Ruhr Economic Papers

Torge Middendorf

Returns to Education in Europe

Detailed Results from a Harmonized Survey

#65

RWI ESSEN

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstraße 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstraße 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen)
Hohenzollernstrasse 1/3, 45128 Essen, Germany

Ruhr Economic Papers #65

Responsible Editor: Christoph M. Schmidt

ISSN 1864-4872 (online) – ISBN 978-3-86788-069-5

Ruhr Economic Papers

#65

Torge Middendorf

Returns to Education in Europe

Detailed Results from a Harmonized Survey

RWI ESSEN

Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.d-nb.de abrufbar.

ISSN 1864-4872 (online)
ISBN 978-3-86788-069-5

Torge Middendorf*

Returns to Education in Europe – Detailed Results from a Harmonized Survey

Abstract

We use the European Community Household Panel, a harmonized data set covering the countries of the European Union, to provide detailed estimates of the returns to education. Our results can be summarized as follows. Firstly, average returns to education have been mostly stable during the second half of the 1990s and are highest in Portugal and Ireland and lowest in the UK and Italy. Secondly, returns to schooling are significantly negatively related to the educational attainment of the population. Thirdly, for most countries we find significant cohort effects and these are in general uniform across countries implying lower returns to education for younger cohorts. Fourthly, in most countries schooling exerts a significantly stronger impact on wages at the top of the wage distribution, aggravating within-group inequality. Finally, we provide evidence that the more pronounced the difference in returns to education along the wage distribution, the higher the average return to education.

JEL Classification: I21, J24, J31

Keywords: Returns to schooling, cohort effects, quantile regression

August 2008

---

* RWI Essen. – The author thanks Thomas Bauer, Michael Fertig, Katja Görlitz, John Haisken-DeNew, Wim Kösters, Christoph M. Schmidt and Mathias Sinning for helpful comments and suggestions. – All correspondence to Torge Middendorf, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen), Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: rwi@rwi-essen.de.

1 Introduction

In the last couple of years it has been recognized that human capital may be one of the key drivers of economic growth (Middendorf 2006; OECD 2003). The channels through which it might work are manifold but higher education is also likely to operate indirectly for example through better health (Berger and Leigh 1989; Kenkel 1991; Groot and van den Brink 2004) or lower crime (Lochner and Moretti 2004; Buonanno and Leonida 2006). Thus, education yields social benefits and policy-makers should strive for a higher educational attainment of the population.

Today, however, the major European countries are losing ground in providing a better educated workforce. In Germany, the share of the population who has attained tertiary education has declined for the 25 to 34-year cohort while Italy did not accomplish to increase it and is now below the level of Chile (OECD 2006: 32).[1] Thus, the goal of the Lisbon agenda, to make the EU "the most competitive and dynamic knowledge-driven economy" by the year 2010 seems far out of reach, which has already been conceded by the European Commission (European Commission 2004).

For the individual, the decision to invest in human capital, like other investment decisions, hinges on the internal rate of return of that investment. If these returns turn out to be disproportionately high relative to other investments, this may be a sign of a market failure (Harmon, Oosterbeck and Walker 2003) and thus, besides the externalities outlined above, another reason for intervention. While there are numerous studies dealing with estimates of the economic return to education in European countries, cross-national comparisons are flawed as they are based on different datasets, different estimation procedures, or both.

This study therefore uses a unique standardized European survey, the ECHP, to provide detailed estimates of the returns to education in Europe. Firstly, we estimate the standard Mincerian wage equation and deliver comparable estimates for the EU-member countries over time. We then explore if cross-national differences in the levels of returns can be attributed to the supply of educated workers.

[1] Figures are for 2004.

Secondly, we analyze if the returns to education have been stable across birth cohorts. This research question is especially relevant in a European context for two reasons. First of all, Europe has experienced a large decline in live births. Since the mid 1960s these dropped by roughly 35 % until 2002. Furthermore, education policy during the 1960s and 1970s provided for a huge upswing in educational attainment. If the demand for skills has however not kept pace with this increase, it is likely that education premia have fallen for younger cohorts. Despite these strong reasons for changes in the returns to education, so far there is only scarce empirical evidence for European countries (see Boockmann and Steiner (2006) for an analysis for West-Germany).

Finally, we use quantile regression techniques to assess the relationship between education and wage inequality. If returns to schooling are different along the wage distribution, schooling would exert an impact upon wage inequality. Previous estimation results from Martins and Pereira (2004) from the mid 1990s for most of the countries included in our own analysis point at returns being higher at the upper part of the wage distribution. Thus, contrary to common beliefs, schooling would have a positive impact upon within-levels wage inequality. Thus far, this question has not been addressed with comparable data, though.

The remainder of the paper is organized as follows. Section 2 provides an overview of recent estimates of the economic returns to schooling in Europe. Section 3 explains the estimation approach as well as the utilized data. In section 4 the estimation results are presented and section 5 concludes.

2 Recent evidence on returns to education in Europe

The project Public Funding and Private Returns to Education (PURE), funded by the European Commission, involved researchers from 15 European countries and aimed at providing comparable estimates of the private returns to education (for the following results see Harmon, Walker and Westergaard-Nielsen 2001). As all of the researchers analyzed their respective national datasets, the results of their study are per se not comparable across countries. Yet, the project partners agreed on estimating a common specification of the wage-equation, which increases comparability.

According to their results, Ireland, the UK and Portugal feature the highest returns to education in 1995, whereas Norway, Denmark and Sweden are characterized by the lowest returns. Furthermore, for the UK, Ireland, Germany, Greece and Italy they observe a substantial difference in returns between genders as females receive a significantly higher education premium than men. As the respective datasets are longitudinal in nature, the PURE project had also the opportunity to provide estimates of the economic return to schooling over time. Across countries, however, they do not identify a common trend in returns. For men, they identify a falling trend in returns from the mid 1980s until the mid 1990s in Austria and Portugal, whereas Denmark, Portugal, the UK and Italy seem to exhibit an increasing trend.

Martins and Pereira (2004) rely on these estimates and address the relation between schooling and wage-inequality. Utilizing quantile regression techniques, they show that for nearly all EU countries, returns to schooling are significantly higher at the top of the wage distribution. Individuals, who are at the top of the conditional wage distribution, are there because of their unobserved characteristics and the results suggest that this group receives a higher education increment. Their results therefore imply that schooling aggravates within-group inequality.

Heinrich and Hildebrand (2005) provide comparable estimates of the return to schooling for the countries of the EU-15 by utilizing wave 3 (1996) of the European Community Household Panel. Their results show, that the returns are highest in Portugal, Spain and Luxembourg and lowest in the Nordic countries Denmark and Finland as well as in the Netherlands. Correcting these estimates by the direct costs of education, which in the original Mincer-framework are assumed to be negligible, their estimates change only slightly by no more than 10%, leaving the overall country-ranking unaffected.

The authors further examine the link between educational attainment and labor force participation as well as between educational attainment and unemployment. Their results show, that the positive effect of education on labor force participation is especially marked for women whereas the probability of unemployment decreases strongly with male educational attainment.

Garcia-Mainar and Montuenga-Gomez (2005) also make use of the ECHP and estimate returns to education in Portugal and Spain both for employees and self-employed workers, respectively. Schooling, however, has to be considered endogenous in the Mincer-framework and the authors try to overcome this problem by using an Instrumental-Variables (IV) approach. In particular, they apply the Efficient Generalized Instrumental Variables estimator (EGIV) by Hausman and Taylor (1981). This makes use of the panel data structure and uses all exogenous variables as well as means of the time-varying regressors as instruments to obtain a consistent estimate of the return to education.

Their estimation results show, that the returns to education in Spain are higher for wage-earners than for self-employed workers while the opposite holds in Portugal. In the latter country, both wage earners (9.5 %) and self-employed workers (10.0 %) exhibit a higher return to education than their counterparts in Spain (8.8 % and 4.9 %, respectively).

The analysis of the relationship between demography and earnings was motivated by the entry of the baby-boom cohorts in the US labor market. If workers are imperfect substitutes across ages, individuals born in a large birth cohort will face lower wages (Welch 1979). Analogical, exogenous shifts in educational attainment across cohorts will change the relative supply of highly educated workers and thus the return to education (Card and Lemieux 2001). At first glance less clearly, the pure size of a birth cohort may matter for education premia, too. If jobs for more educated workers also require more training, the substitutability between young and old workers diminishes with education (Stapleton and Young 1988). Thus, individuals born in a large cohort will face lower returns to education.

