)\right) = S_0(w)^{r(x;\beta)} = \exp\left(-\Lambda_0(w) r(x; \beta)\right)$$

and $\Lambda(w \mid x; \beta) = r(x; \beta)\Lambda_0(w)$. The effect of covariates is to scale the integrated hazard function $\Lambda_0(.)$, the baseline integrated hazard function corresponding to the baseline complementary distribution function $S_0(.)$. Hence the name "proportional hazards model".

While it is convenient to introduce the proportional hazards model in terms of the conditional distributions it sometimes is preferable and possibly more customary to express it in terms of random variables as well. If W is a random variable with conditional complementary distribution function $S_0(w)^{r(x;\beta)}$, then

$$\ln \Lambda_0(W) \simeq_d -\ln r(x; \beta) + \epsilon \tag{4}$$

where $\simeq_d$ denotes equality in distribution and ϵ follows the extreme value distribution with complementary distribution function given by

$$\Pr(\epsilon > u) = e^{-e^u}$$

With the special choice of $r(x;\beta) = \exp(x'\beta)$ one arrives at the familiar linear model

$$\ln \Lambda_0(W) \simeq_d -x'\beta + \epsilon$$

so that some monotone increasing transform of the wage follows a linear regression with a fixed error distribution. Note the minus sign for the linear predictor: An increase in $x'\beta$ decreases expected (transformed) wages but increases integrated hazards.

Returning to the question of comparisons between wage distributions and specifically to (1), one recovers the proportional hazards model from that abstract setting by setting $r^* :\simeq_d \exp(\epsilon)/r(x;\beta)$ and $\Lambda \equiv \Lambda_0$. Having distinguished between "wage structure" and "amount of skill", the latter can now be further decomposed by considering changes in the distribution of X (the distribution of endowments with skills) and changes in the magnitude of the parameters β (the relative prices of skills) across countries.

The estimation of the β parameters may be based on the marginal likelihood of the ranks of the observations:

$$\prod_{i=1}^{n} \frac{r(x_{(i)};\beta)}{\sum_{l\in\{(i),(i+1),\ldots,(n)\}} r(x_l;\beta)}$$

where $Xx(i)$ refers to the covariates corresponding to $i-$th largest wage $w_{(i)}$ (see Fleming and Harrington 1991, chap. 4.3).

The marginal likelihood depends on the observed wages only through their ranks. It is thus invariant under strictly monotone transformations of the wages. Note that this contrasts with classical rank regression which is based on the ranks of the residuals from some regression model (Hettmansperger 1984, chap. 5). Note also how this contrasts with quantile regression which is equivariant under monotone transformations: the quantiles of transformed wages are equal to the transformed quantiles of the wages (Koenker 2005).

Having obtained an estimate for β, the non-parametric likelihood for the baseline complementary distribution function S_0 is

$$L(S_0|x;\hat\beta) := \prod_{i=1}^{n} S_0(w_{i-})^{r(x_i;\hat\beta)} - S_0(w_i)^{r(x_i;\hat\beta)}$$

where $S_0(w_-) := \lim_{u\uparrow x} S_0(u)$ is the left limit of $S_0(.)$ at w. The likelihood is non-zero only if $S_0(.)$ has jumps at all the observations w_i. Thus, the non-parametric maximum likelihood estimator with $\hat\beta$ plugged in will be a step function with jumps at the observed wages. Since this corresponds to a purely discrete distribution, the baseline integrated hazard function (the returns-to-skill function) is

$$\hat\Lambda_0(w) = \sum_{w_k \le w} \frac{\hat S_0(w_{k-}) - \hat S_0(w_k)}{\hat S_0(w_{k-})}$$

where w_k runs through the set of jumps of $\hat{S}_0$.

Finally, to allow for non-linear effects of covariates, we have chosen to model the risk function as

$$r(x;\beta) := \exp\left(\sum_{j=1}^{k} g_j(x_j;\beta_j) + \sum_{j=k+1}^{m} x_j\beta_j\right)$$

where $x_1, \ldots, x_k$ are continuous covariates and $x_{k+1}, \ldots, x_m$ are discrete. The g_j are smooth functions that we approximate by natural cubic splines. These are composed of several cubic polynomials pieced together as smoothly as possible. They are further restricted by the requirement that the function is linear beyond the range of the covariate. The knots, the places where the different polynomials are pieced together, are chosen from appropriate quantiles of the distribution of the covariate.

3 The European Community Household Panel and the wage equation

Our analysis is based on the User Data Base (UDB) of the ECHP. The ECHP is a longitudinal survey of households and individuals covering countries of the European Union (EU) starting in 1994 and ending in 2001. Comparability across countries is the main objective of the ECHP. Due to its far-reaching harmonisation, the ECHP facilitates cross-country comparisons within the EU in many different aspects of economic and social life. Peracchi (2002) provided a comprehensive description of the ECHP and detailed information about the organisation of the survey. The effects of panel attrition and item non-response on empirical analysis in the ECHP, especially on the estimation of wage equations, have been studied in detail by Behr (2004) and Spiess and Goebel (2004). The effects of attrition on empirical results were found to be moderate in both studies.

In the analysis we use the national samples of the ECHP for ten countries: the UK, Germany, Denmark, Belgium, France, Ireland, Italy, Greece, Spain and Portugal. Our sample includes women and men working at least 25 hours a week in the age between 20 and 60. As wage we use reported gross monthly wage. As the social systems as well as payment contracts differ considerably between the countries, these might restrict comparability of the reported wages. Since our main interest is to analyse the rewards for skills in the labour market, we restrict attention to gross wages.

To take into account different working hours, we scale reported monthly gross wages towards hourly wages using reported working hours. To allow for comparability, national currencies are expressed in Euro using 2001 purchasing power parities. To prevent outliers influencing the empirical results, we drop the 1% highest and lowest wages in all countries. In accordance with the literature we use logarithmic wages throughout.

Covariates included are general working experience, tenure, sex, the highest level of attained education and occupation. Unfortunately, general working experience has to be approximated as age minus six years minus average years of schooling common to the obtained level of education, which is 9 years for less than second stage education, 12 for second stage education and 16 for third level education. Tenure is the period for which an employee has been working for the same employer, thus capturing firm-specific experience. The three levels of education are captured by two dummy variables which indicate whether an individual has basic education (lowest level comparable to less than high school) or third stage education (highest level comparable to college) with secondary education (comparable to high school) being the reference category. In all equations we include a gender dummy. Due to data problems, the occupation variables are transformed into 7 rather broad categories. Detailed information on occupational categories is given in the appendix. While occupation might be affected by problems of endogeneity, we regard this problem as much less severe for occupations, which relates at least partly to vocational and other training, than for other variables like sector which are sometimes used in wage decompositions (see Beblo et al. (2003) for some results and discussions on instrumental variables estimators for wage equations based on the ECHP).

4 Descriptive analysis

In this section we provide extensive descriptive evidence on the observed wage differentials across the EU and differences in the individual skill characteristics.

Figure 1 displays box-plots for the hourly wage rates for all countries. The box-plots show the median, the 25% and the 75% (grey box) and the whiskers extend the box by 1.5 multiplied by the interquartile range. We find the UK to have the largest wage dispersion according to the length between the whiskers. While Belgium and Germany have about the same median wage, Denmark has higher and the remaining countries lower median wages. The vertical line indicates the median wage for the UK.[1]

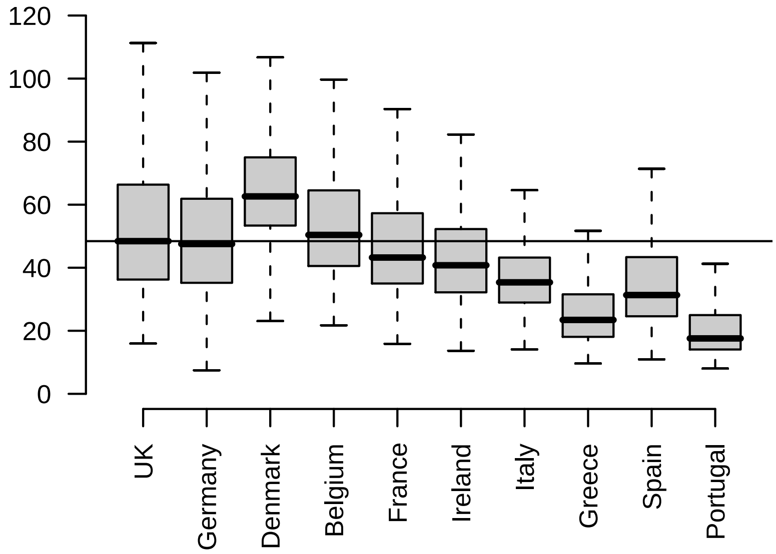

Figure 1: Wage distributions, 2001

[1] Table 7 given in the appendix contains additional descriptive information. The modus is estimated based on the maximal density of a kernel density estimator using a Gaussian kernel and the bandwidth chosen according to the rule suggested by Silverman.

