Schooling, Wage Risk and Inequality*

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Abstract: We analyse the dispersion of returns to education at sixteen Western countries during the mid-nineties by running quantile regressions of Mincer equations, with a view to addressing the link between schooling and wage risk and within-levels inequality. We find a stylised fact: returns to schooling increase over the wage distribution in an overwhelming majority of countries. Moreover, our cross-country analysis suggests that average returns are positively correlated to the education-related wage risk. These findings are consistent with the existence of over-education and/or of a positive interaction between ability and schooling. Overall, they cast some doubts on the inequality-reducing scope attributed to schooling.

Keywords: Returns to Education, Wage Inequality, Wage Risk

JEL codes: C29, D31, I21, J24

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1. Introduction

Returns to education have been thoroughly analysed in the labour economics literature. This is understandable as the pay-off to schooling is important information for both public and private decisions on how much to invest in the sector (see Card (1999) for a survey of recent findings). However, although the investment interpretation to educational choices has been underlined – namely since the seminal work by Becker (1964) – hardly any research has been done on the riskiness of such investments.

This is surprising to the extent that microeconomic theory has devoted great attention to the uncertainty surrounding investments outcomes, namely within the framework of asset markets. Furthermore, it is clear there are several factors which should make schooling a reasonably unpredictable investment: the large number of years spent in schooling, the evolving labour demand for the skills acquired, the interactions with the independent choices of other individuals, etc.

To our knowledge, only Orazem and Mattile (1991) address this issue, although in a different approach. They study occupational and educational choices acknowledging that these are subject to uncertainty regarding future earnings. Their empirical results are consistent with the view that career choices are subject to risk averse behaviour.

Another related issue concerns wage inequality. After witnessing major increases in the spread of wages since the early 1980s,[3] some Western decision-makers have portrayed schooling as the best tool to erode the supposedly globalisation-related forces that increase wage inequality. As Ashenfelter and Rouse (2000, page 111) put it, "The school is a promising place to increase the skills and incomes of individuals. As a result, educational policies have the potential to decrease existing, and growing, inequalities in income".

This line of thought carries with it the presumption that new highly-educated cohorts will benefit from such levels' traditionally high returns. However, this approach disregards whether such levels are characterised by reasonably concentrated or disperse returns. If the latter situation turns out to be the most representative, then one should acknowledge the potential problems concerning within-levels inequality of educational policies designed to erode wage dispersion. Moreover, the scarce evidence available suggests that "differences in the extent of earnings inequality among high-income countries are heavily influenced by the rewards for educational attainment" (Sullivan and Smeeding (1998)).

[3] See Katz and Murphy (1992) and Juhn et at. (1993) for a description of the US case and some tentative explanations.

Our aim with this paper is then to make a first attempt at filling in these twofold gaps by drawing on quantile regression estimates of returns to education. This approach allows us to assess the differences in terms of the schooling-related pay increment across the wage distribution. We therefore compare the returns to education for the "poor" and the "rich" (conditional on their schooling). Furthermore, we provide comparable evidence for a large number of countries.

The paper is structured as follows. Section 2 outlines the quantile regression methodology. The following section describes the data sets used and provides comparable descriptive statistics for the sixteen countries analysed. Section 4 describes the results obtained and the following section discusses them. Finally, Section 6 concludes.

2. Quantile regressions

> *'"On the average" has never been a satisfactory statement with which to conclude a study on heterogeneous populations. Characterisation of the conditional mean constitutes only a limited aspect of possibly more extensive changes involving the entire distribution.'*
>
> Buchinsky (1994, page 453)

An ordinary least squares (OLS) regression is based on the *mean* of the conditional distribution of the regression's dependent variable. This approach is used because one implicitly assumes that possible differences in terms of the impact of the exogenous variables along the conditional distribution are unimportant.

However, this may prove inadequate in some research agendas. If exogenous variables influence parameters of the conditional distribution of the dependent variable other than the mean, then an analysis which disregards this possibility will be severely weakened (see Koenker and Bassett, 1978). Unlike OLS, quantile regression models allow for a full characterisation of the conditional distribution of the dependent variable.[4]

The quantile regression model can be written as:

$$(1) \qquad \ln w_i = x_i b_q + u_{qi} \quad \text{with} \quad \text{Quant}_q(\ln w_i | x_i) = x_i b_q$$

[4] See Abadie et al (1999) for a recent extension of quantile regressions, considering instrumental variables.

where x_i is the vector of exogenous variables and b_q is the vector of parameters. $\text{Quant}_q(\ln w|x)$ denotes the q th conditional quantile of $\ln w$ given x. The q th regression quantile, $0<q<1$, is defined as a solution to the problem:

$$(2) \qquad \min_{b\in R^k}\left\{\sum_{i:y_i\geq x_i b} q\left|\ln w_i - x_i b_q\right| + \sum_{i:y_i<x_i b}(1-q)\left|\ln w_i - x_i b_q\right|\right\}.$$

This is normally written as:

$$(3) \qquad \min_{b\in R^k}\sum_i r_q(\ln w_i - x_i b_q),$$

where $r_q(e)$ is the check function defined as $r_q(e)=qe$ if $e\geq 0$ or $r_q(e)=(q-1)e$ if $e<0$.

This problem does not have an explicit form but can be solved by linear programming methods. Standard errors are obtainable by bootstrap methods.

The least absolute deviation (LAD) estimator of β is a particular case within this framework. This is obtained by setting θ=0.5 (the median regression). The first quartile is obtained by setting θ=0.25 and so on. As one increases θ from 0 to 1, one traces the entire distribution of y, conditional on x.

Summing up, quantile regressions provide snap-shots of different points of a conditional distribution. They therefore constitute a parsimonious way of describing the whole distribution and should bring much value-added if the relationship between the regressors and the independent variable evolves across its conditional distribution.

So far, the returns-to-education literature has imposed that such relationship is unchanged at different points of the conditional distribution. In so doing, it has precluded any wage risk to be associated to education. Similarly, it has left unaddressed the possible impact of schooling upon inequality, through its within-levels inequality component. These are the assumptions we test, by using quantile regression estimates, in the next two sections.

3. Data-sets description

The results for each country considered here were derived from a specific cross-section data set used by each country's team. Table 1 describes such data sets, referring the year for which the information applies and also the number of observations used. In the appendix we provide a more through description of these data sources.

[Table 1 approximately here]

Most data sets are household surveys. The exceptions are administrative registers (the case of Denmark), labour-market surveys (France) and employer-based data sets (Netherlands, Portugal and Spain). The number of observations used varies reasonably, ranging from fewer than 2,000 (Finland, Ireland, Norway and Sweden) to more than 20,000 (Netherlands, Portugal, Spain and the US). For reasons explained below, we have only used information on male workers.