Europe is facing two distinct circumstances, which suggest a rather huge change in education premia across birth cohorts. Firstly, the number of live births has fallen dramatically since the mid 1960s which may positively affect the return to education. Secondly, education reforms in Europe taking place in the 1960s to 1970s provided for a huge increase in educational attainment which may abate education premia. Despite these reasons for a change in the returns to education in European countries, however, empirical evidence is scarce. Boockmann and Steiner (2006) analyze cohort effects in the returns to education for West German workers. For women their results show a large continuous decline in the wage premium and the cohort born in the early 1970s features a 6 percentage points lower return to education compared to the cohort born in the second half of the 1920s. For men of the same birth cohort, they find a rather small decline of the education premium by about one percentage point.

3 Data description and Estimation Approach

3.1 Empirical Approach

The benchmark model for empirical estimates of the economic return to schooling is the Mincer-equation (Mincer 1974) relating earnings (y) of the individual i to his schooling (s), work experience (e) and squared work experience (e^2). The latter can be explained by the proposition of human capital theory that returns to experience result from on-the-job training. Thus, the earnings-experience profile is expected to exhibit concavity. X_i is a set of other variables affecting earnings, for example the sector of the economy the individual is working in, while u_i is the error term. This results in the following model:

$$\ln y_i = \alpha + \beta s_i + \chi e_i + \delta e_i^2 + \gamma X_i + u_i . \tag{3.1}$$

In this framework, β can be regarded as the private financial return to schooling. Yet, the error term u in the wage equation captures individual unobservable effects. These may have an impact on schooling so that this is correlated with the error term. A prime candidate is the ability of the individual. This is unobservable but very likely positively correlated with schooling as more able individuals choose a higher level of schooling. Estimating the Mincer equation by OLS, part of the impact of ability is ascribed to education which implies an upward bias of β (Card 1999).[2] Griliches (1977) emphasizes another source of bias, though. Measurement error in the schooling variable leads to a downward bias in the OLS estimator and this may partially or fully offset the positive bias caused by the omission of ability. As adequate measures of cognitive ability like IQ-test scores are unfortunately not available in our data set, we cannot correct this endogeneity bias but will provide OLS results.

As we argued before, there are reasons to believe that cohort effects are relevant for the returns to schooling. To evaluate this issue, the Mincer-equation is extended by cohort dummies which yields:

$$\ln y_i = \alpha + \beta_i s_i + \chi e_i + \delta e_i^2 + \gamma X_i + \sum_{k=2}^{K} \eta_k D_{ik} + \sum_{k=2}^{K} \mu_k D_{ik} s_i + \nu T_{it} + u_i , \quad i = 1,...,n; \; t = 1994,...,2000. \tag{3.2}$$

[2] Augurzky (2001), utilizing data from the US National Longitudinal Survey of Youth (NLSY), provides evidence that the omission of ability might even bias the functional form of the Mincer-equation, implying that returns to education increase with schooling, whereas the opposite seems to hold.

To increase the sample size, equation (3.2) is estimated on an unbalanced panel of at most 8 years and robust estimation techniques are utilized that account for clustering on individuals. T_{it} denotes dummy variables depicting if the observation is from the survey year t and D_{ik} denotes dummy variables which take on the value one if the individual is a member of the birth cohort k, which may span several years. Thus, in equation (3.2) we not only account for differing returns to education across birth cohorts, but also for birth cohort main effects on wages.

There is, however, a notable problem which complicates the analysis. Due to the short time-frame of the survey, we are unable to observe different birth cohorts at the same stages of their working life. The youngest cohort, for instance, is only observed in their early working years. It might be though that education is rewarded differently across the life cycle. Empirically, it is impossible to separate time-effects, cohort effects and life cycle-effects perfectly from one another because age, birth year and survey year are an exact linear relationship (Heckman and Robb 1985). We will subsequently account for these life-cycle effects by including interaction terms between education and experience (see Boockmann and Steiner 2006). This yields:

$$\ln y_i = \alpha + \beta s_i + \chi e_i + \delta e_i^2 + \gamma X_i + \vartheta e_i s_i + \rho e_i^2 s_i + \sum_{k=2}^{K} \eta_k D_{ik} + \sum_{k=2}^{K} \mu_k D_{ik} s_i + v T_{it} + u_i, \tag{3.3}$$

$$i = 1,\dots,n;\; t = 1994,\dots,2000.$$

Applying OLS to equation (3.1), the regression line passes through the mean of the sample. Thereby one implicitly assumes that a differing impact of the exogenous variables along the conditional distribution is negligible. If however, the earnings gain from additional schooling is not the same across the wage distribution, schooling would have an impact upon wage inequality. We therefore additionally apply quantile regression techniques (Koenker and Bassett 1978), which allow us to estimate the return to schooling within different quantiles of the wage distribution. In particular, wage equation (3.1) can be rewritten as (see Martins and Pereira 2004):

$$\ln y_i = c_i \lambda_\theta + u_{\theta i} \quad \text{and} \quad Quant_\theta(\ln y_i \mid c_i) = c_i \lambda_\theta \text{ with } 0 < \theta < 1.$$

For simplicity, c_i represents the vector of all exogenous variables and λ_θ the vector of parameters. $Quant_\theta(\ln y_i \mid c_i)$ is the θth conditional quantile of ln y given c. The θth regression quantile solves the problem:

$$\min_{\lambda \in R^k} \sum_i \rho_\theta (\ln y_i - c_i \lambda_\theta)$$

where $\rho_\theta(\cdot)$ is the tilted absolute value function that yields the θth sample quantile as the solution. The minimization problem can be solved by linear programming methods whereas the standard errors are obtained by bootstrapping. The first quartile is obtained by setting $\theta = 0.25$, the median by setting $\theta = 0.5$ and so forth. Thus, by increasing θ from 0 to 1 we follow the whole distribution of y, given c.

3.2 Data set

In this paper data from the ECHP is utilized.[3] This is a longitudinal data set which covers eight waves from 1994 to 2001. It started with 60.500 households from 12 member states[4] and has thereafter been extended with Austria, Finland and Sweden joining in 1995, 1996 and 1997, respectively. For most of the countries, a harmonized ECHP questionnaire (the "Community questionnaire") has been used, which is designed by Eurostat. Exceptions are the UK, Germany, Luxembourg and Sweden for which data was converted from national surveys. For the former two countries, converted data from national surveys is provided through 1997 whereas for the latter two countries the ECHP questionnaire has been replaced by national surveys in 1997.

Changes in the member states' population is reflected in the data through births to household members and the formation of new households from existing ones. Non-responses and attrition rates are comparable with other longitudinal household surveys (Peracchi 2002). The ECHP covers topics as demographics, labor force behavior, health, education, migration and income, especially earnings and transfers. The income measure used in this study is gross monthly wages. The survey further reports weakly working hours, which are used to calculate

[3] For a description of the ECHP see Eurostat (2003) as well as the website of the EuroPanel Users Network (EPUNet) http://epunet.essex.ac.uk.

[4] Belgium, Denmark, Germany, Greece, Spain, France, Italy, Ireland, Luxembourg, The Netherlands, Portugal and the UK.

the gross hourly wages, our dependent variable. To compare the estimates across countries as well as over time, gross wages are adjusted by Purchasing Power Parities.

In the ECHP, as in most European surveys, information on the education of the individual is only available as a coded variable denoting the "highest educational level completed". The corresponding three categories are less than second stage of secondary education (ISCED levels 0-2), second stage of secondary education (ISCED level 3) and tertiary education (ISCED levels 5-7). In order to make the estimates comparable to other studies, these have been transformed to a continuous variable "years of schooling" by using information from the OECD's *Education at a Glance* on the usual time-frame necessary to obtain a certain educational level in the various countries (see table 7 in the appendix). However, the estimates do therefore only contain information on the return to an additional year of education between schooling levels. The experience measure used in the analysis is working experience as stated in the questionnaire, yet due to data limitations it is not possible to correct this for unemployment spells. Additional control variables include dummies depicting if one is a native citizen and if the individual is married, sector dummies as well as regional dummies on the NUTS-2 level. Generally, data availability across countries prevented us from estimating a more detailed regression.

For the analysis, data from all waves of the ECHP is used. Estimations are carried out for all male wage earners, since results for females are likely to be distorted by selection into employment. Yet, Sweden and Luxembourg are not included in the analysis, since income is only stated net of taxes. The Netherlands are left out, since apparently there seemed to be coding problem with the Dutch education data (see also Heinrich and Hildebrand 2005: 14).

The mean characteristics of the 1994 and 2001 samples are presented in table 1. Throughout the waves, there has been a notable drop in sample size for most of the countries as individuals have fallen out of the sample. This problem is most severe in Ireland and the Nordic countries, where the high mobility of individuals is likely to be the reason, whereas in Portugal there has even been a slight increase in sample size. In 2001, mean hourly gross wages are highest in Denmark and Belgium and lowest in Greece and Portugal. The latter two countries, though, have seen the largest rise in wages during the period under examination.

