EXPLORING THE ROLE OF LABOUR MARKET UNCERTAINTY IN EXPLAINING DIFFERENCES IN RATES OF RETURN TO EDUCATION IN EUROPE

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Abstract

This paper explores whether international differences in rates of return to education reflect variations in the level of risk associated with educational investments. We find no consistent evidence supporting that international differences in the rates of return to education are explained by variations in the level of market risk. For males we find that higher returns to ISCED-5 qualifications were related to a higher rate of dispersion in both the graduate and lower qualified labour markets, whereas for females we find that higher rates of return to ISCED-5 are more heavily related to general wage dispersion within the economy.

Keywords: returns to education; wage dispersion; risk; EU-SILC.
JEL Codes: C29; I21; J24

1. Background and introduction

This paper explores the idea that cross-country differences in the rates of return to education can be explained by variations in relative dispersion. It seeks to investigate the extent to which cross-country variations in the rates of return to education can be attributed to a standard market orientated risk / return relationship or, alternatively, may be more effectively explained by the emergence of skill biased technological change (SBTC). It intends to build on an earlier contribution by Pereira & Martins (2002) who use cross-national data to present evidence in support of a market based explanation. Specifically, Pereira & Martins (2002) demonstrated, using micro 1995 data for 16 countries, a positive relationship between average rates of return and dispersion in rates of return which, they argue, is consistent with the view that rates of return to education are higher in riskier labour markets[1]. In this paper we explore this notion further by using a methodology that allows us to decompose the cross-country relationship between average rates of return and wage dispersion in more detail. The approach allows us identify the extent to which observed patterns are consistent with a market orientated explanation as opposed to one centred around SBTC or labour market institutions.

The relationship between educational investment and risk has been largely ignored within the literature, however, those papers that do exist tend to stress the commonality

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[1] In their paper Pereira & Martins (2002) draw analogies between investments in education and the predictions of the capital asset pricing model developed by Markowitz (1952) to test the hypothesis that there exists a positive relationship between rates of return to education and the risk associated with the investment.

between human capital and financial assets. Specifically, investments in any asset are assumed to be driven by a preference for higher rates of return and lower variance (risk). Theoretical approached to asset investment stress the importance of holding combinations of investments located an efficiency frontier where the lowest standard deviation is obtained for a given mean rate of return (Sharpe (1964), Lintner (1965)). The exact point chosen on any efficiency frontier will be a function of each individual's indifference curves which incorporate there risk-return preferences. Investors will choose combinations of assets that will maximise their expected lifetime discounted utility. The first order condition for the decision yields the basic asset pricing equation:

$$E_t\left[m_{t+1}R_{j,t+1}\right]=1, \qquad (1)$$

$$m_{t+1=}\beta\frac{u'(c_{t+1})}{u'(c_1)}, \qquad (2)$$

where $R_{j,t+1}$ is the return on asset R at time *t*, E_t is an expectation conditional on information available at time *t*, *m* is the intertemporal marginal rate of substitution between times *t* and *t+1*, *c* denotes consumption, β is the rate of preference, *u(.)* is the utility function. The basic pricing function (1) should hold for any asset and any concave utility function but it will particularly hold for human capital assets (Christiansen *et al* (2007)). Regarding uncertainty, as with all assets, risk is determined by the covariance of asset returns with the stochastic discount fact, therefore, riskier human capital assets must, *ceteris paribus*, offer higher rates of return in order to encourage investors to hold them. While the literature examining the risk-returns relationship is quite sparse, the research that does exist tends to support the predictions of theory. Hogan and Walker (2007) construct a dynamic programming model that predicts a positive relationship between risk and educational investments on the basis that higher risk yields higher returns. Belzil and Hansen (2002) also predict a positive relationship between market risk and education distinguishing between permanent and transitory rises in risk. Palacios-Huerta (2003) found that human capital assets had a higher return per unit of risk than financial assets. Therefore, both theory and empirical papers point to a positive relationship between risk and rates of return to education that occurs contemporaneously.

In relation to the evidence supporting the risk-return relationship, this relates exclusively to the Pereira & Martins (2002) study which forms the basis of the current research. In their work, Pereira & Martins (2002) estimated a set of quantile Mincer regressions for each country and measured wage dispersion, which they attribute exclusively to risk, as the difference in the return to a year of schooling between the first and ninth quantiles. Their results demonstrated a clear positive relationship between variations in average rates of return to education and the level of dispersion in the rates of return which, they argue, is supportive of a market based explanation. While the measurement approach adopted by Pereira & Martins (2002) is novel, it is also not without its drawbacks. Specifically, the quantile regressions were estimated over the total population, thus the technique compares the investments of individuals at the bottom end of the distribution, who have typically low levels of schooling, with

those in the top decile, who are typically graduates. Therefore, the approach is acceptable provided that the returns to schooling are linear and that both returns and dispersion do not vary with the level of education. However, Heckman, Lockner & Todd (2003) demonstrate that the assumption of linearity may not, in fact, hold while Sanmartín (2001) finds only limited support for linearity in a study of returns to education in Spain. This suggests that the dispersion measure adopted in the earlier study is more indicative of the variation in returns across different levels of schooling and may not, therefore, adequately reflect the risk of investing in a particular level of education. Furthermore, it is not clear that a finding of a positive relationship between rates of return and dispersion cannot be attributed to factors other than market risk.