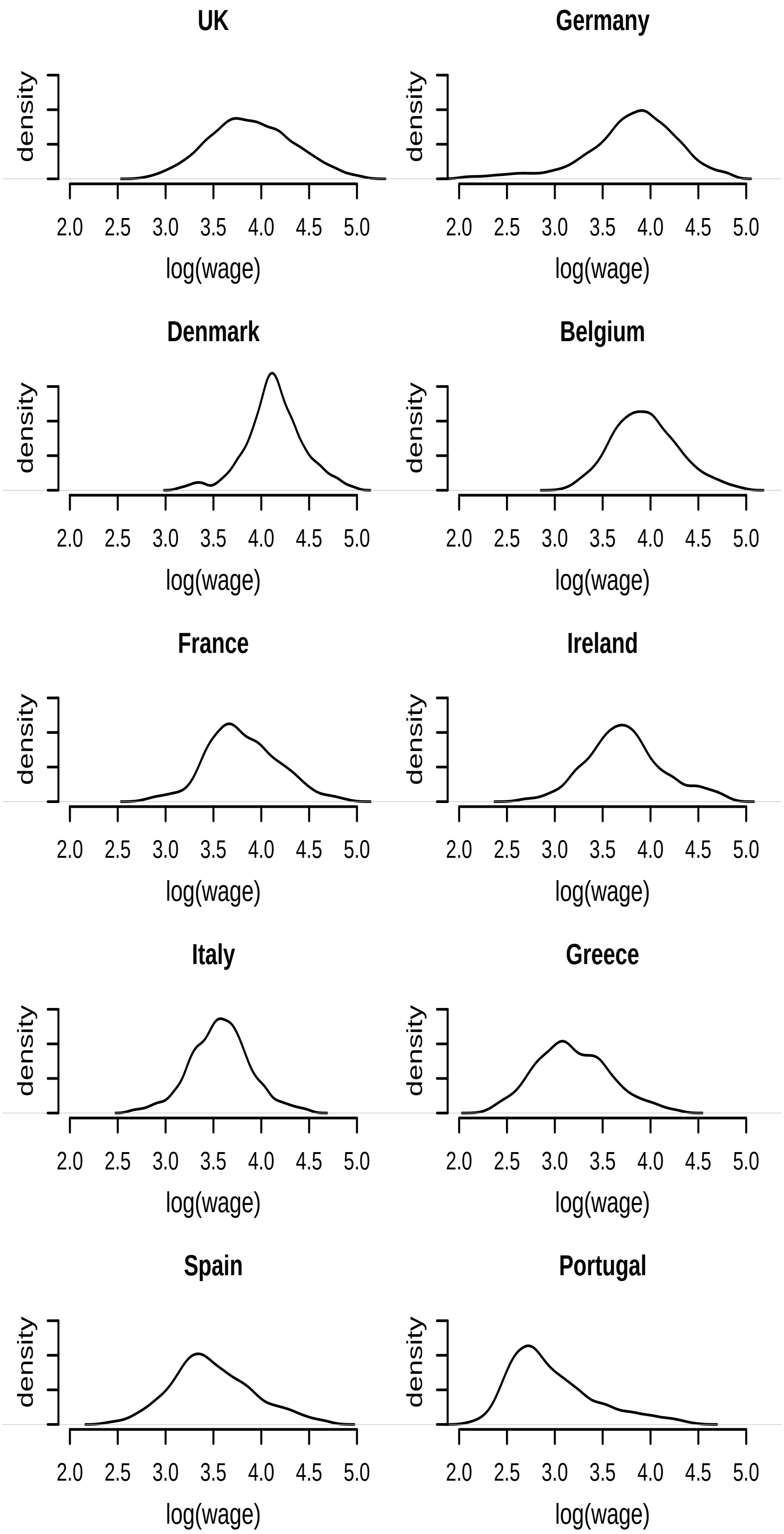

Figure 2: Log-wage distributions, 2001

Kernel density estimates of the log-wage distributions are depicted in Figure 2. It is evident that in Italy and in Denmark, despite the high level of average wages, wage dispersion is rather low compared to the UK. For all countries we find the modus being smaller than the median and the average being the highest location measure. This conforms to the skewness in the log-wage distributions.

Figure 3 shows box plots for the log-wage distributions. For log-wages the interquartile range is still highest for the UK, but at comparable levels in Ireland, Spain and Portugal. In these countries, respondents at the 75% quantile earn about 60% more than respndents at the 25% quantile. The smallest relative differences are found for Denmark and Italy.[2]

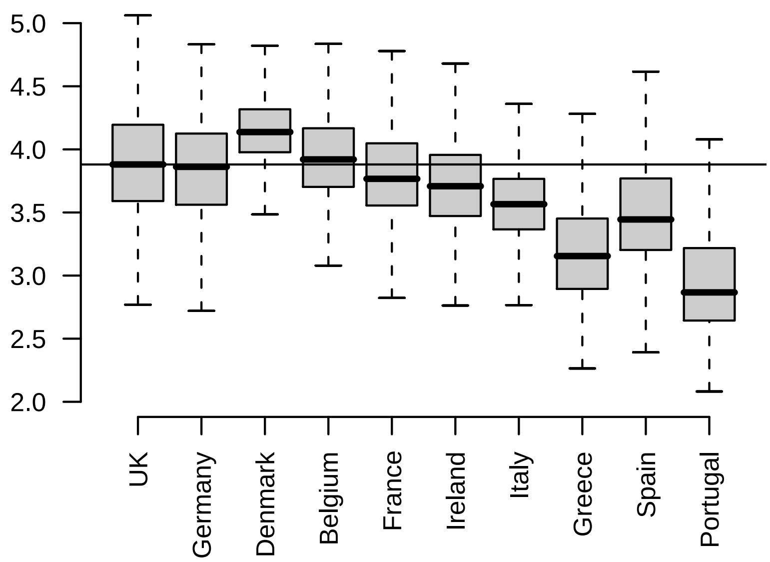

Figure 3: Log-wage distributions, 2001

The information on educational attainment in the ECHP is only categorical. It is reported whether persons have obtained first, secondary or third level education. Figure 4 displays graphically the shares of the three different educational attainments. It is noticeable that in the UK the share of persons having obtained secondary education is extremely low (24%), while this level of education is the largest level in Germany, Denmark, Ireland, Italy and Greece. Comparing the share of persons having obtained only basic education, this share is relatively high in the UK, being only surpassed in France, Italy, Greece, Spain and Portugal. The highest shares of persons having obtained academic education are found in the UK, Denmark and Belgium.[3]

Figure 5 displays average log-wages by educational subgroups. It is remarkable that despite the low level of wages in general in Portugal the premium for third level education (73%) is the highest across all countries. It is also rather high in Ireland and Spain. In all countries the difference between secondary and first level education is very small compared to the difference between third and secondary level education.[4]

Figure 6 displays the relationship between general working experience and average logarithmic wages using robust locally weighted regression. We observe marginally decreasing returns to experience in all countries, but only in Portugal and Ireland

[2]Table 8 given in the appendix contains additional detailed information.
[3]Percentages are given in Table 9 in the appendix.
[4]See Table 10 in the appendix for details.

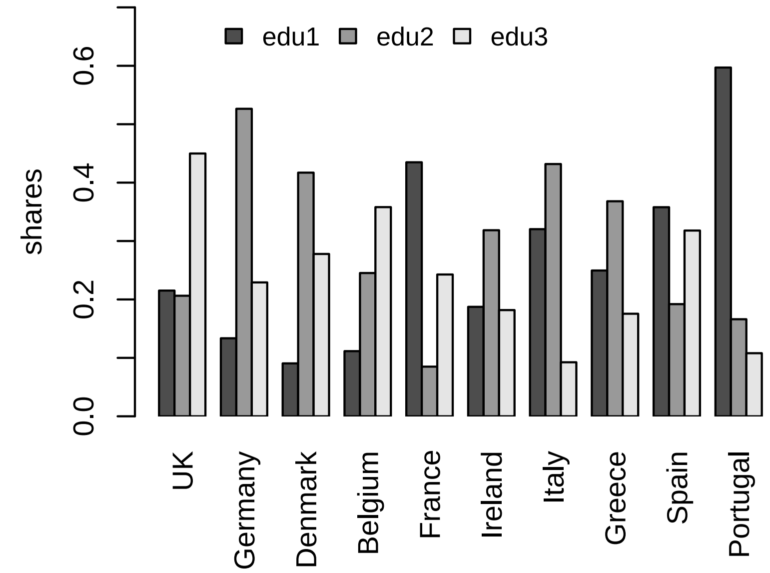

Figure 4: Shares of educational categories, 2001

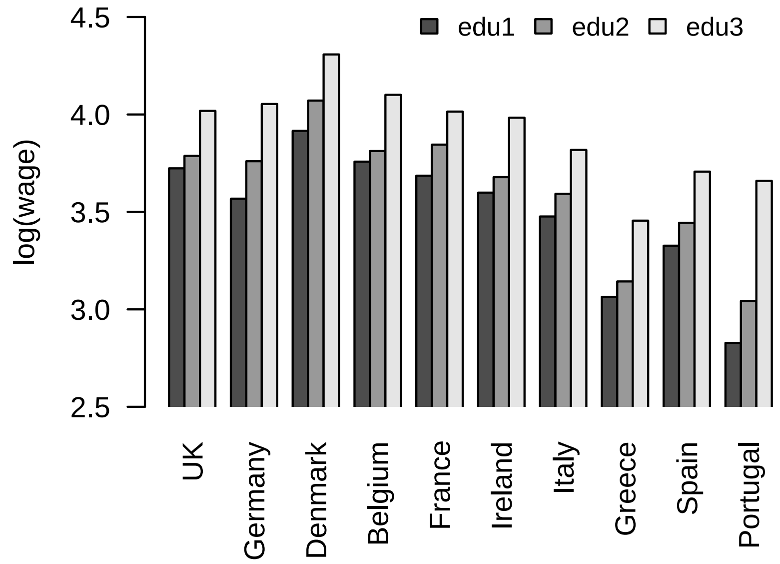

Figure 5: Average log-wage by educational attainment

wages are declining after about 15 years of general working experience. Even though the shapes of the nonlinear relationships vary considerably across countries, in most cases a simple quadratic effect will not be sufficient to model the relationships adequately.

