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Educational Qualifications and Wage Inequality: Evidence for Europe

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ABSTRACT

Educational Qualifications and Wage Inequality: Evidence for Europe*

This paper explores the connection between education and wage inequality in nine European countries. We exploit the quantile regression technique to calculate returns to lower secondary, upper secondary and tertiary education at different points of the wage distribution. We find that returns to tertiary education are highly increasing when moving from the lower to the upper quantiles. This finding suggests that an educational expansion towards tertiary education is expected, ceteris paribus, to increase overall wage inequality through the within-dimension. Returns to secondary education are more homogeneous across quantiles, thus suggesting that an educational expansion towards secondary education is expected to have a more limited impact on within-groups dispersion. Using data from the last decades, we assess how the impact of education on wage inequality has evolved over time. We detect different trends across countries. A common feature is that the inequality increasing effect of tertiary education became more acute over the last years.

JEL Classification: C29, D31, I21

Keywords: returns to education, quantile regression, wage inequality

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0. Introduction

Most national governments consider educational expansion as an important policy tool when trying to reduce economic inequality. At the same time, emerging evidence reveals that aggregate wage inequality is due not only to differences between educational groups but arises from differences within these groups as well. This paper intends to shed further light on the interplay between education and wage inequality using data from nine European Countries: Germany, UK, Greece, France, Finland, Portugal, Norway, Italy, and Sweden.

We explore the connection between education and wage distributions by calculating returns to education. Our central approach is based on quantile regression. Conventionally, returns to education have been estimated using Ordinary Least Squares (OLS). This approach assumes that to each level of education corresponds an average return and, thus, disregards variation in the returns within individuals in the same education group. In contrast, the quantile regression technique allows the return to education to vary within groups. While OLS estimates measure the wage effects of education upon the mean of the conditional wage distribution, quantile returns measure the effects of education at different points of the distribution. Differences in quantile returns can be used to measure of inequality within groups, for they represent the wage differential between individuals that are in the same group but located at different quantiles.

The quantile regression model was first introduced by Koenker and Basset (1978). Since then, several authors have used this framework to explore the wage effects of schooling over the entire wage distribution. Buchinsky (1994) for US, Abadie (1997) for Spain, Machado and Mata (1997, 2005) and Hartog *et al.* (2001) for Portugal, Gosling *et al.* (2000) for UK, and Prasad (2000) for Germany are only some examples. Up to date, however, there is little comparable evidence for Europe. Major differences between the studies arise not only from crucial differences in the model specifications but also from the use of different definitions of variables, diverging data sets and

differently defined sample of individuals. Pereira and Martins (2002a, 2004) contribute to fill this gap by using comparable data and a common wage equation to calculate quantile returns to schooling in fifteen European countries. They find that in most countries education has a positive impact on within-groups dispersion. As a limitation, their analysis implicitly assumes that this impact is constant across education levels, due to the use of years of schooling in the wage regression. In this paper, we offer a more differentiated view by considering four educational qualifications: tertiary, upper secondary, lower secondary and less than lower secondary education as the reference category. As we show, there exist important differences across education levels regarding the marginal impact of education on within-groups dispersion. As a second extension, we investigate how education has shaped the European wage distribution over the last years. We cover a period that ranges from 26 years in the case of Sweden (1974-2000) to 7 years in the case of Portugal (1993-2000).

Our main findings are as follows. In line with previous work, returns to education tend to be increasing over the wage distribution. This is interpreted as a positive impact of education on within-groups inequality. However, this impact differs importantly across education levels. In most countries, differences across quantiles are substantially higher for tertiary educated workers than for less educated workers. Using data from the last decades, we analyze changes in inequality between and within groups. We detect different trends across countries. A remarkable finding is that in most countries wage dispersion increased among the high-educated. As far as within-groups dispersion is concerned, this process contributed towards wage inequality.

The rest of the paper is organized as follows. Section 1 describes the countries, datasets and variables used for the analysis. Section 2 presents the quantile regression model. Section 3 presents quantile as well as OLS estimates of the returns to education. Section 4 uses several waves of the country-specific datasets to investigate the role that education has had in shaping the European wage distribution over the last decades. Section 5 presents the concluding remarks. The paper includes two Appendices.

Appendix A describes the national data sources and estimating samples. Appendix B reports regression results when hourly wages instead of monthly wages are used in regressions.

1. Countries, datasets, and variables

This paper collects empirical evidence on earnings and education for a representative set of European countries. This was achieved under the framework of a research project, 'Education and Wage Inequality in Europe' (EDWIN), where each country team analyzed their country datasets[1]. Appendix A describes such datasets, including the years for which the information applies, the number of observations used, and additional tips concerning country-specific definitions of variables.

We use the same estimation procedure and the same population group for all countries. We focus on male workers in the private sector[2]. We restrict the sample to wage earners aged between 18 and 60, who work normally between 35 and 85 hours a week, and are not employed in the agricultural sector. Thus, self-employed individuals, as well as those whose main activity status is paid apprenticeship, training, and unpaid family worker have been excluded from the sample. The case of women is disregarded on account of the extra complication of potential selectivity bias. Workers with a monthly wage rate that is less than 10% or over 10 times the average wage have been also excluded.

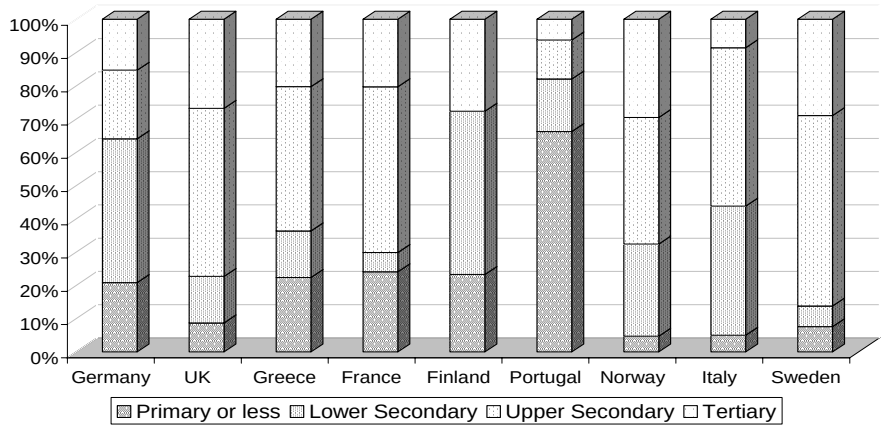
Our dependent variable is monthly earnings rather than hourly wages. This choice is aimed to avoid the measurement error that is typically associated to hours worked. Ideally, we prefer to use gross wages rather than net wages. However, for Portugal, Greece, Italy, and Sweden only net wages were available. Even though differences in

[1] For a description of the EDWIN project, visit http://www.etla.fi/edwin/.
[2] Two exceptions are Greece and Portugal, for which the distinction between private and public servants was not available in some years.

the dependent variable may trouble some comparisons between countries, this is not a fundamental problem for the question under study.

We use the last available year for each country when reporting cross-sectional evidence[3]. Four categories of education are considered: primary or less, lower secondary, upper secondary, and tertiary[4]. In Figure 1 we report the education composition of the sample workers. The proportions are broadly in line with those reported in Eurostat (2003). Portugal stands remarkably far from the educational attainment of the other countries, with only 5.7% of the population having completed a higher degree.

Figure 1. Education composition



In Figure 2 we report the Gini index by education levels. In Figure 3, we report the ratio

[3] These years are: Germany, 1999; UK, 2003, Greece, 1999; France, 2001; Finland, 2001; Portugal, 2000; Norway, 2000; Italy, 1998; Sweden, 2000.

[4] The education categories were constructed following the ISCED-97 classification (OECD, 2003). Two particular cases are Germany and Finland. In Germany, the share of workers in the lowest education level is rather low with the ISCED-97 classification. To avoid this, we consider another 4-level ranking i) 'no vocational education' (and a school degree below the maturity level, i.e., a degree that does not qualify for tertiary education), ii) 'basic vocational education' (no maturity certificate but vocational education), iii) 'intermediate education' (maturity certificate or advanced vocational education), and iv) 'tertiary'. For simplicity purposes we refer to these categories as 'primary or less', 'lower secondary', 'upper secondary', and 'tertiary'. In Finland, the distinction between upper and lower secondary education was not available for the recent years. Here, 'lower secondary' comprises both lower and upper secondary education.

between wages at the top 10% and the bottom 90% of the wage distribution. The most remarkable fact is that earnings inequality tends to increase as we move towards more educated groups. In most countries, inequality is highest among workers with a tertiary level. This evidence gives initial support to the hypothesis that education is positively associated to wage dispersion[5].

Figure 2. Gini index by education groups

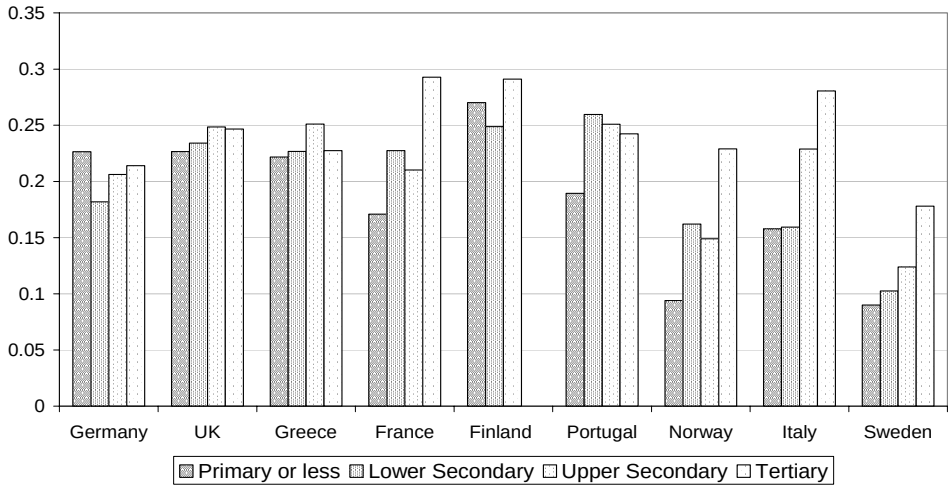
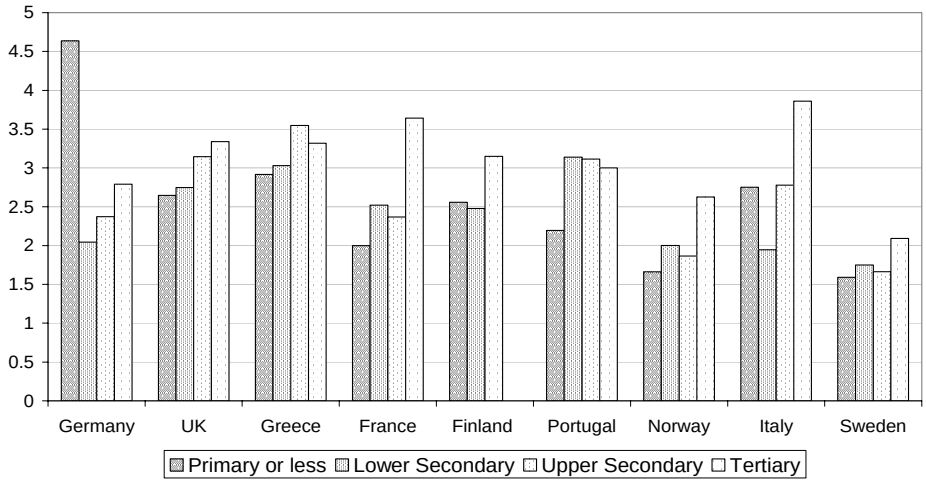


Figure 3. W10/W90 ratio by education groups



[5] For an investigation of the causality between education and inequality at the macroeconomic level see Sullivan and Smeeding (1997), Barro (2000), De Gregorio and Lee (2002) and Hartog *et al*. (2004).

