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EDUCATION IN EUROPE: EARNINGS INEQUALITY, ABILITY AND UNCERTAINTY

Ioannis Cholezas

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Research Fellow
Centre of Planning and Economic Research, Athens, Greece
e-mail for correspondence: ichol@kepe.gr

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«Education in Europe: earnings inequality, ability and uncertainty»

Ι.ΧΟΛΕΖΑΣ

Περίληψη

Η μελέτη αυτή επιχειρεί να διερευνήσει το ρόλο της εκπαίδευσης στην ανισότητα των αποδοχών με τη βοήθεια ποσοστιαίας παλινδρόμησης. Ειδικότερα, εκτιμούμε τις ιδιωτικές αποδόσεις της ανώτερης δευτεροβάθμιας και της τριτοβάθμιας εκπαίδευσης κατά μήκος της κατανομής των αποδοχών για δεκατρείς ευρωπαϊκές χώρες χρησιμοποιώντας το European Community Household Panel (ECHP). Τα αποτελέσματα δείχνουν ότι -ceteris paribus- ο ρόλος της εκπαίδευσης στη διαμόρφωση της ανισότητας των αποδοχών είναι μάλλον περιορισμένος, εφόσον οι διαφορές των εκτιμημένων αποδόσεων της εκπαίδευσης στα διάφορα σημεία της κατανομής των αποδοχών είναι στατιστικά μη σημαντικές, ενώ παράλληλα εξαρτάται σε μεγάλο βαθμό από το εκπαιδευτικό επίπεδο και το φύλο. Για να ακριβολογούμε, στην πλειοψηφία των χωρών η τριτοβάθμια εκπαίδευση φαίνεται να αυξάνει την ανισότητα των αποδοχών μεταξύ τόσο των ανδρών και να την μειώνει μεταξύ των γυναικών αποφοίτων όπου η επίδραση είναι λιγότερο ξεκάθαρη και ισχυρή. Αντίστοιχα, προκύπτει ότι η ανώτερη δευτεροβάθμια εκπαίδευση έχει πιο σύνθετο ρόλο, καθώς φαίνεται να αυξάνει την ανισότητα των αποδοχών μεταξύ των ανδρών αποφοίτων (σε μικρότερο βαθμό συγκριτικά με την τριτοβάθμια εκπαίδευση) και να τη μειώνει μεταξύ των γυναικών αποφοίτων (πιο ξεκάθαρη και ισχυρή επίδραση σε σύγκριση με την τριτοβάθμια εκπαίδευση). Επιπλέον, με βάση την υπόθεση ότι τα ικανότερα άτομα θα βρίσκονται υψηλότερα στην κατανομή των αποδοχών, τα αποτελέσματα συνηγορούν στο συμπέρασμα ότι η εκπαίδευση και οι έμφυτες ικανότητες ενός ατόμου λειτουργούν συμπληρωματικά για τους άνδρες (κατά κανόνα υψηλότερες αποδόσεις για εκείνους που βρίσκονται υψηλότερα στην κατανομή των αποδοχών), αλλά ως υποκατάστατα για τις γυναίκες (κατά κανόνα χαμηλότερες αποδόσεις για εκείνες που βρίσκονται υψηλότερα στην κατανομή των αποδοχών). Τέλος, όσον αγορά στην αβεβαιότητα που εμπεριέχεται στην επιλογή του εκπαιδευτικού επιπέδου, προκύπτει ότι οι απόφοιτοι τριτοβάθμιας εκπαίδευσης και οι άνδρες γενικά αντιμετωπίζουν μεγαλύτερη αβεβαιότητα, γεγονός που είναι σε ένα βαθμό αναμενόμενο, αν σκεφτεί κανείς το μεγάλο βαθμό ανομοιογένειας των συγκεκριμένων ομάδων αποφοίτων.

Education in Europe: earnings inequality, ability and uncertainty

Abstract

This study attempts to investigate the role of education in earnings inequality using quantiles regression. In particular, we calculate returns to upper secondary and tertiary education along the earnings distribution for thirteen European countries using the European Community Household Panel. Our results indicate that the role of education in shaping earnings inequality is rather limited, since differences of quantiles regression estimates across the earnings distribution are often statistically insignificant, and depends crucially on the level of education and gender. More precisely, in the majority of countries examined tertiary education seems to increase/decrease earnings inequality within males/females, while upper secondary education seems to increase/decrease earnings inequality within males (with minor exceptions)/females. Further, the results indicate that interestingly education and ability in the old EU are complements for males and supplements for females. Finally, regarding uncertainty involved, tertiary education graduates and males face higher uncertainty, which is to some extent expected on the grounds of different degrees of heterogeneity.

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[*] **E-mail: ichol@kepe.gr.**

I. Introduction

It is often argued that education is a public good and as such it should be heavily subsidised by the state. Those who express such views also consider education as a powerful income redistribution mechanism, since by allowing individuals to attend a higher level of education higher productivity, higher earnings and improved economic and social status is accomplished. However, existing evidence on whether education indeed reduces earnings inequality is not always clear.

In general, aggregate earnings inequality can be decomposed into two distinct components; inequality between groups and inequality within groups. In our case, groups are defined by levels of education. It is widely established by numerous studies that education affects earnings inequality between groups, since different levels of education provide different returns, thus monetary rewards.[1] But what we are mostly interested in is the role of education in shaping earnings inequality within groups. This role is confirmed by different returns to a level of education along the earnings distribution. Quantiles regression (QR) enables us to examine exactly that, namely to identify the impact of the independent variables on the dependent one, at each point of latter's distribution.

Our sample includes thirteen European countries and comes from the fourth wave (1997) of the European Community Household Panel (ECHP).[2] To our knowledge this is the first attempt to calculate returns to education across Europe using simultaneously ECHP and QR. We calculate returns to upper secondary and tertiary education by gender and country using standard mincerian semi-logarithmic earnings functions. Our argument is straightforward. If returns to a certain level of education at the top end of the earnings distribution are higher/lower than returns at the bottom end, then -ceteris paribus- education increases/decreases earnings inequality by rewarding more able graduates with higher/lower earnings.

Different returns along the earnings distribution have some additional implications, especially if earnings are considered a good proxy of ability[3]. For instance, if returns are higher at the top/bottom end of the earnings distribution, then this implies that education and ability are

[1] See, for example, Psacharopoulos and Patrinos (2002) for an international review of returns to education (social and private) by country, gender, level of education.
[2] See the following "Data and methodology section" for an explanation of the reasons we have chosen 1997 and not a latter wave.
[3] Machado and Mata (2001) and Hartog et al. (2001) make this assumption. Although it might seem bold, we assume that the individual's place along the earnings distribution is determined by a number of factors among which a key role is assumed by ability (other factors might include social networks,

complements/supplements, since higher/lower ability individuals receiving higher/lower earnings enjoy higher returns. On the other hand, variable returns to education along the earnings distribution indicate a risk involved, since individuals face a range of potential returns to education and, thus, uncertainty. Therefore, we use the standard deviation for the distribution of returns to education as a measure of risk involved in investing in education, since the more dispersed the distribution the higher the risk involved.

Section II presents studies using quantiles regression techniques, section III briefly describes the data, section IV presents the methodology adopted, section V presents the results and section VI concludes.

II. Short literature review

Quantiles regression (QR) was originally used in an effort to examine wage inequality over time[4], but soon was expanded to calculate returns to education along the earnings distribution and other issues related to education, e.g. earnings differentials[5], changes in returns to education over time, the effect of other earnings determining variables[6], while it was enriched with other estimation techniques, e.g. correcting for selectivity bias and instrumental variables[7]. Next, we present briefly a number of studies using QR. One should bear in mind that all studies consider the role of education under the hypothesis that everything else remains constant, thus ceteris paribus.