The notion of differing rates of return is also consistent with the Skill Biased Technological Change framework (see Katz & Autor (1999) for an overview of the literature) which emphasises the idea that as the economies grow, technology will disproportionately increase the relative demand for more skilled labour. Thus, given the evidence in support of SBTC, we should expect to observe larger returns to higher levels of educational attainment. Potentially these higher returns will also be associated with higher levels of dispersion as the earnings gap between graduates equipped with technological skills diverges from those that do not. However, it has also been argued that SBTC can result in increased returns to having few or no qualifications at all. Autor, Levy & Murnane (2003) argue that technology can replace human labour in more routine tasks but cannot replace labour in non-routine tasks, a point also made by Keep (2005). So, while computers can replace precise tasks in manufacturing, and even routine clerical operations, tasks such as cleaning and waiting tables cannot be replaced. Moreover, a growth in high-skilled employment may cause an increased demand for low-skilled service jobs. The result of such a scenario would be a rising relative demand in both high-skilled and low-skilled jobs, but a falling-off in relative demand for jobs in the 'middle', where technology skills can replace human labour. These demand changes would result in rising returns for the high skilled, but wages of the low skilled would be maintained or even improved. In a recent study of the UK labour market McGuinness & Bennett (2009) found that the premium to GCSE attainment over no qualifications had fallen to zero, a factor which they attribute exclusively to the impacts of SBTC. Thus, international differences in both the rates of return to education and the associated higher levels of dispersion, such as observed by Pereira & Martins (2002), may also be driven by differential rates of SBTC across countries. Therefore, if the market orientated explanation is correct, then we should observe a positive relationship between average rates of return and dispersion for each level of educational investment, although it is conceivable that risk levels may rise with educational attainment and thus the impact in returns might well be non-linear. Meanwhile, a SBTC explanation will be more consistent with a finding that the relationship that is strongest in the graduate labour markets with no evidence of any impacts in intermediate segments where there has been a "hollowing out" effect.

Finally we cannot ignore the role of institutions as a potential contributory factor. It may be that both returns and dispersion are higher in unregulated labour markets that are characterised by decentralised wage bargaining, low levels of trade-union density, weak equality legislation and a low or non-existent minimum wage. While the dampening effects of institutional factors on wage dispersion are well known, much less is known with respect to the returns to education. While trade-union membership

is generally associated with a wage premium, in centralised economies it is agreement coverage that is the more relevant factor. The Calmfors-Driffill (1988) model links decentralisation to unemployment through the classic hump shaped curve, which predicts that unemployment will be lowest when bargaining takes place at either the individual or national-level and highest where it is concentrated at the level of the industry. The theory does, however also have implications for educational returns on the grounds that if unions and other social partners, through centralised bargaining, are forced to internalise some of the externalities associated with their wage demands, then wage costs may be constrained under a centralised bargaining system and the returns to education lower. In support of this view a recent Irish study by McGuinness, Kelly, & O'Connell (2010) found that labour costs and firm level wage dispersion were substantially lower in firms implementing a national wage agreement. Therefore, the evidence suggests that a positive correlation between educational returns and dispersion may also be driven by variations in the strength of labour market institutions across countries. If institutional factors are at play, their influences will tend to be economy wide as wage growth across all sectors tends to be more standardised resulting in a more condensed wage distribution within which average returns to education will be lower relative to a decentralised comparator. However, with respect to institutional factors, it is unclear the extent to which dispersion levels and rates of return will be differentially effected according to the level of schooling. Thus, within our analyses we develop the following testable hypotheses:

H1: International variations in the rates of return to education are explained by variations in labour market risk. This is consistent with a positive relationship between average rates of return and dispersion in rates of return for each level of schooling. Given that the level of risk, and thus the potential return, will be positively related to the level of investment, we expect impacts to be most evident when relating ISCED level 5 dispersion to ISCED level 5 rates of return. The risk hypothesis is not consistent with any inter-distributional impacts whereby variations in rates of return in one qualification area impact those of another.

H2: International variations in the rates of return to education are explained by SBTC. This is consistent with a positive relationship between average rates of return and dispersion in rates of return within the graduate market combined with distributional impacts possible with respect to the least qualified labour market. It should be noted that SBTC may, as stated, result in a gradual hollowing out of mid-range occupations, which is likely to generate declines in both rates of return and dispersion for individuals with ISCED level 3 attainments. Thus SBTC will also, in theory, yield a positive relationship between risk and returns in the mid-skill range of the labour market. However, existing studies suggest that changes in relative demand, deriving from SBTC, are much more pronounced at the extremes of the distribution (Harkness & Machin (1999), McGuinness & Bennett (2009), McGuinness *et al* (2009)) implying that mid-range impacts are unlikely and that polarisation is the most consistent *ex ante* expectation regarding H2.

Thus, the extent to which any hypothesis is accepted will depend on both the strength and pattern on the relationships between returns and dispersions. With respect to H1, this will tend to be confirmed by a linear relationship between risk and returns with the impact most pronounced at ISCED level 5. With respect to H2 this is consistent with a non-linear relationship, with impacts most pronounced at both

extremes of the ISCED distribution. If neither H1 nor H2 are supported then we can conclude that cross-country variations in the rates of return to education are predominantly driven by unobserved labour market heterogeneity (H3).

