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Evidence from Europe

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POMPEU FABRA UNIVERSITY
INSTITUTO VALENCIANO DE INVESTIGACIONES ECONÓMICAS (Ivie)

■ Abstract

Recent papers argue that higher education does not have a significant effect on growth. However, the data for many countries show a substantial increase in the college premium over the last decades. Most of the explanations argue that the increase in the college premium is due to an acceleration of skill biased technological change, which has increased the demand for college graduates. However, at the same time, labor economists have found that residual inequality, or within educational group inequality, has also increased among university graduates. In this working paper we distinguish between level of education and other skills as well as their utilization. We test the implications of a two-index model of residual inequality using a large sample of higher education graduates from several European countries. The empirical results show a positive and statistically significant relationship between within group inequality and overeducation, using the field of study as the basic stratification variable. We interpret this finding as evidence that the demand for some skills, not appropriately measured by level of education, has increased.

■ Resumen

Investigaciones recientes señalan que la educación superior no tiene un efecto significativo sobre el crecimiento económico. Sin embargo, los datos de muchos países muestran un incremento sustancial en el premio salarial de ser universitario. La mayor parte de las explicaciones argumentan que el aumento en el salario relativo de los universitarios es debido a la aceleración del cambio tecnológico, que ha aumentado la demanda de graduados universitarios. Por su parte, en el campo de la economía laboral se ha constatado que la desigualdad residual, o dentro de cada grupo educativo, ha aumentado también entre los graduados universitarios. En este documento de trabajo se distingue entre el nivel de educación y el nivel de competencias/habilidades así como su utilización. Asimismo, se contrastan las implicaciones de un modelo de dos de desigualdad residual usando una muestra amplia de graduados de enseñanza superior de varios países europeos. Los resultados empíricos muestran una relación positiva entre desigualdad dentro de cada grupo educativo y el nivel de sobrecualificación, usando la rama de estudios como la variable de estratificación. Estos resultados evidencian que la demanda de algunas competencias/habilidades, que no pueden medirse simplemente a partir del nivel de educación, ha aumentado.

■ Key words

Tertiary education, skills, inequality.

■ Palabras clave

Educación superior, habilidades, desigualdad.

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CONTENTS

1. Introduction

In recent years there has been an increasing interest in the effects of technical change on inequality. The main reason has been a steep increase in the college wage premium since the beginning of the 80s. At the same time there has also been a large increase in the size of within educational group, or residual, inequality. Therefore, not only the relative wage of college graduates with respect to higher education graduates is increasing but also, within college graduate wage inequality has increased. This seems reasonable since the same technological shock that may be at the root of the increase in between group inequality can alter the relative demand of different higher education graduates. The purpose of this paper is to analyze the relationship between residual educational inequality and skills mismatch in the case of college graduates. We argue that technological shocks will also have an important effect on the demand for different skills/education among higher education graduates. This means that we should observe a relationship between within group wage inequality and mismatch. The shape of this relationship and its interpretation is the basic objective of this paper.

Recent papers (Aghion et al., 2005; Aghion and Howitt, 2005) have tried to explain why higher education does not have a significant effect on economic growth in empirical studies. In particular the US has been growing faster than Europe since 1975 and invest more in tertiary education. This fact may seem to favor a positive relationship between higher education and growth. However, Europe grew faster than the US from the end of the Second World War until 1975 while investing mostly in primary and secondary education. The Asian miracle was also more based on primary and secondary education than tertiary education. The answer combines the effect of technological change and the distance from the technological frontier. Aghion et al. (2005) argue that when you are far away from the technology frontier you can grow by imitating the country at the technological frontier. This type of growth does not requires a highly educated labor force (tertiary education). By contrast, once at the technological frontier the complementarity between higher education and innovations gives the advantage to countries that invest heavily in tertiary education.

In this working paper we argue that the complementarity between higher education and innovation depends on the effective skills acquired by graduates and not just on their level of education. For this reason we study the skills and their relationship with residual inequality among higher education graduates. The structure of this working paper is the following. In section 2 we discuss the determinants of the increase in the college wage premium and residual inequality. Section 3 presents some basic facts about skill and education mismatch. Most of the discussion about skill/education mismatch is centered around measurement issues. For this reason section 4 analyzes the indicator skills mismatch and its relationship with skills infra-utilization and job satisfaction. Section 5 studies the relationship between residual inequality and overqualification of higher education graduates conditional on the field of specialization. Section 6 concludes.