Most studies employing QR to calculate returns to education in the USA conclude that returns to education are higher at the top end of the earnings distribution and, thus, education leads to higher earnings inequality, especially among tertiary education graduates (Buchinsky, 1994, 1998a). Experience, on the other hand, seems to have the opposite effect, at least as far as older cohorts are concerned, while those at the top end of the earnings distribution consistently enjoy higher returns to tertiary education irrespective of experience (Buchinsky, 1998a). Returns to both education and experience are higher at the top/bottom end of the earnings distribution for skilled/unskilled workers, thus increasing/decreasing earnings inequality (Buchinsky, 1995). Focusing on women, the existing evidence suggests that differences in returns favour mostly those at the top end of the earnings distribution and

parental background, lack etc). Thus, on average we expect more able individuals to be higher in the earnings distribution than less able individuals.

[4] See for example Gonzalez and Miles (2001), Johnson and Kuhn (2004) and Sakellariou (2006).

[5] See for example Poterba and Rueben (1994), Reilly (1999), Bishop et al. (2004), Garcia et al. (2001), Arias et al. (2004), Sakellariou (2004), Montenegro (2001) and Gardeazabal and Ugidos (2001).

[6] See for example Eide and Showalter (1999).

[7] See for example Arias et al. (2001).

middle age groups, while inequality[8] seems to decrease over time (Buchinsky, 1998b). In addition, according to Buchinsky (2001), returns to education for young women show an upward trend over time, but at a higher pace at the top end of the earnings distribution. This leads to the reversal of the role of education through time, which by the 1990 seems to favour those at the top end of the earnings distribution.

Another group of studies covers various European countries. Machado and Mata (2001) and Hartog et al. (2001) focus on Portugal and conclude that returns to education, in general, are higher at the top end of the earnings distribution (the more able individuals) and have increased faster over the years for better paid workers. Hartog et al. (2001) report twice as large returns to education for those at the top end of the earnings distribution, while the role of tertiary education on earnings inequality seems to be gender dependent (it increases/decreases inequality among females/males) contrary to primary and secondary education that both benefit mostly better paid workers. Giustinelli (2004) investigates the role of education in Italy and concludes that education and ability are substitutes/complements at lower/higher quantiles (U-shape returns to education). The same holds for secondary education, but not for tertiary education graduates who enjoy increasing returns as we move up the earnings distribution implying that education and ability are complements. Evidence from the UK provided by Walker and Zhu (2001) shows that returns to education in general are flat for males, although they increase some at the top end of the earnings distribution over time, while they are higher for better paid women suggesting education and ability are complements. As far as more educated individuals are concerned, returns in the early 1990s were higher at the bottom end of the distribution, but over time they seem to have converged across the earnings distribution. On the other hand, Denny and O'Sullivan (2004) argue that education and ability are supplements for male full time workers in the UK. In Austria, on the other hand, education and ability appear to be complements (especially when men are concerned), while returns to education in general fall over time, more so for women at the bottom end of the earnings distribution (Fersterer and Winter-Ebmer, 2003).

The issue of differential returns to education along the earnings distribution has also been examined in the context of a number of developing countries. Mwabu and Schultz (1996) argue that in South Africa the role of education on earnings inequality is race dependent, since both primary and tertiary education -ceteris paribus- reduce/boost earnings inequality within the African/whites graduates by rewarding better those at the bottom/top end of the earnings distribution. The authors claim that education and innate ability are complements

[8] The differences in returns at selected points of the earnings distribution (0.90-0.10 and 0.75-0.25) are proposed as inequality measures.

for whites, but not for Africans, due to strong race discrimination. Patrinos and Sakellariou (2006) report results for males in Venezuela similar to whites in South Africa, but the pattern is reversed for females, possibly due to discrimination or heterogeneity, suggesting -once more- a gender dependent role of education. Likewise, the pattern in Argentina (Giovagnoli et al., 2005) seems to be also gender dependent. Education and ability are also complements, since differential returns increase earnings inequality in Brazil (Stefani and Biderman, 2006; Arabsheibani et al., 2003), Chile (Montenegro, 2001) and Singapore (Sakellariou, 2006), but they seem to be supplements in Ethiopia (Girma and Kedir, 2003) and China (Knight and Song, 2003).

Comparing the role of education in Europe (15 countries) and the USA, Martins and Pereira (2004) calculate returns to education using QR in the mid 1990s using country-specific datasets. They use full-time males only and the logarithm of hourly earnings as dependent variable. Their results indicate that for the majority of countries returns to education are higher at the top end of the earnings distribution, thus -ceteris paribus- education increases inequality by rewarding better those with already higher earnings. Greece is an exception, since no particular pattern of returns to education along the earnings distribution was? found. Explanations offered by the authors include over-education, more pronounced innate ability differences among better educated individuals, differences in the quality of education and the subject of studies. In a very interesting study Patrinos, Ridao-Cano and Sakellariou (2006) estimate returns to education for sixteen Asian and Latin American countries and conclude that, unlike what is usually observed in high-income countries, the role of education on earnings inequality is not clear in middle-income countries and seems to be reversed in low-income countries, where returns are higher at the lower part of the earnings distribution. This could be explained by higher job mobility in developed countries leading to improved matching, the scarcity of skills (mostly unskilled workforce), the differential exposure to market forces and different association between pay and productivity and the differential access to quality education or distribution or quality outcomes.

III. Data and methodology

The European Community Household Panel (ECHP) is a homogeneous European survey – database. It is the first European database, which is based on output harmonisation rather than input harmonisation.[9] Practically, this means that the survey's structure, conduct and questionnaire have been harmonised ex-ante for all EU member-states. ECHP is considered a

[9] According to Ehling and Rendtel (2003) input harmonization is always ex-ante, while output harmonization can either be ex-ante or ex-post, depending on whether the survey's planning takes into account data transformation needed afterwards.

valuable source of information for researchers[10] and we have chosen it mainly for two reasons. First, it provides information on a number of issues at both individual and household level and particularly those we are interested in, such as income, education, employment, training etc. Second, it allows comparisons across countries, which was made possible by adopting common procedures at every stage of the effort; from the planning of a harmonized questionnaire to the use of harmonized definitions and sampling methods.[11]

ECHP lasted for eight consecutive years, from 1994 until 2001 giving a total of eight waves. The data we use in this study come from the fourth wave (1997) of ECHP, in order to achieve maximum homogeneity between countries.[12] We use data from thirteen EU member-countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, UK). We include in our sample full-time paid employees (more than 30 and less than 84 hours per week), since we calculate returns to education and we need to have a close connection between earnings and productivity (not guaranteed among self-employed), aged between 16 (usual age of entering the labour market) and 64 (usual age of retirement), except for the agricultural sector, which in some countries is dominated by small-to-medium size family based firms leading to rewards not directly related to productivity, for whom a complete set of information is available.

Earnings functions are estimated for males and females separately, since a single dummy could not capture the differences between sexes, using quantiles regression (QR) first introduced by Koenker and Basset (1978). QR allows one to overcome the usual drawback of ordinary least squares (OLS) estimators, which is their sensitivity to the variance of the dependent variable or, in other words, the bias caused by outliers. The usual problem of estimating a matrix of unknown parameters (β's) from a sample of independent observations referring to some random variable $Y_1,\ldots Y_T$, which follows a distribution Φ of unknown type is usually solved by assuming a normal distribution Φ (Gaussian). Koenker and Basset prove that, in most cases, when distribution Φ is unknown, estimators derived using QR are more efficient than those derived using OLS, while when Φ is normal, they are equally efficient.[13] QR minimises the sum of absolute deviations from the mean of the dependent variable at every given point at the distribution of the dependent variable. Thus, potentially different

[10] See EPUNet, ECHP User Guide, July 2004.
[11] Although not utilized in this paper, perhaps the most important feature of ECHP is its inter-temporal nature, which provides information on relationships and their transition over time at a microeconomic level. On the other hand, the most important disadvantage is sample attrition due to refusal to continue interviews, death, change of residence etc. (See Rendtel (2002) and Peracchi (2002)).
[12] Although the last ECHP wave refers to year 2001, for some countries the definition of educational levels changes unexpectedly in the fifth wave. In order to assure consistency and credibility, we have decided to use the fourth wave.

solutions at distinct quantiles may be interpreted as differences in the response of the dependent variable to changes in the regressors at various points of the dependent variable's conditional distribution.