Finally, in addition to our distinction between education level specific rates of return and risk to address potential non-linearities in the return-risk relationship, we also perform our analysis separately for males and females. Given that the distribution of risk will be highly correlated to the occupational structure of the labour market and occupational structure tends to differ substantially by gender, there is a strong possibility that the magnitude and nature of the risk-return relationship will also differ between males and females.

2. Data and methods

The data for this study comes from the EU Survey on Income and Living Conditions (EU-SILC) which is a voluntary survey of private households carried out by national statistical units under EU legislation (Council Regulation No 1177/2003) and coordinated by Eurostat. The first survey was launched in 15 countries in 2004 and expanded in 2005 to 26 European countries (plus Turkey). The present piece of work relies on data from waves 2 and 3 (corresponding to 2005 and 2006, respectively). The primary focus of the survey is the collection of information on the income and living conditions of different types of households to compute indicators on poverty, deprivation and social exclusion. It is not, therefore, designed to provide information on the structure of wages, job or employer characteristics, making it more limited than it was in its predecessor, the European Community Household Panel (ECHP). Nevertheless, it provides us with an opportunity for estimating differences in cross-country returns using relatively recent data.

The EU-SILC data set presents a number of challenges in the context of any international study on rates of return. Firstly, we use information on gross monthly wages and average hours worked per week to derive gross hourly wages. Information on gross monthly wages was only available in the period 2005/2006 in nine countries (namely, Austria, Spain, Greece, Italy, Portugal, Ireland, Iceland, Poland and the UK). This is the most restrictive feature of the data set since it hinders the extent of our international comparisons. Nevertheless, the countries for which information was available represent the main European welfare regimes or institutional contexts, with Mediterranean countries fully represented, Nordic (Iceland), Central or Continental (Austria) and new Easter European EU member states (Poland). The Liberal cluster (Ireland and UK), though was finally incomplete as we had to do without the UK sample.

The second challenge in the data-set is the accuracy of the measure of educational attainment, which is also absolutely crucial if returns to education are to be correctly identified. According to Schneider and Müller (2009) the educational attainment variables (following ISCED97 classification) in EU-SILC present problems in a number of countries. The principal problems relate to an overrepresentation of ISCED 3 (compulsory education) and other dissimilarities between the distribution of populations in the home countries Labour Force Survey and that of EU-SILC. While such dissimilarities did not appear to radically affect estimated rates of return, the exception to this was the UK where the estimates appeared much lower than in previous literature, making it necessary for us to exclude the UK from our analysis.

However, a clear advantage of the EU-SILC dataset is its regional geographical component, which provides us with multiple observations per country thus substantially boosting our sample size. The country sample sizes vary from 6,698 observations in Iceland, to 28,928 in Italy. The country level data has been disaggregated into NUTS1 regions (see Table A.4 for concrete labels of the regions).

With respect to the methodology employed, our primary objective was to generate reliable estimates of both educational returns and dispersion for each NUTS region. As stated, the returns to schooling are generally estimated using a standard Mincer regression such as in equation 3 where S_i represents the years of schooling undertaken, *ex* relates to labour market experience and X_i is a vector of earnings related personal or job characteristics. The alternative specification which allows for possible non-linear rates of return is outlined by equation 4 whereby the years of schooling variable S_i in equation 3 is replaced by Q_i, which denotes the highest qualification obtained by the respondent. Thus, both equations 3 and 4 regress education, labour market experience and an range of additional controls (X_i) on earnings, however, in equation 3 education is measured in by years of education (S_i) whereas in equation 4 education is measured by a series of dummy variables (Q_i) indicating the highest level of education attained.

$$LnW_i = \sum_{i=1}^{i} \alpha S_i + \beta X_i + \delta ex_i + \gamma ex_i^2 + \varepsilon_i \qquad (3)$$

$$LnW_{ij} = \sum_{j=1}^{J} \alpha Q_i + \beta X_i + \delta ex_i + \gamma ex_i^2 + \varepsilon_i \qquad (4)$$

We estimate equation 4 to generate returns to ISCED levels 3/4 (post-compulsory) and ISCED 5 (tertiary) with both estimates related to the base category which contains individuals educated to ISCED level 2 and below (up to compulsory). The equations are estimated separately by gender with the female models accounting for selection. In addition to education and experience, the models contain controls for industry while the female equation also included an inverse Mills' ratio to control for the effects of selection bias[2].

With respect to measuring wage dispersion, we follow the unique approach adopted in the Industrial Economics literature by Winter-Ebmer & Zweimuiller (1999) who include the regression standard error of a firm level wage regression as a dependant variable representing conditional intra-firm dispersion in a firm level productivity regression. In a similar vein we estimate equation 5 for each educational level within each region taking the regression standard error σ_{ij} as a measure of wage dispersion controlling for observable differences in the experience profile and sectoral composition of the regions educational cohort. Therefore, our dispersion measure gives an indication of the extent to which earnings are clustered around the regression mean for each level of education within each region within each country. The obvious advantage of this approach is that it allows us to generate a measure of wage variation within each education level. Such a disaggregated analysis would not be possible using the quantile

[2] The stage one probit contains controls for age, educational attainment, marital status and the number of dependant children aged 0-6 and 6-15.