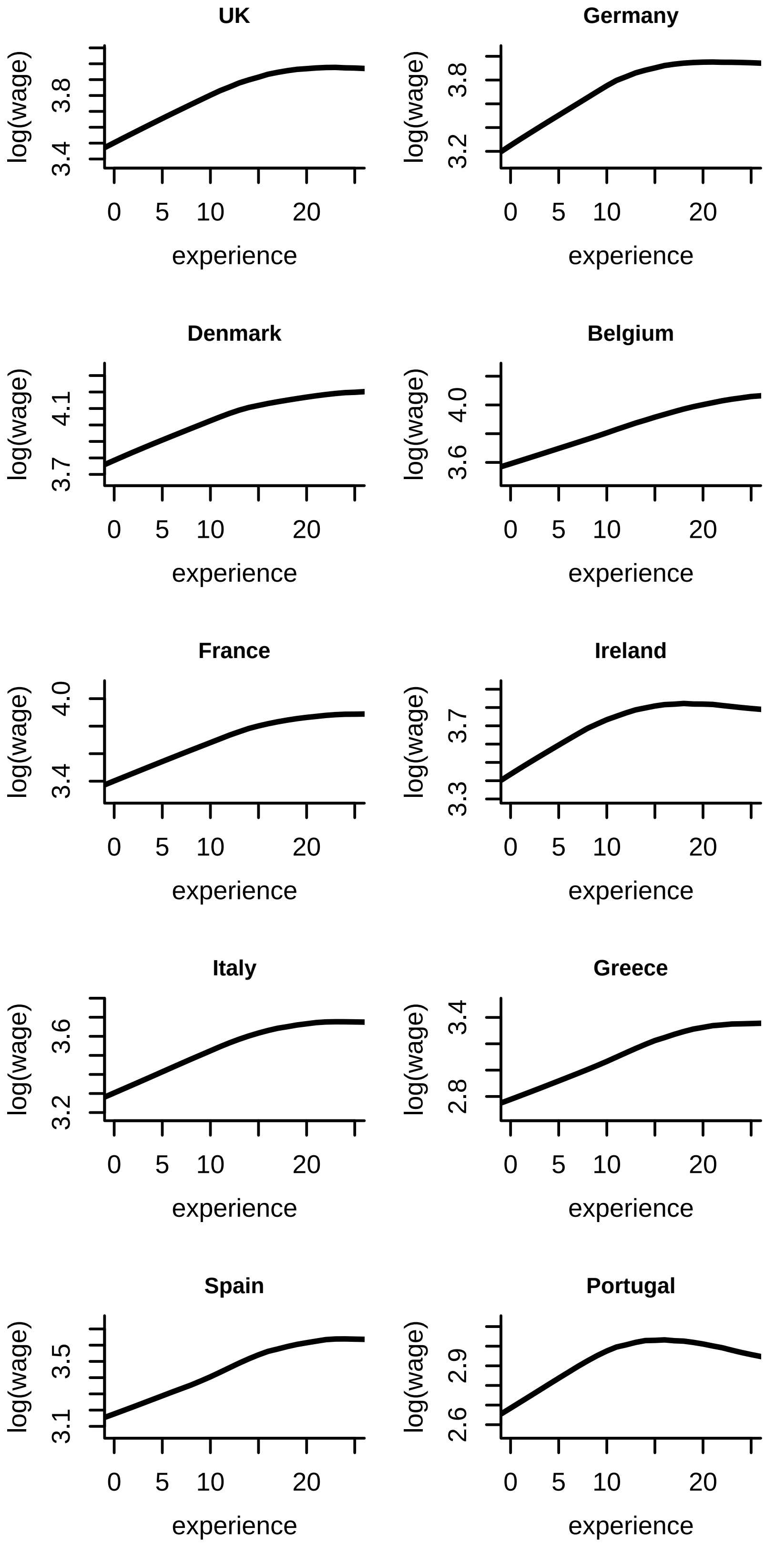

Figure 6: Average log-wage by general experience, 2001

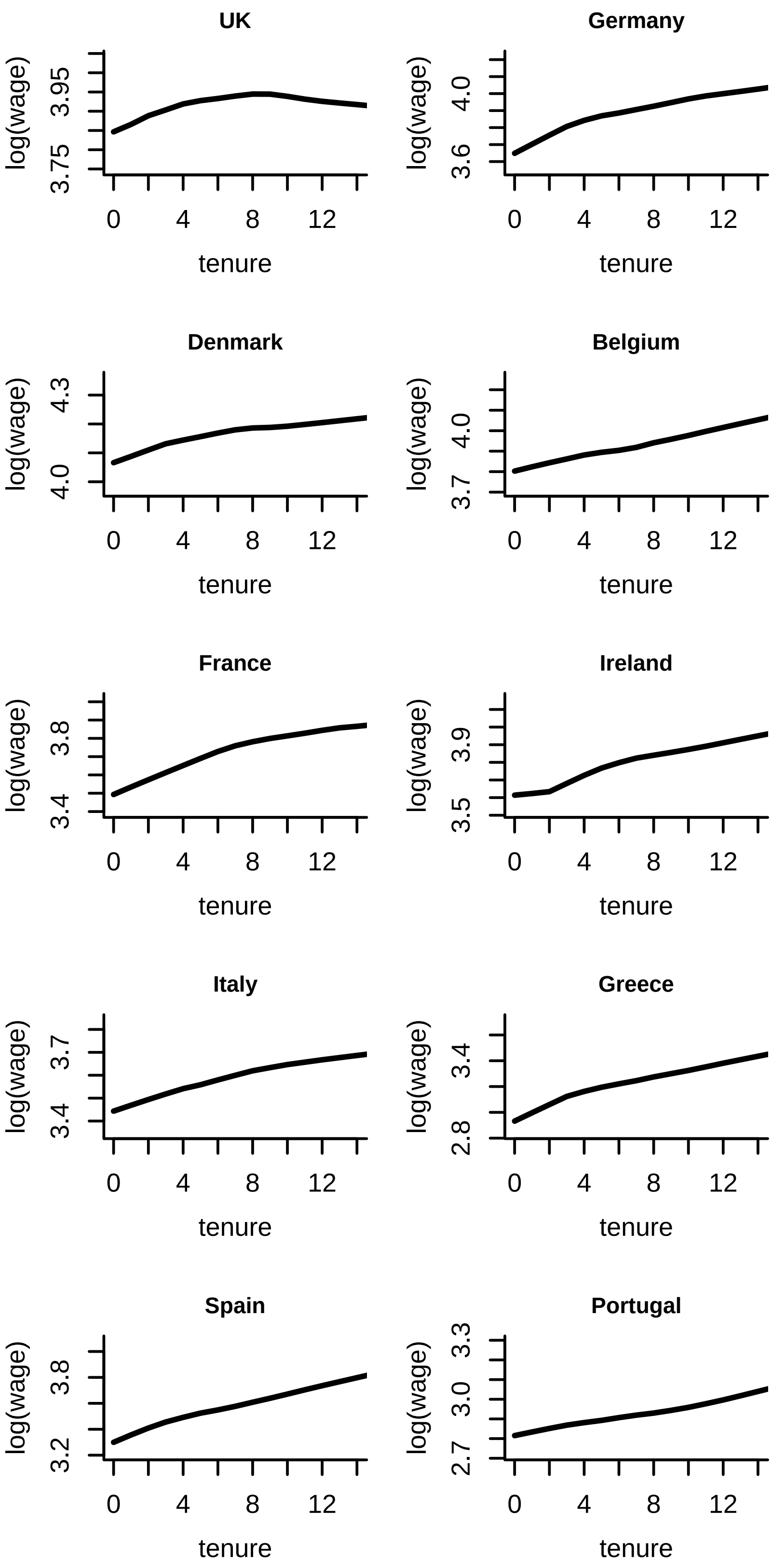

Figure 7: Average log-wage by tenure, 2001

In Figure 7 we compare logarithmic wage profiles for tenure across countries. In the UK tenure seems to be rewarded only slightly as the maximum is just about 12% above the wage for persons with no firm specific experience. Additionally, we observe a decrease in returns to tenure in the UK after about 9 years. Rather steep profiles are observed in Ireland, Greece and Spain. Almost linear profiles are observed for Belgium and Spain, Italy and Portugal.

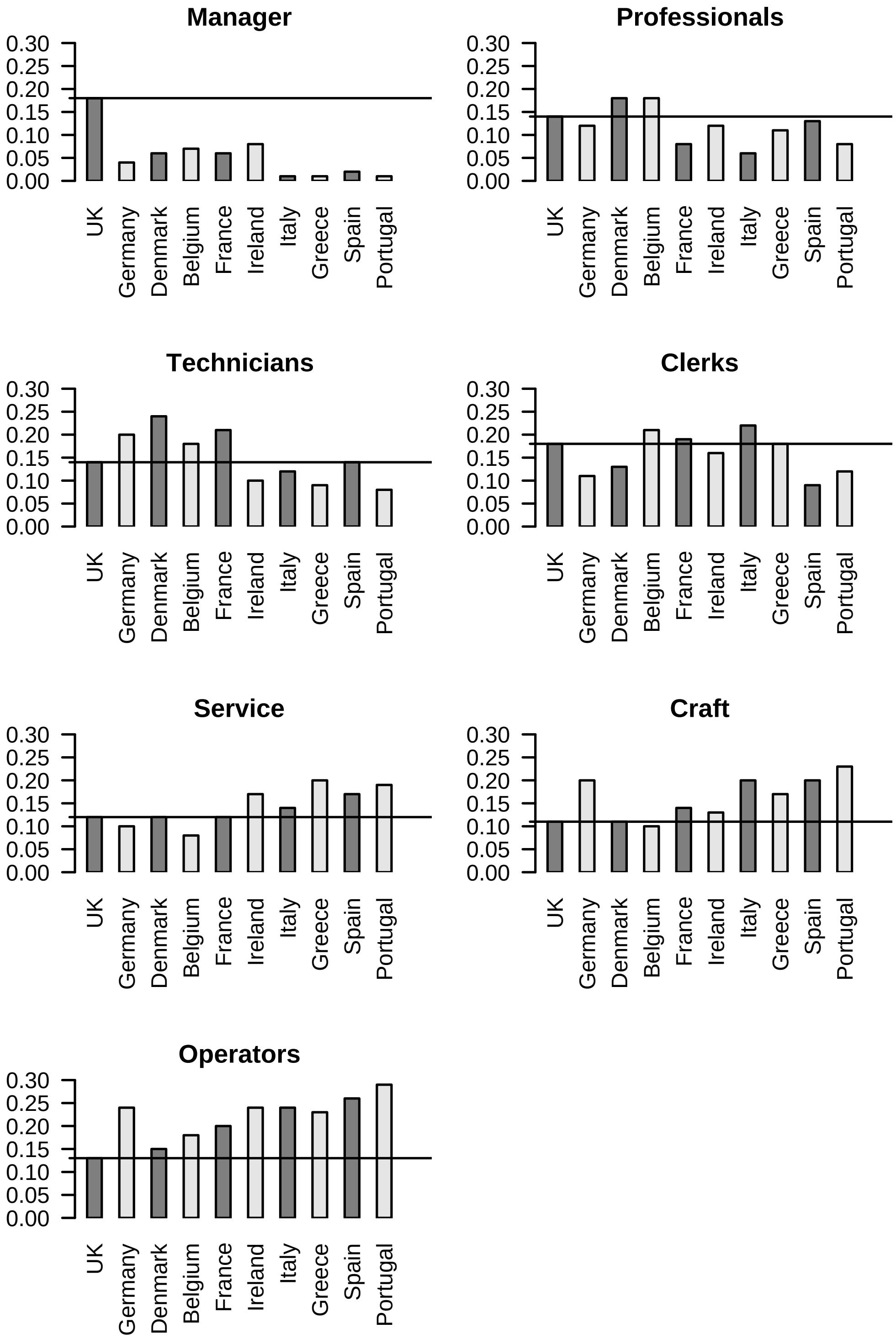

Figure 8: Occupational structure, 2001

Figure 8 displays the share of occupations in total employment for seven occupations.[5] The share of managers is outstandingly high in the UK, but this might reflect

[5]See also Table 11 in the appendix for details on the occupational employment structure.

differences in the delineation of the term in the different surveys. High shares of professionals are found in the UK and Belgium. We observe high shares of technicians in high wage countries. In Belgium, France and Italy the share of clerks is above the share observed in the UK. The highest shares of persons providing service are found in the three southern countries Greece, Spain and Portugal and also in Ireland. Portugal has relatively the most crafts workers and operators.

	AD	EN
Germany	0.26	0.22
Denmark	0.16	0.16
Belgium	0.16	0.14
France	0.18	0.17
Ireland	0.18	0.16
Italy	0.26	0.24
Greece	0.24	0.22
Spain	0.26	0.24
Portugal	0.35	0.29

Table 1: Deviation to the UK occupational structure, 2001

In Table 1 we compare the occupational structure of each country with that of the UK. We measure the difference in structure by the sum of absolute deviations to the UK structure multiplied by 0.5 (AD) and by the Euclidean Norm (EN). We find the lowest deviations for Denmark and Belgium according to both measures. France and Ireland display only small deviations, too. The highest deviation measures are found for Italy, Spain and Portugal, followed by Germany and Greece.

Figure 9 displays mean wages across occupations. Compared to the UK, wages are higher through all occupational categories only in Denmark. Germany is found to have about the same average wage as the UK in most occupations, the exceptions being technicians and crafts with slightly lower wages compared to the UK.[6] Greeks and Portuguese are found to earn the lowest wages in all occupations. It is noteworthy that the difference in highly paid occupations is relatively small between countries compared to the differences in low paid occupations. Portuguese professionals display considerable smaller wage gaps towards their counterparts in high wage countries but craft and service workers as well as operators do much worse.

[6] See also Table 12 in the appendix.