Table 1: **Summary Statistics**

Country	Sample Size		Log hourly wages (PPP-adjusted)		Schooling years		Experience		Native		Married		Industry Sector		Service Sector	
	1994[1]	2001	1994[1]	2001	1994[1]	2001	1994[1]	2001	1994[1]	2001	1994[1]	2001	1994[1]	2001	1994[1]	2001
Austria	1,950	1,299	2.20 (0.56)	2.44 (0.48)	12.73 (2.32)	12.90 (2.26)	19.69 (11.94)	20.85 (11.87)	0.95 (0.21)	0.97 (0.16)	0.61 (0.49)	0.58 (0.49)	0.48 (0.50)	0.48 (0.50)	0.49 (0.50)	0.51 (0.50)
Belgium	1,435	981	2.39 (0.43)	2.65 (0.45)	12.47 (3.18)	12.70 (3.19)	19.41 (10.60)	20.21 (11.05)	0.91 (0.28)	0.98 (0.16)	0.74 (0.44)	0.70 (0.46)	0.40 (0.49)	0.35 (0.48)	0.59 (0.49)	0.64 (0.48)
Denmark	1,670	971	2.39 (0.48)	2.75 (0.45)	13.86 (3.38)	13.99 (3.08)	21.80 (13.12)	23.28 (12.54)	0.98 (0.14)	0.99 (0.11)	0.56 (0.50)	0.62 (0.49)	0.38 (0.48)	0.37 (0.48)	0.60 (0.49)	0.60 (0.49)
Finland	1,748	765	2.27 (0.49)	2.33 (0.46)	13.15 (3.06)	12.88 (2.75)	20.91 (11.05)	16.15 (12.41)	0.99 (0.89)	0.99 (0.10)	0.66 (0.47)	0.49 (0.50)	0.42 (0.49)	0.42 (0.49)	0.54 (0.50)	0.56 (0.50)
France	2,273	1,773	2.23 (0.49)	2.43 (0.49)	11.80 (2.44)	11.24 (3.08)	21.47 (10.91)	17.93 (13.11)	0.94 (0.24)	0.97 (0.17)	0.70 (0.46)	0.57 (0.50)	0.41 (0.49)	0.39 (0.49)	0.58 (0.49)	0.60 (0.49)
Germany	3,017	2,460	2.32 (0.46)	2.55 (0.51)	13.87 (3.01)	14.28 (3.12)	20.30 (11.71)	21.59 (11.26)	0.81 (0.39)	0.86 (0.35)	0.73 (0.44)	0.71 (0.45)	0.58 (0.49)	0.53 (0.50)	0.40 (0.49)	0.46 (0.50)
Greece	1,906	1,389	1.69 (0.47)	1.96 (0.48)	12.04 (2.84)	11.93 (2.65)	17.82 (11.82)	18.81 (11.66)	0.98 (0.13)	0.99 (0.11)	0.71 (0.45)	0.68 (0.47)	0.37 (0.48)	0.34 (0.47)	0.61 (0.49)	0.65 (0.48)
Ireland	2,065	940	2.20 (0.63)	2.40 (0.59)	13.47 (2.24)	13.64 (2.22)	18.94 (13.08)	19.89 (14.16)	0.99 (0.11)	0.99 (0.11)	0.61 (0.49)	0.58 (0.49)	0.41 (0.49)	0.41 (0.49)	0.54 (0.50)	0.55 (0.50)
Italy	3,447	2,321	2.16 (0.41)	2.29 (0.42)	11.03 (3,56)	11,48 (3.61)	19.04 (11.67)	18.28 (11.65)	0.99 (0.03)	0.99 (0.05)	0.72 (0.45)	0.69 (0.46)	0.40 (0.49)	0.38 (0.48)	0.55 (0.50)	0.58 (0.49)
Portugal	2,362	2,434	1.34 (0.58)	1.65 (0.52)	8.86 (2.11)	9.23 (2.47)	21.99 (14.21)	20.42 (14.28)	0.99 (0.07)	0.99 (0.04)	0.68 (0.47)	0.67 (0.47)	0.43 (0.50)	0.46 (0.50)	0.48 (0.50)	0.48 (0.50)
Spain	3,431	2,618	1.93 (0.54)	2.21 (0.51)	12.06 (2.89)	12.50 (3.02)	21.35 (13.23)	19.09 (12.90)	0.99 (0.07)	0.99 (0.07)	0.70 (0.46)	0.63 (0.48)	0.41 (0.49)	0.45 (0.50)	0.54 (0.50)	0.51 (0.50)
UK	2,101	2,048	2.26 (0.55)	2.52 (0.53)	13.50 (3.21)	14.52 (2.88)	18.78 (13.32)	18.52 (13.76)	[2]	0.97 (0.17)	0.61 (0.49)	0.57 (0.49)	0.39 (0.49)	0.36 (0.48)	0.61 (0.49)	0.63 (0.48)

Notes: Figures are means for the sample of employees in wave 1 and wave 8 of the ECHP. Standard deviation in parentheses. [1]: Figures for Austria and Finland from wave 2 (1995) and wave 3 (1996), respectively. [2]: information not available in wave 1.

In 2001, educational attainment of the workforce, as measured by schooling years, is highest in Germany and Denmark with about 14 years of schooling. Portugal, in contrast, still shows by far the lowest schooling of the workforce with 9.2 years. This is notably below the OECD average of 11.4 years (figure for 2004; OECD 2006: 41) and reflects that the educational expansion in Portugal started comparatively late from the mid 1970s on after the dictatorship (Melo and Benavente 1978). In all but three countries the educational attainment of the workforce has risen since the beginning of the survey. Exceptions are Finland, France and Greece, where we observe a small decline. Germany shows the highest share of foreign employees as well as, according to the importance of the German industry sector, the highest share of industry workers. The southern European countries as well as the UK instead show a high share of employees in the service sector.

4. Estimation Results

4.1 Estimates of the average return to education

We begin by estimating the earnings function by OLS for the latest year of the survey, 2001. Estimation results are reported in table 2. The estimated coefficients on years of schooling as well as experience are significant at the 1%-level and the model explains from 28 % (UK) to 43 % (Ireland) of the wage variation in the sample countries. Results show that the average return for males to an additional year of schooling is highest in Ireland and Portugal with rates of return of around 10.0 %, respectively, followed by Austria and Greece with rates of return of roughly 8 %. In contrast, returns to education are lowest in the UK, Italy and Germany with rates of return of around 4.8 % to 5.5 %. Returns to experience are highest in Austria, Germany and the UK. In the former two countries, this might be explained by the rather high degree of unionized wage setting with determinated allowances for age or experience. Furthermore, in all countries, returns to experience exhibit the presumed concave pattern, that is earnings increase with on-the-job experience but at a diminishing rate. Natives earn statistically significant more only in five countries of the sample and this difference is the largest in Italy. Furthermore, married males receive a sizeable wage premium in all countries except Denmark.

Table 2: **Returns to education in Europe – Estimation Results by OLS for Male Wage Earners (Dependent variable: logarithm of gross hourly wage)**