More formally, the problem of minimising absolute deviations takes the following form:

$$\min \quad (1/n)\{\sum_{i\in\{i:Y_i\geq X_i\beta\}}\theta\,|\,Y_i - X_i\beta\,| + \sum_{i\in\{i:Y_i<X_i\beta\}}(1-\theta)\,|\,Y_i - X_i\beta\,|\} \qquad (1)$$

where Y_i is the dependent variable, X_i is a matrix of independent variables of size (κx1) with the first element equal to zero, β is a vector of estimators and θ is the quantile estimated. The vector of β'ς will differ along the quantile estimated. If $Y_i \geq X_i\beta$, then the deviation is positive or at least above the fitted line and it is weighted using (θ), while if $Y_i < X_i\beta$, then the deviation is negative or below the fitted line and it is weighted using (1-θ). Consequently, every quantile, except for the median, is estimated by weighting the residuals based on their position compared to that of the median's residual. The estimation is possible using linear programming techniques.

Finally, the resulting standard errors using QR are downward biased, since they do not take into account residuals' heteroskedasticity. Therefore, residuals are estimated using bootstrapping, which chooses bootstrap samples from the original one with replacement. For every bootstrap sample in every quantile the algorithm of linear programming provides estimators for equation (1). The mean estimators using bootstrap are used to calculate variances, $V(\beta_\theta)$, and relevant standard errors as follows:

$$V(\beta_\theta) = n/B\sum_b(\beta_\theta^b - \beta_\theta)(\beta_\theta^b - \beta_\theta)' \qquad (2)$$

where B is the number of bootstrap samples, β_θ^b is the estimator from the bootstrap iteration b and β_θ is the mean of all bootstrap estimators.

The standard mincerian earnings equation is estimated using QR:

$$\ln Y_i = \beta_j X_i + e_{ji} \qquad (3)$$

for the following points of the distribution of net hourly earnings (in logarithm and purchasing power parity, PPP): 0.10, 0.25, 0.50, 0.75 and 0.90. Two dummies for education (upper secondary and tertiary education[14]), years of potential experience[15] and its square are

[13] Koenker and Hallock (2001) compare estimators from quantiles regression (QR) and OLS and conclude that QR estimators are outside the confidence interval derived by OLS, thus the latter are not constant along the distribution of the dependent variable.

[14] Individuals with less than upper secondary education –lower secondary or basic education- is the reference group.

the independent variables. Returns to each level of education are calculated using the formula exp (β_j)-1, where β_j is the estimator.

Quantiles regression estimates result in multiple returns to education (a distribution of returns to be exact) according to the individual's position on the earnings distribution. This allows us to investigate three interesting issues. First, the role of education on earnings inequality within groups of individuals formed based on certain characteristics, such as education. One should bear in mind that all the analysis that follows leads to conclusions on the assumption that everything else remains constant (ceteris paribus). Therefore, when returns to education are higher/lower at the top end of the earnings distribution, then -ceteris paribus- education tends to increase/decrease within groups earnings inequality. Second, we are able to investigate how education and ability are connected. For instance, if returns are higher/lower at the top end of the earnings distribution, then education and ability are complements/supplements, based on the assumption that higher earnings are directly related to higher innate ability. Third, differential returns along the earnings distribution involve a risk/uncertainty associated with investing in education, which should be added to the risk associated with entering the labour market successfully (e.g. risk of unemployment, which is not addressed in this study). In order to approximate that uncertainty, we have calculated the standard deviation (σ) of returns to education.

All in all, two are the novelties of our work. First, ECHP is strictly comparable across countries and thus results are more reliable and allow comparisons between countries and, second, we examine the role of levels of education on earnings inequality instead of years of education, which prevail in most studies.

IV. Results

Table 1 presents selective descriptive statistics of our sample. On average, females are about 36% of the whole sample, but differences between countries lead to percentages that range from around 29% in Luxembourg to almost 49% in Finland. Countries are also heterogeneous regarding educational qualifications. On average, females are more educated, since almost 30% are tertiary education graduates vs. less than 25% of males. The majority in the case of both genders are upper secondary education graduates. Belgium is an exception, since tertiary education graduates constitute the largest group for both genders (almost 40% of males and over half of females). The same is true for the UK, Denmark and Finland regarding males in the first country and females in the other two (over 40%). Portugal is the

[15] Potential experience equals years of age minus years of age the person first started working, except for France, in which the usual definition is used, e.g. (age)-(age starting school)-(years of education),

country with the least educated employees among EU member-states, since over 80% of males and 70% of females have lower secondary education or even less.[16]

[Table 1]

On the other hand, males are more experienced, since on average they posses 2.7 more years of potential experience. Finland is the only exception. Years of potential experience prove to be very heterogeneous between countries, especially regarding females. Greece is the country with the least experienced employees for both genders, while Denmark/Finland has the most experienced males/females. Last but not least, hourly earnings in PPP euros exhibit considerable cross-country variation. Employees in Portugal have the lowest earnings among EU member-states as opposed to employees in Luxembourg who have the highest earnings. Furthermore, males are better paid in all countries, thus the average European female employee earns a little more than 82% of male earnings per hour worked. In relative terms, females do worst in Luxembourg (73% of male earnings) and best in Spain (almost 87% of male earnings).

Descriptive statistics show important cross-country variation in key variables under concern and make it even more interesting to investigate regression results, which confirm a high degree of heterogeneity between countries. For instance, Graph 1 presents standard returns to tertiary and upper secondary education compared to those with lower educational qualifications. As expected, tertiary education has a higher return than upper secondary education in all countries, but neither the size of the returns nor the difference in returns between the two levels are uniform across countries. The most extreme differences are found between Portugal and Germany. For most countries though, tertiary education seems to be a pretty good investment, usually more so for males, since returns are close to or higher than 50% for both sexes. As far as marginal returns to tertiary education[17] are concerned, Graph 2 verifies that tertiary education is a profitable investment by ensuring a minimum return of around 17%/6% (Finland) and a maximum return close to 164%/143% (Portugal) for males/females.

[Graph 1]

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due to lack of relevant information.

[16] This comes as no surprise, since according to OECD (2005) educational attainment in Portugal expressed in average number of years of formal education in 2002 is 8.1/8.4 years for males/females compared to an average of 12.1/11.9 years in all OECD countries.

[17] Marginal returns are calculated by subtracting upper secondary returns from tertiary returns, thus they stand for the additional return received by tertiary education graduates compared to upper secondary education graduates.

[Graph 2]

Next, we continue to present QR estimation results in Graphs 3, 4, 5 and 6. We start from tertiary education graduates, since -according to available data[18]- tertiary education has the highest mean expenditure and, thus, its role in earnings inequality is of more interest to public discourse. Dividing the sample by gender gives some interesting results, since the role of education on earnings inequality seems to be gender dependent. To make the analysis more straightforward, relevant graphs include a trend line based on QR estimates along the earnings distribution. According to Graphs 3 and 4, returns to tertiary education increase as we move up the earnings distribution, but not to the same extent across countries, with the exception of females in certain countries (Austria, Denmark, France, Italy and Luxembourg) where the effect is exactly the opposite. Thus, tertiary education seems to increase earnings inequality within its graduates in all countries, when males are concerned. Furthermore, tertiary education and ability prove to be complements, since higher ability graduates at the top of the earnings distribution enjoy higher returns from education.