All countries draw on gross wages as the measure of earnings. The exceptions are Austria, Greece and Italy, which use net wages instead, as this was the single type of evidence available. This difference in types of wages may be important, on account of the progressivity of tax systems, and thus trouble the comparability of the results. This will be bore in mind in the following stages of the paper.

Table 2 presents descriptive statistics from each country's data set. Most countries exhibit levels of average schooling above ten years, the highest value being that of Switzerland (13,2). The lowest are those of Portugal and Spain, with 6,5 and 8,8 years of average schooling, respectively. Average experience (measured as age – schooling – 6) is generally above 19 and below 22 years. There are a few exceptions, namely Portugal and Spain, with much higher levels (24,5 and 26, respectively), which is not surprising given their low levels of average schooling.

[Table 2 approximately here]

The means and the standard deviations of the logarithm of hourly wages are also reported. However, they cannot be compared in a straightforward manner as they are based on different currencies (and slightly different years). The same applies to the hourly wages at the first, fifth and ninth deciles. We used this evidence in Table 3, where we report simple inequality measures, such as the ratios between wages at different deciles.

[Table 3 approximately here]

In the first column of Table 3, where the ratio of ninth and first deciles' wages are reported, such figures are generally between two and three. The exceptions are the UK (3,33), US (3,45), Greece (3,62), Spain (3,94), Portugal (4,58) and Ireland (4,74).[5] Comparing the second and the third column, it can also be seen that in most countries the largest share of the ninth-first deciles inequality is bore by the top half of the distribution (ninth-fifth deciles), the exceptions being Greece, Ireland and the US.[6]

4. Empirical results

The empirical results were obtained by regressing the following version of the Mincer equation:

$$\log yh_i = a_q + b_q .educ_i + d_{q1}.\exp_i + d_{q2}.\exp_i^{\,2} + u_i ,$$

where i = 1, …, N (N being the number of observations for each year), θ = .1, .2, …, .9 is the quantile being analysed, *yh* is the hourly wage, *educ* is the number of schooling years[7] and *exp* corresponds to Mincer experience (age minus schooling minus school starting age). Only men working full time (35 hours or more per week) were considered. The case of women was disregarded on account of the extra complication of potential selectivity biases. [8]

As a benchmark, we first present the results obtained with the traditional OLS method.[9] In graph 1, we rank countries by their OLS return to education. As one can see in Table 4, the mean return is 7,9%, with a standard deviation of 2%. Sweden exhibits the lowest value (4%) whereas Portugal displays the highest (12,6%).

[Graph 1 and Table 4 approximately here]

In Table 5 we present the coefficients and associated standard errors for both OLS and quantile regression estimates, for each country. These results are pictured in Graphs 2.1-2.5, where we exhibit both the returns at the mean (OLS) and at different points of the wage distribution (namely the quantiles .1, .2, …, .9). The

[5] With respect to the cases of Austria, Greece and Italy, one should bear in mind that their measures of inequality should be understood as lower bounds of the true measure, as their wage figures are net of taxes, unlike those of the other countries.
[6] These overall results are generally in accordance with those presented at Gottschalk and Smeeding (1997). However, a thorough comparison is impossible as both the time period and the earnings measure covered there are different.
[7] We use information on the highest level achieved. Extra school attainment above the number of school years associated with the degree are thus disregarded.
[8] For an application of quantile regressions accounting for selectivity issues see Buchinsky (1998).
[9] See Asplund and Pereira (1999) and Harmon et al (2001) for surveys of OLS returns to education across Europe.

stylised fact that comes out from this analysis is that returns to education are higher at higher points of the (conditional) wage distribution.[10]

[Table 5 approximately here]

The Swedish case is a good example of this general result. Whereas the average return to education is of 4%, the return at the first decile is no greater than 2% and the return at the ninth decile reaches 6%. The more extreme case of this pattern is the Portuguese case. Here an average return of 13% masks a return of only 6% at the first decile and more than 15% at the last decile.

[Graphs 2.1-2.5 approximately here]

In the set of 16 countries considered here, only three do not follow this pattern: Germany, Greece and Italy. However, the latter two cases are based in net wages, which troubles a full comparison with the remaining countries. This leaves us with Germany as the single country that does not comply with the stylised fact described here.[11]

A summary graphical description of these results can be found in Graph 3. Here we only consider the returns to education at the first and ninth deciles for each country. One can see that most countries are lying on the top left part of the figure, which means that their returns at the top of the distribution (proxied by the ninth decile) are higher than those at the bottom (first decile). The clear exceptions are Germany and Greece while Denmark and Italy are relatively close to the 45-degree line that separates each situation.

[Graph 3 approximately here]

Drawing on the differences between returns to education at the first and ninth decile as a proxy for wage risk, we assessed its relationship with the mean return (see Graph 4). We found a reasonably high positive correlation of 0.59.

Furthermore, we ranked the countries by their mean returns (from the largest to the smaller) and by the spread of their quantile regression results (from the smallest to the largest). These rankings were then added and their standard deviation computed. The results, in Table 6, show that, for almost all countries, their added rankings fall in the interval defined by (average minus standard deviation, average plus

[10] This result is in accordance with previous attempts at estimating wage equations with quantile regressions, such as Fersterer and Winter-Ebmer (1999), Machado and Mata (2000) and Hartog et al (2000).
[11] With respect to the results robustness, we have run two other specifications of the Mincer regression above for the Portuguese case. In one we control also for region, tenure and firm size and in the other we include an experience-schooling interaction term. The same upward sloping pattern was found.

standard deviation). The exceptions are Switzerland (with low risk given its average returns) and Sweden and the US (with a high risk given their average return).

[Table 6 approximately here]

5. Discussion

This paper has produced two main findings. The first one is a stylised fact concerning returns to education across the wage distribution. 'Richer' workers (individuals who receive higher hourly wages conditional on their characteristics) are associated with a stronger education-related earnings increment. One possible interpretation for this result lies on over-education.[12] In fact, a situation where highly-schooled workers take jobs with a low skill requirement and consequent low pay would be consistent with these results.

A second alternative or complementary explanation may have to do with ability. In the line of the polemic results by Herrnstein and Murray (1995)[13] ability may be the most relevant force in explaining socio-economic success. Furthermore, higher schooling levels may compound this situation by enhancing the skills differential of a given population. This would lead to an interaction between schooling and ability that would result in increasingly contrasting education-related payoffs.

It is curious to note the conspicuous exception to this stylised fact mentioned above: Germany. In fact, returns to schooling are remarkably stable across the wage distribution, unlike in the other gross-wage countries. One feature which is also particular to Germany and which may be driving this result is the specific structure and *modus operandi* of the German education system (see Lauer and Steiner (2001)).