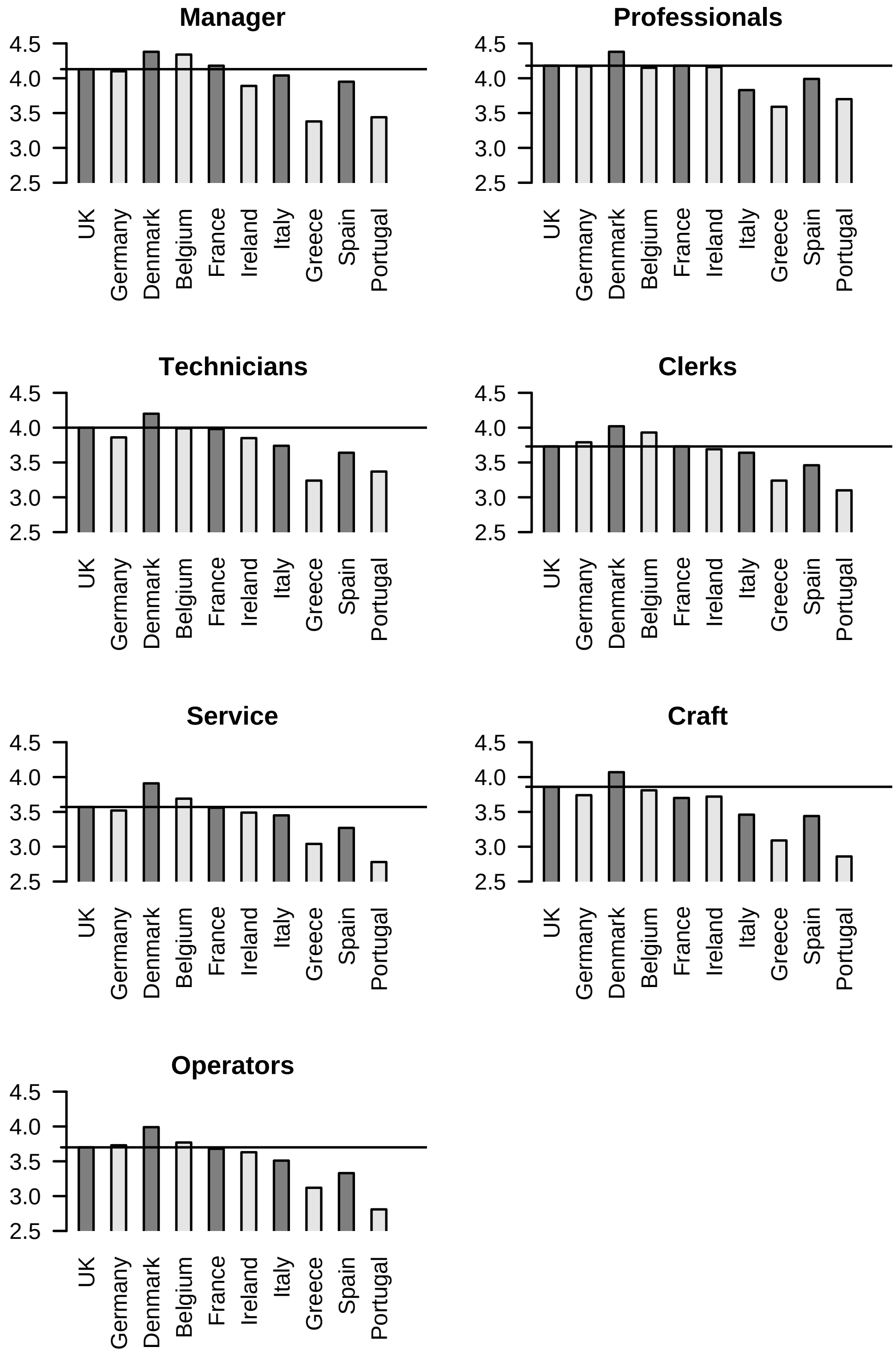

Figure 9: Average occupational log-wages, 2001

Figure 10 shows empirical distribution functions in comparison to the UK. We observe the smallest differences between the distribution functions for Germany, France and Belgium compared to the UK. Due to the high inequality in the UK wage distribution, all countries reveal distribution functions that are steeper in the centre compared to the UK distribution. This is most evident for Denmark and Italy, countries found to have low wage dispersion. The greatest differences are found for Portugal and Greece.

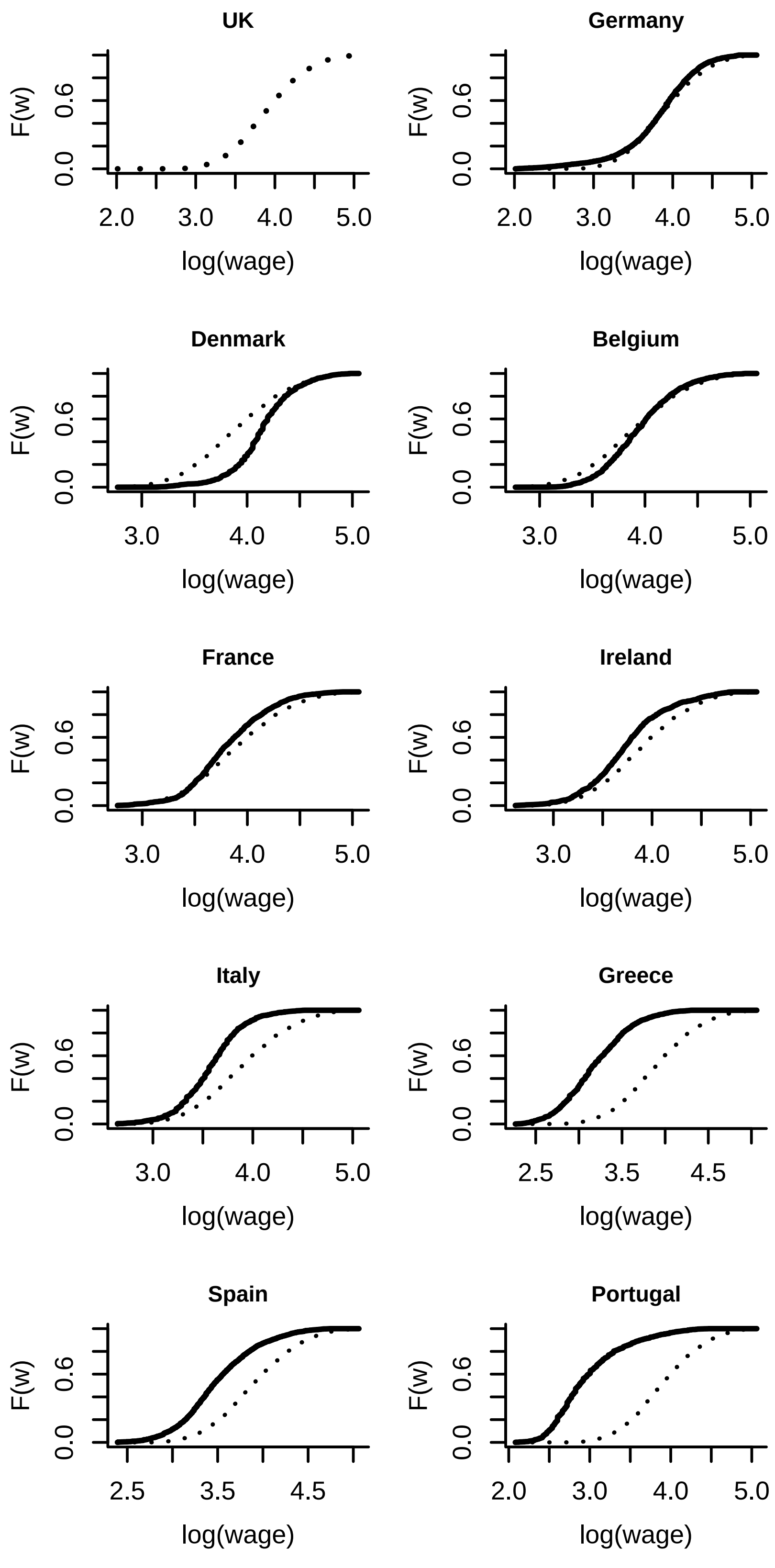

Figure 10: Distribution functions, 2001

5 The decomposition of wage differentials based on the Cox model

In Tables 2 and 3 we show the parameter estimates of the Cox model and the estimated standard errors. When interpreting the estimated coefficients, it has to be kept in mind that due to the model formulation negative signs imply smaller hazards and thus higher wages and vice versa. Throughout, we observe a strong and significant gender effect. While having obtained only basic education has only in some of the analysed countries a negative partial effect on wages, the effect of third level education is significant and large in all countries. We also give detailed results for occupational effects in Tables 2 and 3. The parameters for the components of the natural splines for experience and tenure are given in the appendix (Tables 13 and 14).

	UK	Ger	Den	Bel	Fra
sex	0.469	0.551	0.622	0.357	0.53
	(0.04)	(0.037)	(0.057)	(0.067)	(0.064)
1st lev. ed.	0.153	0.004	0.272	0.25	0.349
	(0.053)	(0.052)	(0.086)	(0.093)	(0.089)
3rd lev. ed.	-0.242	-0.39	-0.354	-0.581	-0.239
	(0.048)	(0.048)	(0.065)	(0.086)	(0.098)
Professionals	0.08	-0.039	0.175	0.456	0.163
	(0.065)	(0.102)	(0.117)	(0.139)	(0.146)
Technicians	0.315	0.391	0.598	0.848	0.628
	(0.065)	(0.097)	(0.115)	(0.142)	(0.13)
Clerks	0.82	0.453	1.132	0.854	1.244
	(0.065)	(0.104)	(0.131)	(0.141)	(0.141)
Sales	1.26	1.256	1.433	1.123	1.605
	(0.071)	(0.107)	(0.13)	(0.172)	(0.152)
Craft	0.885	0.862	1.126	1.102	1.388
	(0.073)	(0.1)	(0.136)	(0.171)	(0.15)
Operators	1.123	0.831	1.203	1.09	1.361
	(0.069)	(0.097)	(0.129)	(0.155)	(0.142)
R-sq.	0.32	0.36	0.4	0.33	0.4
n	3111	3678	1684	1146	1476

Table 2: Estimates of the Cox-model

	Ire	Ita	Gre	Spa	Por
sex	0.479	0.515	0.671	0.562	0.841
	(0.076)	(0.047)	(0.055)	(0.043)	(0.042)
1st lev. ed.	0.212	0.208	0.151	0.287	0.45
	(0.082)	(0.05)	(0.062)	(0.051)	(0.053)
3rd lev. ed.	-0.52	-0.363	-0.523	-0.189	-0.896
	(0.095)	(0.075)	(0.076)	(0.056)	(0.088)

	Ire	Ita	Gre	Spa	Por
Professionals	-0.457	0.309	-0.057	0.037	0.153
	(0.149)	(0.196)	(0.215)	(0.142)	(0.189)
Technicians	0.039	0.503	0.65	0.801	0.371
	(0.148)	(0.19)	(0.215)	(0.141)	(0.185)
Clerks	0.299	0.797	0.574	1.28	0.556
	(0.14)	(0.188)	(0.209)	(0.148)	(0.184)
Sales	0.748	1.143	0.739	1.5	1.215
	(0.139)	(0.193)	(0.208)	(0.143)	(0.181)
Craft	0.145	1.278	1.029	1.235	1.223
	(0.148)	(0.193)	(0.211)	(0.143)	(0.181)
Operators	0.407	1.129	0.856	1.439	1.317
	(0.135)	(0.191)	(0.208)	(0.142)	(0.18)
R-sq.	0.35	0.28	0.43	0.42	0.46
n	1017	2492	1762	3014	3109

Table 3: Estimates of the Cox-model, continued

The effects of experience and tenure have been modeled by natural splines to allow for non-linearities. The estimated (partial) effect of experience is displayed in Figure 11 (solid line). As reference, in all country specific figures the relationship found for the UK is given (dotted line). We find experience to have a wage decreasing effect beyond twenty years of experience in the majority of countries, Denmark, Belgium and France being the exceptions. Rather steep profiles in the interval up to 15 years of education are found in in the UK, Germany and Denmark.