2. The model

The quantile regression model can be written as

$$ln\, w_i = X_i \beta_\theta + e_{\theta i} \qquad \text{with } Quant_\theta(\, ln\, w_i | X_i\,) = X_i \beta_\theta \tag{1}$$

where X_i is the vector of exogenous variables and β_θ is the vector of parameters. $Quant_\theta(ln\ w_i|X_i)$ denotes the θth conditional quantile of $ln\ w$ given X. The θth regression quantile, $0<\theta<1$, is defined as a solution to the problem

$$\min_{\beta \in R^k} \left\{ \sum_{i: y_i \geq x_i \beta} \theta \left| ln\, w_i - X_i \beta_\theta \right| + \sum_{i: y_i < x_i \beta} (1-\theta) \left| ln\, w_i - X_i \beta_\theta \right| \right\} \tag{2}$$

which, after defining the check function $\rho_\theta(z)=\theta z$ if $z \geq 0$ or $\rho_\theta(z)=(\theta-1)z$ if $z < 0$, can be written as

$$\min_{\beta \in R^k} \left\{ \sum_i \rho_\theta(\, ln\, w_i - X_i \beta_\theta) \right\} \tag{3}$$

This problem is solved using linear programming methods. Standard errors for the vector of coefficients are obtainable by using the bootstrap method described in Buchinsky (1998).

Estimation by OLS assumes that the marginal impact of education on log-wages is constant over the log-wage distribution. In this case, the effect of having one additional level of education can be represented by a shift (to the right) of the conditional log-wage distribution. Quantile returns, in turn, measure the wage effect of education at different quantiles, thus describing changes not only in the location but also in the shape of the distribution. While OLS returns measure the average differential between education groups, differences in quantile returns represent the wage differential between individuals that are in the same group but located at different quantiles.

Our wage equation includes a set of education dummies, experience, and experience squared,

$$\ln w_i = \alpha_\theta + \beta_{\theta 1} lowersec_i + \beta_{\theta 2} uppersec_i + \beta_{\theta 3} tertiary_i + \delta_{\theta 1} exp_i + \delta_{\theta 2} exp_i^2 + e_{\theta i} \quad (4)$$

where *lowersec*, *uppersec* and *tertiary* are activated only if the highest education level completed by the individual is, respectively, lower secondary, upper secondary or tertiary education. The reference category is 'less than lower secondary education'.

3. Empirical results

In the following, we calculate OLS returns as well as conditional returns at five representative quantiles: 0.10, 0.25, 0.50, 0.75 and 0.90, which we will denote by 10q, 25q, 50q, 75q and 90q, henceforth.

In Table 1 we report the results. A glance to the OLS estimates reveals that in all countries the coefficients on education are positive and significant at the 1% level. An exception is the lower secondary level in Finland and Sweden. In some countries, differences between education groups are substantial. In Portugal, Germany, Italy and France individuals with higher education earn wages that are at least 75% higher than the wages earned by individuals in the lowest educational category, and more than 40% higher than those earned by individuals in the upper secondary group[6]. In Sweden the 28.4% return to higher education is surprisingly low as compared to the other countries.

Next, we turn to the estimates at different quantiles. To facilitate the analysis, in Figure 4 we plot the quantile-return profile for the selected education levels. Clearly, in most countries the estimated coefficients are increasing over the wage distribution. This is typically interpreted as a positive impact of education on within-groups dispersion: if

[6] The wage premium is expected to be even larger in Portugal and Italy. The use of net wages for these countries may generate downward biased estimates of the market price of education, due to the progressivity of the tax system.

Table 1. OLS and conditional returns to education

	OLS	10q	25q	50q	75q	90q
Germany						
Lower Secondary	**14.90*****	18.11***	13.84***	9.70***	8.66***	11.80***
	(2.33)	(5.82)	(3.16)	(2.37)	(1.97)	(3.25)
Upper Secondary	**37.51*****	32.42***	32.60***	30.41***	33.49***	38.15***
	(2.87)	(6.99)	(4.18)	(3.31)	(2.96)	(3.90)
Tertiary	**85.61*****	74.49***	79.30***	76.83***	79.40***	87.35***
	(3.29)	(8.53)	(5.48)	(3.53)	(4.00)	(4.48)
UK						
Lower Secondary	**14.72*****	13.03***	14.21***	15.69***	16.31***	16.30***
	(0.66)	(0.95)	(0.70)	(0.85)	(0.98)	(1.37)
Upper Secondary	**23.71*****	19.69***	22.20***	24.47***	28.17***	30.01***
	(1.04)	(1.47)	(0.77)	(1.26)	(1.60)	(2.31)
Tertiary	**59.92*****	48.32***	57.10***	65.14***	68.34***	67.81***
	(0.56)	(0.97)	(0.58)	(0.69)	(0.78)	(1.11)
Greece						
Lower Secondary	**11.39*****	11.65	7.78	11.75***	12.62***	15.30***
	(3.74)	(12.35)	(5.45)	(4.50)	(4.01)	(5.83)
Upper Secondary	**30.16*****	37.96***	31.03***	30.81***	32.52***	35.22***
	(3.17)	(8.56)	(3.89)	(3.07)	(2.49)	(4.67)
Tertiary	**56.39*****	57.36***	54.34***	55.58***	59.56***	59.06***
	(3.73)	(9.80)	(4.40)	(4.16)	(2.68)	(5.13)
France						
Lower Secondary	**19.95*****	8.12***	11.76***	18.07***	23.37***	29.35***
	(1.10)	(1.63)	(1.24)	(1.20)	(1.32)	(2.87)
Upper Secondary	**20.16*****	12.67***	13.88***	16.99***	23.20***	28.61***
	(0.56)	(0.67)	(0.60)	(0.64)	(0.76)	(1.10)
Tertiary	**74.66*****	41.95***	54.65***	71.05***	89.37***	103.01***
	(0.87)	(1.46)	(1.09)	(0.90)	(0.94)	(1.42)
Finland						
Secondary	**11.81*****	18.05***	8.69***	8.90***	9.68***	14.35***
	(1.68)	(3.77)	(1.52)	(1.42)	(1.62)	(3.11)
Tertiary	**49.80*****	47.22***	41.35***	47.12***	52.46***	63.15***
	(1.91)	(3.68)	(1.70)	(1.48)	(2.30)	(3.91)