This system has been characterised by strong ability tracking, particularly at the secondary level (which corresponds to the modal educational attainment level of the German working population). Depending on whether one attends 'Hauptschule', 'Realschule' or 'Gymnasium', one gets increasingly more academic-oriented (and supposedly prestigious) education. Access to these courses depends on the proficiency demonstrated at exams. Another feature concerns vocational schools: they are attended by a large number of individuals and, more importantly, they are considered to offer high-quality skills that closely match evolving labour-market needs.

These features support both the over-education and the schooling-ability interaction interpretations put forward previously. Given that the education system makes sure that a balance is obtained between the

[12] See Hartog (2000) for a survey of the over-education literature.
[13] See Heckman (1996) for a critique of the methodology and conclusions of 'The Bell Curve'.

skills on offer and the skills on demand, one would expect there would be few workers carrying out tasks which would be suitable for workers with lower educational levels. On the other hand, the ubiquitous ability tests across the several stages of the system ensure that the spread of ability at each educational level is small, thus preventing a possible schooling-ability interaction from influencing differently the return to education at different points of the wage distribution.

The second main result of this work is the positive correlation we found between education-related wage risk and the average wage premium. This finding is consistent with standard results from the finance literature: uncertain assets must be sold with a premium with respect to no-risk assets. This is also found in our international results as countries with higher educational risk (measured by the difference in returns to education at the top and at the bottom of the wage distribution) are also characterised by higher average returns.

This finding suggests that the interpretation of schooling as an investment and the related concept of human capital (put forward by Becker (1964) and Mincer (1974)) should take a further step. Following the capital markets mechanism, human capital acquisition procedures also acknowledge the role of uncertainty and demand a premium to be compensated for that.

6. Conclusions

In this paper we analyse the dispersion of the returns to education at different Western countries during the mid-nineties, with a view to addressing the link between schooling and wage risk, on the one hand, and schooling and within-levels inequality, on the other hand. These have been issues neglected by the literature, which has assumed so far that the schooling-related earnings increment is constant across the wage distribution.

This assumption is surprising given the evidence that suggests that a unique return does not fully depict the earnings-enhancing scope associated to schooling. In light of this, Card (1998) asked, ‘Is the labour force reasonably well described by a constant return to education for all workers?’ The evidence we provide suggests that this question should be answered negatively.

In fact, we found a stylised fact over the sixteen developed countries we cover: returns to schooling increase over the wage distribution. Or, to put it differently, the earnings increment associated to schooling is higher for those individuals whose unobservable characteristics place them at the top of their conditional wage distribution.

These results suggest that the Becker-Mincer framework should be extended in order to account for uncertainty. A single return to schooling is misleading to the extent it is perceived to imply that all individuals have the same schooling-related earnings increment. Moreover, and as predicted by microeconomic theory, our cross-country analysis suggested that average returns are positively correlated to the education-related wage risk.

These findings also imply that schooling may have a positive impact upon within-group wage inequality, as the spread of returns increases for higher educational levels. One possible explanation for this is over-education (when individuals with higher schooling attainment work in jobs requiring lower skills).

Another possibility is that there is an interaction between schooling and ability, in which the most able can extract more from their schooling and the gap between the more and less able deepens for higher educational levels. Anyway, regardless of the explanation one may prefer, we believe this result rings some alarm bells at policies designed to cut wage inequality by simply investing in the attainment of higher schooling levels.

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Table 1 - Data-sets description

Country	Data-set	Year	N. Obs.
Austria	Mikrozensus	1993	7175
Denmark	Longitudinal Labour Market Register	1995	4416
Finland	Labour Force Survey	1993	1175
France	Training and Professional Qualifications + Employment Survey	1993	4606
Germany	Socio-Economic Panel	1995	?
Greece	Household Budget Survey	1994	2096
Ireland	ESRI Household Survey	1994	1903
Italy	Survey of Household Income and Wealth	1995	3441
Netherlands	Structure of Earnings Survey	1996	49805
Norway	Level of Living Survey	1995	870
Portugal	Personnel Records	1995	28055
Spain	Wage Structure Survey	1995	118005
Sweden	Level of Living Surveys	1991	1508
Switzerland	Labour Force Survey	1995	6334
UK	Family Expenditures Survey	1995	2183
USA	Current Population Survey	1995	42347

Note: See the appendix for a more detailed characterisation of the datasets.

Table 2 - Descriptive statistics

			Log Wage		Wage		
Country	**Educ.**	**Exp.**	**Mean**	**St.Dev.**	**1st dec.**	**5th dec.**	**9th dec.**
Austria	10.1	21.3	4.57	0.35	65.8	93.8	150.0
Denmark	12.0	19.4	4.97	0.36	96.5	138.4	230.4
Finland	11.4	19.5	4.16	0.38	41.9	62.1	106.1
France	11.4	21.9	10.92	0.39	19.8	29.8	54.1
Germany	?	?	?	?	?	?	?
Greece	10.1	21.9	6.93	0.64	527	1103	1907
Ireland	12.4	23.8	1.74	0.61	2.5	5.9	11.9
Italy	10.1	22.9	2.52	0.41	7.8	12.5	20.8
Netherlands	12.5	20.0	3.23	0.46	15.5	24.9	43.8
Norway	12.2	20.9	4.65	0.33	71.4	101.1	158.0
Portugal	6.5	24.5	6.42	0.61	318	531	1456
Spain	8.8	26.0	7.30	0.52	761	1410	2999
Sweden	11.8	21.5	4.45	0.31	61.0	81.0	127.0
Switzerland	13.2	19.8	3.60	0.40	23.9	35.9	60.3
UK	12.3	22.6	2.00	0.49	4.1	7.3	13.5
USA	12.6	18.5	2.33	0.47	5.5	10	19

Notes:
Results for France and Spain refer to yearly earnings.
Hourly wages for France and Spain were computing assuming 1760 hours per year.

Table 3 - Inequality computations

	Wage Ratios (1)		
Country	**9/1**	**9/5**	**5/1**
Austria	2.28	1.60	1.43
Denmark	2.39	1.67	1.43
Finland	2.53	1.71	1.48
France	2.73	1.81	1.50
Germany	?	?	?
Greece	3.62	1.73	2.09
Ireland	4.74	2.01	2.36
Italy	2.67	1.67	1.60
Netherlands	2.83	1.75	1.61
Norway	2.21	1.56	1.42
Portugal	4.58	2.74	1.67
Spain	3.94	2.13	1.85
Sweden	2.08	1.57	1.33
Switzerland	2.53	1.68	1.51
UK	3.33	1.85	1.80
USA	3.45	1.82	1.90

Notes:
(1) - Refers to 1st, 5th and 9th deciles.