Figure 12 contains the estimated (partial) effect of tenure. The profile in the UK, which is displayed in all country specific figures to ease comparison, is extremely flat. Almost linear profiles are found in Ireland, Italy and Portugal. Highly nonlinear profiles are observed for Denmark, Belgium, France and Greece.

For both tenure and experience, the non-linearities seem to be stronger than in the marginal non-parametric regressions of the last section. In both cases, however, tenure has a smaller effect than experience.

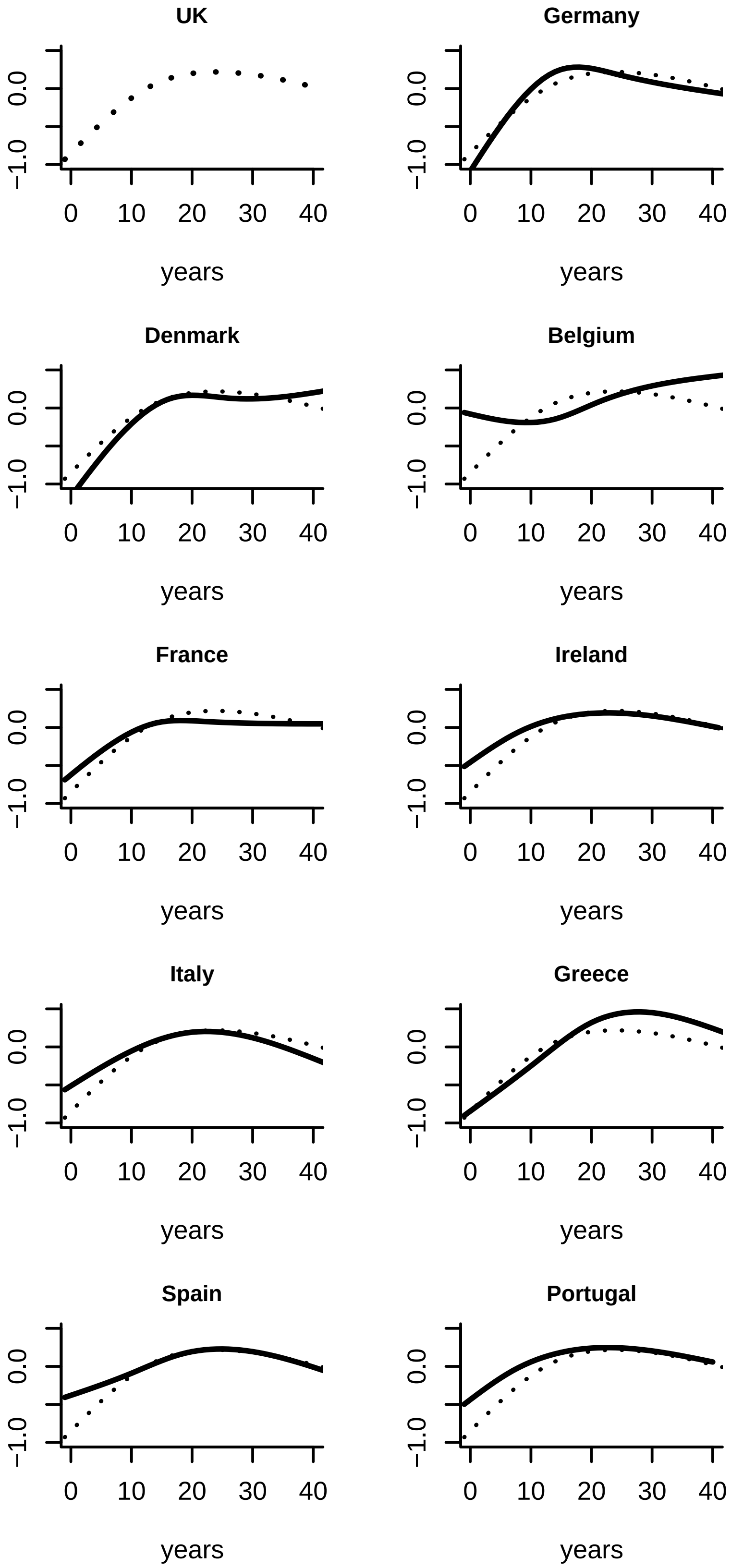

Figure 11: Estimated effect of experience

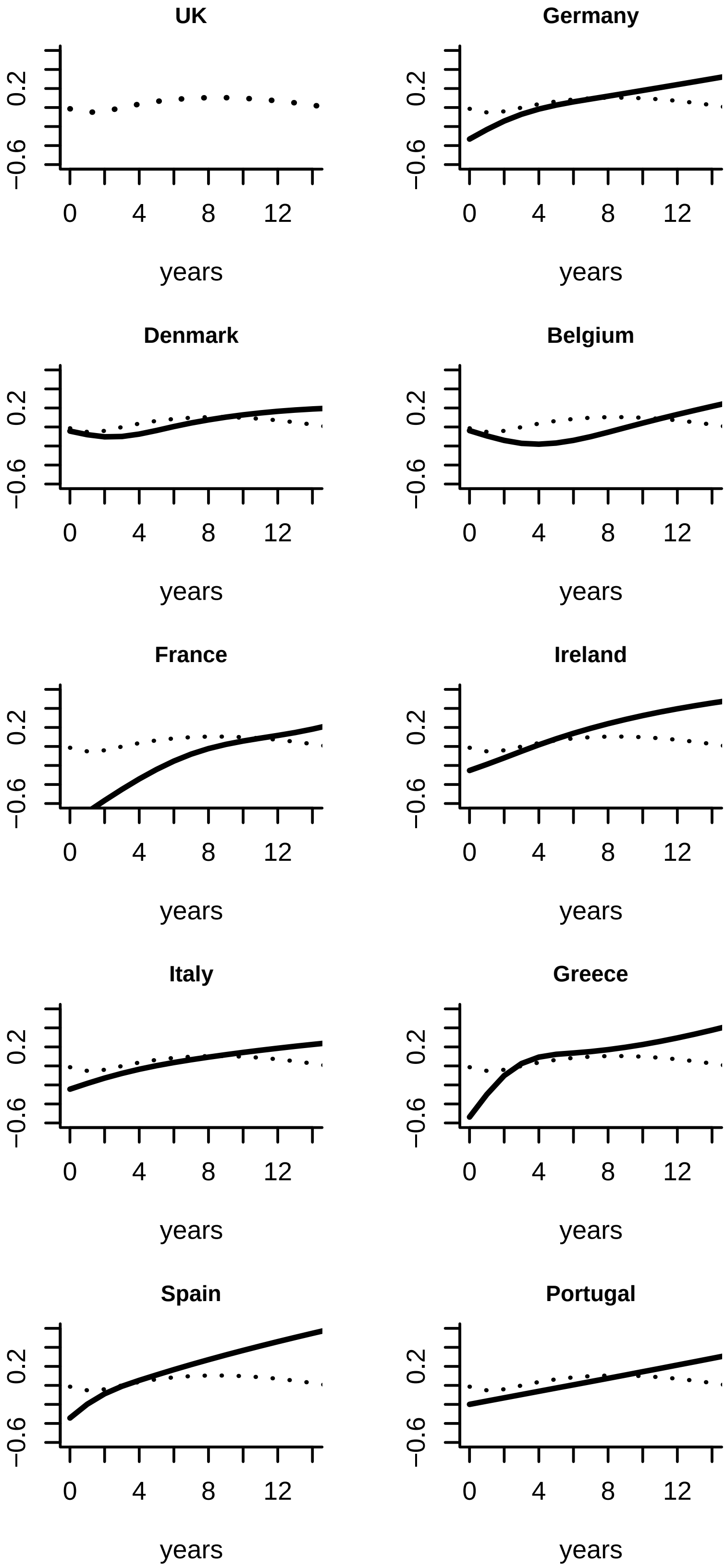

Figure 12: Estimated effect of tenure

Based on the estimated parameters we derive an estimate of the skill index for each individual in the sample. The estimated densities are given in Figure 13. In all density plots we show also the estimated distribution for the UK for comparison (dotted line). All skill distributions are highly skewed to the right, especially so in Belgium, Italy, Spain and Portugal. For most countries we find a higher excess than for the UK distribution, exceptions being Germany, Denmark and Greece.