regression technique of Pereira & Martins (2002) as the lack of variation in the years of education variable would render it impossible to generate a range for the estimated rate of return. It is perhaps worth considering at this point the relationship between both measurement approaches as, arguably, both methods are measuring different aspects of wage dispersion. In the case of a regression based on a population wide sample of individuals, the standard error based approach measures dispersion in terms of the overall unexplained variation in wages controlling for educational attainment, while the quantile regression based approach measures variations in the wage effects of education. Thus, the prior measure relates to the extent to which earnings will vary either side of what is predicted given educational attainment (its external bounds) while the latter measured the extent to which earnings will vary within the educational category (its internal bounds). Intuitively the quantile regression (QR) based measure is, arguably, more attractive, however, as stated, the principal drawback of the approach is that it cannot generate a measure of dispersion within educational categories.

$$LnW_{ij} = \sum_{j=1}^{J} X_i\beta + \delta ex_i + \gamma ex_i^2 + \varepsilon_i \qquad (5)$$

3. Results

Table A.1 (in the on-line Annex) displays the distribution of employees in NUTS1 by gender according to the three education levels defined in this paper. While we have estimated returns for each region for both 2005 and 2006, for convenience we report the two-year averages for each of our 28 regions. Table A.1 shows wide dispersion in educational attainment across Europe and even within European countries. The proportion of employees with ISCED 0 to 2 (up to compulsory education) is particularly high in Portugal (with around 70 percent of males and 58 percent of females) followed by Southern regions in Spain and Italy. At the opposite extreme we find Polish and Austrian regions, where ISCED 3 and 4 count for more than half of the employee population. Finally, very high educational attainment (measured by the proportion of higher education graduates, ISCED 5 or above) is found in Spain for both men and women and in Greece and Ireland.

As for differences within countries, considerable variation may be found between North-East and Central versus Southern Spain as regards both extremes in the distribution. In Greece, Attiki (GR3) registers far more higher education graduates than the other regions, whereas Poland, Central (PL1) has a much higher share of graduates relative to the rest of the country, with the difference particularly pronounced among males. Finally, educational attainment is usually higher amongst women than amongst men, which the cases of Austria and Iceland being the only exceptions.

Table A.2 (in the on-line Annex) shows returns to education (namely, the coefficients from simple region-gender-specific Mincer equations outlined in equation 4). Since returns to education with dummy variables need a category to be used as a base-case (in our case, ISCED 0, 1 and 2) we only display and use the coefficient for ISCED 3/4 and ISCED 5. Due to the semilogarithmic shape of the wage equations, coefficients may be interpreted as rates of return to the specific ISCED levels compared to the base case.

Returns to secondary and non-tertiary education (ISCED 3/4) are high in Austria (and are particularly high in the Southern region of Austria) and Portugal, followed closely by Poland. The highest nation-wide rates are of return to ISCED 3/4 attainment range between 30 and 40 percent for both men and women (depending on the country). The lowest rates of return to this level of education are registered in Spain, Italy and Greece, with rates averaging around 16 percent for men in these countries. Women tend to enjoy higher returns to this level of education, with the noteworthy exceptions of Iceland and Austria (which are consistent with the special observed education attainment across genders in Table A.1). Amongst higher education graduates, returns range for males from between 42 percent in Spain to 92 percent in Portugal, whereas for females the lowest return is registered in Iceland (44 percent) and the highest, again, in Portugal (approximately 100 percent). There is again notable variation between regions within countries, such as in Spain (between North-East and the Centre) and Italy (it varies across genders, but South and Islands appear to reward higher education more than North East and Centre).

We now move onto the regression analysis. In order to assess the extent to which the dispersion measurement approach adopted here is comparable with that of Pereira & Martins (2002) we estimate equation 3 in a sample containing workers of all education levels for quantiles 1 and 9 at regional level and take the absolute difference in the years of schooling coefficients as a measure of dispersion. The measures of overall dispersion for each region are then used to estimate the corresponding average return to a year of education estimated for each region under equation 3. The quantile regression based approach is then compared with one whereby the rates of return are regressed on the regression standard errors generated by equation 3. Table 1 presents the results from OLS models that regress the rates of return to education on the corresponding measures of dispersion for each region. Thus we are testing the extent to which international differences in the rates of return to a year of education estimated across the entire population are correlated with general levels of wage dispersion in the labour market. This is in line with the approach of Pereira & Martins (2002); however, the models here are estimated separately according to gender whereas the Pereira & Martins (2002) were based on pooled estimates. Furthermore, the models here are estimated both with and without country level dummies whereas this was not feasible for Pereira & Martins (2002) as a consequence of their much smaller sample size. In line with Pereira & Martins (2002) our model contains a dummy variable relating to the year of data-collection. In the models excluding fixed effects we found the Root Mean Squared Error (RSME) based measure generated a positive coefficient for both males and females whereas the quantile regression (QR) based estimated found a positive impact for males only. This suggests that the Pereira & Martins (2002) result may have been primarily driven by the male proportion of their sample. Including country level dummies within our equation will tend to control for any unobserved country level factors that potentially impact rates of return, thus the equations will explicitly control for any cross-country differences that may impact the relationship between dispersion and rates of return. Comparing the estimates generated without fixed effects it would appear, on the basis of the R^2 statistic, that the RSME based measure was more effective to explain the variance in international rates of return to education. While the quantile regression based estimate is relatively insensitive to the inclusion of country level fixed effects, this is not the case for the RSME measure as the female coefficient became insignificant. Reassuringly, both

approaches yield a very similar result when the more reliable fixed effects estimates are compared, with the RSME (QR) model suggesting that 6 (4) per cent increase in dispersion yields a 1 per cent increase of average returns to schooling, somewhat smaller than the marginal effect reported by Pereira & Martins (2002).