Table 4 - Summary of results

Country	**OLS**	**1st dec.**	**9th dec.**	**Diff.**
Austria	9.7%	7.2%	12.8%	5.6%
Denmark	6.6%	6.3%	7.1%	0.8%
Finland	8.9%	6.8%	10.1%	3.3%
France	7.6%	5.9%	9.3%	3.4%
Germany	8.0%	8.5%	7.5%	-1.0%
Greece	6.5%	7.5%	5.6%	-1.9%
Italy	6.4%	6.7%	7.1%	0.4%
Ireland	8.9%	7.8%	10.4%	2.6%
Netherlands	7.0%	5.3%	8.3%	3.0%
Norway	6.0%	5.5%	7.5%	2.1%
Portugal	12.6%	6.7%	15.6%	8.9%
Spain	8.6%	6.7%	9.1%	2.4%
Sweden	4.1%	2.4%	6.2%	3.8%
Switzerland	9.5%	8.7%	10.6%	1.9%
UK	8.6%	4.9%	9.7%	4.8%
USA	6.3%	3.9%	7.9%	4.0%
Means	7,9%	6,5%	9,1%	2,7%
St. Dev.	2,0%	1,6%	2,6%	2,7%
Coeff. Var.	0,25	0,24	0,29	1,00

Table 5 - Quantile regressions results (coefficients and SE's)

	Austria		Denmark		Finland		France		Germany	
	1993		1995		1993		1993		1995	
0,1	0,070	0,0034	0,061	0,0026	0,066	0,0067	0,0571	0,00203	0,082	0,0045
0,2	0,075	0,0030	0,062	0,0020	0,083	0,0048	0,0652	0,00197	0,077	0,0053
0,3	0,082	0,0020	0,061	0,0016	0,080	0,0052	0,0682	0,00183	0,073	0,0032
0,4	0,087	0,0028	0,061	0,0017	0,081	0,0042	0,0728	0,00188	0,074	0,0033
0,5	0,091	0,0031	0,061	0,0021	0,088	0,0045	0,0755	0,00174	0,076	0,0033
0,6	0,098	0,0034	0,065	0,0019	0,087	0,0050	0,0809	0,00210	0,078	0,0032
0,7	0,106	0,0042	0,067	0,0024	0,092	0,0048	0,0825	0,00216	0,077	0,0030
0,8	0,113	0,0031	0,069	0,0024	0,092	0,0062	0,0840	0,00290	0,075	0,0037
0,9	0,120	0,0046	0,069	0,0041	0,096	0,0096	0,0890	0,00345	0,072	0,0044
OLS	0,093	0,0021	0,064	0,0018	0,086	0,0042	0,0733	0,00156	?	?

	Greece		Ireland		Italy		Norway		Netherlands	
	1994		1994		1995		1995		1996	
0,1	0,073	0,0072	0,075	0,0102	0,065	0,0034	0,053	0,0071	0,051	0,0014
0,2	0,063	0,0043	0,085	0,0056	0,063	0,0024	0,048	0,0043	0,054	0,0008
0,3	0,060	0,0041	0,087	0,0048	0,057	0,0021	0,051	0,0042	0,059	0,0008
0,4	0,059	0,0028	0,089	0,0040	0,057	0,0017	0,049	0,0025	0,061	0,0007
0,5	0,056	0,0027	0,099	0,0052	0,056	0,0015	0,056	0,0039	0,063	0,0007
0,6	0,056	0,0028	0,098	0,0055	0,057	0,0019	0,065	0,0044	0,066	0,0008
0,7	0,055	0,0029	0,100	0,0044	0,061	0,0020	0,069	0,0060	0,070	0,0008
0,8	0,053	0,0034	0,102	0,0032	0,065	0,0026	0,070	0,0049	0,074	0,0010
0,9	0,055	0,0047	0,099	0,0049	0,068	0,0033	0,073	0,0080	0,079	0,0013
OLS	0,063	0,0033	0,086	0,0047	0,062	0,0017	0,059	0,0039	0,068	0,0006

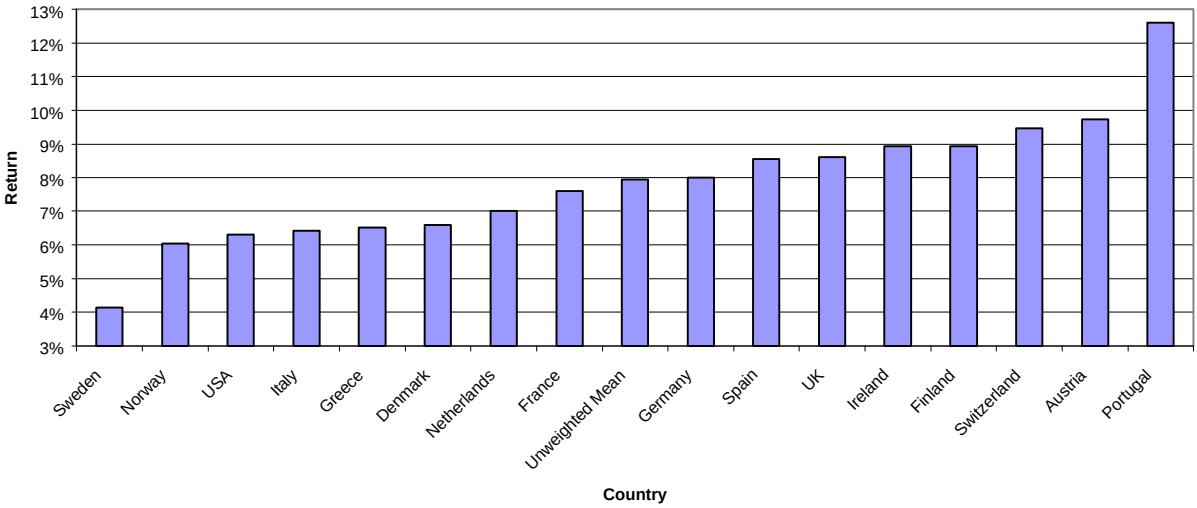
	Portugal		Spain		Sweden		Switzerland		United Kingdom	
	1995		1995		1991		1995		1995	
0,1	0,065	0,0010	0,065	0,0004	0,024	0,0027	0,084	0,0036	0,048	0,0070
0,2	0,083	0,0010	0,076	0,0004	0,028	0,0021	0,084	0,0024	0,056	0,0056
0,3	0,099	0,0009	0,083	0,0004	0,031	0,0022	0,086	0,0022	0,066	0,0053
0,4	0,112	0,0009	0,086	0,0004	0,036	0,0023	0,090	0,0016	0,071	0,0047
0,5	0,122	0,0009	0,087	0,0004	0,043	0,0026	0,092	0,0014	0,070	0,0042
0,6	0,131	0,0011	0,087	0,0004	0,045	0,0025	0,094	0,0018	0,070	0,0036
0,7	0,136	0,0012	0,087	0,0004	0,050	0,0029	0,096	0,0016	0,069	0,0040
0,8	0,140	0,0013	0,087	0,0005	0,055	0,0036	0,100	0,0020	0,075	0,0049
0,9	0,145	0,0017	0,087	0,0006	0,060	0,0044	0,101	0,0026	0,092	0,0060
OLS	0,119	0,0009	0,082	0,0003	0,041	0,0022	0,090	0,0019	0,083	0,0041