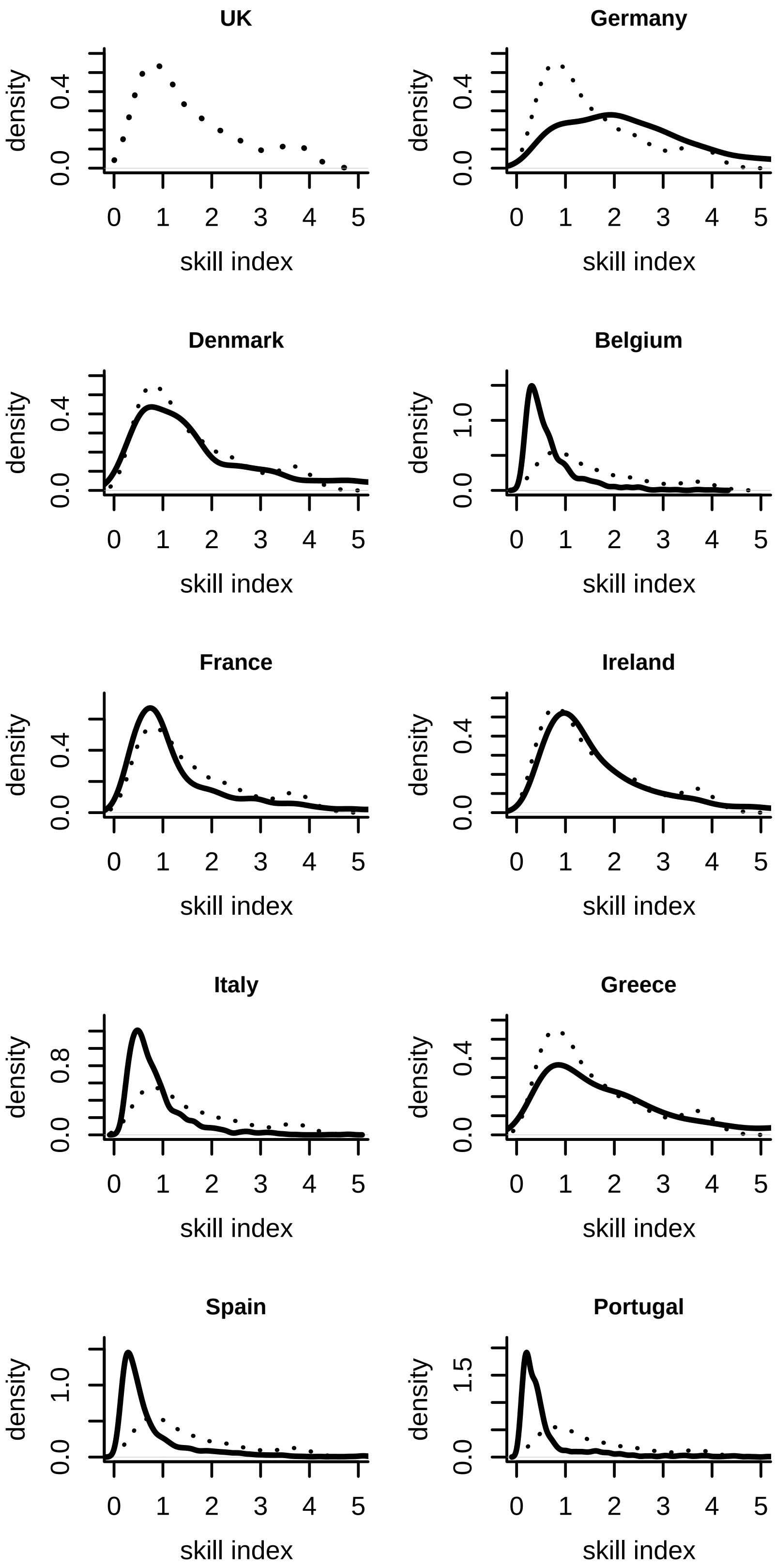

Figure 13: Distribution of estimated skill index, 2001

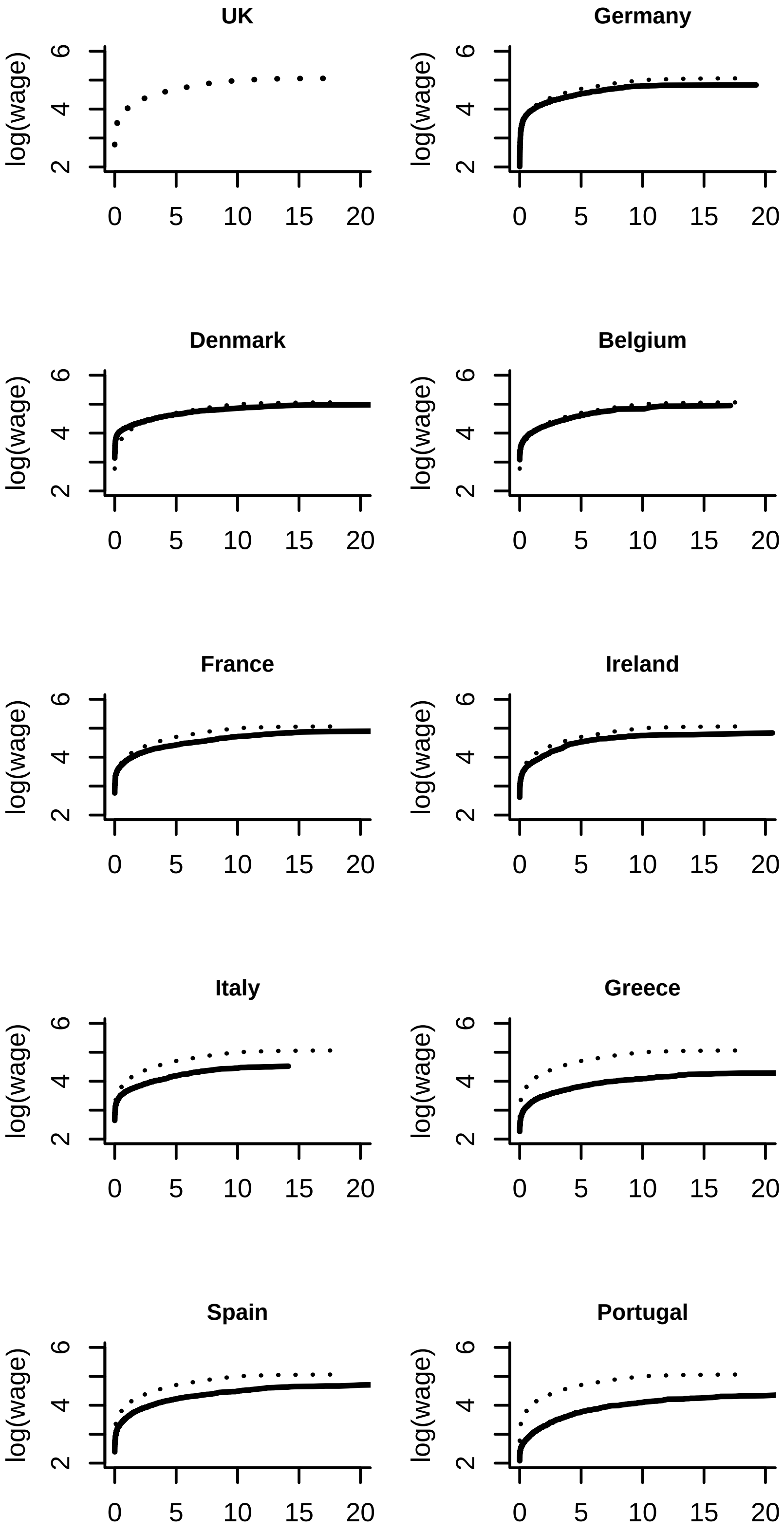

Figure 14: returns-to-skill functions, 2001

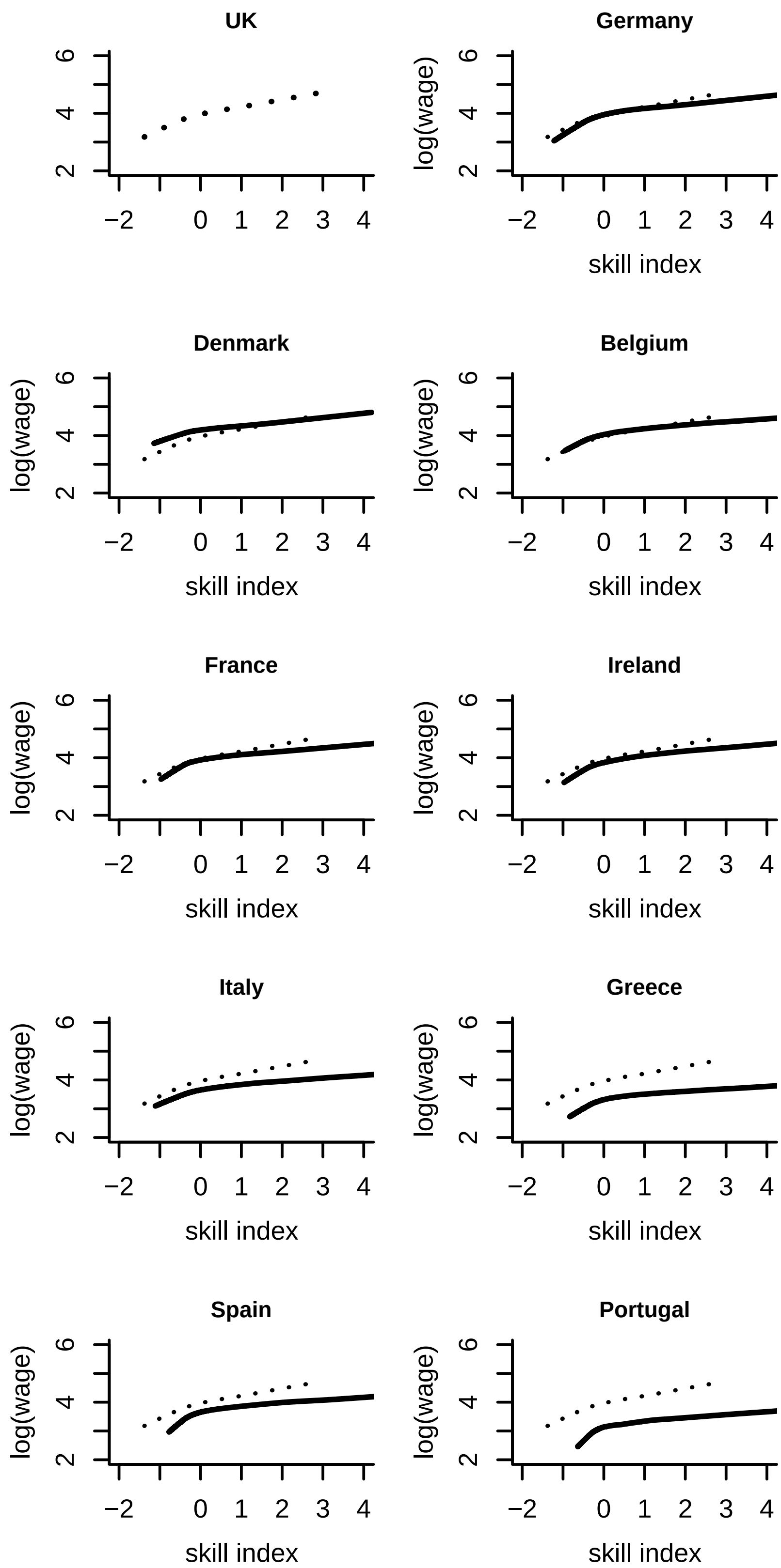

Figure 15: Estimated skills and wages, 2001

The returns-to-skill functions transform the estimated individual amount of skills calculated according to the estimated coefficients $\hat{\beta}$ of the skill function into log-wages. In Figure 14, we show the estimated returns-to-skill functions. We find the returns-to-skill functions in Germany, Denmark, Belgium, France and Ireland to reveal only small differences with respect to the UK function which is displayed as reference in all country specific figures. In Italy and Spain the function are located slightly below the UK function whereas in Greece and Portugal the estimated returns-to-skill functions are located considerably below the UK function.

By displaying quantiles of the estimated skill indices at the horizontal and the corresponding quantiles of estimated log-wages on the y-axis we provide an illustrative presentation of the average relation (Fig. 15). To ensure comparability, the values $\hat{r}^*$ have been normalised. We find this average relations to be almost linear in the UK and Denmark. When comparing the relations with the relation for the UK we find the difference to increase with increasing skill index. This finding corresponds to the high inequality measures observed in the UK. For Italy, Spain, Greece and Portugal the average relation of skill index and log-wage quantiles lies considerably below the UK function.

The adequacy of our flexible wage model can be judged based on Figure 16 which displays the empirical as well as the estimated distribution functions for log-wages for all countries.