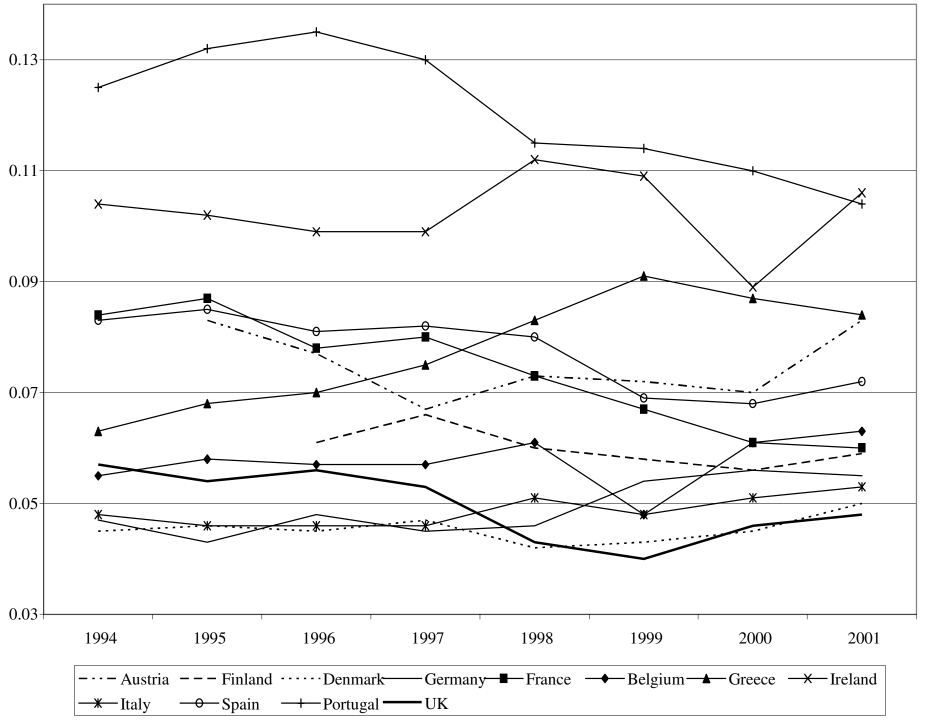
Variable	*Austria*	*Belgium*	*Denmark*	*Finland*	*France*	*Germany*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*	*UK*
Years of schooling	0.083	0.063	0.058	0.059	0.060	0.055	0.084	0.106	0.053	0.104	0.072	0.048
	(16.60)***	(15.13)***	(13.54)***	(10.10)***	(17.60)***	(18.15)***	(18.86)***	(13.68)***	(22.46)***	(21.32)***	(21.71)***	(13.07)***
Experience	0.046	0.032	0.037	0.021	0.032	0.040	0.034	0.025	0.029	0.025	0.028	0.040
	(12.27)***	(6.19)***	(7.82)***	(5.48)***	(11.67)***	(9.40)***	(10.41)***	(4.97)***	(13.53)***	(10.02)***	(11.96)***	(16.06)***
Experience^2*10^{-2}	-0.077	-0.044	-0.063	-0.032	-0.052	-0.073	-0.050	-0.037	-0.048	-0.040	-0.041	-0.081
	(9.32)***	(3.94)***	(6.73)***	(3.35)***	(8.29)***	(8.22)***	(7.10)***	(3.68)***	(8.68)***	(9.06)***	(8.66)***	(15.36)***
Native	0.225	0.142	0.205	0.089	0.237	0.020	0.044	0.019	0.319	0.018	0.132	-0.027
	(3.63)***	(2.59)***	(1.83)*	(0.40)	(4.09)***	(0.77)	(0.45)	(0.15)	(2.64)***	(0.12)	(1.11)	(0.45)
Married	0.074	0.066	0.048	0.075	0.173	0.093	0.136	0.253	0.101	0.122	0.124	0.137
	(3.06)***	(2.26)**	(1.54)	(2.28)**	(8.09)***	(4.57)***	(4.70)***	(5.32)***	(5.69)***	(6.17)***	(5.50)***	(5.99)***
Industry Sector †	0.183	0.335	0.034	0.118	0.208	0.306	0.299	0.977	0.184	0.334	0.313	0.492
	(2.03)**	(1.96)**	(0.58)	(1.27)	(4.10)***	(4.02)***	(2.26)**	(6.33)***	(4.51)***	(7.28)***	(6.99)***	(4.29)***
Service Sector [1]	0.125	0.323	-0.056	0.045	0.164	0.234	0.316	0.938	0.247	0.435	0.324	0.458
	(1.38)	(1.92)*	(0.93)	(0.47)	(3.26)***	(3.32)***	(2.42)**	(6.00)***	(6.42)***	(9.43)***	(7.06)***	(3.98)***
Constant	0.472	0.941	1.311	1.113	0.832	0.662	0.039	-0.450	0.752	-0.033	0.386	1.120
	(3.64)***	(4.72)***	(9.63)***	(4.51)***	(9.14)***	(6.59)***	(0.22)	(1.91)*	(5.80)***	(0.19)	(2.87)***	(7.77)***
R^2	0.42	0.32	0.30	0.30	0.33	0.34	0.41	0.43	0.40	0.41	0.37	0.28
Obs.	1,299	981	971	765	1,773	2,460	1,389	940	2,321	2,434	2,618	2,048

Notes: Data from wave 8 (2001) of the ECHP. Regional dummies omitted. Robust estimates. t-ratios in parentheses. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level. [1]: Individuals working in the agricultural sector form the basis.

As there are multiple countries with economic returns to schooling that are similar in size, we further test if these point estimates are significantly different. For Germany, Italy, Denmark and Finland, returns to education for men of equal value could not be rejected at conventional significance levels. The same holds for the two countries with the highest returns in the sample, Portugal and Ireland.

It is interesting to see if the economic downturn that occurred in 2001 might have caused a drop in the returns to schooling. We investigate this issue further and allow for varying coefficients over time. This means that the wage equations are estimated separately for each wave of the ECHP, that is from 1994 to 2001. From the years 1995 to 1997 however, the results may be slightly upward biased as only the highest educational attainment of new entrants to the survey has been recorded.

Figure 1: **Returns to Education in Europe 1994-2001**



Notes: Estimation results by OLS based on the ECHP.

As can be seen from figure 1, for the large portion of countries the returns to education have been very stable during the observation period. In these countries, returns have changed by at most 1 percentage point and there is no clear tendency across countries that they have either increased or decreased. In contrast, three countries have experienced a rather huge change in education premia. In Portugal, the returns to schooling have fallen by around 3 percentage points from a peak of 13.5% in 1996 to 10.4 % in 2001 while in France returns dropped from 8.4% in 1994 to 6 % in 2001. In Greece, though, returns to education have increased by around 2 percentage points from 1994 to 2001.

Explaining the cross-country differences in returns to education is a difficult task as they reflect multiple factors such as the demand for skills, the distribution of workers across occupations, employment legislation, the strength of unions, educational attainment and international trade (OECD 2006: 122). Despite the huge number of empirical estimates of the Mincerian return to education, there are only very few attempts (Denny, Harmon and Lydon 2002, Psacharopulos 1994; Trostel et al. 2001) to explain their cross-country variance. Acemoglu (1999), in a more general framework, shows that the impact of the relative supply of skilled workers on the skill premia depends on the skill bias of technology. When countries are technological followers, an increase in the supply of skills will not induce skill-biased technological change and the return to education decreases strongly with the supply of skills. In contrast, when the supply of skills has a huge impact on technology, the demand for skills rises with supply and may even induce an increase in the education premium.

In a simple model we investigate this further by regressing the estimated returns to schooling in our sample countries on the educational attainment of the population, as measured by average schooling years from the data set of Barro and Lee (2001). As the Barro and Lee data is only available for 5-year intervals, this leaves 23 observations (estimated returns in 1995 for 11 countries and estimated returns in 2000 for 12 countries), and our analysis should rather be regarded explorative. Estimation results (table 3) confirm previous findings, that there is a negative relationship between the educational attainment of the workforce and the returns to schooling and thus variations in returns to education across countries are closely related to scarcity (Psacharopoulos and Patrinos 2004). A rise in the years of schooling of the workforce by one standard deviation (1.5 years in 2000) yields a decrease in the return to education of 1.5 percentage points. Yet, as our dependent variable is itself an estimate, we have to allow for the uncertainty associated with it. This is done in a further regression by weighting the estimates according to their standard errors (variance-weighted least squares). Results show, that the point estimate gets rather small, implying a drop in the return to schooling by 0.75 percentage points if the years of schooling of the workforce rise by 1.5 years. Although we cannot rule out changes in demand for skills by using this simple framework, these were obviously not strong enough to balance the rise in supply of educated workers.

Table 3: **Returns to education across countries and educational attainment of the population**

	OLS	Variance-weighted LS
Average years of schooling in the population aged 15 and over	-0.010 (3.88)	-0.005 (8.95)
Constant	0.153 (7.01)	0.099 (22.45)
Obs.	23	23

Notes: Based on estimation results from wave 2 (1995) and wave 7 (2000) of the ECHP and data from Barro and Lee (2001). t-ratios in parentheses.

4.2 Cohort effects and returns to education

In the previous section, we already considered that there might by time effects which exert an impact on the average return to schooling. Although the latter remained mostly stable in most of the sample countries over time, the returns to education might differ depending on the cohort an individual is born in. Firstly, there may exist exogenous cohort specific factors which have an impact on the relative supply of educated workers and thus the return to schooling. Secondly, even the absolute size of the birth cohort might have an impact on educational premia if the elasticity of substitution between young and old workers varies with their educational level. There is evidence that elasticities of substitution indeed decrease with education, which can be explained by the fact that jobs for higher educated workers also require more on-the-job training (Stapleton and Young 1988).