2. The Rise of the College Premium

THE literature on education and inequality decomposes total inequality in two components: between educational groups inequality and within educational group inequality. Between groups inequality represents the relative wages usually for different educational groups. Residual inequality, measures the evolution of wage inequality within each educational, skills or occupational group. The recent surge of the literature on wage inequality has emphasize the first of these inequality components. From a theoretical perspective the need to account separately for the relative wage of two types of workers implies the inclusion of two categories of workers, usually denoted as skilled and unskilled. The simplest model (Aghion, 2002; Acemoglu, 1998, 2002; Manacorda and Petrongolo, 1999) assumes a CES production function with two kinds of workers: low education or unskilled (L) and high education or skilled (H). Both types are imperfect substitutes. Therefore we can write the production function as

$$Y = [(A_L L)^\rho + (A_H H)^\rho]^{1/\rho}.$$

The elasticity of substitution is $\sigma = 1/(1-\rho)$. Obviously if $\sigma > 1$ $(\rho > 0)$ the low quality and the high quality workers are gross substitutes while if $\sigma < 1$ $(\rho > 0)$ they are gross complements.

If labor markets are competitive then the relative wage can be written as

$$\omega = \frac{w_H}{w_L} = \frac{\frac{\partial Y}{\partial H}}{\frac{\partial Y}{\partial L}} = \left(\frac{A_H}{A_L}\right)^{\frac{(\sigma-1)}{\sigma}} \left(\frac{H}{L}\right)^{-\frac{1}{\sigma}}.$$

Taking logs of both sides of equation we get [1]

1. This is basically identical to Manacorda and Petrongolo (1999) before changing labor force by the employment rate.

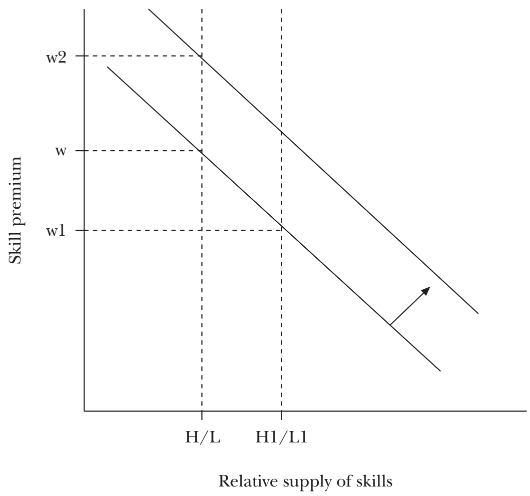
$$\ln \omega = \frac{\sigma - 1}{\sigma} \ln \left(\frac{A_H}{A_L} \right) - \frac{1}{\sigma} \ln \left(\frac{H}{L} \right).$$

Notice that this equation leads to a very simple demand-supply interpretation. For a given skill bias technological change $\left(\frac{A_H}{A_L}\right)$, the substitution effect implies that the skill premium increases when skilled workers are scarce relative to unskilled workers. Therefore one over the elasticity of substitution determines the (negative) slope of the relative demand of skilled versus unskilled workers. On the other hand the bias of technological change shifts the relative demand schedule. The movement is determined by the derivative

$$\frac{\partial \ln \omega}{\partial \ln \left(\frac{A_H}{A_L}\right)} = \frac{\sigma - 1}{\sigma}.$$

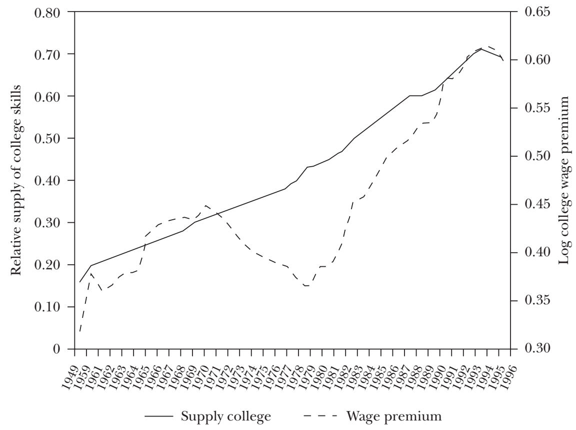
Therefore, given a relative supply of skilled versus unskilled workers the wage premium will increase if there is skill biased technological change ($\sigma > 1$). This is to say that if skills and technology and complementary then an improvement in the productivity of skilled workers relative to the unskilled will shift the relative demand up. Graphic 2.1 shows these effect in graphical form. An increase in the relative supply of skilled versus unskilled workers (from H/L to H_1/L_1) reduces the skill premium (from w to w_1) while a skill biased technological shock (shift of the line outwards), given relative supply, increases the skill premium from w to w2.