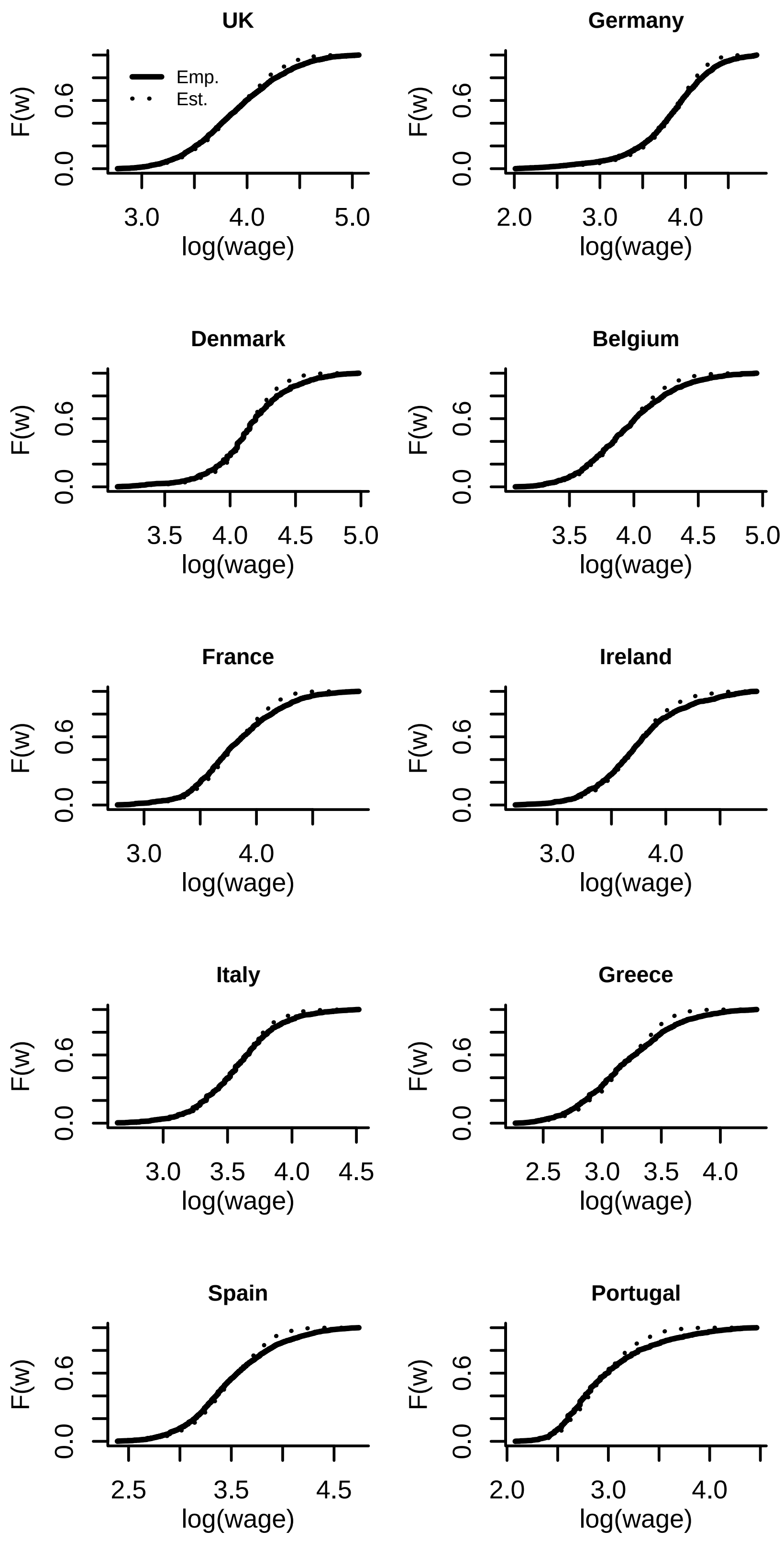

Figure 16: Empirical and estimated distribution functions, 2001

Due to slightly less variation in the estimated log-wages, the estimated distribution functions cross the empirical distribution functions and lie slightly above the empirical ones at higher log-wages. The excellent fit of the estimated distribution functions is also reflected in Table 4 which contains empirical and estimated wage differentials between the UK and all other countries based on the estimates. Denmark is the only country for which we find positive differences towards the UK throughout different quantiles. For Belgium and France we find positive differences at lower parts of the wage distribution but negative differences for median and high wages. The highest differentials are found between the UK and Portugal. Throughout the wage distribution Portuguese earn only slightly more than half the wage of their UK counterparts at comparable relative wage positions. The fact that we observe increasing differences (mainly negative differences increasing in absolute value) reflects the very high rewards for highly skilled persons in the UK causing the highest level of inequality in the EU to be observed in the UK.

		10%	25%	50%	75%	90%
Germany	Emp.	-12	-2.9	-1.9	-7	-12
	Est.	-9.3	-1.1	-2.3	-7.1	-11.9
Denmark	Emp.	42.5	38.7	25.7	12.3	4.8
	Est.	44.8	37.9	24.5	12.7	3.6
Belgium	Emp.	18.5	11.2	4	-2.8	-7.2
	Est.	16.3	10.2	3.4	-2.7	-6.7
France	Emp.	4.5	-3.5	-11.4	-14.7	-16.7
	Est.	3.5	-3.3	-10.8	-15	-18.5
Ireland	Emp.	-9.6	-11.9	-17.2	-23.9	-19.9
	Est.	-10.8	-11.4	-17	-23.6	-24
Italy	Emp.	-14	-22.4	-31.4	-42.9	-50.4
	Est.	-15.1	-23.6	-31.8	-40.6	-47.3
Greece	Emp.	-63.2	-69.5	-72.5	-74.3	-77.4
	Est.	-61.4	-65.3	-72.1	-76.1	-82.4
Spain	Emp.	-37.2	-38.8	-43.5	-42.5	-38.1
	Est.	-35.7	-38.4	-42.5	-43.4	-45.8
Portugal	Emp.	-84.7	-94.7	-101.3	-97.7	-84.5
	Est.	-84.4	-92.8	-99.6	-101.5	-100.5

Table 4: Wage differences to the UK at quantiles

To isolate underlying forces of the observed wage differentials, we calculate for all countries three counterfactual distribution functions. Firstly, we use the estimated prices and returns-to-skill function for the UK but the individual characteristics of the country j under analysis ($F.x.j$ in Figure 16). The difference between the observed distribution function for the UK ($F.UK$) and the counterfactual distribution function ($F.x.j$) isolates the difference in wage distribution functions due to differences in skill distributions. This is called x-effect in the following. Using the individual characteristics and returns-to-skill function for the UK but the estimated price vector for country j, $\hat{\beta}_j$ results in the counterfactual distribution function $F.\beta.j$. The difference between $F.UK$ and $Fb.j$ isolates the effect of prices for skills and is named price-effect. Finally using the skills and estimated prices for the UK but the returns-to-skill function for country j leads to the counterfactual distribution function $F.\Lambda.j$. The difference between $F.UK$ and $F.\Lambda.j$ isolates the differences in rewards for the skill index. This effect is called Λ-effect. For each country j we display in Figure 17 the original distribution function for the UK and the three counterfactual distribution functions.

We find that for Germany the counterfactual distribution using the German skill distribution to be indistinguishable from the factual distribution in the UK. The price effect shifts the distribution to the right and is therefore favouring German employees relative to their UK counterparts. The opposite holds for the Λ-effect. For Denmark the isolated effect of the Danish returns-to-skill function would shift the UK distribution towards the right, hence, would have a wage increasing effect. For Belgium the findings are just the opposite of the German findings. The counterfactual distributions using components from France display almost no differences from the original UK distribution. Rather small effects are found for Ireland, Italy and Spain, too.

The huge wage differentials between the UK and, respectively, Greece and Portugal are mainly driven by a very strongly decreasing returns-to-skill effect.

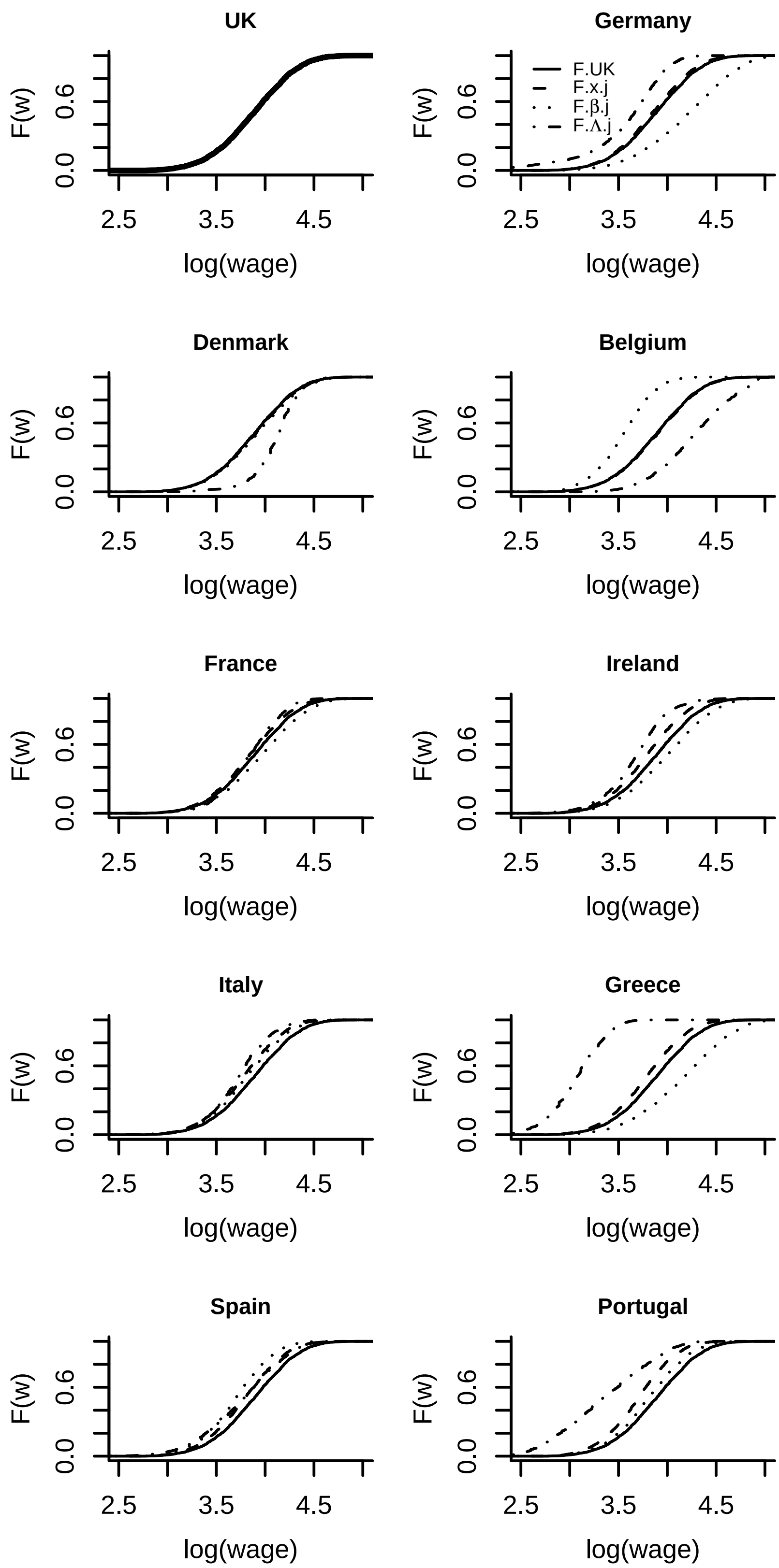

Figure 17: Counterfactual distribution functions, 2001

Table 5 contains the results of the decomposition analysis at the 25% quantile, the median and the 75% quantile. We find almost no differences between the empirical and the estimated wage differences at the quartiles. This reflects the excellent fit across the distribution. The decomposition analysis reveals that the small negative differences found for Germany are the result of a positive price and an offsetting negative returns-to-skill effect. The same with reversed signs holds for Belgium. The positive wage difference observed for Denmark is almost completely due to the strong returns-to-skill effect. We observe almost no differences in individual characteristics and prices. The slightly lower wages in France are mainly brought about by the negative returns-to-skill effect. For Ireland we find a disadvantageous returns-to-skill effect which is most pronounced at higher quantiles. The considerably lower wages in Spain compared to the UK must be attributed to all three isolated effects, each being favourable to the UK. For Greece and Portugal the largest wage differences are observed. According to the decomposition model, in both countries these differences can mainly be attributed to returns-to-skill functions being strongly disadvantageous compared to the UK.