[Graph 3]

[Graph 4]

Contrary to tertiary education, the role of education is more mixed within upper secondary graduates. According to Graphs 5 and 6, returns to education for males increase as we move up the earnings distribution in most countries (four countries are the exception), but the opposite effect dominates within female graduates (again four countries are the exception). Therefore, as far as upper secondary education is concerned, it seems that overall the role depends crucially on gender, since education appears to increase earnings inequality among male graduates and decrease earnings inequality among female graduates in most countries respectively. It should be noted though, that in those countries (namely Finland, France, Luxembourg and the UK) in which upper secondary education seems to decrease earnings inequality among male graduates, the same conclusion holds for female graduates. Therefore, in those countries upper secondary education and ability seem to be supplements, since more able persons at the top of the earnings distribution receive lower returns to their investment in education.

[Graph 5]

[Graph 6]

[18] According to OECD (2005), mean expenditure across OECD countries on education in 2002 (in US dollars converted using PPP's for GDP) is 5313 for primary education, 7002 for secondary education and 10655 for tertiary education.

In order to verify the results presented so far using graphs, we have calculated two measures of earnings inequality following Buchinsky (1998b), which we present in Table 2 (tertiary education) and Table 3 (upper secondary education). The first measure (M1) stands for the difference in returns to the 90th and 10th quantile and the second measure (M2) stands for the difference in returns to the 75th and the 25th quantile. At first sight, inequality measures seem to tell the same story as graphs, since they have matching signs. But when the statistical significance of the measures is tested, it turns out that the role of education in earnings inequality is not universally supported. More precisely, we consider education to have an active role in shaping earnings inequality if either M1 or M2 are statistically significant.

Based on this criterion it seems that tertiary education increases earnings inequality within its male graduates (eight counties using M1 and six countries using M2) and, consequently, education and ability are complements. The role of tertiary education proves quite weak regarding female graduates, since either M1 or M2 is statistically significant and only in three countries overall, but seems to have the opposite effect compared to males. As far as upper secondary education is concerned, evidence shows that education increases earnings inequality (except in Finland and France) within males, but the effect is less pronounced compared to tertiary education. On the contrary, upper secondary seems to have a more active role in decreasing earnings inequality within female graduates compared to tertiary education and, therefore, education and ability are supplements.

To sum up, the role of education on earnings inequality does not seem to be utterly confirmed. According to our results, generally tertiary education has a more important role in shaping earnings inequality within its male graduates, while upper secondary education seems to have a modest role, but affect proportionately both sexes. Thus, tertiary education seems to increase/decrease earnings inequality within males/females and upper secondary education seems to increase/decrease earnings inequality within males (with minor exceptions)/females. Further, the results indicate that education and ability are complements for males and supplements for females. Thus, there is a distinct role of education in earnings inequality by gender, although weak in some cases. If an analysis by country is attempted, it turns out that education (both levels) has a strong increasing role in earnings inequality only in Belgium and only within males, while upper secondary education seems to have a strong increasing role in earnings inequality for both sexes only in Portugal.

Before comparing our results to other studies, one important difference should be stressed out. We use levels of education, while most studies use years of education. For instance, Machado and Mata (2001) also conclude that education in Portugal has a positive impact on wage inequality, although their estimates refer to years of education instead of levels and gender differences are accounted for by a dummy variable. Hartog et al. (2001) investigate

returns to education by gender and show that education leads to more earnings inequality. Contrary to our results, they argue that education has a significant role on determining earnings inequality irrespective of its level, but they do not refer to any test of statistical significance. Giustinelli (2004) reports results for Italy, which verify the positive impact of tertiary education on earnings inequality within its male graduates. Martins and Pereira (2004) provide evidence that supports the reinforcing role of education on earnings inequality in all sixteen countries under consideration. Our results, on the other hand, point to a modest role for education, which in most cases is not statistically significant. Nevertheless, their data come from national data sources, which are heterogeneous, while ours come from ECHP and are absolutely comparable.[19] Regarding the UK previous results from two studies are contradictory and use years of education instead of levels. Our results, thus, are not directly comparable. Results for Austria, on the other hand, are comparable to those of Fersterer and Winter-Ebmer (2003) regarding females (education and ability are complements), but not regarding males.

The last goal of this work is to investigate the consequences of QR estimates on risk and uncertainty coming from different returns to education across the earnings distribution. Therefore, we report the standard deviation (see Table A1 and Table A2 in the Appendix) for every distribution of returns by gender and level of education. It turns out that tertiary education graduates face the highest uncertainty in almost all countries under examination (except for males in Finland and Portugal and females in the UK). Since tertiary education graduates are more heterogeneous compared to upper secondary education graduates, this is to some extent expected. On the other hand, it turns out that male tertiary education graduates face far more uncertainty than their female counterparts. Again, this is to some extend expected if one adopts the view that females with tertiary education are much more concentrated in certain sectors of economic activity and occupations, therefore more homogeneous, compared to males. Regarding secondary education graduates and gender differences in risk involved, evidence is not clear. Finally, returns to education are more uncertain for both males and females in Portugal, where -it should be noted- the total of QR estimators differs significantly (see Table 2 and Table 3, columns headed by σ).

V. Conclusions

Our results indicate that the role of education in shaping earnings inequality is rather limited, since differences of QR estimates across the earnings distribution are often statistically insignificant, and depends crucially on the level of education and gender. More precisely, in

[19] According to the authors, QR estimates are statistically different along the earnings distribution and

the majority of countries examined tertiary education seems to increase/decrease earnings inequality within males/females and upper secondary education seems to increase/decrease earnings inequality within males (with minor exceptions)/females. Further, the results indicate that education and ability in the old EU are complements for males and supplements for females. Finally, regarding uncertainty involved, tertiary education graduates and males face higher uncertainty, which is to some extent explained on the grounds of different degrees of heterogeneity.

The general conclusion is that more work is needed to be done in order to decide on the impact of education on earnings inequality. Our results, although similar to some extent, do not verify earlier findings fully, mostly because quantiles regression estimates do not differ significantly along the earnings distribution in many countries. In addition, we use levels of education instead of years. This should by no means be considered as evidence against the role of education on earnings inequality though. It should rather be the fuse to further research on the field. What seems evident though is that ordinary least squares estimates do not tell the whole story. Additionally, the role of education is much more complex than expected and, therefore, arguments concerning the equalising role of education should be examined more cautiously. Perhaps other means of exercising social policy and combating economic inequality can prove less costly and more efficient.

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the results are provided upon request.

TABLES

Table 1. Descriptive statistics

	Males						Females					
	Observ.	Lo.Sec. or less	Up.Sec.	Tertiary	Pot. exper.	Hourly earnings	Observ.	Lo.Sec. or less	Up.Sec.	Tertiary	Pot. exper.	Hourly earnings
Austria	1575	13.6	79.2	7.2	21.53	8.36	736	20.0	68.9	11.1	17.69	6.85
Belgium	1074	25.7	36.1	38.2	20.46	9.27	615	16.1	29.9	54.0	17.23	7.83
Denmark	1175	18.9	43.1	38.0	22.21	8.81	843	16.9	39.6	43.5	21.70	7.36
Finland	1467	19.4	44.8	35.8	21.58	7.46	1393	19.2	32.6	48.2	23.08	6.20
France	2306	28.9	46.0	25.2	21.88	9.20	1457	25.5	41.7	32.9	21.29	7.67
Germany	2785	16.1	60.9	23.0	20.64	8.39	1489	17.8	59.2	23.0	19.29	6.66
Greece	1338	38.7	36.9	24.4	18.69	6.21	632	28.5	35.9	35.6	13.65	4.96
Ireland	1150	38.4	40.7	20.9	19.23	8.37	578	19.6	55.0	25.4	14.48	6.50
Italy	2525	49.4	41.8	8.9	18.81	7.33	1305	36.4	55.1	8.5	15.71	6.36
Luxembourg	1392	39.7	42.9	17.4	20.72	13.99	581	43.4	42.5	14.1	16.04	10.24
Portugal	2101	83.1	11.9	5.1	20.23	4.58	1390	72.5	19.1	8.5	16.54	3.96
Spain	2328	55.4	20.3	24.3	21.16	7.04	1015	38.1	25.9	36.0	16.32	6.11
UK	1936	41.0	14.0	45.0	18.67	8.18	1296	43.9	13.9	42.2	17.61	6.79

Note: Hourly earnings are expressed in euros (PPP), thus comparable across countries. Numbers regarding levels of education refer to percentages.