	USA	
	1995	
0,1	0,039	0,0012
0,2	0,050	0,0012
0,3	0,057	0,0011
0,4	0,065	0,0012
0,5	0,068	0,0010
0,6	0,072	0,0009
0,7	0,074	0,0010
0,8	0,075	0,0010
0,9	0,076	0,0015
OLS	0,061	0,0008

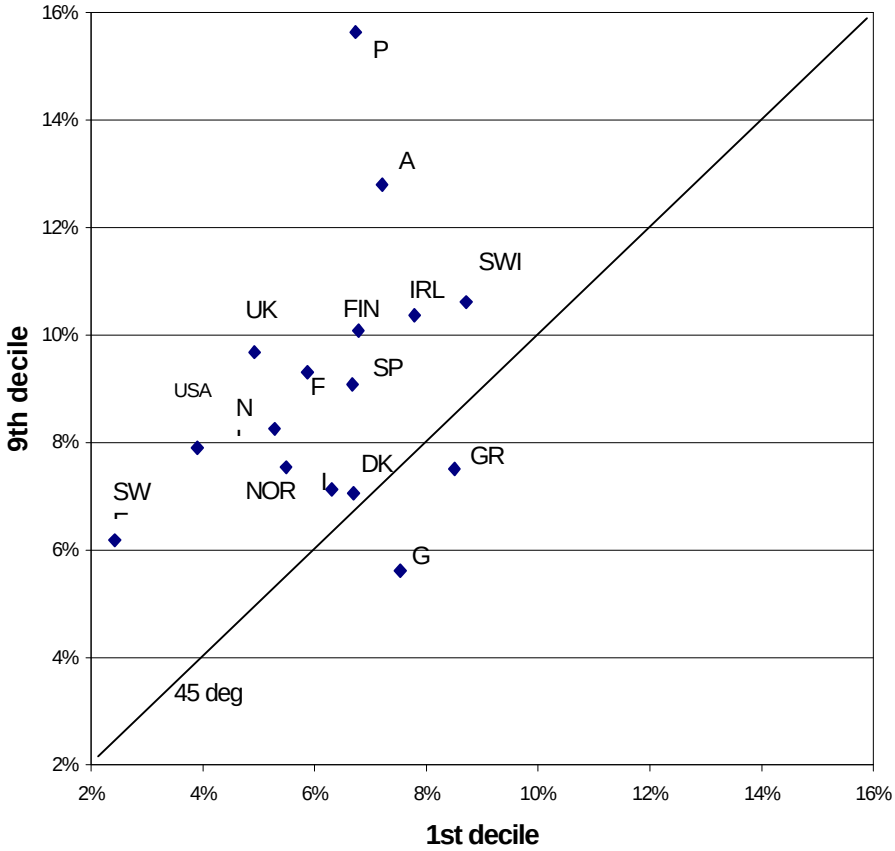
Table 6 - Rankings of mean and quantile returns

	OLS	Rank 1	Diff	Rank 2	Sum
Portugal	12,6%	1	8,9%	16	17
Austria	9,7%	2	5,6%	15	17
Switzerland	9,5%	3	1,9%	5	8
Ireland	8,9%	4	2,6%	8	12
Finland	8,9%	5	3,3%	11	16
Spain	8,6%	6	2,4%	7	13
UK	8,6%	7	4,8%	14	21
Germany	8,0%	8	-1,0%	2	10
France	7,6%	9	3,4%	10	19
Netherlands	7,0%	10	3,0%	9	19
Greece	6,5%	11	-1,9%	1	12
Denmark	6,6%	12	0,8%	4	16
Italy	6,4%	13	0,4%	3	16
US	6,3%	14	4,0%	13	27
Norway	6,0%	15	2,1%	6	21
Sweden	4,1%	16	3,8%	12	28
Average					17
Standard Deviation					5,5