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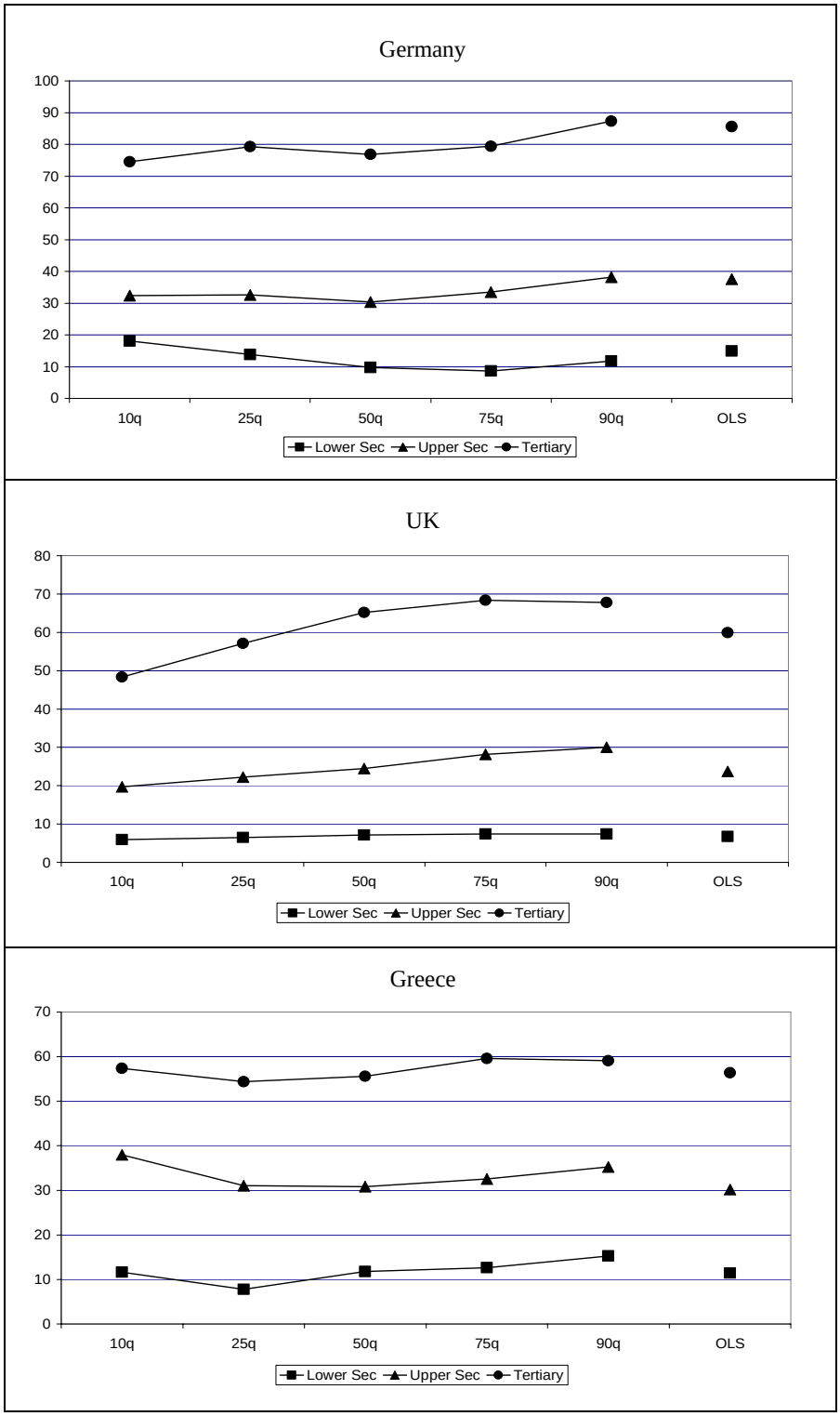
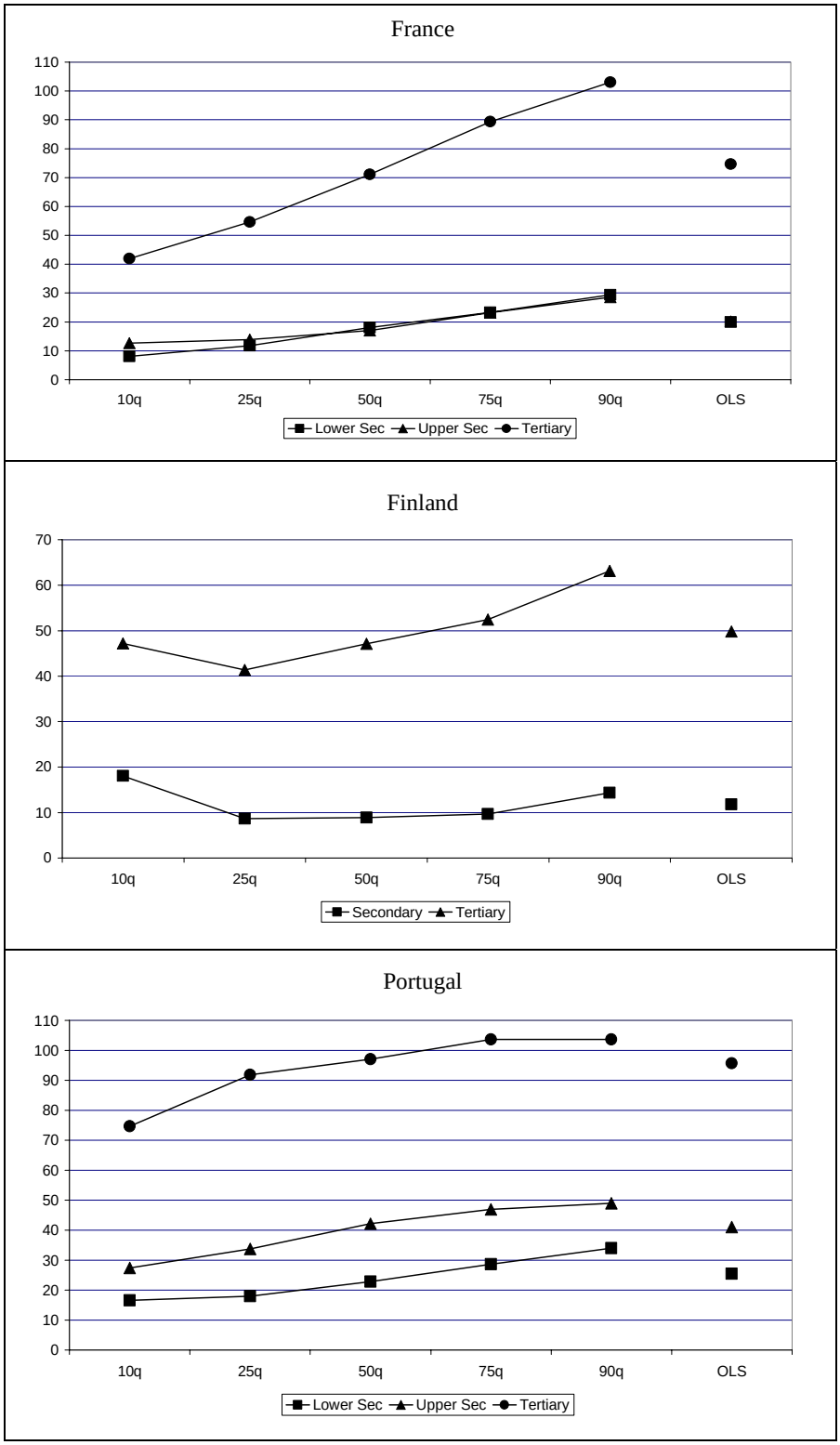
Portugal						
	OLS	10q	25q	50q	75q	90q
Lower Secondary	**25.49*****	16.62***	17.97***	22.89***	28.69***	34.00***
	(1.41)	(1.74)	(1.27)	(1.43)	(2.32)	(3.13)
Upper Secondary	**41.00*****	27.39***	33.72***	42.21***	46.92***	48.93***
	(1.56)	(1.91)	(2.22)	(1.50)	(1.57)	(3.10)
Tertiary	**95.72*****	74.63***	91.87***	97.07***	103.63***	103.66***
	(2.06)	(3.54)	(2.76)	(2.30)	(2.55)	(5.31)
Norway						
	OLS	10q	25q	50q	75q	90q
Lower Secondary	**3.84**	-7.38	-0.69	-1.49	6.57	13.53**
	(4.33)	(9.53)	(4.33)	(6.84)	(5.42)	(6.85)
Upper Secondary	**20.96*****	11.27	14.26***	13.31**	20.89***	27.85***
	(4.49)	(9.57)	(4.29)	(6.80)	(5.69)	(7.12)
Tertiary	**53.69*****	29.46***	36.22***	44.07***	56.88***	76.04***
	(5.11)	(10.12)	(5.69)	(6.96)	(6.47)	(8.72)
Italy						
	OLS	10q	25q	50q	75q	90q
Lower Secondary	**26.02*****	38.15**	25.30***	22.44***	19.26***	24.12**
	(6.86)	(15.27)	(7.82)	(7.76)	(9.40)	(13.08)
Upper Secondary	**52.03*****	59.22***	45.29***	44.92***	47.58***	60.14***
	(6.94)	(15.45)	(8.06)	(7.98)	(9.04)	(13.70)
Tertiary	**91.70*****	90.86***	76.89***	79.97***	88.58***	115.50***
	(7.57)	(16.17)	(8.07)	(8.54)	(10.38)	(14.84)
Sweden						
	OLS	10q	25q	50q	75q	90q
Lower Secondary	**3.47**	3.82	3.24	4.12***	2.67	3.80
	(2.29)	(3.05)	(1.91)	(1.58)	(4.69)	(5.19)
Upper Secondary	**7.63*****	5.27	5.17**	7.20***	6.24	19.64***
	(2.83)	(5.61)	(2.33)	(2.81)	(5.27)	(6.57)
Tertiary	**28.44*****	17.79***	18.80***	28.57***	34.72***	42.41***
	(2.80)	(3.28)	(3.25)	(2.79)	(5.41)	(6.21)

Notes to Table 1: * denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level.

Figure 4. Quantile-return profiles by education levels

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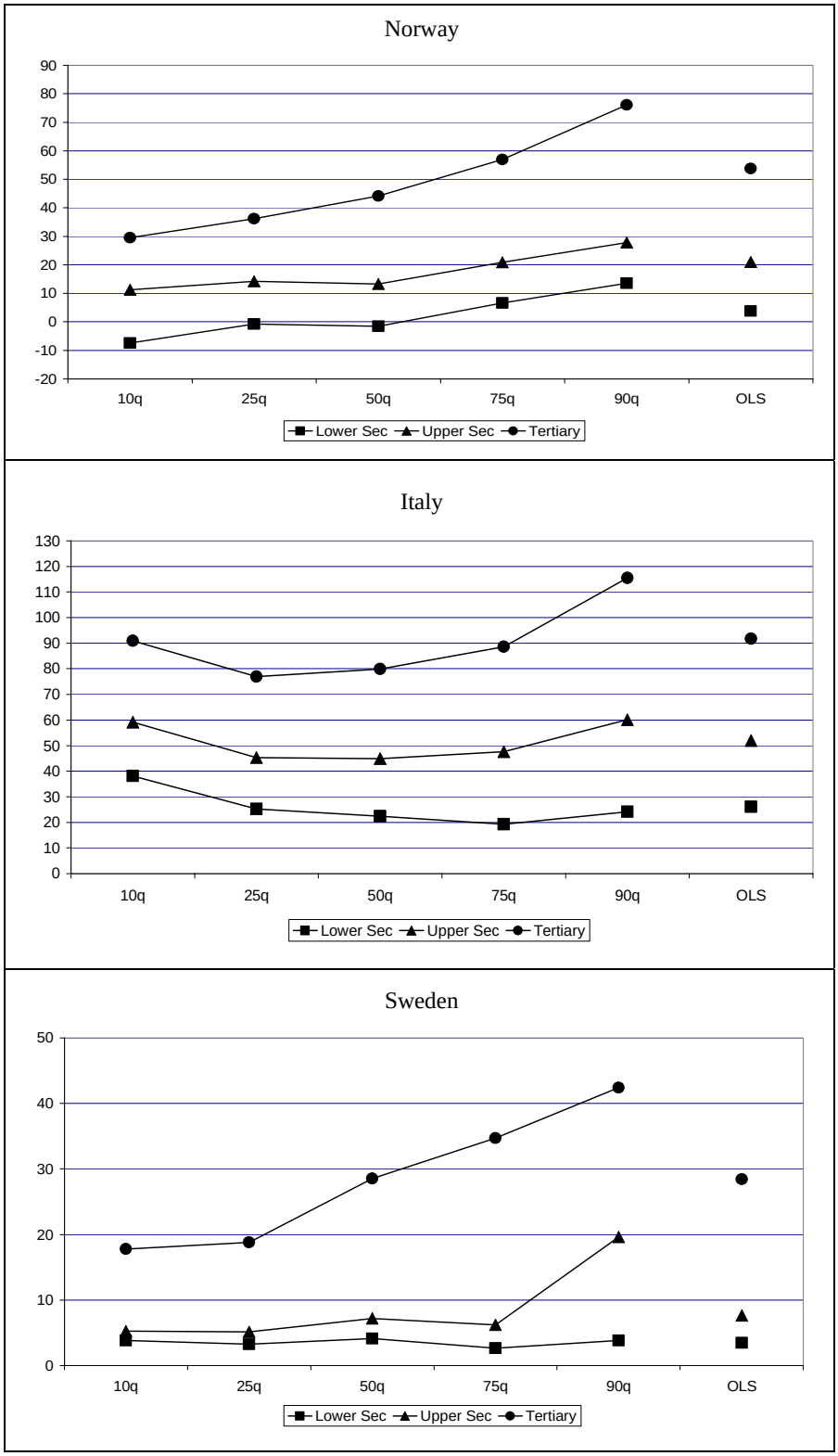
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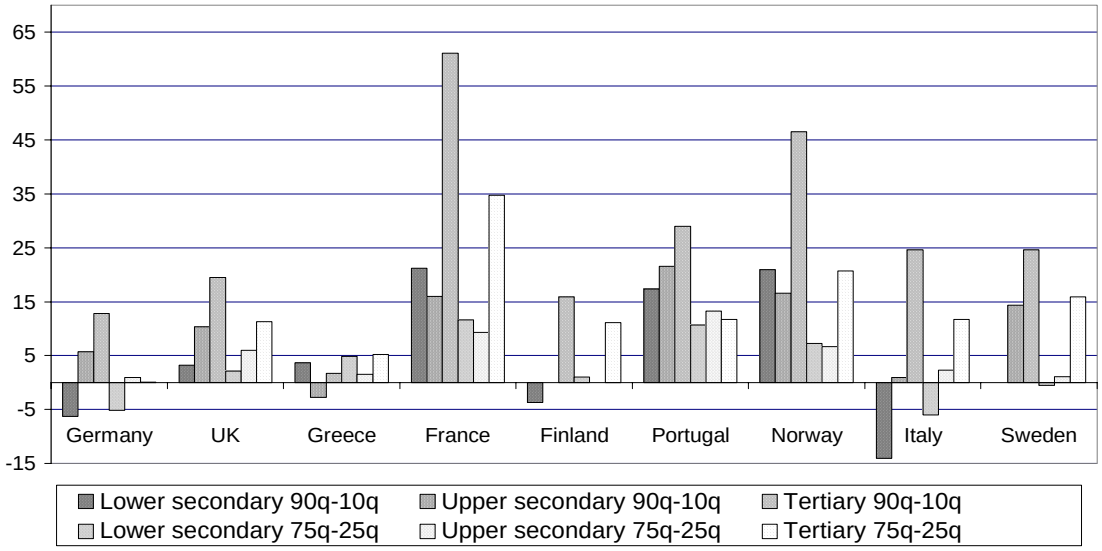
countries the estimated coefficients are increasing over the wage distribution. This is typically interpreted as a positive impact of education on within-groups dispersion: if returns to education are higher at the upper quantiles and we give an extra level of education to workers that are seemingly equal but located at different quantiles, then their wages will become more dispersed. Germany and Greece, where the estimated returns are roughly constant across quantiles, are exceptions to the general pattern.