Abbreviations: Observ.= observarions, Lo.Sec.or less= lower secondary education or less, Up.Sec.= upper secondary education, Pot.exper.= potential experience.

Table 2. Inequality measures (tertiary)

	Males			Females		
	M1	M2	All	M1	M2	All
Austria	*0.157*	*-0.042*		*-0.234*	*-0.149*	
Belgium	0.336 **	0.145 **	**	*0.015*	*0.020*	
Denmark	0.150 *	0.098 **	**	-0.129 *	*-0.043*	
Finland	*0.139*	0.020 **		*-0.158*	-0.024 *	**
France	*0.025*	*0.088*	**	*0.068*	*0.030*	
Germany	0.605 **	0.378 **	**	*-0.019*	*0.034*	
Greece	0.272 **	*0.016*		*0.197*	*0.050*	
Ireland	0.245 **	*0.080*	**	*0.002*	*0.060*	
Italy	0.460 **	0.169 **	**	*-0.209*	*0.014*	**
Luxembourg	*0.070*	*-0.029*		*-0.277*	-0.613 **	**
Portugal	*0.057*	0.078	*	*0.337*	*0.240*	**
Spain	0.331 **	0.176 **	**	*0.081*	*0.060*	
U.K.	0.225 **	*0.062*	**	*-0.007*	*0.017*	

Note: M1=[0.90-0.10], M2=[0.75-0.25]

"All" tests the hypothesis that all estimators are statistically different

***(**) = statistically significant difference at 10% (5%)**

Table 3. Inequality measures (upper secondary)

	Males			Females		
	M1	M2	All	M1	M2	All
Austria	*-0.081*	*-0.015*		*0.079*	*0.086*	
Belgium	0.100 *	0.067 **		*-0.045*	*-0.020*	
Denmark	*0.062*	*0.040*		-0.118 *	*-0.061*	
Finland	*-0.116*	-0.046 *		*-0.071*	-0.083 **	
France	-0.137 *	-0.048 **		*-0.068*	*0.014*	
Germany	0.256 **	0.170 **	*	*-0.018*	*0.014*	
Greece	*0.120*	*-0.034*		*0.083*	*-0.017*	
Ireland	*0.013*	*0.016*		*-0.055*	*0.106*	**
Italy	*0.059*	*0.005*	*	-0.200 **	-0.074 *	
Luxembourg	*-0.010*	*0.006*		*-0.024*	-0.142 *	**
Portugal	0.481 **	0.291 **	*	0.603 **	0.336 **	**
Spain	0.138 **	*0.051*		*0.006*	*-0.055*	**
U.K.	*-0.022*	*-0.027*		-0.213 *	-0.148 *	**

Note: M1=[0.90-0.10], M2=[0.75-0.25]

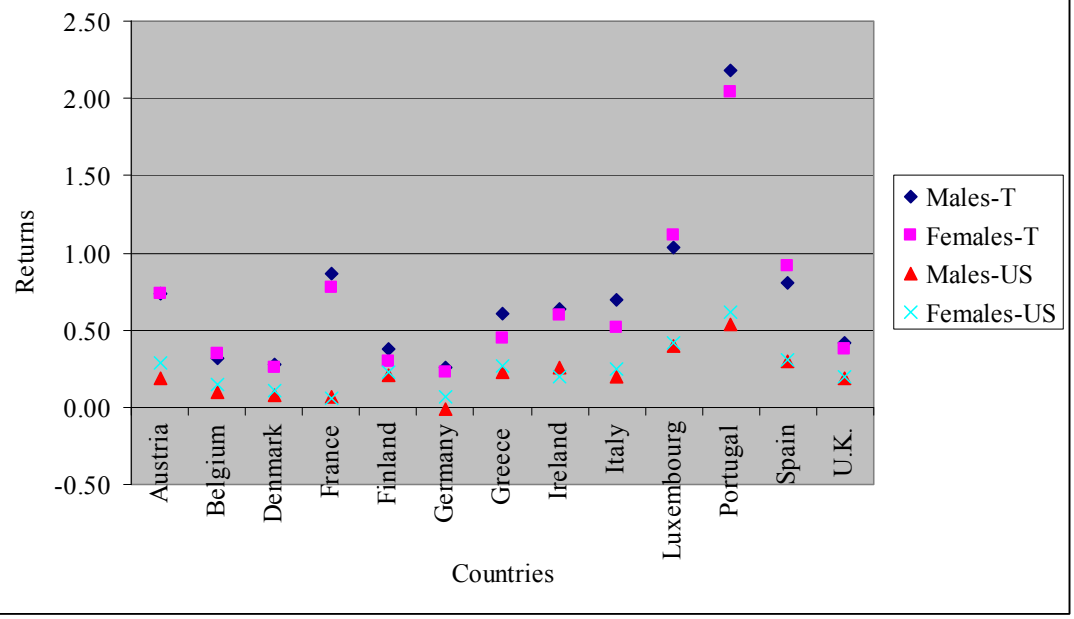
"All" tests the hypothesis that all estimators are statistically different

Statistically non significant estimators in italics

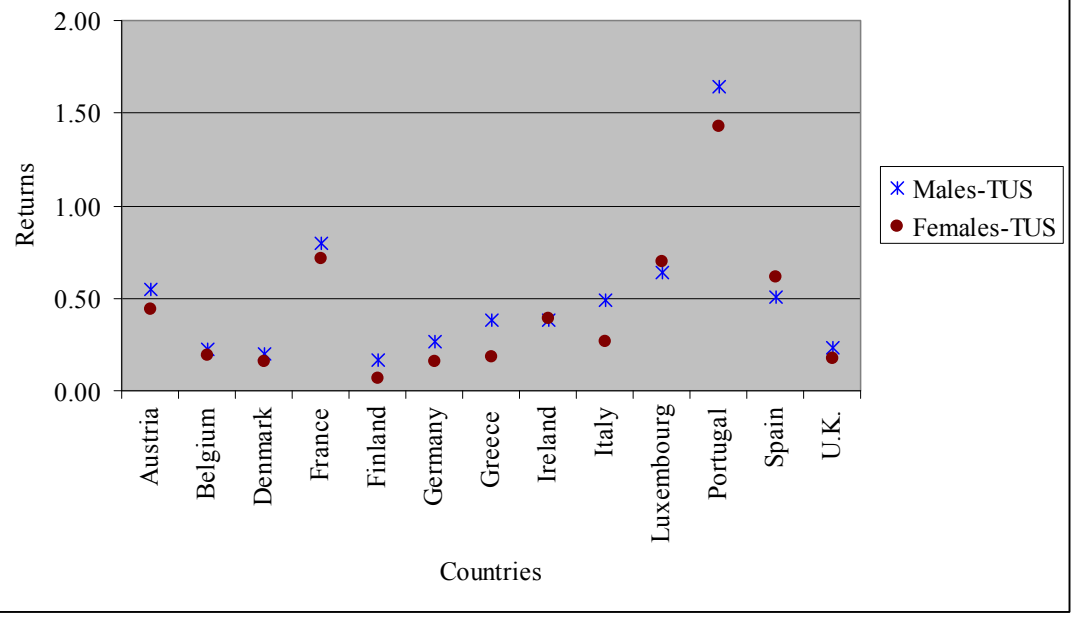
***(**) = statistically significant difference at 10% (5%)**