GRAPHIC 2.1: Skill premium and relative supply of skills



This scheme is used to interpret the historical evolution of the

GRAPHIC 2.2: Wage premium and the supply of college skills in the US



college premium. Graphic 2.2 shows the college wage premium compared with the relative supply of college graduates versus lower educational levels [2]. The construction of the relative supply follows closely the proposal of Autor, Katz and Krueger (1998) who consider the ratio of college equivalents (individuals with at least college plus one half the individuals with some college) to non-college equivalents (individuals with high school or less plus one half the individuals with some college). The steep increase in the wage premium during the 80's and 90's has been one of the basic facts that have attracted a lot of attention from labor economists in recent years (Katz and Murphy, 1992; Autor, Katz and Krueger, 1998; Katz and Autor, 2000). Graphic 2.2 shows three clearly distinguished periods. During the 50's and the 60's there is an increase in the college wage premium together with an increase in the relative supply of college graduates. During the 70's the relative supply of college graduates continue increasing while the college wage premium drops to levels the level of the beginning of the 60's. Finally, since 1980 there is an explosion of the college wage premium in spite of the increase in continuing increase in the relative supply of college skills. Following the description presented above the negative relationship between the college premium and the relative supply of skills during the 70's can be interpreted as an increase in the relative supply of college skills [3].

However, this literature has taken off over the last two decades, when

2. See Autor, Katz and Krueger (1998); Aghion (2002); Acemoglu (2002) for the case of the US. For an UK perspective see Walker and Zhu (2005).

3. This period is particularly important for the argument in this paper since it led to one of the first studies on overeducation (Freeman, 1976).

the college premium increased very fast. Most of the papers argue that there has been an acceleration in the skill biased technological change although the causes of this acceleration are much more controversial. Acemoglu (1998, 2002) argues that the acceleration in the skill-biased technical change has been the endogenous response to a rapid increase of the supply of skills during the same decades. Krussel et al. (2000) point out that unskilled labor is more substitutable for physical equipment than skilled labor. For this perspective the decline in the relative price of production equipment goods during the period of study can explain most of the college premium. Notice that for such a conclusion we need to include in the aggregate production function the possibility of substitution between capital and both types of labor

$$Y_t = A_t SK_t[\gamma L_t^{\alpha} + (1-\gamma)(\lambda EK_t^{\rho} + (1-\lambda)H_t^{\rho})^{\sigma/\rho}]^{(1-\alpha)/\sigma},$$

where *A* represents neutral technological change, *SK* is the structural capital (fixed), *EK* is the equipment capital (flexible), and L and H are, as above, unskilled and skilled labor respectively. The basic assumption in Krussel et al. (2000) is that $\sigma > \rho$, that is to say that the elasticity of substitution between unskilled labor and equipment is greater than the elasticity of substitution between equipment and skilled labor [4].

4. For other explanations of the acceleration of the skill-biased technical change (the increase in international trade, the change in labor market institutions, etc.) see Acemoglu, 2002; Aghion, 2002.

3. Residual Inequality and Skills Mismatch

THE second component of inequality is within educational group inequality. Residual inequality has increase independently of how we define the groups (in terms of education, age, experience, industry, occupation, etc.). In fact within group inequality accounts for a large fraction of the overall increase in income inequality. Even more interesting, residual inequality has continue to grow even when between groups inequality has decrease as we show in graphic 2.1 during the last two years. But, what are the causes of within educational group inequality? Is the acceleration in skilled biased-technological change also a factor in the sharp increase in residual inequality? The explanations for the sharp increase in residual inequality are more controversial than the effect of skill-biased technological change on between educational groups inequality. In fact, the most difficult challenge is to find a model that could explain a negative correlation between the college premium and residual inequality. Any single index model of residual inequality will have many problems to explain the experience of the 70's when the relative supply of skilled versus unskilled labor increased but the college premium decreased. Imagine that education and skills are imperfectly correlated. Consider that the probability of a college graduate (noncollege graduate) be highly skilled is $\phi_c(\phi_{nc})$ respectively. The college premium is, by definition,

$$premium = \frac{w_c}{w_{nc}} = \frac{\phi_c w + (1 - \phi_c)}{\phi_{nc} w + (1 - \phi_{nc})},$$

where w is the skill premium. If the proportion of high skill individual among college graduates is larger than among noncollege graduates ϕ_l $< \phi_h$, which seems a reasonable assumption, then the relationship between college premium and within group inequality has to be positive as long as the probabilities ϕ_l and ϕ_h are constant.

$$\frac{\partial premium}{\partial w} = \frac{\phi_c - \phi_{nc}}{(\phi_{nc} w + (1-\phi_{nc}))^2} > 0.$$

The models of sorting have a different problem. They cannot explain why residual inequality increases for all education levels without changes in the price of unobserved skills. Another approach (churning models) emphasizes that only some workers are able to adapt to the new technologies. This theory points out that a temporary increase in dislocation can increase inequality [5]. However, as workers adapt to this new technology inequality should fall. In addition there is no much evidence of churning.