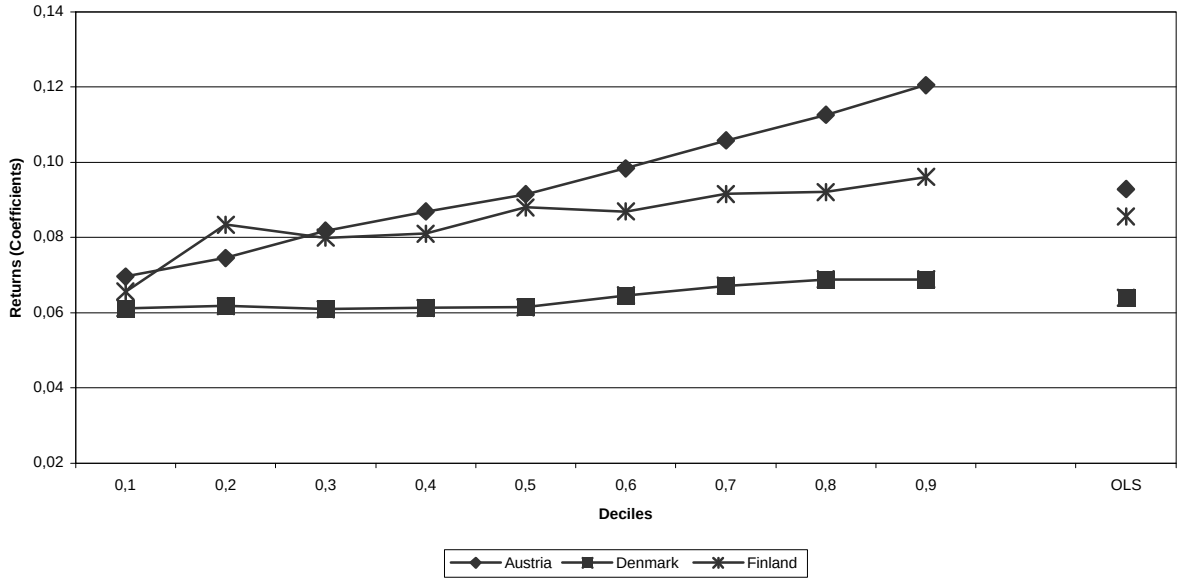
Graph 1 - Returns to Education, OLS



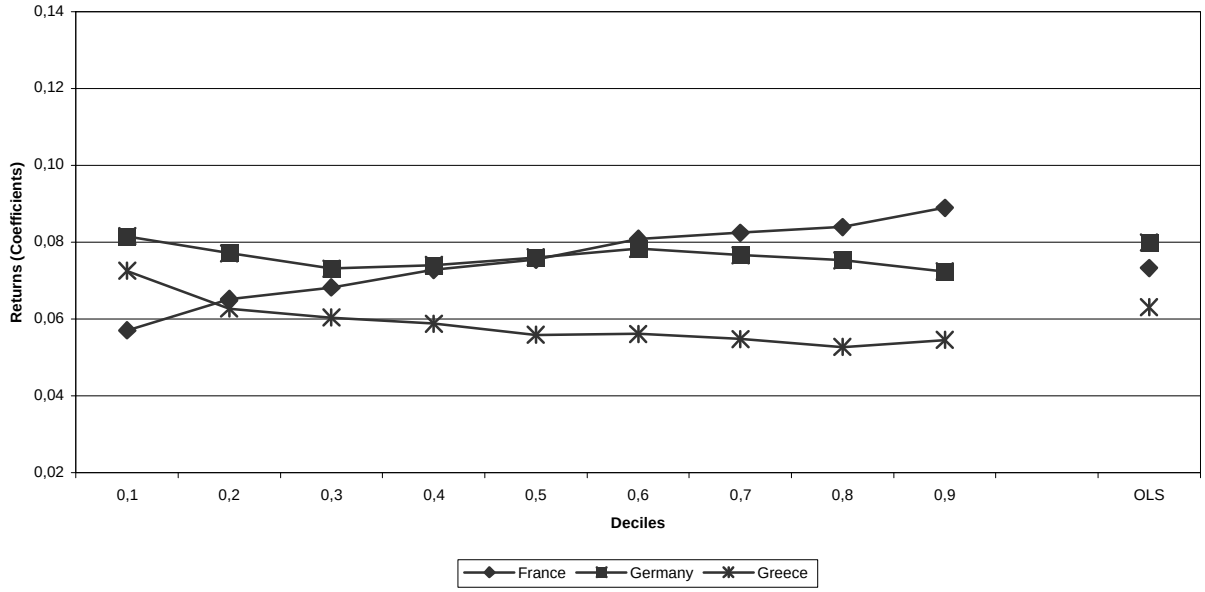
Graph 3 - Returns to Education, Quantile Regressions



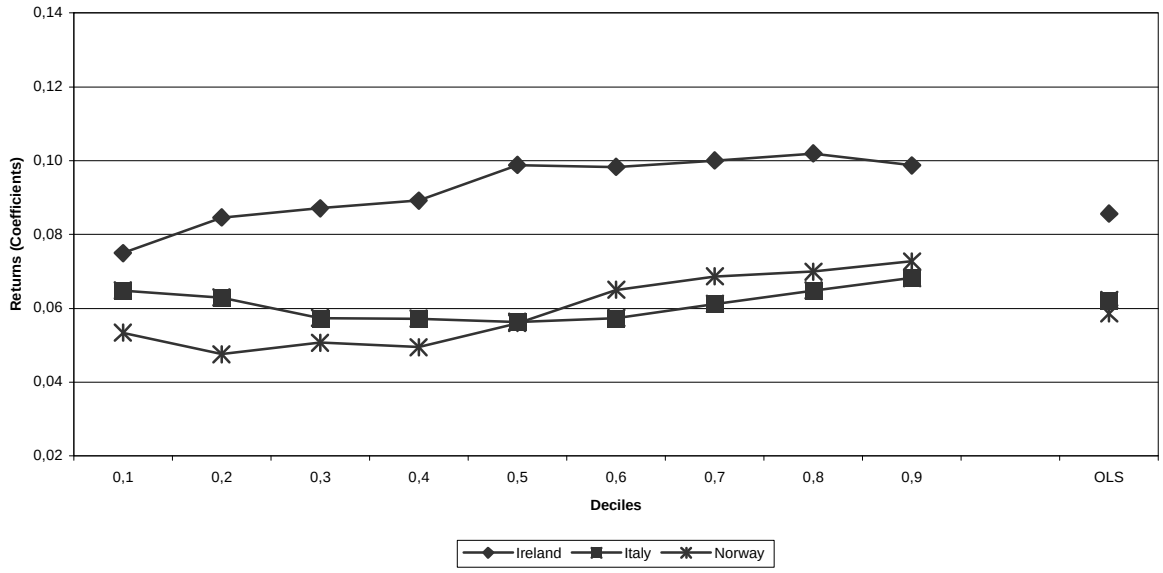
Graph 2.1 - Returns to Education, QR and OLS



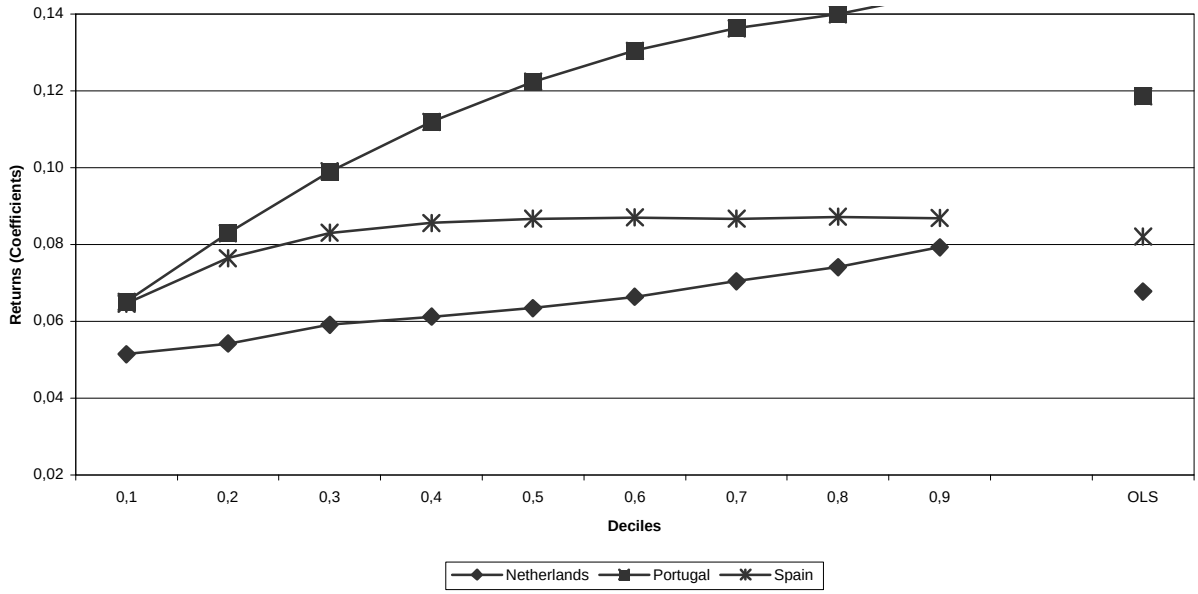
Graph 2.2 - Returns to Education, QR and OLS