GRAPHS

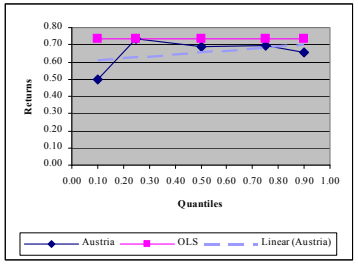
Graph 1. Returns to levels of education (OLS)

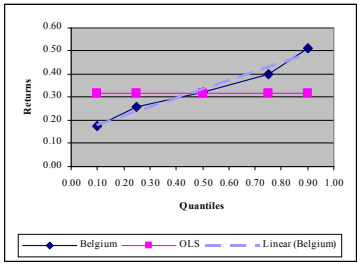


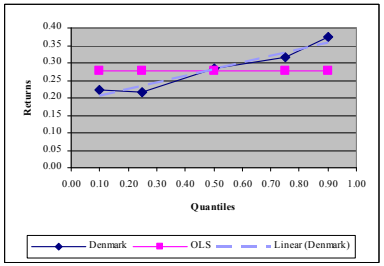
Graph 2. Marginal returns to tertiary education (OLS)

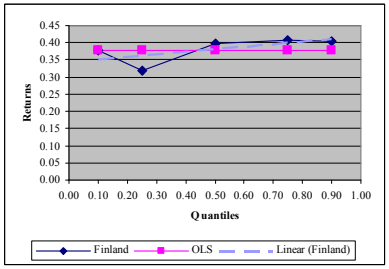


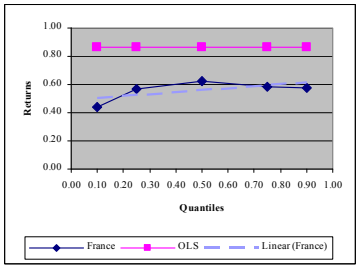
Graph 3. Returns to tertiary education male graduates

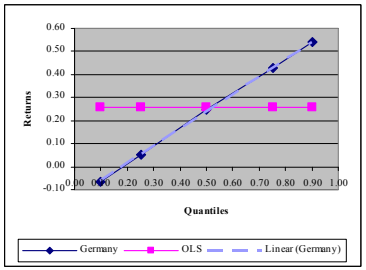


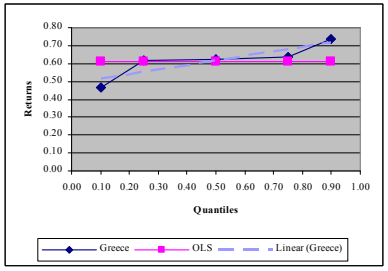


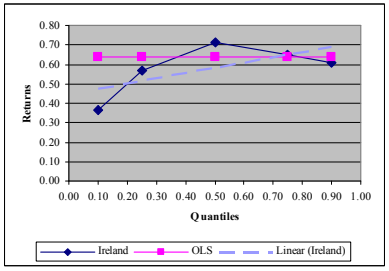


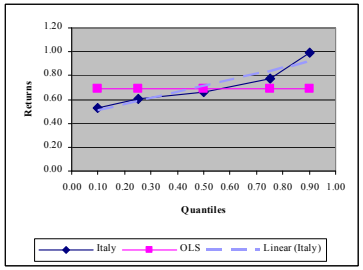


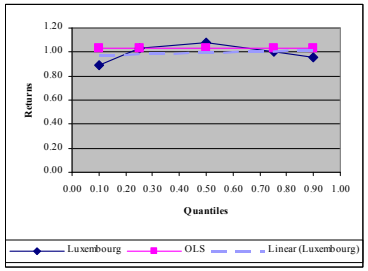


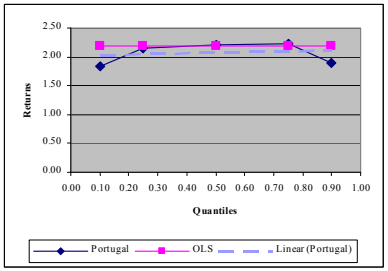


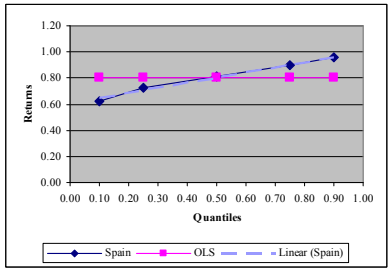


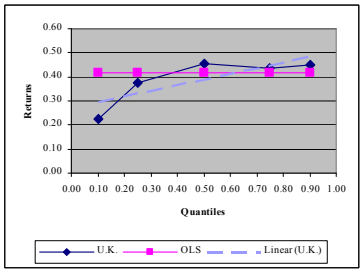




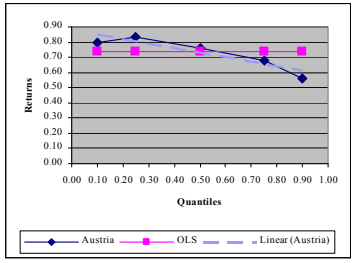


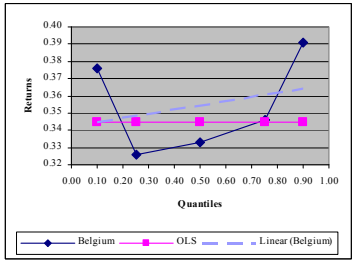


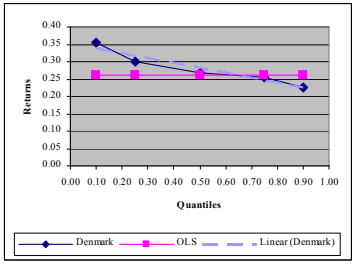


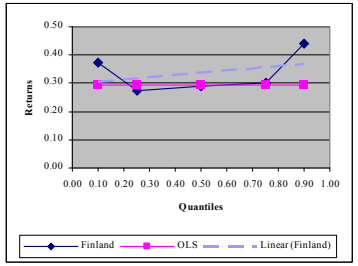


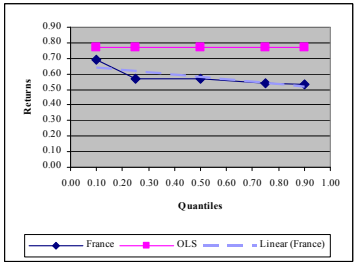
Graph 4. Returns to tertiary education female graduates