TABLE 1: OLS ROBUST REGRESSION: OVERALL RETURNS TO EDUCATION EXPLAINED BY OVERALL DISPERSION

	RMSE Based Estimate				Quantile Regression Based Estimate			
	No Fixed Effects		Country-specific Fixed Effects		No Fixed Effects		Country-specific Fixed Effects	
	Men	Women	Men	Women	Men	Women	Men	Women
Dispersion	0.136***	0.095***	0.147***	0.014	0.191**	-0.085	0.260***	-0.005
	(0.015)	(0.030)	(0.020)	(0.037)	(0.094)	(0.131)	(0.084)	(0.083)
Constant	-0.023***	-0.005	-0.018*	0.044**	0.032***	0.038***	0.051***	0.051***
	(0.007)	(0.014)	(0.011)	(0.018)	(0.003)	(0.005)	(0.003)	(0.004)
Obs	56	56	56	56	56	56	56	56
R^2	0.599	0.142	0.879	0.796	0.039	0.010	0.823	0.795
F	46.15	5.131	52.31	47.22	2.082	0.213	64.17	44.25

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Country and year-specific fixed effects not shown for space reasons.
Source: EU-SILC, 2005, 2006, Eurostat

Next we regress the rates of return to specific levels of educational attainment generated by equation 4 on our overall measures of dispersion. This allows us to assess the extent to which the relationships uncovered in Table 1 are general in nature or specific to various levels of educational attainment. From the regressions excluding country level fixed effects we found that conditional general dispersion, as measured by the RSE, was positively related to rates of return for all education levels with the exception of ISCED 3/4 among females where the coefficient was negative and non-significant (Table 2). Interestingly, the R^2 statistic suggests that general RSME was particularly effective when explaining spatial variations in the rates of return to ISCED level 5 among males. We then included country level dummies to assess the relationship after taking account of unobserved country level differences. We found that the controls remain positive and significant for ISCED level 5 confirming the robustness of the result. The fixed effects model also confirms the observation of higher relative returns to ISCED level 5 attainments in Portugal, Austria and Poland (coefficients not shown for space reasons but available from the authors upon request). The marginal effects are much larger than those reported in Table 1 with a 1 per cent increase in general dispersion associated with a 1.5 per cent increase in the average return to ISCED 5 attainment among men and 1 per cent increase among women. Conversely, the ISCED 3/4 result was no longer significant when country level fixed effects were included, suggesting that the previously observed effect was largely attributable to unobserved country level influences.

TABLE 2: OLS ROBUST REGRESSION: SPECIFIC RETURNS TO EDUCATION EXPLAINED BY OVERALL DISPERSION AND DIFFERENCES IN RETURNS TO 9TH AND 1ST DECILE

	NOT Controlling for country effects				Controlling for country effects			
	ISCED 3/4		ISCED 5		ISCED 3/4		ISCED 5	
	Men	Women	Men	Women	Men	Women	Men	Women
Overall RMSE	0.628***	-0.404	2.354***	1.524***	0.122	-0.120	1.568***	1.085**
	(0.155)	(0.272)	(0.238)	(0.461)	(0.359)	(0.431)	(0.530)	(0.533)
Constant	-0.035	0.436***	-0.366***	0.072	0.127	0.316	-0.146	0.221
	(0.073)	(0.107)	(0.098)	(0.176)	(0.176)	(0.194)	(0.258)	(0.240)
R^2	0.124	0.0448	0.545	0.188	0.754	0.449	0.874	0.756
F	8.749	1.123	49.04	5.530	48.68	28.71	68.05	142.8
absdif91	0.638***	0.062	-0.021	0.240**	0.253***	0.026	0.207**	-0.026
	(0.099)	(0.078)	(0.185)	(0.103)	(0.091)	(0.069)	(0.092)	(0.075)
Constant	0.134***	0.264***	0.601***	0.617***	0.176***	0.261***	0.556***	0.717***
	(0.021)	(0.022)	(0.065)	(0.040)	(0.040)	(0.053)	(0.062)	(0.072)
R^2	0.438	0.0128	0.000247	0.0925	0.789	0.450	0.862	0.727
F	20.68	0.343	0.00655	2.702	19.11	4.182	32.00	13.63
Obs.	56	56	56	56	56	56	56	56

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Country and year-specific fixed effects not shown for space reasons.
Source: EU-SILC, 2005,2006, Eurostat.

The second part of Table 2 replicates the model with the quantile regression based estimate and it is immediately obvious that some differences exist relative to the results reported in the upper part. For instance, concentrating again on the fixed effects model, no relationship between overall dispersion and rates of return was found within the female ISCED 5 equation, despite the fact that this was a relatively strong effect in the RSME based model. Furthermore, the relationship between the male returns to ISCED 3/4 while significant in the lower part of Table 2 was not apparent in the previous regression. Generally, the finding, implied by the specification in the upper part in Table 2, suggest that the general dispersion / education return relationship is only present for males whereas our preferred approach suggests that it is observed for both males and females with higher levels of educational attainment. The marginal effects are also somewhat lower with a 4-5 per cent increase in dispersion necessary to generate a 1 per cent increase in the returns to each level of male educational attainment.