Note that using years of schooling in the wage regression would assume that the impact of one additional year of schooling on within-groups dispersion is constant across education levels. Instead, the use of education dummies uncovers important differences across qualifications. Dispersion across quantiles is relatively small in the secondary level and remarkably large in the tertiary level. In other words, the impact of education on within-groups dispersion is large when it comes to tertiary education and only modest when it comes to either lower or upper secondary education. France and Portugal are two illustrative examples. In France an average return of 74.66% to tertiary education masks a return of only 41.95% in the first quantile and 103.01% in the top quantile. In Portugal, the average return to a tertiary degree is 95.72%. However, the return at 10q and 90q are, respectively, 74.63% and 103.66%. Note how it is that returns to secondary education are subject to much lower variation across quantiles.

To get further insights, in Figure 5 we have plotted the 90q-10q and the 75q-25q spreads for each education group. We detect some differences across countries regarding the contribution of the bottom and upper tails of the wage distribution to inequality. Thus, for example, in Portugal and Norway the 90q-10q spread more than doubles the 75q-25q spread for university graduates (3^{rd} and 6^{th} bars), which indicates that wage dispersion within this group takes place mostly at the tails of the wage distribution. In contrast, in France and UK the intermediate quantiles account for a significant fraction of the overall wage dispersion.

Figure 5. Inequality within education groups



Finally, in Table 2 we have tested whether differences across quantiles are statistically significant. The results for hourly wages are reported in Appendix B. The first column reports the F-test for the equality of coefficients at 90q and 10q. The second column reports a joint test of equality of coefficients at all quantiles. Using a 5% confidence level, in most cases (UK, France, Finland, Portugal, Norway and Sweden) we reject that returns to tertiary education are constant over the wage distribution. In contrast, only in some cases (France, Portugal, and partially Finland) we reject the equality of coefficients for lower secondary and upper secondary education. Overall, these results indicate that the amount and significance of wage dispersion increase as we move towards higher levels of education. Conditional on observable characteristics, wage dispersion is much higher among tertiary educated individuals than among individuals with less educational attainment. Germany, Greece and Italy are the exceptions. In these countries, differences across quantiles are relatively small and, thus, conditional wage dispersion is similar across education levels[7].

[7] In Germany, the return to lower secondary education is lower at the upper quantiles than at the bottom quantiles, indeed, and the difference is statistically significant. This suggests that, relative to the other educational categories, wage dispersion is lower among individuals in this group.

Table 2. Inter-quantile hypothesis testing by education levels

	Countries	90q equal to 10q	All quantiles equal
Germany	Lower Secondary	F(1, 1895) = 3.81*	F(4, 1895) = 6.47***
	Upper Secondary	F(1, 1895) = 0.51	F(4, 1895) = 0.90
	Tertiary	F(1, 1895) = 1.79	F(4, 1895) = 1.42
UK	Lower Secondary	F(1, 14641) = 0.87	F(4, 14641) = 0.49
	Upper Secondary	F(1, 14641) = 10.35***	F(4, 14641) = 3.49***
	Tertiary	F(1, 14641) = 34.08***	F(4, 14641) = 18.36***
Greece	Lower Secondary	F(1, 1885) = 0.10	F(4, 1885) = 0.41
	Upper Secondary	F(1, 1885) = 0.08	F(4, 1885) = 0.50
	Tertiary	F(1, 1885) = 0.03	F(4, 1885) = 0.66
France	Lower Secondary	F(1, 21142) = 44.40***	F(4, 21142) = 20.76***
	Upper Secondary	F(1, 21142) = 174.46***	F(4, 21142) = 62.76***
	Tertiary	F(1, 21142) = 1059.84***	F(4, 21142) = 328.53***
Finland	Secondary	F(1, 5589) = 0.72	F(4, 5589) = 2.83**
	Tertiary	F(1, 5589) = 8.38***	F(4, 5589) = 8.17***
Portugal	Lower Secondary	F(1, 5738) = 24.64***	F(4, 5738) = 8.05***
	Upper Secondary	F(1, 5738) = 45.19***	F(4, 5738) = 26.10***
	Tertiary	F(1, 5738) = 21.27***	F(4, 5738) = 15.76***
Norway	Lower Secondary	F(1, 974) = 3.30*	F(4, 974) = 1.08
	Upper Secondary	F(1, 974) = 2.10	F(4, 974) = 0.83
	Tertiary	F(1, 974) = 13.02***	F(4, 974) = 4.48***
Italy	Lower Secondary	F(1, 2116) = 0.60	F(4, 2116) = 0.38
	Upper Secondary	F(1, 2116) = 0.00	F(4, 2116) = 0.54
	Tertiary	F(1, 2116) = 1.47	F(4, 2116) = 1.81
Sweden	Lower Secondary	F(1, 973) = 0.00	F(4, 973) = 0.09
	Upper Secondary	F(1, 973) = 3.26*	F(4, 973) = 1.37
	Tertiary	F(1, 973) = 13.00***	F(4, 973) = 5.16***

Notes to Table 2: * denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level.

4. Changes over time

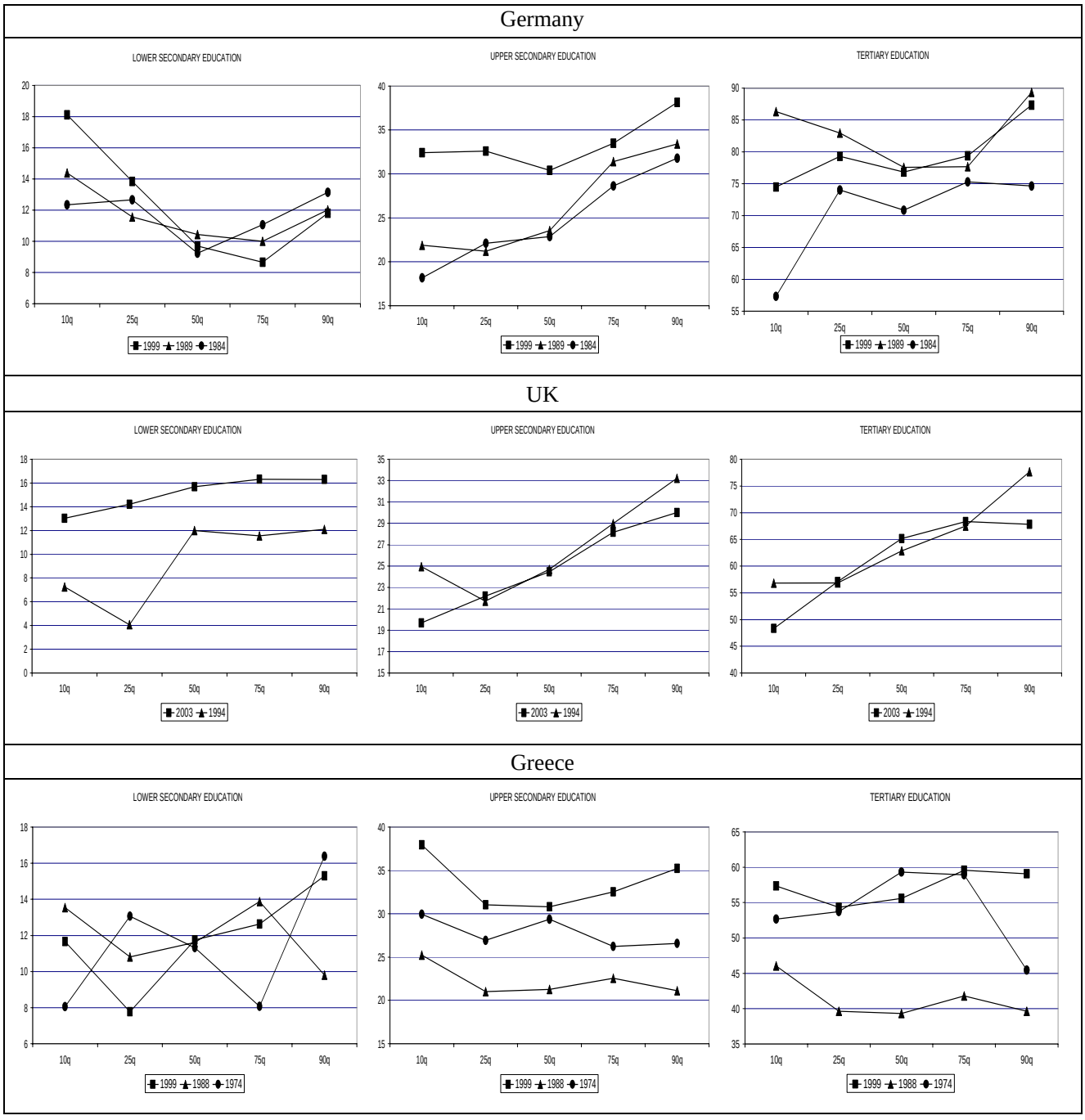
In this section, we examine how the impact of education on wage levels and wage dispersion has evolved over the last years. To describe changes in the conditional wage distribution, Figure 5 plots the quantile-return profile at different years. These years are centered around 2000, 1990 and, when possible, 1980. The full set of estimates is available from the authors upon request. Throughout the analysis we use the coefficient at 50q as a measure of between-groups inequality and the 90q-10q spread as a measure of within-groups inequality. Increases (decreases) in the 50q coefficient represent shifts to the right (left) of the conditional log-wage distribution. Increases (decreases) in the 90q-10q spread correspond to increases (decreases) in wage inequality within a particular group. In the following, we briefly comment the results for each country.