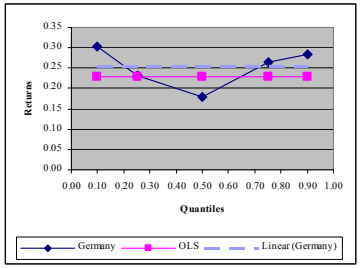


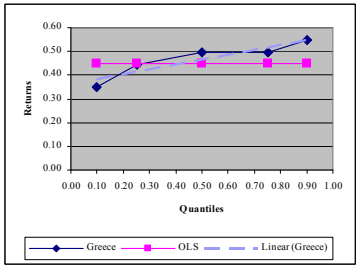


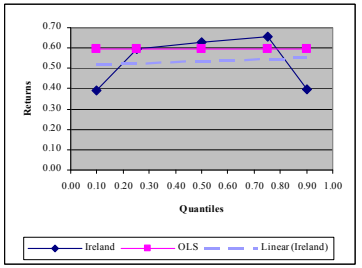


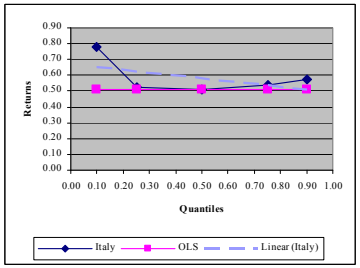


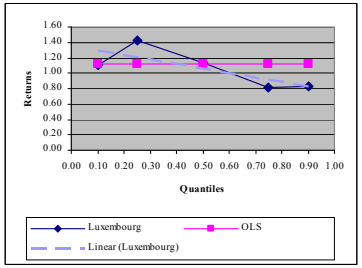


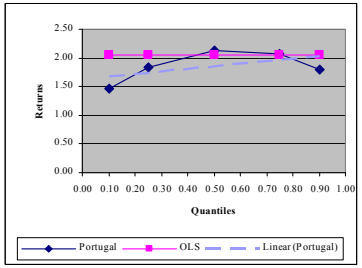


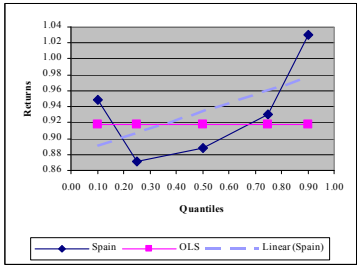


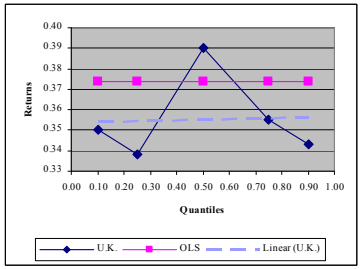




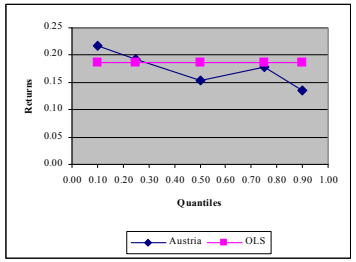


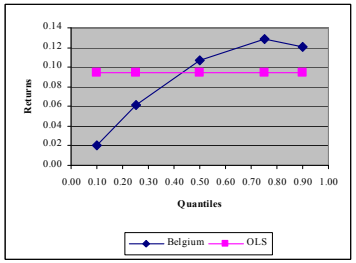


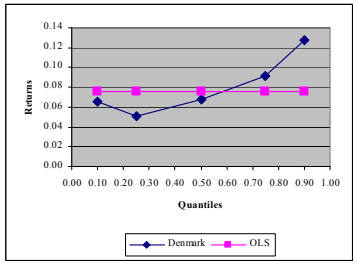


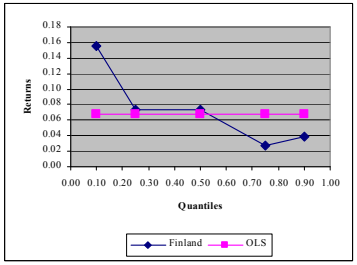


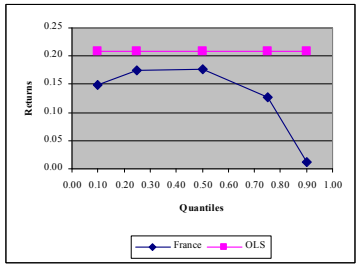
Graph 5. Returns to upper secondary education male graduates

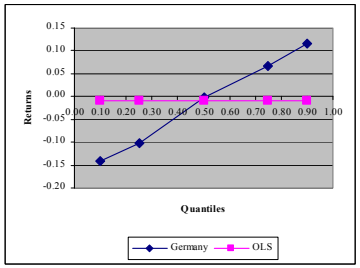


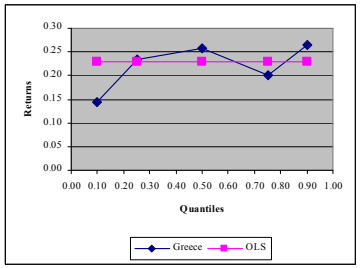


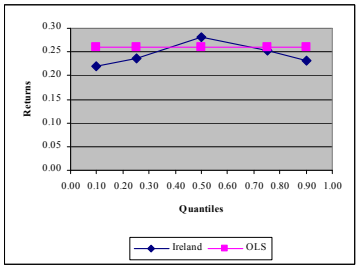


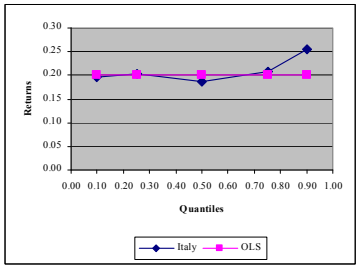


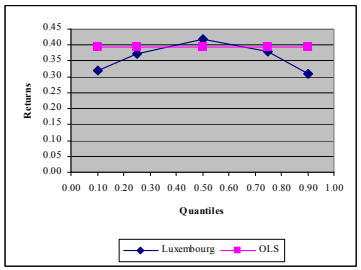


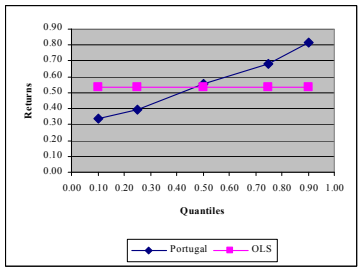


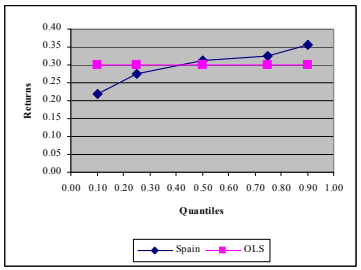


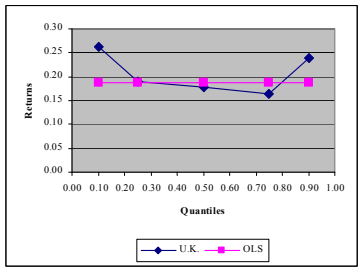




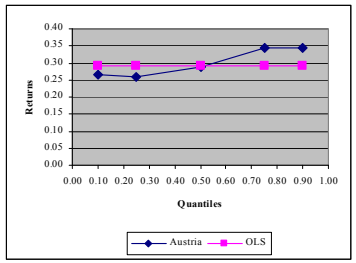


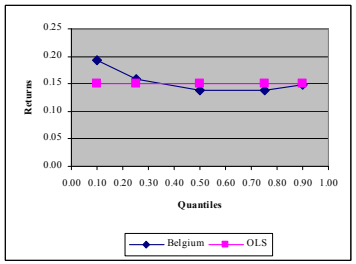


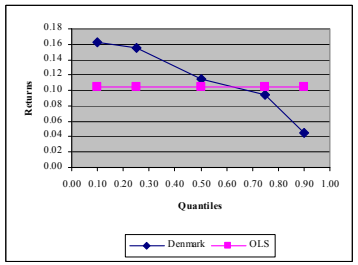


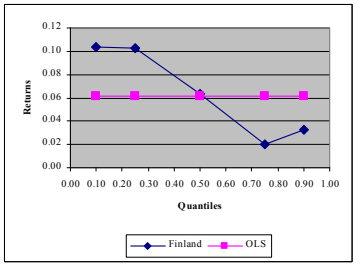


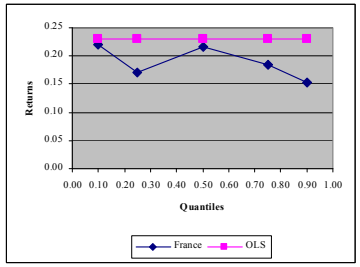
Graph 6. Returns to upper secondary education female graduates