While the analysis of the impact of overall labour market conditional dispersion on rates of return is interesting, it is not highly informative as, given the high correlation between overall labour market dispersion and that in the various components of the wage distribution, we cannot distinguish the extent to which the relationship is driven by risk as opposed to other factors. To test our competing hypotheses, we regress the rates of return of each education level within each region generated by equation 5 on the corresponding conditional dispersion measures. However, given that within country levels of dispersion are likely to be highly correlated, concerns regarding colinearity dictate that we cannot simply estimate a model that includes multiple conditional dispersion measures without some degree of consistency checks. The issue is examined in Table A.3 (in the on-line Annex) which reports the correlation coefficients for the various RSME measures. Note, we also include conditional dispersions from the regression estimated using the ISCED 2 and below educational category. Generally

speaking, the correlation coefficients are larger for males with the rate of correlation highest between the ISCED 3/4, 5 and overall conditional dispersion measures while that based on ISCED 2 and below was relatively poorly correlated with the other education specific measures. With respect to females, the correlation was highest between the measure of conditional dispersion estimated using the ISCED 3/4 population and that based on the overall and ISCED level 2 distributions. However, as was the case with males, the female ISCED level 2 conditional dispersion measure was poorly correlated with that based on ISCED 5.

Given our concerns with colinearity, we estimate our models to include each measure of dispersion as a singular right hand side variable, before estimating a model that includes all measures. The results are reported in Table 5. As we move from the models excluding fixed effects to those including country level controls, we observe a fall in the number of significant results, which again emphasises the importance of unobserved country level factors. Focusing on the fixed effect model, the results are relatively stable as we move from specifications including ISCED-level educational control separately to the final specification which contains all controls simultaneously, suggesting that colinearity is not a strong concern. The one exception to this relates to the model for male ISCED 3/4 attainment where the control for ISCED level 5 dispersion is significant only in the final model, suggesting that we should treat the result with some degree of caution. While the earlier results (Table 2) demonstrated that returns to ISCED level 5 female educational attainment were higher in countries where the overall return to educational investment was more dispersed, no relationship was found with respect to educational specific measures of wage dispersion. The result suggests that variations in female ISCED level 5 returns are strongly related to higher levels of general wage dispersion rather than a higher variations in ISCED level 5 attainments *per se*. The results for females demonstrably do not support the hypothesis that variations in the returns to education are driven by the risk associated by each educational investment. We find no evidence of a correlation with respect to intermediate qualifications while the relative return to level 5 attainments is uncorrelated with wage dispersion among graduates but correlated with the level of general wage dispersion in the economy, suggesting that institutional factors are potentially more important in this respect. In the case of females we reject both H1 and H2.

TABLE 3: OLS ROBUST REGRESSIONS: RETURNS TO EDUCATION EXPLAINED BY OVERALL AND ISCED-SPECIFIC DISPERSION AND SPILLOVER EFFECTS ACROSS ISCED LEVELS

	Not controlling for country fixed - effects				Controlling for country fixed effects			
	ISCED 3/4		ISCED 5		ISCED 3/4		ISCED 5	
	Males	Females	Males	Females	Males	Females	Males	Females
Own ISCED	**0.433****	-0.046	**2.220*****	**1.261*****	-0.179	0.112	**1.196*****	0.661
RMSE	**(0.215)**	(0.269)	**(0.313)**	**(0.445)**	(0.320)	(0.326)	**(0.322)**	(0.425)
R2	0.0622	0.00164	0.433	0.154	0.755	0.450	0.883	0.744
RMSE	**0.593*****	0.023	**1.293*****	**0.588****	0.228	0.153	**0.235***	0.327
ISCED 2	**(0.187)**	(0.164)	**(0.257)**	**(0.281)**	(0.168)	(0.194)	**(0.136)**	(0.230)
R2	0.347	0.00121	0.516	0.0705	0.769	0.460	0.852	0.742
RMSE	**0.433****	-0.046	**2.162*****	**1.380*****	-0.179	0.112	0.672	**0.566***
ISCED 3/4	**(0.215)**	(0.269)	**(0.271)**	**(0.436)**	(0.320)	(0.326)	(0.500)	**(0.324)**
R2	0.0622	0.00164	0.481	0.214	0.755	0.450	0.855	0.738

RMSE	0.334	-0.245	**2.220*** **	**1.261*** **	0.351	-0.105	**1.196*** **	0.661
ISCED 5	(0.255)	(0.277)	**(0.313)**	**(0.445)**	(0.217)	(0.405)	**(0.322)**	(0.425)
R2	0.0316	0.0202	0.433	0.154	0.763	0.450	0.883	0.744
RMSE	**0.696** **	0.058	**0.838*** **	0.113	0.225	0.149	**0.264***	0.284
ISCED 2	**(0.274)**	(0.206)	**(0.253)**	(0.293)	(0.161)	(0.207)	**(0.139)**	(0.223)
RMSE	-0.222	0.044	0.590	**0.996***	-0.361	0.072	0.192	0.433
ISCED 3/4	(0.339)	(0.381)	(0.430)	**(0.539)**	(0.256)	(0.332)	(0.387)	(0.334)
RMSE	-0.102	-0.289	**0.989** **	0.712	**0.485** **	-0.116	**1.154*** **	0.620
ISCED 5	(0.292)	(0.385)	**(0.390)**	(0.554)	**(0.237)**	(0.398)	**(0.321)**	(0.388)
R2	0.366	0.0238	0.658	0.255	0.787	0.462	0.890	0.766
Obs.	56	56	56	56	56	56	56	56

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: EU-SILC, 2005, 2006, Eurostat.