To analyze if cohort effects are present in our sample of European countries, we subsequently extend the Mincer-equation with birth cohort dummies as well as interactions between schooling and these dummy variables. To have a sufficient number of observations, firstly we

Table 4: **Returns to education in Europe and cohort effects – Estimation Results by OLS for Male Wage Earners (Dependent variable: logarithm of gross hourly wage)**

Variable	*Austria*	*Belgium*	*Denmark*	*France*	*Germany*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*	*UK*
Cohort 1940-1949	0.158	0.122	-0.219	0.162	-0.162	-0.188	-0.125	0.063	0.036	-0.092	-0.408
	(0.73)	(0.71)	(1.53)	(0.79)	(1.49)	(1.14)	(0.37)	(0.83)	(0.20)	(0.64)	(2.08)**
Cohort 1950-1959	0.117	0.013	-0.398	0.125	-0.155	-0.365	-0.023	0.073	0.133	-0.053	-0.407
	(0.44)	(0.06)	(1.94)*	(0.52)	(1.07)	(1.91)*	(0.05)	(0.87)	(0.64)	(0.31)	(1.65)*
Cohort 1960-1969	0.725	0.104	0.124	0.196	0.153	-0.373	0.313	0.138	0.036	0.209	-0.258
	(2.25)**	(0.47)	(0.54)	(0.74)	(0.88)	(1.76)*	(0.65)	(1.52)	(0.15)	(1.09)	(0.94)
Cohort >1969	0.877	0.136	0.392	0.541	-0.067	-0.476	0.823	0.193	0.233	0.506	-0.145
	(2.32)**	(0.54)	(1.44)	(2.00)**	(0.31)	(2.10)**	(1.69)*	(1.98)**	(0.94)	(2.53)***	(0.49)
Years of schooling	0.223	0.101	0.141	0.131	0.121	0.040	0.150	0.068	0.157	0.123	0.059
	(8.47)***	(4.92)***	(7.71)***	(6.09)***	(7.26)***	(1.97)**	(3.82)***	(6.77)***	(5.63)***	(7.16)***	(2.70)***
Years of schooling*experience	-0.009	-0.001	-0.007	0.001	-0.005	0.001	-0.001	0.001	0.001	-0.001	-0.001
	(6.69)***	(0.43)	(8.16)***	(0.88)	(4.57)***	(1.43)	(0.44)	(0.41)	(0.16)	(1.10)	(1.95)**
Years of schooling*experience^2	0.014	-0.001	0.010	-0.005	0.007	-0.001	-0.001	-0.001	-0.001	-0.001	0.001
	(4.54)***	(0.45)	(6.12)***	(2.23)**	(3.52)***	(0.37)	(0.13)	(0.38)	(0.36)	(0.39)	(0.53)
Years of schooling 1940-1949	-0.018	-0.022	0.004	-0.033	0.001	0.008	0.001	-0.014	-0.015	-0.001	0.026
	(1.16)	(1.63)	(0.40)	(1.97)**	(0.19)	(0.55)	(0.02)	(1.68)*	(0.73)	(0.04)	(1.73)*
Years of schooling 1950-1959	-0.032	-0.030	0.009	-0.043	-0.010	0.015	-0.017	-0.023	-0.040	-0.014	0.021
	(1.72)*	(1.82)*	(0.68)	(2.21)**	(0.96)	(0.88)	(0.49)	(2.61)***	(1.72)*	(0.95)	(1.15)
Years of schooling 1960-1969	-0.080	-0.042	-0.028	-0.060	-0.032	0.003	-0.043	-0.035	-0.045	-0.050	0.009
	(3.64)***	(2.36)**	(1.87)*	(2.83)***	(2.75)***	(0.15)	(1.09)	(3.72)***	(1.76)*	(3.06)***	(0.45)
Years of schooling >1969	-0.090	-0.049	-0.052	-0.104	-0.023	-0.003	-0.081	-0.047	-0.077	-0.083	-0.012
	(3.48)***	(2.52)**	(3.01)***	(4.78)***	(1.58)***	(0.13)	(2.05)**	(4.72)***	(2.86)***	(4.90)***	(0.56)
Experience	0.158	0.036	0.128	0.017	0.102	0.003	0.047	0.016	0.016	0.029	0.051
	(9.15)***	(2.19)**	(10.35)***	(1.81)*	(6.96)***	(0.26)	(2.23)**	(2.87)***	(1.56)	(3.73)***	(4.98)***
Experience^2*10^{-2}	-0.256	-0.051	-0.206	-0.006	-0.179	-0.033	-0.062	-0.032	-0.037	-0.037	-0.084
	(6.64)***	(1.37)	(8.74)***	(0.23)	(6.41)***	(1.28)	(1.18)	(2.28)**	(1.67)*	(2.08)**	(3.95)***
Constant	-1.083	1.157	0.475	0.677	0.143	0.992	-0.557	1.084	-0.181	0.238	1.286
	(2.97)***	(4.27)***	(1.61)	(2.51)**	(0.57)	(3.97)***	(1.11)	(9.77)***	(0.68)	(1.04)	(4.03)***
F-test years of schooling-cohort interactions (p-value)	0.00	0.14	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00
R^2	0.39	0.32	0.40	0.38	0.37	0.42	0.46	0.39	0.46	0.43	0.30
Individuals	2,617	2,995	2,321	3,671	4,627	2,995	3,259	5,221	4,219	5,921	3,142
Obs.	11,377	12,413	9,573	15,095	22,187	12,413	11,710	22,989	19,681	22,983	10,694

Notes: Data from all waves of the ECHP. Regional dummies, survey-year dummies, native dummy, married dummy and sector dummies omitted. Standard errors adjusted for clustering on individuals. t-ratios in parentheses. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

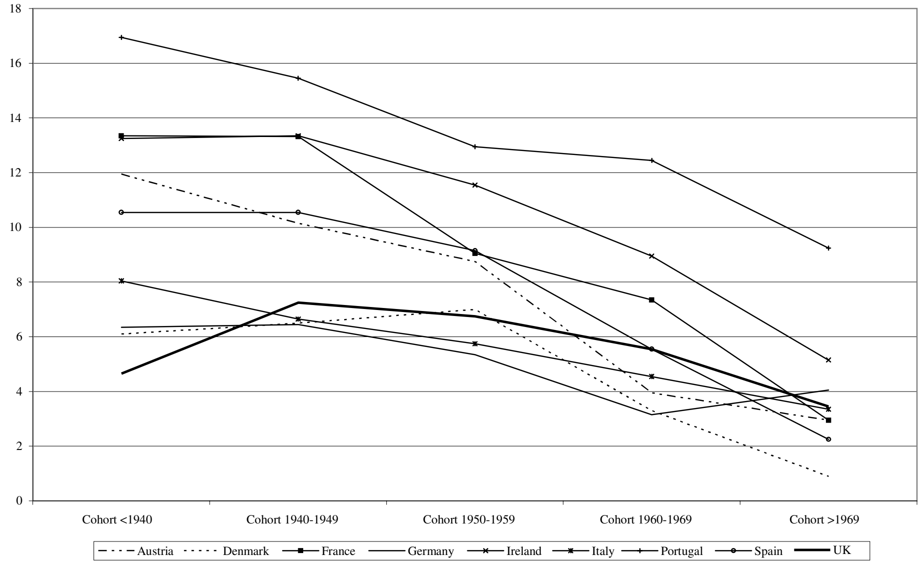
pool the data and use robust estimation techniques that account for clustering on individuals. Secondly we only distinguish five different cohorts: those born between 1940 and 1949, those born between 1950 and 1959, those born between 1960 and 1969, and those born 1970 or after whereas the oldest cohort, that is those born before 1940, is our base category. The Finish data, however, did not provide enough observations even for this rather rough classification so that Finland had to be excluded from the sample.

The estimation results of the extended Mincer-equation are presented in table 4. In all countries, except for Belgium and Greece, we find significant cohort effects in the returns to education as the schooling-cohort interaction terms are jointly significant at the 1%-significance level. Most interestingly, the pattern of educational premia across adjacent birth cohorts is the same for nearly all countries with significant cohort effects. In these countries, returns to education decrease continuously over cohorts born after 1940.[5] Figure 2 shows this graphically. To compare the returns across cohorts, it is assumed that workers of all birth cohorts possess a work experience of 15 years, which certainly does not hold for each cohort. Therefore, the absolute values of returns cannot be interpreted but only the evolution of returns across birth cohorts.

The figure shows, that in some countries the decline of returns to education is quite marked. For instance, the youngest cohort in France suffers from a 10 percentage point lower education premia compared to the oldest cohort whereas in Austria the difference is 9 percentage points. Yet, it has to be bourn in mind that the youngest cohort, who is born after 1969, may not have totally entered the labor market by the time of the survey, which implies that their returns may be biased downwards. Furthermore, the returns to education of the oldest cohort may be biased upwards as there might exist a positive selection of older workers into employment. Those individuals, whose returns to education are relatively high, might choose to stay in employment, possibly beyond their retirement age. Disregarding the youngest as well as the oldest cohort, the decline in education premia is less pronounced. According to these estimates, returns to education in France and Austria have fallen by 6 percentage points for the cohort born in the 1960s compared to the cohort born in the 1940s.

[5] Calculations with a slightly different classification of birth cohorts showed, that this general tendency also holds for Finland. Results are available from the author upon request.

Figure 2: **Returns to education in Europe for different birth cohorts**



Notes: Calculations based on data from the ECHP under the assumption that workers of all birth cohorts possess 15 years of work experience.