An alternative possibility is that the increase in the proportion of skilled labor has led to an increase in the demand of unobservable skills and/or abilities at the same time as it improves the demand of observable skills. Using a two-index model of residual inequality Acemoglu (2002) argues that the demand for unobservable skills can explain the rise in within educational groups inequality and the 70's anomaly. The basic assumption is that observed and unobserved skills are imperfect substitutes [6]. The aggregate production function includes, therefore, that there are two educational groups (as before high and low) and, in each of them, there is a subgroup with high unobservable skills (*Hh* and *Lh*) and another with low unobservable skills (*Hl* and *Ll*). Therefore the production function is

$$Y = [(A_{Lh} Lh)^{\rho} + (A_{Hh} Hh)^{\rho} + (A_{Ll} Ll)^{\rho} + (A_{Hl} Hl)^{\rho}]^{1/\rho}.$$

From this expression it is easy to show that between group inequality can be written as

$$\omega = \frac{w_H}{w_L} = \left(\frac{1+\phi_l}{1+\phi_h}\right)^{\rho} \left(\frac{H}{L}\right)^{-(1-\rho)},$$

where ϕ_h is the proportion of high unobservable skills among high education individuals while ϕ_l $(< \phi_h)$ is the proportion of high unobservable skills workers in the low education group. However, what matters for residual inequality is the relative wage of high and low

5. This is basically the argument in Aghion (2002). His explanation is based on the different adaptability of workers to the leading edge technology.

6. This assumption is also important in our application to higher education graduates. Taber (2001) argue that there has been an increase in unobserved ability and not in college skills.

unobservable skills within each educational group. For instance, Dolton and Vignoles (2000) point out that what matters is not how long a person spends in school but rather what academic standard they achieve. It is reasonable to assume that this academic standard depend on some unobservable skills, attitudes and competencies. The relative wage within the group of college graduates is

$$\frac{w_{Hh}}{w_{Hl}} = \left(\frac{A_{Hh}}{A_{Hl}}\right)^{\rho} \phi_h^{-(1-\rho)}.$$

Obviously this structure allows the breaking of the positive correlation between educational groups inequality and residual inequality which helps to explain the episode of the 70's. In fact residual inequality is independent of the relative supply of high education workers.

Even though we have reviewed some models where skill mismatch is related with residual inequality none of them had a complete vision of the relationship between skill-biased technological change, mismatch shocks and unemployment. An step in this direction is Cuadras and Mateos (2004). They use two basic assumptions. The first is labor market segmentation: vacancies in the higher education segment requires a degree while this is not so in the low education sector. The second assumption implies imperfect correlation between skills and educational status. Additionally they assume that the choice of education is endogenous. Cuadras and Mateos (2002) use a standard search-matching theoretical model to derive the basic conclusions. The calibrated model shows that a skill-biased technological change implies an increase in the wage premium and the unemployment rate of low education workers. The increase in the unemployment among high education workers is the consequence of higher education workers participating in the low education segment of the labor market, where unemployment is increasing. In addition an skill-biased technological shock will generate an increase in *overeducation* and within group wage inequality.

4. The Data

WE are interested in the effect of the demand for skills on residual inequality among higher education graduates. The relationship between wages and cognitive skills has been previously analyzed in the context of the explanation of the return to education [7]. Murnane, Willett and Levy (1995) argue that the increase in the return to cognitive skills can explain all the increase in the wage premium of post-secondary education in the period 1978-1986. More recently, Ingram and Neumann (2006) find that the return to years of education has been constant since 1970 while direct measures of skills account for a large proportion of the increased dispersion among college graduates. Ingram and Neumann (2006) use the information in the *DOT (Dictionary of Occupational Titles)* to measure the skills content of the jobs of workers in the CPS and the NLSY. Therefore, the skill content is basically an occupation-average and it is not individual specific but occupation specific. Using this definition of skills, Ingram and Neumann (2006) find that for highly educated workers variations in skill can explain between 4 and 8% of the variations in wages in the 80's and close to 10% of the variation in wages in the 90's.