		total	total est.	x-effect	β-effect	Λ-effect
Germany	q25	-2.9	-1.1	-2.8	26.8	-24.2
	q50	-1.9	-2.3	-4.7	33.1	-22.4
	q75	-7	-7.1	-4.6	37.8	-28.4
Denmark	q25	38.7	37.9	0.6	1.6	36.7
	q50	25.7	24.5	0.6	2.8	24.1
	q75	12.3	12.7	1	2.9	11.5
Belgium	q25	11.2	10.2	0.6	-26.8	38.2
	q50	4	3.4	0.6	-33.7	39.6
	q75	-2.8	-2.7	1	-41.5	41.8
France	q25	-3.5	-3.3	-3.5	5.5	-1
	q50	-11.4	-10.8	-5.5	7	-5.3
	q75	-14.7	-15	-5.9	7.2	-10.2
Ireland	q25	-11.9	-11.4	-7.9	7.9	-15.2
	q50	-17.2	-17	-10.4	9.9	-20.3
	q75	-23.9	-23.6	-12.5	11	-27.8
Italy	q25	-22.4	-23.6	-9.2	-6.1	-10.2
	q50	-31.4	-31.8	-11.8	-8.2	-16.8
	q75	-42.9	-40.6	-13.7	-9.6	-22.4
Greece	q25	-69.5	-65.3	-8	21.6	-73.6
	q50	-72.5	-72.1	-10.5	28.3	-81.2
	q75	-74.3	-76.1	-12.5	30.8	-88.5
Spain	q25	-38.8	-38.4	-7.8	-15.3	-16.1
	q50	-43.5	-42.5	-10.3	-19.1	-10.9
	q75	-42.5	-43.4	-12.5	-23.1	-10.3
Portugal	q25	-94.7	-92.8	-15.1	-6.7	-63
	q50	-101.3	-99.6	-19	-8.7	-56
	q75	-97.7	-101.5	-22.9	-10.3	-44.1

Table 5: Components of wage differences to the UK

6 Conclusion

The analysis of the wage differentials observed between the UK and nine European countries has been carried out using an empirical decomposition analysis based on a proportional hazards model using a marginal likelihood. This approach based on rank invariant estimators has been suggested by Behr and Pötter (2006) who extended the Donald et al. (2000) approach. By means of natural splines we allowed for nonlinear regression effects and isolated three different underlying forces for wage differentials: differences in skills, differences in prices of skills and differences in the returns-to-skill functions.

We find strong differences in wage distributions. Firstly, wages in the UK exhibit the highest degree of inequality across the ten countries under analysis. This high inequality in the UK is due mainly to the outstanding steepness of the UK returns-to-skill function. Highly paid employees do relatively much better in the UK compared to the lesser paid. The decomposition revealed that the returns-to-skill effect attributes most to the observed wage differences across European countries towards the UK. This effect has been favouring UK employees relative to most of their European counterparts with Denmark, Belgium and France being exceptions. The effect of differences in individual characteristics attributes surprisingly little to the observed wage differences. This holds even for the relatively low wage level countries Greece and Portugal.

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Appendix

Group	ECHP-Code	Description
1	1	Legislators, senior officials and managers
2	2	Professionals
3	3	Technicians and associate professionals
4	4	Clerks
5	5,6	Service, sales and agricultural workers
6	7	Craft and related trades workers
7	8,9	Operators and assemblers, Miscellaneous
-	-8,-9	Missing (merged with group 7)

Table 6: Occupations

	n	mean	median	modus	sd	IQR
UK	3111.0	54.1	48.4	39.1	24.8	30.1
Germany	3678.0	50.0	47.5	42.9	21.7	26.7
Denmark	1684.0	65.6	62.6	60.2	20.1	21.6
Belgium	1146.0	55.0	50.4	43.7	20.3	24.0
France	1476.0	48.4	43.2	37.1	19.4	22.3
Ireland	1017.0	45.6	40.8	37.0	20.1	20.1
Italy	2492.0	37.5	35.4	34.3	12.2	14.2
Greece	1762.0	26.2	23.4	20.4	11.0	13.5
Spain	3014.0	36.2	31.3	26.8	17.3	18.8
Portugal	3109.0	21.9	17.6	14.5	12.5	10.9

Table 7: Wage by country, 2001

	mean	median	modus	sd	IQR
UK	3.89	3.88	3.74	0.44	0.60
Germany	3.81	3.86	3.91	0.49	0.56
Denmark	4.14	4.14	4.11	0.30	0.34
Belgium	3.95	3.92	3.90	0.34	0.46
France	3.81	3.77	3.66	0.37	0.49
Ireland	3.74	3.71	3.70	0.40	0.48

	mean	median	modus	sd	IQR
Italy	3.57	3.57	3.57	0.31	0.40
Greece	3.19	3.15	3.08	0.39	0.56
Spain	3.49	3.44	3.34	0.43	0.57
Portugal	2.97	2.87	2.72	0.45	0.57

Table 8: Log-wage by country, 2001

	edu1	edu2	edu3
UK	0.25	0.24	0.52
Germany	0.15	0.59	0.26
Denmark	0.12	0.53	0.35
Belgium	0.16	0.35	0.50
France	0.57	0.11	0.32
Ireland	0.28	0.46	0.26
Italy	0.38	0.51	0.11
Greece	0.31	0.46	0.22
Spain	0.41	0.22	0.37
Portugal	0.69	0.19	0.12

Table 9: Shares of educational attainments, 2001

	edu1	edu2	edu3
UK	3.73	3.79	4.02
Germany	3.56	3.76	4.06
Denmark	3.92	4.07	4.31
Belgium	3.76	3.81	4.10
France	3.68	3.85	4.02
Ireland	3.60	3.68	3.99
Italy	3.48	3.59	3.82
Greece	3.07	3.14	3.46
Spain	3.33	3.44	3.71
Portugal	2.83	3.04	3.66

Table 10: Log-wage by education, 2001

	occ1	occ2	occ3	occ4	occ5	occ6	occ7
UK	0.18	0.14	0.14	0.18	0.12	0.11	0.13
Germany	0.04	0.12	0.20	0.11	0.10	0.20	0.24
Denmark	0.06	0.18	0.24	0.13	0.12	0.11	0.15
Belgium	0.07	0.18	0.18	0.21	0.08	0.10	0.18

	occ1	occ2	occ3	occ4	occ5	occ6	occ7
France	0.06	0.08	0.21	0.19	0.12	0.14	0.20
Ireland	0.08	0.12	0.10	0.16	0.17	0.13	0.24
Italy	0.01	0.06	0.12	0.22	0.14	0.20	0.24
Greece	0.01	0.11	0.09	0.18	0.20	0.17	0.23
Spain	0.02	0.13	0.14	0.09	0.17	0.20	0.26
Portugal	0.01	0.08	0.08	0.12	0.19	0.23	0.29

Table 11: Occupational employment structure, 2001

	occ1	occ2	occ3	occ4	occ5	occ6	occ7
UK	4.13	4.18	4.00	3.73	3.57	3.86	3.70
Germany	4.10	4.17	3.86	3.79	3.52	3.74	3.73
Denmark	4.38	4.38	4.20	4.02	3.91	4.07	3.99
Belgium	4.34	4.15	3.99	3.93	3.69	3.81	3.77
France	4.18	4.18	3.98	3.73	3.56	3.70	3.68
Ireland	3.89	4.16	3.85	3.69	3.49	3.72	3.63
Italy	4.04	3.83	3.74	3.64	3.45	3.46	3.51
Greece	3.38	3.59	3.24	3.24	3.04	3.09	3.12
Spain	3.95	3.99	3.64	3.46	3.27	3.44	3.33
Portugal	3.44	3.70	3.37	3.10	2.78	2.86	2.81

Table 12: Occupational mean wages, 2001

	UK	Ger	Den	Bel	Fra
exper.,1	-0.865	-0.726	-0.781	-0.428	-0.432
	(0.081)	(0.079)	(0.115)	(0.154)	(0.134)
exper.,2	-1.921	-2.64	-2.822	-0.221	-1.458
	(0.199)	(0.18)	(0.323)	(0.426)	(0.374)
exper.,3	-0.317	-0.246	-0.69	-0.612	-0.316
	(0.101)	(0.098)	(0.138)	(0.243)	(0.193)
tenure,1	-0.296	-0.398	-0.287	-0.208	-0.681
	(0.112)	(0.085)	(0.137)	(0.141)	(0.119)
tenure,2	0.01	-0.962	-0.165	-0.16	-1.871
	(0.097)	(0.133)	(0.137)	(0.212)	(0.262)
tenure,3	0.126	-0.708	-0.311	-0.607	-0.831
	(0.145)	(0.102)	(0.131)	(0.127)	(0.109)

Table 13: Spline coefficients in the Cox-model

	Ire	Ita	Gre	Spa	Por
exper.,1	-0.624	-0.745	-1.368	-0.728	-0.692
	(0.156)	(0.107)	(0.126)	(0.098)	(0.093)
exper.,2	-1.079	-1.04	-1.848	-0.757	-1.105
	(0.324)	(0.218)	(0.271)	(0.182)	(0.145)
exper.,3	-0.246	-0.087	-0.767	-0.16	-0.319
	(0.169)	(0.159)	(0.169)	(0.153)	(0.115)
tenure,1	-0.558	-0.35	-0.424	-0.571	-0.303
	(0.172)	(0.106)	(0.137)	(0.102)	(0.093)
tenure,2	-0.824	-0.687	-1.547	-1.135	-0.653
	(0.168)	(0.13)	(0.15)	(0.094)	(0.112)
tenure,3	-0.805	-0.489	-0.955	-1.022	-0.683
	(0.162)	(0.104)	(0.131)	(0.101)	(0.099)

Table 14: Spline coefficients in the Cox-model, continued