One exception to the general trend of falling education premia is Germany, where we observe a u-shaped pattern. The returns do not change for the cohort born in the 1940s then decrease for the two following cohorts before the youngest cohort experiences a rise in the return of about 1 percentage point. In the UK, the returns to education first rise for individuals of the 1940s cohort before they decrease continuously over all cohorts born after 1950. In the latter country, the variation in returns over cohorts though is rather small. The youngest cohort exhibits a return which is only 1.2 percentage points lower than that of the oldest cohort.

As we could only control for experience, there may still be an autonomous impact of age on the return to education, which is wrongly ascribed to cohort effects. This problem, however, may be much more prevalent in cases where individuals work in the public sector because there age, and not working experience, is mostly relevant for the pay scale grouping (Boockmann and Steiner 2006). We investigate this further by estimating our model just for employees working in the private sector. Estimation results (table 5) show, that in some countries the cohort effects in returns to education are even more pronounced for this group of individuals. This may be explained by the more flexible wage-setting in the private compared to the public sector. An exception is Ireland, where the cohort effects are no longer significant. In all other countries our previous result, namely that individuals born after 1940 are continuously facing lower returns to education, is confirmed. Admittedly, in Austria, the UK and Portugal, the decline in returns applies to later cohorts born in the 1950s or 1960s, respectively.

The results are however at odds with the presumed impact of demography on education premia. From a peak in the mid 1960s live births declined steadily all over Europe (Biagi and Lucifora 2005) and this should accordingly raise the returns to education for subsequent cohorts. A different explanation may be that educational attainment has risen so strong in most European countries, that this has lowered the return on investments in education. As explicated in the preceding section, the overall scarcity of educated workers seems to be positively related to the education premia. Drawing again on the data set by Barro and Lee (2001), this may partly explain our results. In Austria, for instance, the educational attainment of the workforce (those aged between 15 and 65) increased in the 1980s (see figure 3 in the appendix). The cohort born in the 1960s, which entered the labor market about 20 years later, should therefore exhibit the largest decline in returns, which is reflected in our results. Furthermore, Spain and Portugal experienced the strongest increase in educational attainment of all sample countries and these are two countries where the returns to education fall off very strong.

It has to be noted, however, that the general tendency of a drop in education premia across cohorts experienced in many of the sample countries might be attributed to developments in certain fields of study. College enrollments might have risen in a particular field of study, outpacing demand for that specific labor market group, while in other fields of study there is still a lack of graduates. In Germany, for instance, there is a reported enduring lack of engineers. Unfortunately, it is not possible to investigate this issue further. Neither is the field of study part of the questionnaire of the ECHP, nor is this information available at the country level.[6]

[6] Data from the World Bank on the field of study of college graduates just starts in 2000.

Table 5: **Returns to education in Europe and cohort effects – Estimation Results by OLS for Male Wage Earners in the private sector (Dependent variable: logarithm of gross hourly wage)**

Variable	*Austria*	*Belgium*	*Denmark*	*France*	*Germany*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*	*UK*
Cohort 1940-1949	-0.186	0.295	-0.110	0.276	-0.017	-0.358	-0.195	0.009	-0.353	0.034	-0.445
	(0.58)	(1.35)	(0.62)	(1.10)	(0.13)	(1.52)	(0.31)	(0.07)	(1.25)	(0.15)	(2.09)**
Cohort 1950-1959	-0.220	0.254	-0.203	0.328	-0.037	-0.329	-0.115	-0.017	-0.371	0.114	-0.553
	(0.59)	(1.03)	(0.83)	(1.12)	(0.21)	(1.22)	(0.14)	(0.13)	(1.14)	(0.41)	(2.03)**
Cohort 1960-1969	0.538	0.360	0.489	0.407	0.305	-0.336	0.010	0.060	-0.289	0.524	-0.303
	(1.14)	(1.34)	(1.75)*	(1.28)	(1.47)	(1.10)	(0.01)	(0.40)	(0.82)	(1.71)*	(0.99)
Cohort >1969	0.799	0.362	0.835	0.679	0.116	-0.286	0.391	0.143	-0.010	0.820	-0.205
	(1.51)	(1.20)	(2.59)***	(2.11)**	(0.46)	(0.89)	(0.44)	(0.95)	(0.03)	(2.64)***	(0.63)
Years of schooling	0.222	0.133	0.180	0.132	0.139	0.048	0.107	0.061	0.115	0.139	0.055
	(5.80)***	(5.25)***	(8.19)***	(4.69)***	(6.81)***	(1.64)*	(1.48)	(3.70)***	(2.75)***	(4.87)***	(2.31)**
Years of schooling*experience	-0.012	-0.001	-0.007	0.002	-0.005	-0.001	-0.001	0.001	-0.001	-0.001	-0.002
	(7.09)***	(0.18)	(7.49)***	(2.53)***	(3.61)***	(0.27)	(0.37)	(0.65)	(0.17)	(0.08)	(2.04)**
Years of schooling*experience^2	0.021	-0.004	0.008	-0.010	0.006	0.002	0.001	-0.001	-0.001	-0.002	0.001
	(4.88)***	(1.04)	(4.74)***	(3.36)***	(2.27)**	(0.69)	(0.20)	(0.57)	(0.20)	(1.35)	(0.62)
Years of schooling 1940-1949	0.016	-0.041	-0.008	-0.037	-0.011	0.029	0.006	-0.008	0.030	-0.010	0.029
	(0.68)	(2.15)**	(0.63)	(1.61)	(1.09)	(1.30)	(0.12)	(0.54)	(0.88)	(0.47)	(1.79)*
Years of schooling 1950-1959	0.001	-0.059	-0.010	-0.055	-0.021	0.014	-0.006	-0.014	0.017	-0.027	0.030
	(0.02)	(2.74)***	(0.64)	(2.07)**	(1.66)*	(0.56)	(0.08)	(0.94)	(0.45)	(1.03)	(1.50)
Years of schooling 1960-1969	-0.058	-0.073	-0.061	-0.072	-0.045	0.003	-0.013	-0.029	-0.004	-0.077	0.013
	(1.68)*	(3.15)***	(3.35)***	(2.55)***	(3.09)***	(0.11)	(0.17)	(1.76)*	(0.09)	(2.68)***	(0.58)
Years of schooling >1969	-0.076	-0.078	-0.091	-0.109	-0.038	-0.014	-0.040	-0.043	-0.045	-0.107	-0.008
	(1.99)**	(3.15)***	(4.38)***	(3.85)***	(2.11)**	(0.50)	(0.54)	(2.63)***	(1.09)	(3.71)***	(0.34)
Experience	0.196	0.034	0.133	-0.001	0.102	0.020	0.044	0.014	0.020	0.023	0.053
	(9.43)***	(1.85)*	(9.90)***	(0.12)	(5.93)***	(1.44)	(1.72)*	(2.07)**	(1.54)	(2.56)***	(4.81)***
Experience^2*10^{-2}	-0.345	-0.036	-0.198	0.042	-0.167	-0.064	-0.074	-0.029	-0.039	-0.014	-0.086
	(6.58)***	(0.83)	(7.64)***	(1.42)	(5.03)***	(1.88)*	(0.97)	(1.43)	(1.19)	(0.60)	(3.70)***
Constant	-1.270	0.884	0.370	0.466	-0.360	0.847	-0.213	1.080	0.157	-0.165	1.109
	(2.40)**	(2.76)***	(0.11)	(1.46)	(1.24)	(2.42)**	(0.24)	(6.86)***	(0.42)	(0.51)	(3.17)***
F-test years of schooling-cohort interactions (p-value)	0.01	0.03	0.00	0.00	0.00	0.09	0.34	0.00	0.00	0.00	0.00
R^2	0.39	0.32	0.45	0.39	0.38	0.34	0.41	0.36	0.41	0.40	0.32
Individuals	2,059	1,510	1,815	2,859	3,909	2,168	2,586	3,872	3,607	5,039	2,750
Obs.	8,401	5,050	6,859	11,235	17,317	7,623	8,228	15,273	15,599	18,056	8,896

Notes: Data from all waves of the ECHP. Regional dummies, survey-year dummies, native dummy, married dummy and sector dummies omitted. Standard errors adjusted for clustering on individuals. t-ratios in parentheses. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Furthermore, the observed decline in education premia in most of the sample countries may be driven by decreasing education quality. Studies for the U.S. (Murnane et al. 2000; Lazear 2003), Canada (Finnie and Meng 2002; Green and Riddell 2003) and the United Kingdom (McIntosh and Vignoles 2001) suggest that cognitive skills have an impact on individual earnings. Meanwhile, Wößmann (2002: 106) compares students' scores on various tests of student performance in some of our sample countries, namely Belgium, France, Germany and the UK, over time and shows that these have actually fallen between 1970 and 1995, despite the huge increase in spending on education.[7] Thus, the apparent decline in education quality may be an additional factor causing the drop in education premia across subsequent cohorts.