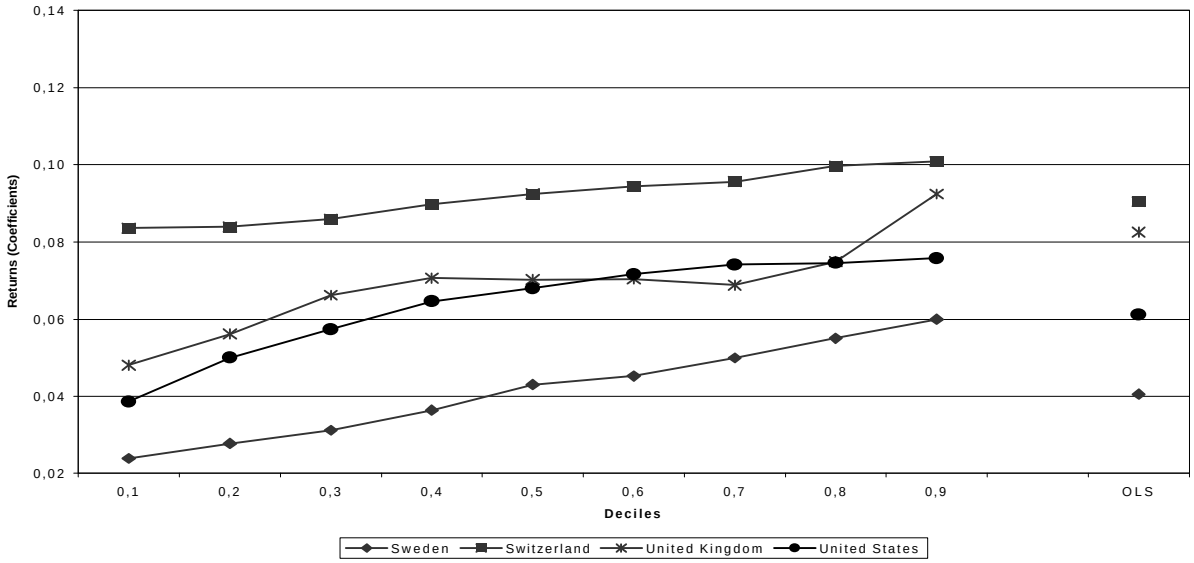
Graph 2.3 - Returns to Education, QR and OLS



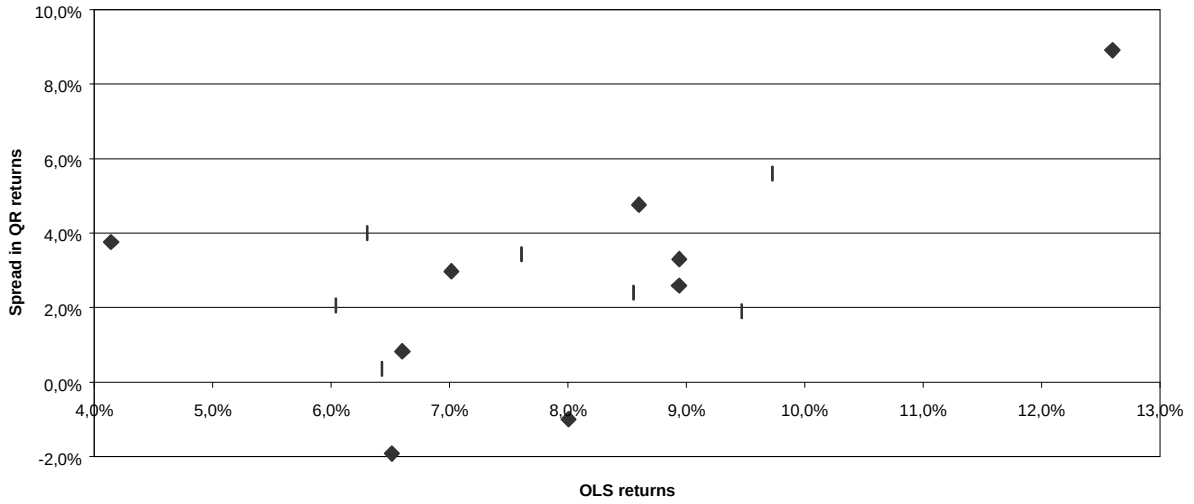
Graph 2.4 - Returns to Education, QR and OLS



Graph 2.5 - Returns to Education, QR and OLS



Graph 4 - Spread in QR returns and OLS returns to education



Appendix – Description of data sets used.

AUSTRIA: Mikrozensus. A representative 1% household survey, including detailed information about human capital variables. Information on net monthly earnings. Contains information about the highest level of schooling achieved. Years of schooling can easily be identified up to the secondary level. Completing the tertiary level is assumed to last 17 years, so students are on average 4 to 5 years at university. As there is no information about actual work experience or years of work interruption the potential experience is defined as (age – years of schooling – 6). All employees (white-collar, blue-collar and civil servants) aged between 15 and 65 years are included in the sample. Apprentices have been eliminated from the analysed population.

DENMARK: Longitudinal Labour Market Register. A random 0,5% sample of the adult population, covering the years 1976-1995. All information in LLMR is drawn from administrative registers and is merged by Statistics Denmark. Estimations are based on people aged 16-64.

FINLAND: Finnish Labour Force Survey. Compiled by Statistics Finland. 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 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 earnings concept refers to the individual's average gross hourly wage as calculated from tax record information on taxable annual earnings and self-reported numbers of months and normal hours worked. The annual earnings comprise all kinds of compensation, such as overtime and vacation pay. The gross hourly wage appearing in the estimations reported in subsequent sections is exclusive of fringe benefits. The education acquired by each individual is according to the register of degrees and examinations compiled by Statistics Finland and based on information collected annually from educational institutions. The register gives the single highest education completed by the individual.

FRANCE: Training and Professional Qualifications. Survey conducted by INSEE, the French national statistics institute. Richest French data set in terms of initial as well as post-school education and their professional outcomes. Because of the 8-years periodicity of FQP, the household survey called *Enquête Emploi* (Employment Survey) is also used. Both FQP and Emploi contain the actual number of years of schooling as well as individuals' highest qualifications, but only FQP gives detailed information on individuals' educational record and family background. On the other hand, FQP and Emploi provide direct information on individuals' gross earnings, excluding their contribution to social expenses, as these are, in general, directly paid by the employer. However, in FQP, only gross annual earnings are available, while in Emploi, gross monthly earnings as well as the usual number of weekly work hours are provided. As a result, gross hourly earnings can be calculated from Emploi as monthly gross earnings divided by four times the usual weekly worked hours. Therefore, the results drawn from FQP and Emploi are based on gross annual earnings and gross hourly wages respectively, excluding individuals' social expenses.