The results for males suggest that higher returns to ISCED level 5 attainments are explained by higher levels of dispersion in graduate labour markets and are also associated with higher levels of wage dispersion among workers with ISCED level 2 and below attainment. The lack of a widespread relationship between educational attainment and wage dispersion at both the graduate and intermediate levels leads us to again reject H1 that variations in the returns to education across countries are explained by variations in labour market risk. The observed pattern whereby higher rates of return to graduate attainment are associated with both higher dispersion both within the graduate wage distribution and the lower tails of the skills distribution appears consistent with a scenario of differential rates of SBTC across countries. The results is indicative of a situation whereby rates of return are higher in countries where the adoption of technology has led to an increased demand for educated labour, which, in turn, has led to a rise in graduate wage inequality as the earnings of graduates with technology related competencies accelerate at a faster pace than those from less technical backgrounds. SBCT will result in a decline in the relative demand of intermediate labour as many of the tasks undertaken by such workers are replaced as a consequence of technological change. The increased demand for skilled labour may also be associated with an increased demand for services generally undertaken by workers with fewer qualifications, which, in turn, leads to an increase in the wage rates of this section of the labour market and increased wage dispersion[3]. Thus, we argue with respect to males the evidence is supportive of H2.

4. Summary and conclusions

This paper uses EU-SILC data to explore the relationship between wage dispersion and rates of return. The analysis seeks to shed further light on the hypothesis that variations in cross-country returns are positively related to the risk level of the human capital investment, as measured by dispersion in the rate of return. The results find that there is no consistent evidence that returns to educational attainment are highest in countries where the potential earnings for a given qualification are more dispersed. We

[3] A number of authors have reported that the premium to high school level qualifications over no qualifications has been declining and in some case eradicated over time (Keep (2005), McGuinness & Bennet (2009)).

conclude that distributional factors are more important in explaining spatial variations in rates of return for males. The findings would seem to confirm that international variations in male rates of return to ISCED level 5 attainments are associated with a higher level of variation in the return to that particular investment. However, the results for males also appear consistent with a scenario whereby changes in the relative demand have resulted in an increased rate of dispersion for individuals at both extremes of the distribution which is consistent with the notion that SBTC will result in increased demand for both high and low skilled labour.

Finally, for females, higher rates of return to graduate schooling are more heavily related to general wage dispersion within the economy, as opposed to greater levels of uncertainty associated with ISCED level 5 investments per se. We find no evidence of a link between wage dispersion and rates of return to intermediate levels of educational attainment. Our results suggest that institutional factors that tend to impact on overall levels of wage inequality, such as trade-union membership, equality legislation or the extent of centralised wage bargaining, may be more relevant for explaining international variations in female rates of return to graduate education than either the market orientated risk/return hypothesis or that related to skill biased technological change. Thus, for females, the results support H3. The observed gender differences suggest that males and females may respond somewhat differently to market incentives when choosing to invest in education and subsequent career decisions. The higher likelihood among females to take time out from the labour market and occupationally downgrade for family reasons will result in lower expected returns to education which, in turn, may be resulting in a lower sensitivity to any movements in the risk return ratio.

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ON-LINE ANNEX

TABLE A.1: EDUCATIONAL ATTAINMENT IN REGIONS, ORDERED BY COUNTRY AND WELFARE REGIME.

			Men			Women		
			ISCED 0-2	ISCED 3/4	ISCED 5	ISCED 0-2	ISCED 3/4	ISCED 5
Regime	Country	Regions						
Central European	Austria	AT1	0.147	0.650	0.203	0.185	0.612	0.203
		AT2	0.100	0.723	0.177	0.166	0.651	0.183
		AT3	0.159	0.658	0.183	0.203	0.632	0.165
		AT	*0.141*	*0.668*	*0.190*	*0.188*	*0.627*	*0.185*
Mediterranean	Spain	ES1	0.430	0.259	0.311	0.343	0.264	0.393
		ES2	0.333	0.255	0.412	0.247	0.239	0.513
		ES3	0.313	0.277	0.410	0.209	0.276	0.515
		ES4	0.484	0.228	0.288	0.336	0.229	0.435
		ES5	0.463	0.259	0.279	0.354	0.262	0.384
		ES6	0.522	0.230	0.248	0.360	0.260	0.379
		ES7	0.539	0.249	0.212	0.402	0.255	0.343
		ES	*0.440*	*0.252*	*0.308*	*0.318*	*0.258*	*0.424*
	Greece	GR1	0.340	0.417	0.243	0.206	0.398	0.396
		GR2	0.383	0.457	0.161	0.284	0.463	0.253
		GR3	0.235	0.448	0.317	0.148	0.449	0.402
		GR4	0.406	0.404	0.190	0.256	0.507	0.237
		GR	*0.307*	*0.437*	*0.256*	*0.193*	*0.443*	*0.364*