4.3 Quantile Regressions

In order to evaluate what masks behind the average return to education across the wage distribution, we will subsequently apply quantile regression (QR) techniques which allow estimates of the returns within different quantiles of the wage distribution. Most interesting is the impact of schooling on wages at the very top and at the very end of the wage distribution. Table 6 therefore shows estimates of the returns to schooling for the top (9th percentile) and the bottom (1st percentile) of the wage distribution together with the OLS estimates for the survey years 1994 (1995 and 1996 in the case of Austria and Finland, respectively) and 2001.

Estimation results show, that in all countries and both survey years, except Denmark in 2001, the return to education for the 9th decile is higher than the return for the 1st decile. The case of Portugal in 2001 may illustrate this general finding. While the OLS estimate of the return to schooling is 10.4 %, the bottom decile features a return to education of just 7.0 % whereas the top decile exhibits a return of 11.7 %. Thus, returns to schooling increase over the wage distribution. Individuals, who are at the top of the conditional wage distribution, are there because of their unobserved characteristics and the results suggest that this group receives a higher education increment. We have tested if the differences in point estimates between the deciles are statistically significant.[8] In all but four countries (Austria, Denmark and Finland in 1994 and 2001 as well as Belgium in 2001) the null of no difference in the coefficients could

---

[7] One exception being Italy, where student performance has slightly improved.

[8] Results are available from the author upon request.

be rejected. Thereby, our results in general confirm those by Martins and Pereira (2004) for a somewhat different country sample.[9]

Table 6: **Estimates of the Return to Schooling (in %) by quantile regressions and OLS**

	Year	1st dec.	9th dec.	OLS	Year	1st dec.	9th dec.	OLS
Austria	1995	7.9	8.7	8.3	2001	7.6	8.6	8.3
		(7.08)	(11.54)	(15.31)		(8.52)	(13.67)	(16.60)
Belgium	1994	4.4	6.7	5.5	2001	5.6	6.6	6.3
		(5.16)	(20.89)	(16.0)		(8.95)	(17.38)	(15.13)
Denmark	1994	3.7	5.0	4.5	2001	6.5	5.8	5.0
		(5.59)	(12.65)	(14.44)		(9.29)	(8.75)	(13.54)
Finland	1996	4.4	5.7	6.1	2001	6.0	6.7	5.9
		(6.72)	(13.82)	(17.59)		(4.95)	(6.92)	(10.10)
France	1994	6.1	9.7	8.4	2001	4.7	7.1	6.0
		(10.65)	(15.52)	(20.42)		(8.65)	(11.75)	(17.60)
Germany	1994	3.5	5.4	4.7	2001	4.9	5.9	5.5
		(6.46)	(11.38)	(16.43)		(13.16)	(13.48)	(18.15)
Greece	1994	5.7	7.8	6.3	2001	6.8	10.3	8.4
		(6.32)	(16.45)	(16.69)		(7.53)	(17.94)	(18.86)
Ireland	1994	7.7	11.0	10.4	2001	7.2	11.9	10.6
		(7.14)	(11.71)	(18.70)		(7.39)	(8.59)	(13.68)
Italy	1994	3.5	6.6	4.8	2001	4.0	7.0	5.3
		(9.31)	(25.99)	(20.05)		(10.54)	(17.20)	(21.55)
Portugal	1994	8.4	13.8	12.5	2001	7.0	11.7	10.4
		(6.82)	(17.28)	(19.40)		(8.35)	(22.90)	(21.32)
Spain	1994	6.6	9.5	8.3	2001	5.3	8.6	7.2
		(12.49)	(13.12)	(25.31)		(10.40)	(13.37)	(21.71)
UK	1994	4.0	6.3	5.7	2001	3.0	5.9	4.8
		(5.04)	(10.34)	(15.80)		(4.42)	(8.77)	(13.07)

Notes: Own calculations based on the ECHP. t-ratios in parentheses.

Arias et al. (2001) show, that once controlling for ability differences, there remain significant differences in returns to education along the wage distribution. Thus, the omission of ability in the wage equation is unlikely to be the main reason for our results. Martins and Pereira (2004: 365 f.) offer different explanations for the observed pattern. In general, schooling

[9] The sample of Martins and Pereira (2004) includes the Netherlands, Norway, Sweden, Switzerland and the US but does not contain Belgium.

interacts with other factors that also have an impact on wage-differentials and the impact of these factors is stronger for higher schooling levels. Firstly, there may exist over-education and high-skilled workers take on low-skilled jobs with a correspondingly lower salary. Thus, the observed differences in returns to education represent within-skill dispersion of pay. Secondly, differences in ability may have a stronger impact on wages the higher the schooling level of the individuals. Thirdly, individuals at the bottom of their conditional wage distribution may be those that suffer from low school quality, which is neglected in the Mincer-framework. For highly skilled individuals, with a corresponding higher variety in schooling paths and fields of study, this problem may be more severe.

Comparing the quantile regression results of 2001 with those of 1994, there are no signs that either the returns at the bottom of the conditional wage distribution or those at the top have moved in either direction. Thus, there is no indication that the complementarity between education and one of the factors outlined above became stronger over time, although the observation period is rather small. Nevertheless, policies, which aim at reducing wage inequality in Europe by raising the educational attainment of the workforce, will have to face that even in a very homogenous educated population wage differentials would be substantial.

Another interesting question is if there is a link between the difference in returns to education along the wage distribution and the average return to schooling in the population. Pereira and Martins (2002) note that the former can be understood as a measure of risk associated with an investment in education as people are doubtful at which position of the wage distribution they will end up when they enter the labor market. In finance, there is a well known positive relation between risk and return and Pereira and Martins (2002) indeed find that this also holds for the risk and return to education.

In general, we can confirm their results. The correlation between the risk of education (the difference in returns between the first and last decile) and the average return to education is quit high with 0.69 and 0.65 in 1994 and 2001, respectively. Thus, the return-risk link may be another factor explaining the differences in observed returns to education within our sample of EU-countries. There are, however, three exceptions. In Italy and the UK, the difference in returns between the first and last decil is quite high whereas the average return is rather low. In contrast, in Belgium the risk of investing in education is very low but the average return is comparatively high.

5 Conclusions

In recent years human capital received a prominent role in the political discussion in Europe which culminated in the Lisbon Agenda. It is, however, becoming increasingly unlikely that Europe will outperform the US and Japan and become the leading knowledge-based economy. The aim of economic policy therefore has to be to spur investment in education in European countries.

This article analyses the individual incentives of investments in education in more detail, relying on a harmonized European dataset. Our estimation results show, that schooling has considerable positive effects on earnings and in most of the countries these returns are above comparable returns on other investments. According to our estimates returns to an additional year of schooling are in most of the sample countries relatively stable during the second half of the 1990s and highest in Portugal and Ireland with about 10 % and lowest in the UK and Italy with about 5 %. Furthermore, we show that the returns to education are negatively related to the educational attainment of the workforce.

Estimates of the economic return to education for different birth cohorts show, that in nearly all countries significant cohort effects exist. Furthermore, there seems to be a common trend among most European countries which implies a continuous decrease in returns to schooling across subsequent cohorts. While for some countries like France or Denmark, this drop in education premia is rather huge, for other countries like the UK the decline is far less pronounced. In sum, these results are at odds with the prediction, that the decline in birth rates would raise the returns to schooling. Yet, this phenomenon may be explained by the huge increase in educational attainment during the 1960s and 1970s which might have outpaced demand. Still unexplained, however, is whether this trend in most of the sample countries is caused by an education expansion in certain fields of study rather than a broad based tendency. An additional factor which might explain the drop in education premia across subsequent cohorts is an apparent decline in education quality. Wößmann (2002) shows for some of our sample countries, that students did perform worse over time in various tests on student performance, despite the huge increase in spending on education.

Finally, we analyze the relation between schooling and wage inequality. Utilizing quantile regression techniques, results show that in nearly all countries the returns to education are significantly higher at the top of the wage distribution than at the bottom. Results therefore imply that schooling aggravates within-group inequality. Furthermore, we confirm a previous result in the literature (Pereira and Martins 2002): the "risk" of education, as indicated by the difference in returns to schooling along the wage distribution, is positively related to the average return of education and may further explain the differences in observed returns to education within our sample of EU-countries.