GERMANY: German Socio-Economic Panel. Longitudinal household survey conducted on a yearly basis. Detailed information about income, labour market status, education and various other socio-economic variables is collected. The sample was restricted to West-German citizens. The self-employed, pensioners, military personnel, people still engaged in education or training were also excluded, as well as foreigners, whose educational background may fundamentally differ from that of German people.

GREECE: Household Budget Surveys (1993/94). The only data set available which covers in a consistent way the entire labour force over the last twenty-five years and contains income information. Carried out by the national statistical service of Greece. They cover the entire non-institutional population of the country and their sampling fraction is 2‰. They contain detailed information about consumption expenditures, incomes and socio-economic characteristics of the households and their members. The income component reported in the surveys and used in the paper is "earnings net of income taxes and

social insurance contributions". It includes wages, salaries, overtime payments, bonuses, holiday payments, and related benefits received from the main and secondary employer, normalised on a monthly basis. Further, the surveys report the number of hours normally worked by each worker per week. Division of monthly income adjusted on a weekly basis by this figure yields "net hourly earnings". Information on education is provided in grouped form – "highest level of education completed" – and the continuous education variable is created assuming that primary education lasts six years, lower secondary, upper secondary and technical tertiary education three years each and university education four years. As there is no information on actual working experience potential experience is calculated as "age–years in education–6". The samples used in the paper consist of employees outside the agricultural sector aged 14-64. Thus, self-employed, employers, unpaid family members and apprentices are excluded. Persons who declared as "normal" working time more than 84 hours per week and persons with incomes from self-employment as well as paid employment were excluded.

IRELAND: Household Survey. Carried out by the Economic and Social Research Institute (ESRI), in 1994. First wave of the Irish part of the European Community Household Panel. Information for 4,048 households and over 8,500 individuals. Rich survey with regards to labour market experience, providing the authors with a measure of actual experience along with a very comprehensive list of current gross earnings, deductions and net earnings. Includes a measure of the number of schooling years and the highest level of education attained. The Census of Population provided a means to check the demographic characteristics of the ESRI survey data and there is a high level of confidence in the reliability of the data, in terms how representative it is of the population. Also, the earnings data closely corresponds to that of figures by the Labour Force Survey.

ITALY: Survey of Household Income and Wealth. Conducted by the Bank of Italy. Based on a random sample of approximately 8,000 households per year, and is available from 1977 annually and at odd years after 1987. It contains information both on households (family composition) and on individuals. This information includes the highest completed school degree, gender, age, potential and actual work experience, net yearly earnings, average weekly hours of work and number of months of employment per year. It also contains information on family background (the education, age, occupation and sector of parents). There are no other nationally representative surveys in Italy that cover the same range of information. The sample is restricted to non-agricultural employees aged from 14 to 65.

NETHERLANDS: Structure of Earnings Survey of the Dutch Central Bureau of Statistics. Until 1979, the Structure of Earnings Surveys were large cross-sectional employer surveys in which information on gross earnings, educational level, sex, age, and industry of employees was gathered. In the 1985 and 1989 versions, the same information was obtained by gathering additional educational information for a subsample of the yearly "Wage Survey", which is an employer survey in which normally no information on education is asked. The 1995 version of the Structure of Earnings Survey was created by combining information at the individual level of three different data sources: the 1995 "Employment and Wages Survey", the 1995 "Insured Persons Register", and the 1994-1996 "Labour Force Surveys".

NORWAY: Level of Living Surveys. Ongoing project at Statistics Norway, surveying a sample of the Norwegian adult population. Panel survey, adding young persons in every wave. Every LLS contains about 5,000 individuals, comprising around 2,500 wage observations. The analysis is limited to wage earners, 16-67 years of age. The *wage variable* is calculated as reported monthly/weekly/hourly gross wage, divided by the number reported weekly hours. The individuals are asked to report their *usual* level of wages and hours – including usual level of overtime. The *level of education* is based on a three or five digit code of highest completed education. In the surveys from 1989 and onwards, the educational variable is merged from administrative registers (5-digit code).

PORTUGAL: Personnel Records. Every year since the late 1970s, all firms, either private or public, are obliged by the Ministery of Employment to fill in a table that asks for data concerning every employee and also detailed firm-specific information. Panel information available since 1991. Observations for which no information on earnings, hours worked or schooling attainment was available were dropped. Imputation of

schooling years by assuming that individuals needed the minimum required years of schooling to achieve their degrees and that they did not attended further years of schooling.

SPAIN: Wage Structure Survey 1995. Employer survey of 175.000 wage earners, which contains an important amount of characteristics related to each worker (qualification, tenure, type of contract, type of job, sector, firm size, and so on). Wages are gross and net and they are provided on hourly, monthly and annual basis. All surveys were purged dropping those observations with wages below minimum wage and age below 18 or above 65.

SWEDEN: Swedish Level of Living Survey, 1991. SLL surveys are the most widely used Swedish data sets for wage equations. SLLS contains about 6000 randomly sampled people between ages 16 and 75 (18-75 for 1991), where the primary sample from 1968 constitutes the base for these surveys: 1974, 1981, and 1991. The non-response rate has increased over time, from nine per cent in 1968 to roughly 20 per cent in 1991. Examples of available variables in SLLS are: years of schooling, highest educational level and field, work experience, seniority, gross and net hourly wage (constructed from weekly, monthly or annual earnings), working conditions, sector of employment, occupational status, parental occupation and education.

SWITZERLAND: Swiss Labour Force Survey. Main data source for labour-market related questions in Switzerland. Produced annually by the Swiss Federal Statistical Office since 1991. The sample of 32000 in 1995 is representative for the adult population (older than 15 years) permanently living in Switzerland. The data are collected by telephone interviews. The available information on earnings, paid holidays and working hours per week allows us to calculate an hourly wage rate. Years of schooling are deducted from the highest educational level achieved by imputing the theoretical number of years of full-time education necessary to attain a certain degree.

UNITED KINGDOM: Family Expenditure Survey. Random sample of approximately 7000 households each year, available since the 1960's. In addition to education and earnings FES contains some information relating to union status and has smoking and other expenditures. Refers to Great Britain (i.e UK excluding Northern Ireland).

UNITED STATES: Current Population Survey. Monthly household survey used to address labour-market related issues, e.g. unemployment rates.