	Italy	ITC	0.440	0.428	0.132	0.338	0.504	0.157
		ITD	0.429	0.442	0.129	0.298	0.515	0.187
		ITE	0.386	0.456	0.158	0.279	0.489	0.233
		ITF	0.488	0.374	0.138	0.225	0.503	0.272
		ITG	0.526	0.359	0.115	0.230	0.537	0.233
		IT	*0.445*	*0.419*	*0.136*	*0.292*	*0.506*	*0.202*
	Portugal	PT	0.712	0.167	0.121	0.584	0.194	0.222
Liberal	Ireland	IE0	0.312	0.384	0.304	0.223	0.391	0.386
Nordic	Iceland	IS	0.308	0.461	0.231	0.344	0.356	0.300
Eastern European	Poland	PL1	0.080	0.656	0.264	0.041	0.566	0.393
		PL2	0.045	0.776	0.179	0.040	0.634	0.326
		PL3	0.072	0.731	0.197	0.030	0.622	0.349
		PL4	0.085	0.750	0.165	0.072	0.631	0.297
		PL5	0.061	0.776	0.164	0.042	0.683	0.275
		PL6	0.084	0.756	0.160	0.074	0.666	0.259
		PL	*0.070*	*0.737*	*0.193*	*0.049*	*0.627*	*0.324*

Source: EU-SILC 2005, 2006. Eurostat.

TABLE A.2: RETURNS TO EDUCATION IN REGIONS, ORDERED BY COUNTRY AND WELFARE REGIME

			Men		Women	
Regime	Country	Regions	ISCED 3/4	ISCED 5	ISCED 3/4	ISCED 5
Central European	Austria	AT1	0.384	0.713	0.324	0.673
		AT2	0.563	0.803	0.336	0.628
		AT3	0.360	0.643	0.330	0.608
		AT	*0.398*	*0.691*	*0.329*	*0.642*
Mediterranean	Spain	ES1	0.224	0.446	0.219	0.575
		ES2	0.072	0.298	0.168	0.493
		ES3	0.206	0.615	0.160	0.553
		ES4	0.169	0.467	0.219	0.563
		ES5	0.163	0.409	0.176	0.543
		ES6	0.149	0.402	0.259	0.633
		ES7	0.074	0.413	0.175	0.491
		ES	*0.159*	*0.427*	*0.209*	*0.572*
	Greece	GR1	0.173	0.509	0.313	0.729
		GR2	0.190	0.405	0.309	0.644
		GR3	0.096	0.450	0.374	0.781
		GR4	0.172	0.379	0.329	0.801
		GR	*0.158*	*0.488*	*0.351*	*0.755*
	Italy	ITC	0.174	0.531	0.239	0.508
		ITD	0.153	0.433	0.255	0.442
		ITE	0.111	0.424	0.274	0.493
		ITF	0.148	0.464	0.447	0.797
		ITG	0.142	0.607	0.315	0.654
		IT	*0.158*	*0.485*	*0.283*	*0.530*
	Portugal	PT	*0.340*	*0.920*	*0.393*	*1.037*
Liberal	Ireland	IE0	*0.185*	*0.610*	*0.260*	*0.704*

Nordic	Iceland	IS	*0.240*	*0.586*	*0.152*	*0.436*
Eastern European	Poland	PL1	0.281	0.937	0.252	0.899
		PL2	0.235	0.738	0.204	0.812
		PL3	0.273	0.847	0.226	0.826
		PL4	0.293	0.851	0.381	0.922
		PL5	0.249	0.866	0.282	0.848
		PL6	0.328	0.907	0.252	0.776
		PL	*0.306*	*0.893*	*0.286*	*0.889*

Source: EU-SILC 2005, 2006. Eurostat.

TABLE A.3: CORRELATION BETWEEN MEASURES OF CONDITIONAL DISPERSION

Males	Stand Error 0/2	Stand Error 3/4	Stand Error 5	Overall SE
Stand Error 0/2	1.0000			
Stand Error 3/4	0.6034	1.0000		
Stand Error 5	0.4738	0.7627	1.0000	
Overall SE	0.7485	0.9451	0.8014	1.0000
Females				
Stand Error 0/2	1.0000			
Stand Error 3/4	0.7416	1.0000		
Stand Error 5	0.2575	0.4713	1.0000	
Overall SE	0.5451	0.8430	0.7321	1.0000

Source: EU-SILC 2005, 2006, Eurostat.

TABLE A.4.: LABELS OF THE NUTS1 REGIONS IDENTIFIED IN THE DATA-SET

AUSTRIA		ITALY	
AT1	OSTÖSTERREICH	ITC	NORD-OVEST
AT2	SÜDÖSTERREICH	ITD	NORD-DEST
AT3	WESTÖSTERREICH	ITE	CENTRO (I)
SPAIN		ITF	SUD
ES1	NOROESTE	ITG	ISOLE
ES2	NORESTE	POLAND	
ES3	COMUNIDAD DE MADRID	PL1	REGION CENTRALNY
ES4	CENTRO (E)	PL2	REGION POLUDNIOWY
ES5	ESTE	PL3	REGION WSCHODNI
ES6	SUR	PL4	REGION POLNOCNO-ZACHODNI
ES7	CANARIAS	PL5	REGION POLUDNIOWO-ZACHODNI
GREECE		PL6	REGION POLNOCNY
GR1	VOREIA ELLADA		
GR2	KENTRIKI ELLADA	PT	PORTUGAL
GR3	ATTIKI	IE0	IRELAND
GR4	NISIA AIGAIOU, KRITI	IS0	ÍSLAND