Ingram and Neumann (2006) use as skills the corresponding to the job held by the worker. They argue that there are reasons to believe that exception to adequate qualification will be of minor importance. However, it is well known that an important proportion of graduates are overqualified. The studies summarized in Groot and Van den Brink (2000) show that, depending on the time period and the country, between 15 and 35% of the workers are overqualified. We are going to use individual specific skills and account for the possibility of overqualification. We use a large dataset of more that 36,000 graduates from 11 countries compiled by the European project "Higher Education and Graduate Employment in Europe" [8]. This dataset is an international comparative study of higher

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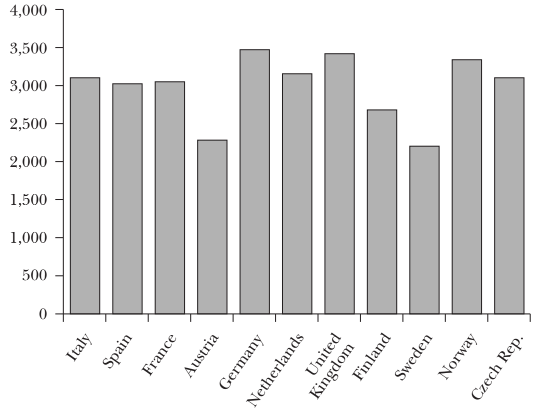
7. See for instance Card (2001) for a recent summary of this literature.

8. Also known as CHEERS (Careers after Higher Education: An European Research Survey). The project was partially funded by the European Commission under the Targeted Socio-Economic Research (TSER) program.

education and labor market of graduates from higher education [9]. It includes the answers to a sixteen pages questionnaire with very detailed questions about skills and skills utilization in the workplace. The countries that participated in the project were Italy, Spain, France, Austria, United Kingdom, Germany, Finland, Norway, Sweden, Netherlands and the Czech Republic. Graphic 4.1 shows the sample size of each country.

GRAPHIC 4.1: Sample size by country



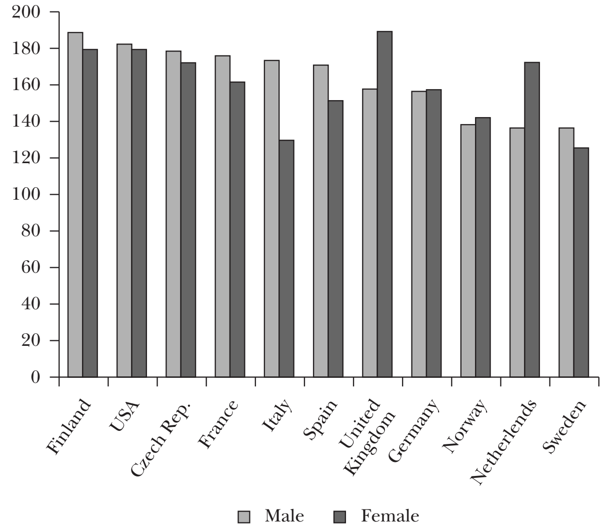
The population for which the sample was taken corresponds to the all the graduates from higher education institution of the eleven countries included in the study who had finished their studies in 1994-1995. Therefore the sample includes basically young higher education graduates which could have been working for at least five years before the survey took place. Graphic 4.2 gives an indication of the degree of between educational groups inequality in some of the countries from the sample. It shows the average wage of higher education graduates over high school graduates [10]. The largest divergence take place in Finland followed by the US (included only for comparison considerations) and the Czech Republic.

The survey includes questions to calibrate multidimensional skills. The measurement of knowledge, skills and abilities is done by using a five points Lickert scale on each item. The interest of this questions is double: first it scans a large number of skills, knowledge and abilities [11]. Second, it

9. García Montalvo (2001) contains a detailed analysis of the basic findings obtained using these data.

10. The source of these data is the Organisation for Economic Cooperation and Development (OECD).

GRAPHIC 4.2: Relative wage of university graduates over lower educational levels



asks separately the level of such knowledge and competencies acquired by the graduate and the required at the workplace.

Table 4.1 list all the abilities, skills and knowledge items that represent professional competencies. Since the list is too long for an analysis item by item we use, as an exploratory device, factor analysis to reduce the dimensionality of skills and competencies. We use principal components with a Varimax rotation to estimate the commonalities [12]. The number of factors extracted is determined by the number of eigenvalues larger than 1. The Kaiser-Meyer-Olkin (KMO) measure is 0.86 which denotes overall sampling adequacy. Using this procedure we extract seven factors which are *named* as it appears in table 4.2 [13].

The results of the factor analysis indicate that we can group these skills in seven categories: knowledge, leadership, ability to solve specific problems, organizational skills, ability to work under pressure, social skills and stamina.

11. To be more precise 36.

12. The detailed explanation of the results of the factor analysis can be obtained upon request.

13. As this factor analysis is not the objetive of the paper we do not present the whole loads matrix which, as the reader may expect, is huge. The matrix is provided upon request.