Germany (1984–1999)

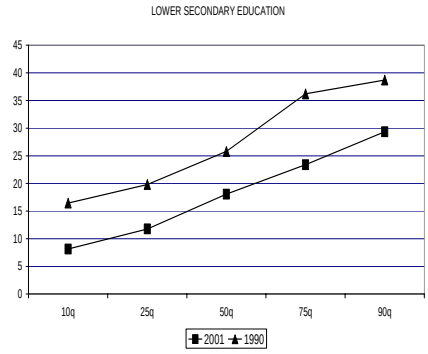
Differences between groups tended to increase over the sample period. While the median return to lower secondary education remained roughly constant, the return to upper secondary and tertiary education increased from 23% and 71% in 1984 to 30% and 77% in 1999, respectively. As regards differences across quantiles, we find that workers at low-pay jobs improved relative to workers at high-pay jobs. In all education levels, the return at 10q increased more than the return at the middle and upper quantiles. This process took place basically over the nineties in the secondary group and over the eighties in the tertiary group, and contributed towards wage compression. In the nineties, though, decreases in the returns to tertiary education at the lowest quantile contributed to enlarge wage differentials among the high-educated.

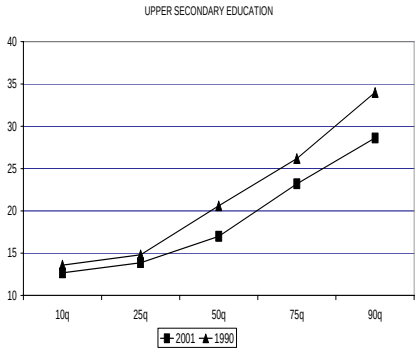
Prasad (2000) examines the recent evolution of wage inequality in Germany, and finds a roughly stable distribution of earnings. According to our results, this stability was the result of opposing effects: increases in between-groups inequality were offset by decreases in within-groups inequality.

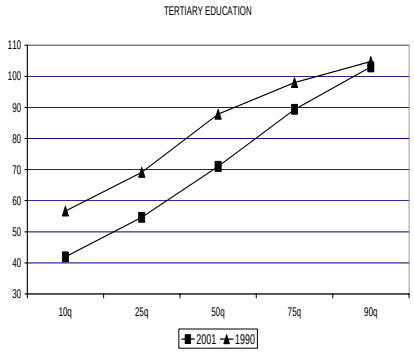
Figure 5. Returns to education at different years