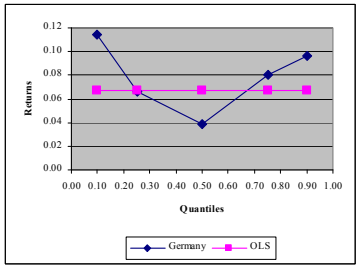


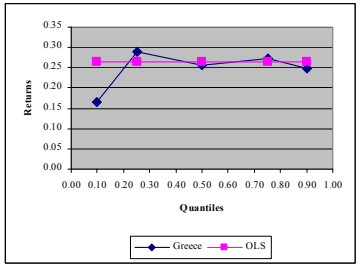


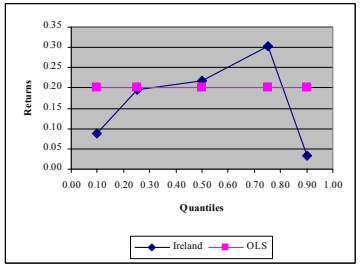


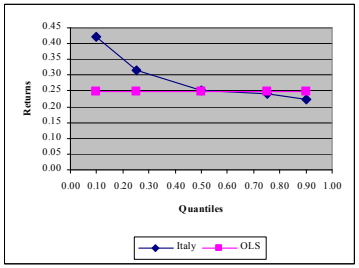


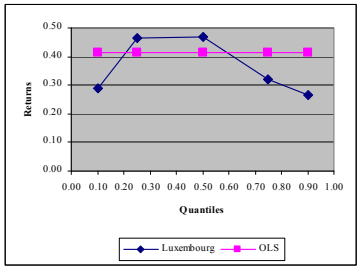


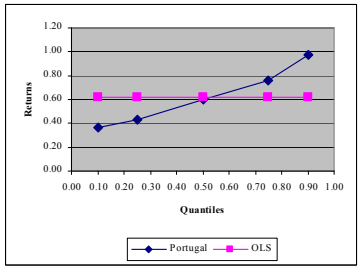


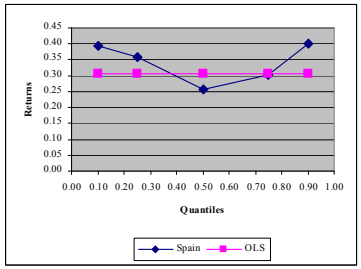


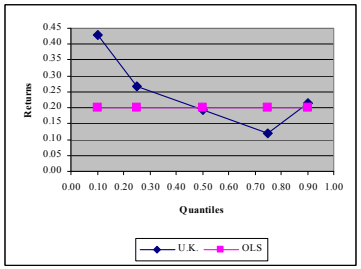












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APPENDIX

Table A1. Returns to tertiary education

	Males							Females						
	OLS	0.10	0.25	0.50	0.75	0.90	σ	OLS	0.10	0.25	0.50	0.75	0.90	σ
Austria	0.732**	0.500**	0.736**	0.691**	0.694**	0.657**	0.091	0.735**	0.798**	0.830**	0.763**	0.681**	0.564**	0.107
Belgium	0.319**	0.174**	0.257**	0.320**	0.402**	0.510**	0.130	0.345**	0.376**	0.326**	0.333**	0.346**	0.391**	0.028
Denmark	0.277**	0.223**	0.217**	0.285**	0.315**	0.373**	0.065	0.262**	0.356**	0.299**	0.268**	0.256**	0.227**	0.049
Finland	0.379**	0.379**	0.318**	0.399**	0.406**	0.404**	0.037	0.294**	0.374**	0.273**	0.288**	0.303**	0.442**	0.071
France	0.865**	0.437**	0.568**	0.622**	0.588**	0.576**	0.071	0.772**	0.694**	0.567**	0.566**	0.543**	0.536**	0.065
Germany	0.255**	*-0.064*	0.051*	0.247**	0.429**	0.541**	0.148	0.228**	0.304**	0.231**	0.180**	0.265**	0.285**	0.049
Greece	0.609**	0.465**	0.619**	0.624**	0.635**	0.737**	0.097	0.450**	0.350**	0.445**	0.498**	0.495**	0.547**	0.075
Ireland	0.640**	0.365**	0.568**	0.714**	0.648**	0.610**	0.132	0.596**	0.394**	0.598**	0.626**	0.658**	0.396**	0.129
Italy	0.693**	0.528**	0.603**	0.666**	0.772**	0.988**	0.179	0.512**	0.780**	0.522**	0.508**	0.536**	0.571**	0.112
Luxembourg	1.035**	0.886**	1.034**	1.076**	1.005**	0.956**	0.073	1.114**	1.111**	1.426**	1.135**	0.813**	0.834**	0.252
Portugal	2.178**	1.839**	2.148**	2.200**	2.226**	1.896**	0.181	2.044**	1.457**	1.831**	2.131**	2.071**	1.794**	0.267
Spain	0.807**	0.624**	0.726**	0.810**	0.902**	0.955**	0.133	0.918**	0.949**	0.871**	0.888**	0.931**	1.030**	0.062
U.K.	0.418**	0.224**	0.376**	0.457**	0.438**	0.449**	0.097	0.374**	0.350**	0.338**	0.390**	0.355**	0.343**	0.021

Statistically non significant estimators in italics

*(**) Statistically significant estimator at 10% (5%)

Table A2. Returns to upper secondary education

	Males							Females						
	OLS	0.10	0.25	0.50	0.75	0.90	σ	OLS	0.10	0.25	0.50	0.75	0.90	σ
Austria	0.186**	0.217**	0.193**	0.153**	0.178**	0.136*	0.032	0.292**	0.266**	0.258**	0.287**	0.344**	0.345**	0.042
Belgium	0.094**	*0.021*	0.062*	0.107**	0.129**	0.121**	0.046	0.150**	0.193*	0.158**	0.138**	0.138**	0.148**	0.010
Denmark	0.076**	*0.066*	*0.051*	*0.068*	*0.091*	0.128**	0.030	0.105**	0.163*	0.155**	0.114**	0.094**	*0.045*	0.031
Finland	0.068**	0.155**	0.073**	0.073**	0.027**	0.039**	0.050	0.061**	0.104**	0.103**	0.063**	0.020**	0.033**	0.039
France	0.209**	0.149**	0.174**	0.176**	0.126**	*0.012*	0.068	0.230**	0.220**	0.170**	0.216**	0.184**	0.152**	0.029
Germany	*-0.009*	*-0.141*	*-0.102*	*-0.001*	0.068**	0.115**	0.109	0.067**	*0.114*	*0.066*	*0.039*	0.080**	0.096**	0.011
Greece	0.230**	0.145**	0.234**	0.258**	0.200**	0.265**	0.049	0.264**	*0.165*	0.290**	0.255**	0.273**	0.248**	0.019
Ireland	0.260**	0.219**	0.237**	0.281**	0.253**	0.232**	0.024	0.202**	*0.088*	0.196**	0.219**	0.302**	*0.033*	0.056
Italy	0.200**	0.197**	0.202**	0.187**	0.207**	0.256**	0.027	0.247**	0.422**	0.315**	0.252**	0.241**	0.222**	0.081
Luxembourg	0.393**	0.321**	0.374**	0.417**	0.380**	0.311**	0.044	0.416**	0.289**	0.463**	0.467**	0.321**	0.265**	0.097
Portugal	0.536**	0.336**	0.394**	0.558**	0.685**	0.817**	0.200	0.615**	0.369**	0.428**	0.602**	0.764**	0.972**	0.247
Spain	0.301**	0.219**	0.274**	0.312**	0.325**	0.357**	0.053	0.305**	0.395**	0.359**	0.258**	0.304**	0.401**	0.061
U.K.	0.187**	0.262**	0.191**	0.178**	0.164**	0.240**	0.042	0.200**	0.428**	0.268**	0.193**	0.120**	0.215**	0.115

Statistically non significant estimators in italics
*(**) Statistically significant estimator at 10% (5%)

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