TABLE 4.1: Skills, knowledge and abilities considered in the CHEERS questionnaire

1	Broad general knowledge
2	Cross-disciplinary thinking/knowledge
3	Field-specific theoretical knowledge
4	Field-specific knowledge of methods
5	Foreign language proficiency
6	Computer skills
7	Understanding complex social, organisational and technical systems
8	Planning, co-ordinating and organising
9	Applying rules and regulations
10	Economic reasoning
11	Documenting ideas and information
12	Problem-solving ability
13	Analytical competencies
14	Learning abilities
15	Reflective thinking, assessing one's own work
16	Creativity
17	Working under pressure
18	Accuracy, attention to detail
19	Time management
20	Negotiating
21	Fitness for work
22	Manual skill
23	Working independently
24	Working in a team
25	Initiative
26	Adaptability
27	Assertiveness, decisiveness, persistence
28	Power of concentration
29	Getting personally involve
30	Loyalty, integrity
31	Critical thinking
32	Oral communication skill
33	Written communication skill
34	Tolerance, appreciating of different points of view
35	Leadership
36	Taking responsibilities, decision

TABLE 4.2: Results from the exploratory factor analysis

Knowledge	
E1B01GEN	Broad general knowledge
E1B02CRO	Cross-disciplinary thinking/knowledge
E1B03THE	Field-specific theoretical knowledge
E1B04MET	Field-specific knowledge of methods
E1B05LAN	Foreign language proficiency
E1B06CSK	Computer skills
Leadership	
E1B27ASS	Assertiveness, decisiveness, persistence
E1B36RES	Taking responsibilities, decision
E1B25INI	Initiative
E1B35LEA	Leadership
E1B32ORA	Oral communication skill
E1B20NEG	Negotiating
Ability to solve specific problems	
E1B12PRO	Problem-solving ability
E1B15REF	Reflective thinking, assessing one's own work
E1B16CRE	Creativity
E1B13ACO	Analytical competencies
E1B31CRI	Critical thinking
E1B33WRI	Written communication skill
E1B14LEA	Learning abilities
E1B23IND	Working independently
Organizational skills	
E1B07UND	Understanding complex social, organisational and technical systems
E1B08PLA	Planning, co-ordinating and organising
E1B09RUL	Applying rules and regulations
E1B10ECO	Economic reasoning
E1B11DOC	Documenting ideas and information
Ability to work under pressure	
E1B17PRE	Working under pressure
E1B18ACC	Accuracy, attention to detail
E1B19TIM	Time management
E1B28CON	Power of concentration
Social abilities	
E1B24TEA	Working in a team
E1B26ADA	Adaptability
E1B29INV	Getting personally involve
E1B30LOY	Loyalty, integrity
E1B34TOL	Tolerance, appreciating of different points of view
Stamina (physical ability)	
E1B21FIT	Fitness for work
E1B22MAN	Manual skill

4.1. Educational mismatch and skills underutilization

In principle there are several ways [14] of computing overeducation [15]. The first alternative is to use the actual required education, as recorded by surveys to workers in different occupations, to fix the reference level of education required in each occupation. Using this methodology the mean, or the mode, of the education level of the workers by occupation is used to set a confidence interval around it. If a worker in a particular occupation had a level of education over twice times the standard deviations she would be classified as overeducated [16]. The second criteria relies on a job analysis of the required educations by occupation, done by an expert. An example is the *US Dictionary of Occupational Titles (DOT)*. An individual would be classified as overeducated if she had a level of education higher than the required by her occupation. Finally, a third measure of overeducation come from the self-rating of the worker as overeducated, undereducated or properly educated for her job. This could be done by asking directly this question or by comparing the answer of two questions. (1. What is your level of education? 2. What level of education would be necessary to perform your job?)

The CHEERS survey includes a question on the level of educational mismatch, overeducation or undereducation, of the graduate. The measurement on the CHEERS survey is based on the employee self-rating of the level of education most appropriate for the current job. In particular the question is:

What is the most appropriate of level of course of study/degree for your employment in comparison to that which you graduated from?

1. *A higher level than the one I graduated from.*
2. *The same level.*
3. *A lower level of higher/tertiary education.*
4. *No higher/tertiary education at all.*
5. *Others.*

In general we call *strong overeducation* to a situation where the graduate points out that for her job she would need no higher education. By *weak overeducation* we denote the graduates that answer they would have

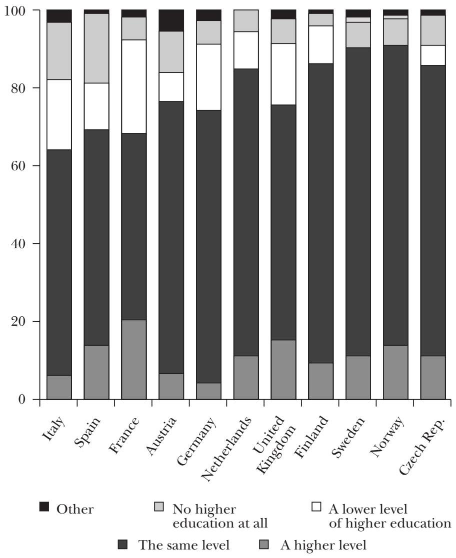
14. For a lenghty discussion of these alternative measures see García Montalvo (2001).