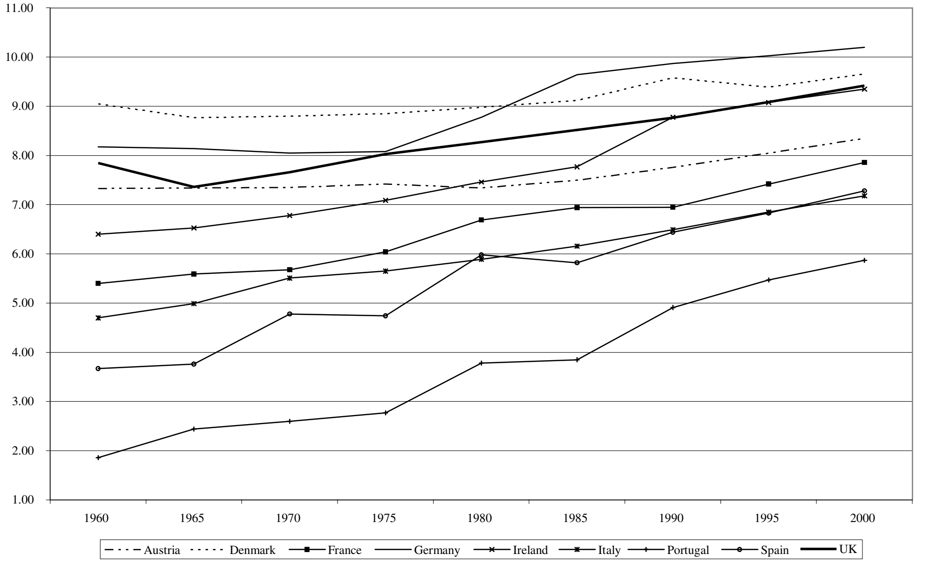
Appendix

Table 7: **Conversion of levels of education to years of schooling**

Level of education	Years of schooling											
	Austria	***Belgium***	***Denmark***	***Finland***	***France***	***Germany***	***Greece***	***Ireland***	***Italy***	***Portugal***	***Spain***	***UK***
Less than second stage of secondary education	9	8	9	9	9	10	9	11	8	8	10	10
Second stage of secondary education	13	12	13	12	12	13	12	14	13	12	12	14
More than second stage of secondary education	19	16	18	17	16	19	16	17	19	16	17	17

Notes: Education levels converted to years of schooling by means of the OECD's *Education at a glance* statistics on typical graduation ages (OECD 2000: 319-320).

Figure 3: **Average years of schooling in the population aged 15 and over**



Source: Barro and Lee (2001). German data contains the former German Democrat Republic from 1990 on.

Bibliography

Acemoglu, D. (1999), Patterns of Skill Premia. NBER Working Paper 7018.

Augurzky, B. (2001), Post-Secondary Education: The Magic Potion? University of Heidelberg Economics Discussion Paper No. 349.

Barro, R. J. and J.-W. Lee (2001), International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers* **53**, 541-563.

Berger, M. C. and J. P. Leigh (1989), Schooling, Self-Selection, and Health. *The Journal of Human Resources* **24**, 433-455.

Biagi, F. and Lucifora, L. (2005), Demographic and Education Effects on Unemployment in Europe: Economic Factors and Labor Market Institutions. IZA Discussion Paper No. 1806.

Boockmann, B. and V. Steiner (2006), Cohort Effects and the Returns to Education in West Germany. *Applied Economics* **38**, 1135-1152.

Buonanno, P. and L. Leonida (2006), Education and Crime: Evidence from Italian Regions. *Applied Economics Letters* **13**, 709-713.

Card, D. (1999), The Causal Effect of Education on Earnings. In: O. Ashenfelter and D. Card (eds.), *Handbook of Labor Economics*. Amsterdam and New York: North Holland.

Card, D. and T. Lemieux (2001), Can falling supply explain the rising return to college for younger men? A cohort-based analysis. *Quarterly Journal of Economics* **116**, 705-746.

Denny, K., Harmon, C. and R. Lydon (2002), Cross-Country Evidence on the Returns to Education: Patterns and Explanations. CEPR Discussion Paper No. 3199.

European Commission (2004), Jobs, Jobs, Jobs. Creating more Employment in Europe. Report of the Employment Taskforce chaired by Wim Kok. Brussels: EC.

Eurostat (2003), ECHP UDB Manual. Waves 1-8, Survey Years 1994-2001.

Fersterer, J., Winter-Ebmer, R. (2003), Are Austrian Returns to Schooling Falling over Time? *Labour Economics* **10**(1), 73-89.

Finnie, R. and R. Meng (2002), Minorities, Cognitive Skills, and Incomes of Canadians. *Canadian Public Policy* **28**, 257-273.

Garcia-Mainar, I. and V. M. Montuenga-Gomez (2005), Education Returns of Wage-Earners and Self-Employed Workers: Portugal vs. Spain. *Economics of Education Review* **24**, 161-170.

Green, D. A. and W. C. Riddell (2003), Literacy and Earnings: An Investigation of the Interaction of Cognitve and Unobsrved Skills in Earnings Generation. *Labour Economics* **10**, 165-184.

Griliches, Z. (1977), Estimating the Returns to Schooling: Some Econometric Problems. *Econometrica* **45**, 1-22.

Groot, W. and H. M. van den Brink (2004), The Health Effects of Education. University of Amsterdam Working Paper Series No. 49.

Harmon, C., Oosterbeck, H. and I. Walker (2003), The Returns to Education: Microeconomics. *Journal of Economic Surveys* **17**, 115-155.

Harmon, C., Walker, I. and N. C. Westergaard-Nielsen (2001), *Education and Earnings in Europe: A Cross-Country Analysis of the Returns to Education*. Cheltenham, Glos (a.o.): Elgar.

Hausman, J. A. and W. E. Taylor (2001), Panel Data and Unobservable Individual Effects. *Econometrica* **49**, 1377-1398.

Heckman, J. and R. Robb (1985), Using Longitudinal Data to Estimate Age, Period and Cohort Effects in Earnings Equations. In: Mason, W. M. and S. F. Fienberg (eds.), *Cohort Analysis in Social Research*.

Heinrich, G. and V. Hildebrand (2005), Returns to Education in the European Union: A Reassessment from Comparative Data. *European Journal of Education* **40**, 13-34.

Kenkel, D. S. (1991), Health Behavior, Health Knowledge, and Schooling. *Journal of Political Economy* **99**, 287-305.

Koenker, R. and G. Bassett (1978), Regression quantiles. *Econometrica* **46**, 33-50.

Lazear, E.P. (2003), Teacher Incentives. *Swedish Economic Policy Review* **10**, 179-214.

Lochner, L. and E. Moretti (2004), The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports. *The American Economic Review* **94**, 155-189.

Martins, P. S. and P. T. Pereira (2004), Does Education Reduce Wage Inequality? Quantile Regression Evidence from 16 Countries. *Labour Economics* **11**, 355-371.

McIntosh, S. and A. Vignoles (2001), Measuring and Assessing the Impact of Basic Skills on Labor Market Outcomes. *Oxford Economic Papers* **53**, 453-481.

Melo, A. and A. Benavente (1978), Experiments in Popular Education in Portugal 1974-1976. UNESCO Educational Studies and Documents. New Series No. 29.

Middendorf, T. (2006), Human Capital and Economic Growth in OECD Countries. *Jahrbücher für Nationalökonomie und Statistik* **226**, 670-686.

Mincer, J. (1974), Schooling, Experience and Earnings. New York: Columbia University Press.

Murnane, Richard J., John B. Willett, M. Jay Braatz, and Yves Duhaldeborde (2001), Do Different Dimensions of Male High School Students' Skills Predict Labor Market Success a Decade Later? Evidence from the NLSY. *Economics of Education Review* **20**, 311-320.

OECD (2000), *Education at a Glance*. Paris: OECD.

OECD (2003), *The Sources of Economic Growth in OECD Countries*. Paris: OECD.

OECD (2006), *Education at a Glance*. Paris: OECD.

Peracchi, F. (2002), The European Community Household Panel. *Empirical Economics* **27**, 63-90.

Pereira, P. T. and P. S. Martins (2002), Is there a Return-Risk Link in Education? *Economics Letters* **75**, 31-37.

Psacharopoulos, G. (1994), Returns to Investment in Education: A Global Update. *World Development* **22**, 1325-1343.

Psacharopoulos, G. and H. Patrinos (2004), Returns to Investment in Education: A further Update. *Education Economics* **12**, 111-134.

Stapleton, D. C. and D. J. Young (1988), Educational Attainment and Cohort Size. *Journal of Labor Economics* **6**,330-361.

Trostel, P., Walker, I. and P. Woolley (2002), Estimates of the Economic Returns to Schooling for 28 Countries. *Labour Economics* **9**, 1-16.

Walker, I., Zhu, Y. (2005), The College Wage Premium, Overeducation, and The Expansion of Higher Education in the UK. IZA Discussion Paper No. 1627.

Welch, F. (1979), Effects of Cohort Size on Earnings: The Baby Boom Babie's' Financial Bust. *The Journal of Political Economy* **87**, 65-79.

Wößmann, L. (2002), Schooling and The Quality of Human Capital. Berlin: Springer.