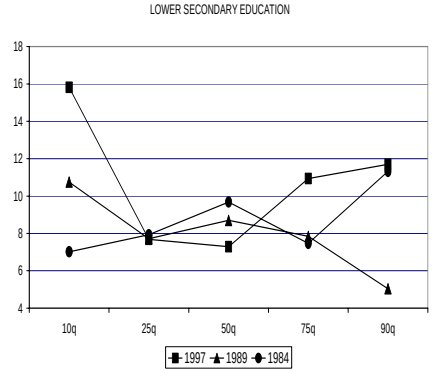
France

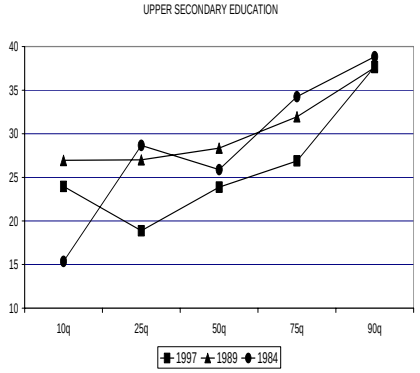


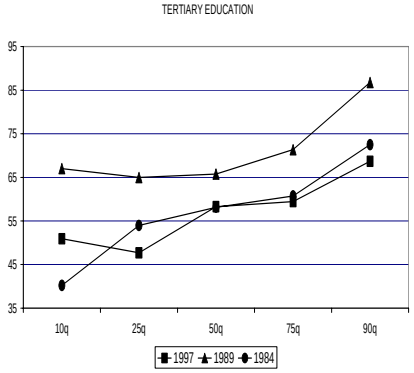




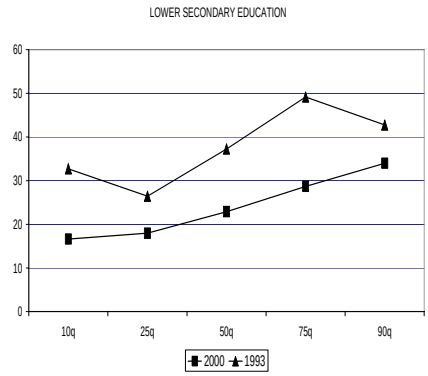
Finland

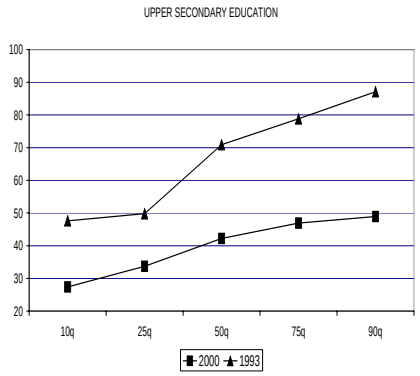


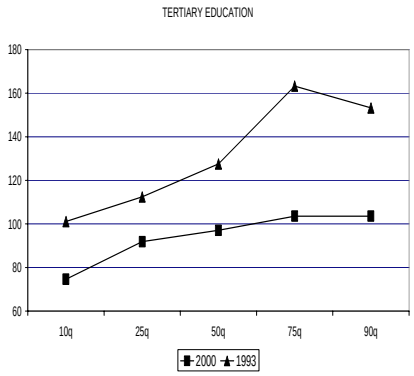




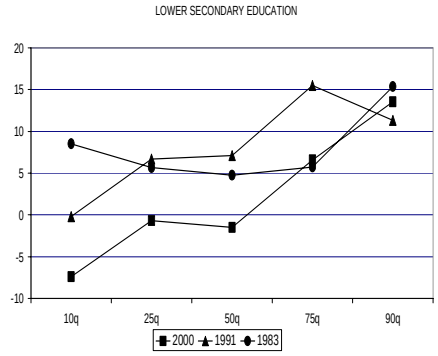
Portugal

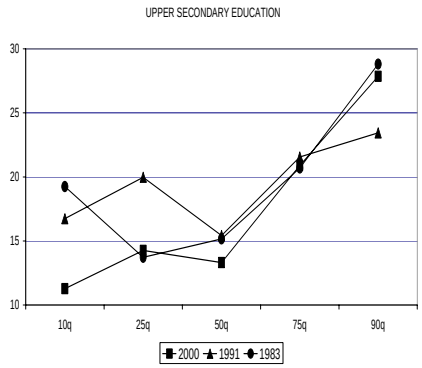


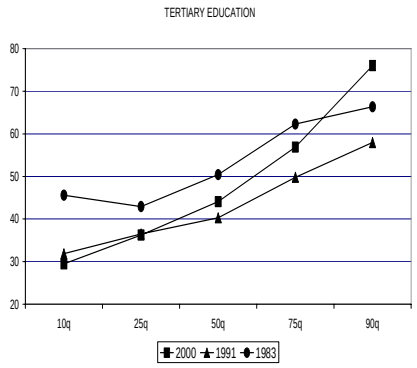




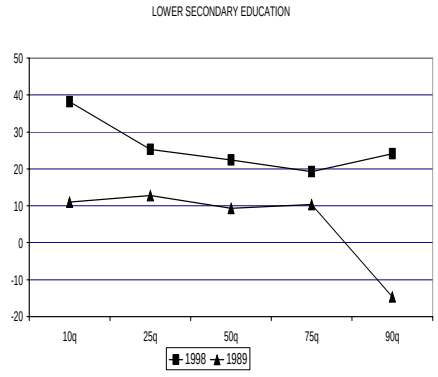
Norway

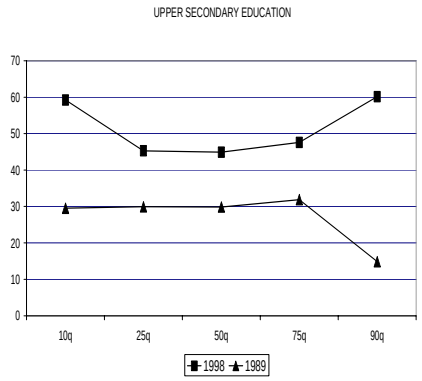


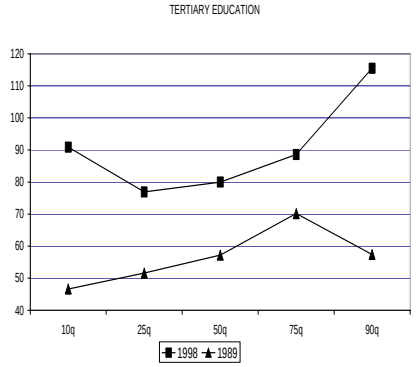




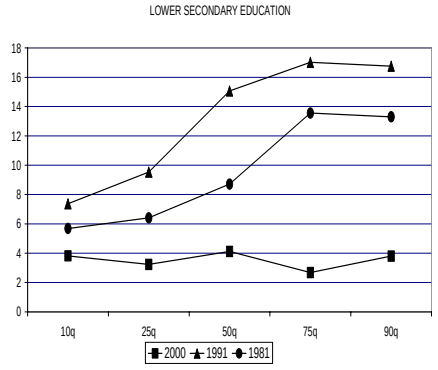
Italy

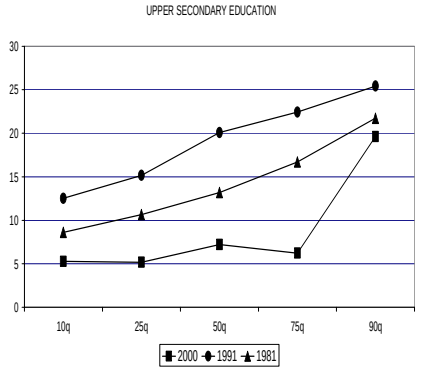


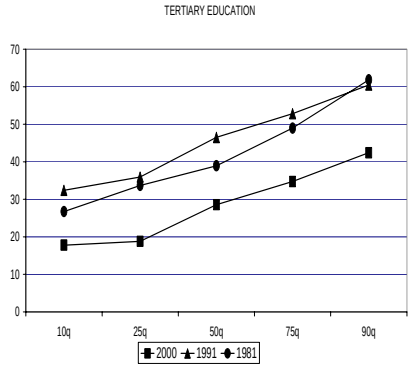




Sweden







UK (1994-2003)

Changes in inequality between groups were modest. At the median quantile, returns to upper secondary and tertiary education remained roughly constant, while returns to lower secondary education rose from about 12% in 1994 to 16% in 2003. Wage dispersion remained roughly stable in the upper secondary and tertiary levels. In these groups, decreases at the lowest quantile were offset by similar decreases at the top quantile and, as a consequence, the 90q-10q spread remained practically unchanged. In turn, wage dispersion fell slightly within the lower secondary group, as indicated by the flattening of the quantile-return profile.

Overall, the role of education in shaping overall wage inequality in UK was modest over the recent years. Chevalier *et al*. (1999) document substantial increases in between-groups inequality in UK from the seventies up to the early nineties. According to our estimates, this trend vanished by the mid-nineties. Likewise, Harmon *et al.* (2003) analyze changes in OLS returns as well as in the dispersion of individual returns, and find that the nineties was a period of relative stability.

Greece (1974–1999)

From 1974 to 1988, median returns to upper secondary and tertiary education decreased from 29% and 59% to 22% and 39%, respectively, contributing towards wage compression. During this period, the pattern of change of within-groups inequality was less clear cut, due to increasing inequality in the tertiary group and decreasing inequality in the lower secondary group.

From 1988 to 1999 education premia rose, from 39% to 56% for the tertiary level and from 22% to 31% for the upper secondary level. Changes within groups worked in the same direction. The 90q-10q spread increased for the lower secondary and tertiary levels, though it remained roughly constant for the upper secondary level. Over the nineties, therefore, education contributed to increase overall wage inequality through simultaneous effects in the between- and within- dimensions.

In a recent survey, Tsakloglou and Cholezas (2005) document changes in the Greek wage structure, and find that wage inequality increased substantially over the nineties. Our results suggest that education played a major role in this process.

France (1990–2001)

Wage differentials across education groups tended to decrease. Taking the median quantile as a reference, the returns to lower secondary, upper secondary and tertiary education decreased by about 8, 4, and 9 percentage points, respectively. As regards within-groups inequality, we detect different trends across education groups. Due to a compression in the upper tail, the wage distribution of secondary workers became less dispersed. In contrast, wage dispersion rose markedly among tertiary workers, due to an enlargement of the bottom tail of the distribution. In this group, returns at the lower quantiles decreased by more than from 15 percentage points, and the 90q-10q spread rose from 48% to 61%.

According to most studies, the French wage structure was quite stable during the nineties (Ben-Abdelkarim and Skalli, 2005). As far as education is concerned, our results suggest that this stability was due to opposing effects: decreases in between-groups inequality were offset by increases in wage inequality among the high-educated.

Finland (1984–1997)[8]

Differences across education groups were similar in 1984 and 1997. Still, some changes occurred during this period. The median return to tertiary education rose from 58% in 1984 to 66% in 1989, and then returned back to its initial level by 1997. Changes in the secondary level were small, with a slight decrease in the return to upper secondary education from 1989 to 1997.

[8] In 1998 there was a change in the educational classification used in the Finnish dataset. As the resulting educational categories are not directly comparable to the previous ones, we analyze changes only up to 1997.

The tendency of within-groups inequality is clear cut. In all education levels, wage inequality was lower in 1997 than in 1984. Most of the change took place over the second half of the eighties, and was due to increases in the returns earned by workers at low paid jobs.

Asplund and Leijola (2005) summarize recent empirical work on the connection between education and wage inequality in Finland. They conclude that little is still known on the relative impact of the between- and within- dimensions on the Finnish wage structure. Even though our results do not allow for a quantitative decomposition of these two effects, they point to different and sometimes opposing patterns of change along these two dimensions.

Portugal (1993-2000)

Over the sample period, wage inequality decreased between and within groups simultaneously. The wage premium earned by lower secondary, upper secondary and tertiary workers fell from 38%, 69% and 128% in 1993 to 23%, 42% and 97% in 2000, respectively. This process was more severe among workers at high-pay jobs, contributing to reduce the upper tail of the earnings distribution. As a result, the 90q-10q spread decreased, from 39% to 22% in the upper secondary group and from 53% to 29% in the tertiary group.

Hartog *et al.* (2001) document important increases in wage inequality both between and within groups over the eighties and first half of the nineties. Pereira and Martins (2002b) report similar evidence, but detect a decreasing trend in the returns to education from 1995 onwards. As we show, this trend continued over the second half of the nineties and was accompanied by substantial decreases in wage differentials within education groups. In Portugal, therefore, education contributed towards wage compression over the recent years.

Norway (1983-2000)

Returns to education tended to decrease during the nineties for the secondary level and during the eighties for the tertiary level. While changes in average returns were small, changes in conditional returns were large. The quantile-return profile became increasingly steeper over the eighties and particularly the nineties for all education levels. In other words, within-groups dispersion rose. This process was mostly due to increases in the returns at the upper part of the wage distribution among workers with tertiary education and decreases in the returns at the bottom part of the distribution among workers with secondary education.

Barth and Roed (2002) suggest that increases in the demand for skills contributed to maintain returns to education at relatively high levels despite the increase in the relative supply of high-educated workers. Our analysis shows that, moreover, this phenomenon was accompanied by increasing heterogeneity in the group of skilled workers, thus resulting into higher wage dispersion. As changes in the within- dimension were quantitatively more important than changes in the between- dimension, education presumably had a net positive impact on wage inequality over the sample period.

Italy (1989-1998)

Differences across groups sharpened during the nineties. The wage premium earned by lower secondary, upper secondary and tertiary workers rose, respectively, from 10%, 30% and 58% in 1989 to 22%, 45% and 80% in 1998. Moreover, increases in the returns to education were not proportional across quantiles. Changes were sharper at the tails of the distribution. Education premia among workers at low-pay and particularly high-pay jobs increased, relative to workers at average-pay jobs. This process resulted in a compression of the lower tail and an expansion of the upper tail of the wage distribution. As the second effect was larger, within-groups inequality rose.

Overall, our results for Italy indicate that education exerted a positive effect on wage inequality over the last years.

Sweden (1981-2000)

Earnings differentials across education groups tended to decrease, particularly during the nineties. Over this period, changes in average returns were accompanied by changes in the shape of the conditional wage distribution. Wage dispersion decreased substantially in the lower secondary group and remained roughly constant in the upper secondary and tertiary group. In the upper secondary group this stability was due to opposing effects: a compression of the wage structure at the intermediate quantiles and an enlargement of the top tail of the wage distribution.

Overall, changes in the labour market reward to secondary and tertiary education contributed to reduce wage inequality. This process was driven by simultaneous decreases in inequality between groups and, to a lesser extent, inequality within groups.

Similarities and differences across countries

In the following, we draw some conclusions regarding the evolution of wage inequality in the surveyed countries. We restrict the analysis to the last ten years (or closest) available for each country.

Table 3 documents changes in the returns to education in a coherent and summarized fashion. The third and fourth columns report changes in OLS returns and the 90q-10q spread, respectively. The last two columns report changes at the two extreme quantiles. First, we focus on changes in OLS returns. We differentiate between three groups of countries. In the first group, France, Portugal and Sweden, the returns to all education levels decreased over the sample period, contributing towards wage compression. In the second group, Germany, UK, Finland and Norway, we find mixed evidence across education levels. In Germany and UK, decreases in the coefficient of tertiary education were accompanied by similar increases in the coefficient of lower or upper secondary education. In these countries, therefore, changes in average returns had an ambiguous effect on wage inequality. In Norway and Finland, changes were relatively larger for the tertiary group. In Norway, the evolution of the coefficient of tertiary education points to

Table 3. Changes in OLS and conditional returns over the last decade

		Δ (OLS)	Δ(90q-10q)	Δ (90q)	Δ(10q)
Germany (1989-1999)	Lower Sec	-1.23	-3.94	-0.21	3.73
	Upper Sec	5.89	-5.80	4.74	10.54
	Tertiary	-8.13	9.82	-2.01	-11.83
UK (1994-2003)	Lower Sec	4.82	-1.57	4.20	5.77
	Upper Sec	-1.53	2.03	-3.22	-5.26
	Tertiary	-3.10	-1.39	-9.87	-8.48
Greece (1988-1999)	Lower Sec	-0.88	7.40	5.50	-1.89
	Upper Sec	8.00	1.39	14.11	12.72
	Tertiary	14.56	8.10	19.44	11.34
France (1993-2001)	Lower Sec	-8.38	-1.02	-9.35	-8.33
	Upper Sec	-2.34	-4.47	-5.39	-0.92
	Tertiary	-9.10	12.96	-1.75	-14.71
Finland (1989- 1997)	Lower Sec	2.57	1.59	6.66	5.07
	Upper Sec	-3.40	3.11	0.12	-2.99
	Tertiary	-11.80	-1.98	-18.09	-16.11
Portugal (1993-2000)	Lower Sec	-14.37	7.34	-8.76	-16.09
	Upper Sec	-28.06	-17.97	-38.20	-20.23
	Tertiary	-35.37	-23.19	-49.66	-26.47
Norway (1991- 2000)	Lower Sec	-3.88	9.41	2.21	-7.20
	Upper Sec	1.28	9.88	4.41	-5.47
	Tertiary	10.87	20.44	18.06	-2.39
Italy (1989-1998)	Lower Sec	21.53	11.58	38.76	27.17
	Upper Sec	25.91	15.62	45.31	29.69
	Tertiary	37.28	13.86	58.09	44.22
Sweden (1991-2000)	Lower Sec	-9.48	-9.40	-12.95	-3.55
	Upper Sec	-11.99	1.43	-5.81	-7.23
	Tertiary	-18.69	-3.45	-18.05	-14.61

rising wage inequality, while the opposite applies for Finland. Finally, in the third group, Italy and Greece, differences between groups rose over the last decade.