15. We agree with Bishop (1993) that the word *overeducation* is not a good choice. It would be better to call it *overqualification*. However since we are going to compare, at some point, educational mismatch and skills mismatch the use of *overqualification* would be a little confusing.

16. For instance Verdugo and Verdugo (1989).

enough with a lower level of higher education (for instance a 2 years short program instead of a 4/5 years long program). Graphic 4.3 shows the distribution of the answer to the question by countries. It is particularly important to notice the high level of strong overeducation in Spain and Italy where the proportions reach over 14%.

GRAPHIC 4.3: Skills required for their job



Since we want to use overeducation as the basic measure of graduates with low unobservable skills over total graduates it would be interesting to see if the subjective self-rating of graduates' overqualification with respect to their level of education is compatible with other well know facts about overeducation: skills infra-utilization, lower job satisfaction, jobs in elementary occupations, etc. First of all we show that overqualified graduates exhibit higher skill mismatch than the rest. For this purpose we can compute the percentage of skills' mismatch *(PSM)*, aggregating from individual data, as

$$PSM_i = \frac{AS_i - RS_i}{RS_i},$$

where *AS* is the acquired skill level and *RS* is the required skills level for the job of the graduate [17]. Negative *PSM* imply a skill deficit while the

17. Allen and Van der Velden (2005) use the same dataset but define skill mismatch using the answer to the questions *My current job offers me sufficient scope to use my knowledge and skills* and *I would perform better in my current job if I possessed additional knowledge and skills.* We believe that our approach is more tightly related to the measurement of skills utilization.

opposite is true if *PSM* is positive. Table 4.3 shows the average of the numerator of the *PSM* and the average for each factor as a function of the level of job-education match/mismatch.

TABLE 4.3: Relationship between PSM and education mismatch

	Higher	Same	Weak	Strong
Average difference in skills	-0.63	-0.50	-0.35	-0.07
Knowledge	-0.49	-0.26	0.01	0.34
Leadership	-0.88	-0.81	-0.68	-0.35
Ability to solve specific problems	-0.56	-0.40	-0.19	0.13
Organizational skills	-0.82	-0.68	-0.51	-0.18
Ability to work under pressure	-0.74	-0.62	-0.53	-0.35
Social skills	-0.45	-0.38	-0.31	-0.08
Stamina	-0.17	-0.11	-0.14	-0.07

The first noticeable fact in table 4.3 is that the required level of skills in the job are, in most cases, higher than the acquired levels of skills. However, we also observe that the relationship between skills demands and educational mismatch goes in the right direction: the higher the level of *overeducation* the lower the level of skills underutilization [18]. This result is strictly monotonic for all the skills factors and the average which confirms our hypothesis. Notice that this is a strong test since we are using the principal components that define each of the basic skills.

Additionally table 4.4 presents three other indications of the *appropriateness* of education mismatch, as a measure of skill underutilization, and subjective expectations. It shows that the mean of each of these items (five point scales) decreases as overeducation increases.

TABLE 4.4: Educational mismatch and skills utilization

	Higher	Same	Weak	Strong
Use of knowledge and skills	-0.63	-0.50	-0.35	-0.07
Appropriateness of my ed. level	-0.49	-0.26	0.01	0.34
Current work respect to expectations	-0.88	-0.81	-0.68	-0.35

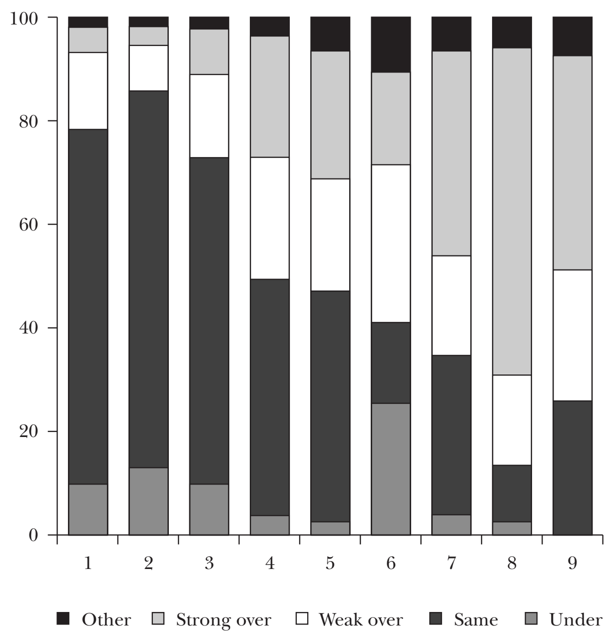
As an additional indication of the relationship between educational mismatch and skills underutilization we can see in graphic 4.4 that the proportion of strong educational mismatch increases the more elementary the occupation. We consider nine occupational groups which are