Next, we focus on changes in within-groups inequality. We differentiate between three groups of countries. In the first group, Portugal and Sweden, there was a tendency towards wage compression. In these countries, the 90q-10q spread decreased in two out of three the education categories, and these decreases were quantitatively more important than the increase observed in the remaining category. In the second group, Germany, UK, Finland and France, overall within-groups dispersion did not follow a clear trend. In Germany, UK and Finland changes across groups had a similar magnitude and opposite signs. In France, however, the rise in wage dispersion among tertiary educated workers was quantitatively more important than the decrease in wage dispersion among secondary educated workers, suggesting that overall within-groups dispersion may have risen over the last decade. Finally, in the third group, Greece, Norway and Italy, wage dispersion rose within all education levels.

Finally, differentiating between education levels, an important conclusion arises. Over the last years, the wage distribution of the high-educated became increasingly dispersed. In Germany, Greece, France, Norway and Italy the tendency of tertiary education to be more valued at high pay jobs became more acute. For this group, the 90q-10q spread rose markedly, ranging from an 8.1 percentage points increase in Greece to a 20.4 percentage points increase in Norway. These results point to increasing heterogeneity within the group of high-educated workers. Even though assessing the underlying causes of this process is beyond the scope of this paper, some candidate explanations may be advanced. Changes in the distribution of skills, experience, and type and quality of qualifications awarded by universities may have contributed to enlarge wage differentials among university graduates. Thus, for example, the educational expansion occurred over the last decades may have been parallel to an increasing proportion of low ability individuals accessing higher education. If ability and education are complementary, then we should observe a deterioration of the returns earned by

individuals at the lower part of the wage distribution (i.e., with lower ability) and, thus, an increase in the dispersion of returns. The results for Germany and France seem to confirm this hypothesis. A look to the last two columns of Table 3 indicates that in these countries, increasing wage differentials among the high educated were mostly due to decreasing returns among workers at low-pay jobs. However, the opposite occurs in Greece, Norway, and Italy, where rising dispersion was mostly due to rising returns among workers at high-pay jobs.

Clearly, further research needs to be done, in order to assess the causes of increasing wage differentials among the high-educated, and to investigate whether this is a European or worldwide phenomenon. The results presented here give initial evidence that over the last years tertiary education has contributed to raise European wage inequality through the within- dimension. Furthermore, in some cases (Norway, Italy, and Greece), the positive association between higher education and within-groups dispersion was reinforced by increases in the wage premium earned by tertiary educated workers. In countries where returns to tertiary education fell, such as Germany and France, increasing wage dispersion among the tertiary group could have offset or even reversed the tendency towards wage compression.

5. Conclusions

In this paper we used the quantile regression technique to explore the connection between education and wage inequality in nine European countries. We found that returns to education tend to be increasing over the wage distribution. This is interpreted as a positive impact of education on within-groups dispersion.

We differentiated between education levels, and found that tertiary educated workers show much larger wage dispersion than workers with less education. As far as within-groups inequality is concerned, this finding suggests that, by raising the weight of the high-spread group, and educational expansion towards tertiary education is expected to

increase overall wage inequality. In turn, an educational expansion from primary to secondary education is expected to have only a modest effect on wage dispersion.

Using data from the last years, we examined changes in the European wage distribution. Overall, three groups of countries emerged. In the first group, Greece, Norway and Italy, inequality between and within groups tended to increase. In these countries, therefore, education contributed towards overall wage dispersion. In the second group, Germany, UK, France and Finland, the impact of education on wage inequality was ambiguous, due to differences across education levels and opposing effects along the between- and within- dimensions. In the third group, Portugal and Sweden, inequality decreased between and within groups simultaneously.

We found that in Europe there is a tendency towards wage dispersion among the high-educated. In most countries, the tendency of higher education to be more valued at high-pay jobs has become more acute over the last years. This process is contributing towards overall wage inequality through the within- dimension. Since further enrolment in higher education can be expected, changes in the educational composition of the workforce are likely to result into further inequality.

A clear implication from our analysis regards the demand for education. Investing in education, rather than assuring a certain level of earnings, gives access to a distribution of earnings. We found that not only average wages increase with education level, but also wage dispersion. To the extent that prospective students are not aware of the characteristics which will place them at some point of the wage distribution, the returns to tertiary education are largely unpredictable. In other words, investing in higher education is subject to a considerable (and increasing) amount of wage risk.

We can draw some tentative (and complementary) explanations for the observed dispersion of returns across quantiles. The first one is over-education. Over-educated workers earn less than their adequately-educated peers, and more than workers who are

in the same job but have less education (Hartog, 2000, Dolton and Silles, 2001, Sloane, 2002). Thus, a situation where a proportion of high skill individuals take jobs with low skill requirement and low pay would be consistent with having increasing returns to education over the wage distribution. The rising proportion of over-educated workers in Europe documented in Hartog (2000) would be consistent with observing increasing wage dispersion among the high-educated.

A second explanation is ability. If ability interacts with schooling, then returns to education must be higher among workers at high-pay jobs, i.e., with more ability. In those countries where higher education does not function as a screening device, the group of university graduates is rather heterogeneous in terms of ability and, consequently, dispersion in the returns across quantiles is larger.

A third explanation regards differences in the quality and type of educational qualifications. If certain qualifications or institutions give a better reward in the labour market, then we should expect some degree of heterogeneity in the estimated returns. Differences across time and countries regarding the amount of wage dispersion within groups would be due to different levels of dispersion in the quality and type of educational qualifications.

Testing the previous hypotheses is a task for future research. If wage equality is a political goal, a country where such joint mechanisms promote wage inequality might wish to reverse the underlying causes. The development of new data sources containing detailed information on school quality indexes, qualifications, and ability measures such as tests scores could enormously help in this task.

Appendix A. Description of data sources and estimating samples

Table 1A. National datasets

Country	Data source	Period covered	Final number of observations in the last available year	Comments
Germany	German Socio-Economic Panel (GSOEP)	1984 – 1999	1,895	Schooling levels correspond to: 1 = no vocational education, 2 = basic vocational education, 3 = intermediate education, 4 = tertiary.
UK	Labour Force Survey (LFS)	1994 – 2003	14,642	
Greece	Household Budget Surveys (HBS)	1974 – 1999	1,885	Net wages, no distinction between the public and the private sector
France	Labour Force Survey (LFS)	1990 – 2001	21,142	
Finland	Labour Force Survey (LFS)	1984 – 2001	5,590	Change in the educational categories in 1998. From then onwards, only three education levels are available, which are not directly comparable to the previous ones.
Portugal	Labour Force Survey (LFS)	1993 – 2000	5,738	Net wages, no distinction between the public and the private sector before 1998.
Norway	Level of Living Surveys (LLS)	1983 – 2000	974	
Italy	Survey of Household Income and Wealth (SHIW)	1989 – 1998	2,116	Net wages
Sweden	Level of Living Survey (LLS)	1981 – 2000	973	Monthly wages are net, but hourly wages are in gross terms.

Germany. The data is taken from the German Socio-Economic Panel. The GSOEP is a longitudinal household survey conducted on an annual basis since 1984. In the first wave, some 12,000 individuals aged 16 and over, and distributed across roughly 6,000 households, were interviewed. The information available is drawn from the statements of the individuals. Individual and household identifiers make it possible to track individuals over time. Due to panel attrition, sample size reduces somewhat each year, but in 1998, a refreshment sample of

about 2,000 persons has been added to the data base. Initially, the sample only referred to residents in West Germany, but following German unification, the sample has been extended to the former German Democratic Republic in 1990. The GSOEP is representative of the population residing in Germany and contains a large number of socio-economic variables on demography, education, employment, income, housing and health. For the data request, only West Germany has been retained.

UK. The data set used to carry out the analysis is the Labour Force Survey. It is a survey of households living at private addresses in Great Britain. It is conducted by the Social Survey Division (SSD) of the Office for National Statistics (ONS) and by the Department of Finance and Personnel in Northern Ireland. The survey covers 60,000 households and over 150,000 individuals every quarter. The time series used in this paper comprise the period 1994-2003. We do not include previous years as LFS contains information on earnings just after 1993.

Greece. The data comes from the Household Budget Survey. This dataset is conducted in irregular time intervals (mostly every 5 years in recent years) by the National Statistical Service of Greece (NSSG). The Surveys are representative of the entire Greek population and they collect data on consumer expenditures, income and various socio-economic characteristics of the population members. The main purpose of the surveys is the collection of information for the construction of the weights used in the Consumer Price Index. In recent surveys, the employees of the NSSG interview each household for a period of 14 days (7 days in earlier surveys). Earnings information is self-reported net of income taxes and social insurance contributions. Although the purpose of the Surveys is not directly related to education, the relevant information is considered as quite reliable.

France. The French results are based on the 1990-2000 waves of the Labour Force Survey (so-called in France "Enquête Emploi"). It is a household survey conducted each year by INSEE the French statistics institute. Each data set has information on some 150,000 individuals belonging to some 80,000 households. It is a rotating panel as only a third of the sample is renewed each year. It contains information on a variety of indicators related to family background, education, employment and occupational status, though the main focus is on employment history, current employment and job search. The survey also provides information on monthly wages and working hours for the employed, so that we can construct hourly wages. Wages are given before

income tax, though net of social contributions. Since income tax in France is based on household income and depends on a variety of socio-demographic factors, net wages are impossible to determine.

Finland. The Labour Force Survey is a representative sample of the whole Finnish population. The sample has traditionally contained some 9,000 individuals aged 15-64 as stratified according to age, sex and region. Apart from these specific individual characteristics, also the information on education and income is register based. The rest of the information is self-reported through questionnaires and interviews undertaken by Statistics Finland. The LFS has the advantage of comprising a rich set of background characteristics concerning the individual and his/her job. A less satisfactory feature of the data is that it lacks the panel property, i.e. the survey sample varies from year to year. The LFS was previously conducted biannually, but from 1995 onwards it has been undertaken on an annual basis.

Portugal. We use the Portuguese Labour Force Survey. The PLFS is a quarterly survey of a representative sample of households in Portugal. Its sample size is about 45,000 individuals, and it has a rotating structure in which 1/5 of the sample is dropped randomly in each quarter. However, individuals can not be tracked over time. The IE asks individuals about their monthly net wage, age, education level, time when the first contract was obtained, sector of employment, type of contract, professional activity, hours worked, tenure, and region, among other variables, including information regarding past training activities

Norway. The results are based on the Level of Living Surveys. This dataset has a panel structure in which about 5,000 individuals are interviewed in each wave. Individuals are wage earners, aged between 16 and 67. They are asked to report the usual level of wages and hours, as well as their level of education.

Italy. The data comes from the Survey of Household Income and Wealth. This survey is conducted every two years since 1987 by the Bank of Italy. It is based on a random sample of approximately 8,000 households. It contains data on households and individuals aged between 14 and 65, including highest completed school degree, age, work experience, gender, net yearly earnings, average weekly hours of work, and family economic background.

Sweden. The data is drawn from the Swedish Level of Living Survey, conducted by the Swedish Institute for Social Research in 1968, 1974, 1981, 1991 and 2000. It is a probability sample of approximately 6,000 individuals (1/1000 of the Swedish adult population) and contains information on years of schooling, highest education level, work experience, seniority, gross monthly wages and gross and net hourly wages, sector of employment and occupation status.

Appendix B. Estimates using hourly wages

Table B1. OLS returns to education – Hourly wages

Countries	Lower Secondary	Upper Secondary	Tertiary
Germany	29.19*** (2.42)	36.70*** (2.93)	81.80*** (3.35)
UK	1.11*** (0.13)	1.83*** (0.09)	3.77*** (0.08)
Greece	10.74*** (3.96)	33.93*** (3.31)	58.46*** (3.91)
France	18.06*** (1.06)	18.52*** (0.55)	65.00*** (0.81)
Finland	12.41*** (1.72)		49.60*** (1.93)
Portugal	26.81*** (1.47)	43.29*** (1.62)	100.80*** (2.05)
Norway	1.01*** (4.37)	18.80*** (4.46)	44.98*** (5.03)
Italy	30.31*** (8.12)	56.18*** (8.20)	92.55*** (8.69)
Sweden	6.44*** (2.34)	15.43*** (3.08)	39.30*** (3.15)

Notes to Table B1: * denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level. In Finland, 'lower secondary' comprises both lower and upper secondary education.

Table B2. Inter-quantile hypothesis testing by education levels – Hourly wages

	Countries	90q equal to 10q	All quantiles equal
Germany	Lower Secondary	F(1, 1895) = 3.48*	F(4, 1895) = 4.56***
	Upper Secondary	F(1, 1895) = 0.35	F(4, 1895) = 2.28*
	Tertiary	F(1, 1895) = 0.67	F(4, 1895) = 0.58
UK	Lower Secondary	F(1, 14641) = 1.91	F(4, 14641) = 0.64
	Upper Secondary	F(1, 14641) = 20.06***	F(4, 14641) = 5.47***
	Tertiary	F(1, 14641) = 58.34***	F(4, 14641) = 30.88***
Greece	Lower Secondary	F(1, 1885) = 0.12	F(4, 1885) = 0.49
	Upper Secondary	F(1, 1885) = 0.21	F(4, 1885) = 0.62
	Tertiary	F(1,1885) = 0.30	F(4, 1885) = 0.31
France	Lower Secondary	F(1, 21142) = 60.80***	F(4, 21142) = 15.86***
	Upper Secondary	F(1, 21142) = 99.86***	F(4, 21142) = 33.15***
	Tertiary	F(1, 21142) = 563.98***	F(4, 21142) = 191.01***
Finland	Secondary	F(1, 5589) = 1.21	F(4, 5589) = 2.74**
	Tertiary	F(1, 5589) = 3.13*	F(4, 5589) = 3.15**
Portugal	Lower Secondary	F(1, 5738) = 31.18***	F(4, 5738) = 12.90***
	Upper Secondary	F(1, 5738) = 23.61***	F(4, 5738) = 11.78***
	Tertiary	F(1, 5738) = 14.00***	F(4, 5738) = 6.87***
Norway	Lower Secondary	F(1, 974) = 0.63	F(4, 974) = 0.24
	Upper Secondary	F(1, 974) = 0.38	F(4, 974) = 0.28
	Tertiary	F(1, 974) = 5.37**	F(4, 974) = 2.82**
Italy	Lower Secondary	F(1, 2116) = 0.06	F(4, 2116) = 0.37
	Upper Secondary	F(1, 2116) = 0.02	F(4, 2116) = 0.52
	Tertiary	F(1, 2116) = 0.22	F(4, 2116) = 0.70
Sweden	Lower Secondary	F(1, 1006) = 0.46	F(4, 1006) = 0.99
	Upper Secondary	F(1, 1006) = 9.39***	F(4, 1006) = 3.41***
	Tertiary	F(1, 1006) = 29.53***	F(4, 1006) = 11.34***

Notes to Table B2: * denotes significant at the 10% confidence level, ** denotes significant at the 5% confidence level, *** denotes significant at the 1% confidence level.

References

Abadie, A. (1997), Changes in Spanish Labor Income Structure during the 1980's: A Quantile Regression Approach, *Investigaciones Económicas* 21(2), 253-272.

Asplund, R. and L. Leijola (2005), Education and Wage Inequality in Finland: A Review of the Empirical Literature, in Asplund, R. and E. Barth (eds), *Education and Wage Inequality in Europe: A Literature Review*, The Research Institute of the Finnish Economy ETLA, Series B209, Helsinki.

Barro, R.J. (2000), Inequality and Growth in a Panel of Countries, *Journal of Economic Growth* 5, 5-32.

Barth, E. and M. Roed (2002), Do We Need all that Higher Education?, in Asplund, R. (ed.), *Education and Earnings: Further Evidence from Europe*, The Research Institute of the Finnish Economy ETLA, Series B183, Helsinki.

Ben Abdelkarim, O. and A. Skalli (2005), Educational and Economic Inequality in France: A Survey of the Literature, in Asplund, R. and E. Barth (eds), *Education and Wage Inequality in Europe: A Literature Review*, The Research Institute of the Finnish Economy ETLA, Series B209, Helsinki.

Buchinsky, M. (1994), Changes in the US Wage Structure 1963-1987: Application of Quantile Regression, *Econometrica* 62, 405-458.

Buchinsky, M. (1998), Recent advances in quantile regression models: a practical guideline for empirical research. Journal of Human Resources 33, 88-126.

Chevalier, A., G. Lanot, I. Walker, and P. Woolley (1999), The Returns to Education in the UK, in *Returns to Human Capital in Europe – A Review of the Literature*, R. Asplund and P. Telhado (eds), ETLA, Helsinki.

De Gregorio, J. and J. Lee (2002), Education and Income Inequality: New Evidence from Cross-Country Data, *Review of Income and Wealth* 48(3), 395-416.

Dolton, P. and M. Silles (2001), *Over-education in the Graduate Labour Market: Some Evidence from Alumni Data*, Centre for the Economics of Education, Discussion Paper Series, 9.

EUROSTAT (2003), *Labour force survey results 2002*, European social statistics, Luxembourg, Office for Official Publications of the European Communities, 2003.

Gosling, A., S. Machin and C. Meghir (2000), The changing distribution of Male Wages in the UK, *Review of Economic Studies* 67, 635-666.

Harmon, C., V. Hogan and I. Walker (2003), Dispersion in the Economic Return to Schooling, *Labour Economics* 10, 205-214.

Hartog, J. (2000), Over-education and earnings: where are we, where should we go, *Economics of Education Review* 19, 131-147.

Hartog, J., P. Pereira and J.A. Vieira (2001), Changing Returns to Education in Portugal during the 1980s and Early 1990s: OLS and Quantile Regression Estimators, *Applied Economics* 33, 1021-2037.

Hartog, J., H. van Ophem and S. Bajdechi (2004), *Investment in education in seven nations – return and risk*, Discussion Paper, Amsterdam.

Koencker, R. and G. Basset (1978), Regression Quantiles, *Econometrica* 46, 33-50.

Machado, J. and J. Mata (1997), Earning functions in Portugal 1982-1994: evidence from quantile regressions, *Empirical Economics* 26, 115-134.

Machado, J. and J. Mata (2005), Counterfactual Decomposition of Changes in Wage Distributions using Quantile Regression, *Journal of Applied Econometrics* 20(4), 445-465.

OECD (2003), *OECD Education at a Glance*, Anex 3: Sources methods and technical notes 2003 edition. OECD: Paris.

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

Pereira, P.T. and P.S. Martins (2002b), *Education and Earnings in Portugal.* Bank of Portugal Conference Proceedings 2002.

Pereira, P.T. and P.S. Martins (2004), Does Education Reduce Wage Inequality? Quantile Regressions Evidence from Fifteen European Countries, *Labour Economics*, 11(3), 355-371.

Prasad, E. (2000), The Unbearable Stability of the German Wage Structure: Evidence and Interpretation, International Monetary Fund Working Paper 00/02

Sloane, P. J. (2002), *Much Ado About Nothing? What does the Over-education Literature really Tell Us?* Keynote Address, International Conference on Over-education in Europe: What Do We Know? 22-23 November, Berlin.

Sullivan, D. and T.M. Smeeding (1997), Educational Attainment and Earnings Inequality in Eight Nations, *International Journal of Education Research* 27(6), 513-526.

Tsakloglou, P. and I. Cholezas (2005), Education and Inequality in Greece: A Literature Review, in Asplund, R. and E. Barth (eds), *Education and Wage Inequality in Europe: A Literature Review*, The Research Institute of the Finnish Economy ETLA, Series B209, Helsinki.