18. For the relationship between education match and job match the reader can also see Hersch (1991).

aggregated following the standard classification of the ISCO 88. Depending on the countries the data have a higher or a lower level of aggregation. However the only level that is comparable across all the countries is one digit. Therefore we separate the following occupational groups: legislators and senior officials and managers, professionals, technicians and associate professionals, clerks, service workers and shop and market sales workers, skilled agricultural and fishery workers, craft and related trade workers, plant and machine operators and assemblers and elementary occupations.

Graphic 4.4 shows that among professionals and senior officials the degree of strong overeducation is quite low. However it increases when we move from highly qualified occupations to elementary occupations. In fact the highest level of strong overeducation is associated with plant and machine operators and elementary occupations. Therefore the variable that measures the level of overeducation is compatible with the answer to the question about the last occupation of the graduate: the more qualified the job the less the level of overeducation.

GRAPHIC 4.4: Degree of mismatch by occupation



Notes: 1. Legislators, senior officials and managers. 2. Professionals. 3. Technicians and associate professionals. 4. Clerks. 5. Service workers and shop and market sales workers. 6. Skilled agricultural and fishery workers. 7. Craft and related trades workers. 8. Plant and machine operators and assemblers. 9. Elementary occupations.

4.2. Educational mismatch and job satisfaction

Another well-known effect of the educational mismatch, or overeducation, is its effect on job satisfaction. For instance Tsang, Rumberger and Levin (1991) show the negative effect of the surplus of education on job satisfaction [19]. The CHEERS survey contains a question on the job satisfaction of the graduates that we could use to analyze if the usual results on the relationship between overeducation and job satisfaction hold also for this dataset. Since the job satisfaction variable is measured in a five points scale (JS = 5 is the highest level of job satisfaction) we estimate a multinomial logit model. The results are presented in table 4.5 [20]. The number of observations is 28.543. In the regression we include also country specific effects although we do not report all these estimators since they are not important for our conclusions. The explanatory variables include also gender (Male) [21], age and the length of the studies (Long). Long is equal to one if the individual graduated from a long duration program (more than 3 years) or 0 otherwise (less than 4 years). Finally there are three variables that measure the mismatch between education and required education: underqualification, weak overqualification and strong overqualification. The omitted variable represents a correct match between educational level and required education. Underqualification implies that the individual has a lower educational level than the required. Weak overeducation and strong overeducation were described before.

Table 4.5 shows that most of the effect on job satisfaction come from the relationship between the level of education of the graduate and the required educational level of the job. In fact, in most of the cases, neither gender, nor age nor long program has a statistical significant effect on job satisfaction. However weak, and specially strong, have a very important and statistically significant effect on job satisfaction. Additionally the size and sign of those effects correspond with which we should have expected: the coefficients decrease when we compare higher levels of job satisfaction with the omitted category.

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19. See also Cabral (2005) and Allen and Van der Velden (2005).

20. Full tables with all the parameter estimates are available upon request.

21. For a differential approach to overeducation based on gender see McGoldrick and Robst (1996).

TABLE 4.5: Job satisfaction and overeducation, multinomial logit model. Dependent variable: job satisfaction (JS)

	JS = 1		JS = 2		JS = 3		JS = 4	
	Coef.	Std	Coef.	Std	Coef.	Std	Coef.	Std
Male	0.03*	(0.07)	0.13**	(0.04)	0.02	(0.03)	0.11**	(0.03)
Age	0.02**	(0.007)	0.008	(0.005)	0.001**	(0.004)	-0.007*	(0.003)
Long	-0.15	(0.12)	-0.12	(0.07)	0.05	(0.71)	-0.01	(0.04)
Under	-0.16	(0.14)	-0.48**	(0.08)	-0.45**	(0.05)	-0.20**	(0.04)
Weak	1.95**	(0.11)	1.67**	(0.07)	1.17**	(0.06)	0.43**	(0.06)
Strong	3.16**	(0.11)	2.14**	(0.09)	1.26**	(0.08)	0.33**	(0.08)
Country	yes							
N	28.543							

Note: Standard error between parenthesis.

5. Residual Inequality and Higher Education

LAST two sections showed how overeducation, measured by the CHEERS survey, is related with skills underutilization and job satisfaction in the expected manner. In a companion paper we show that this overeducation variable is robust to many other analysis: as reported by the literature in the case of other datasets, the extent of overeducation has an important effect on the wage earned by the graduate [22]. Conditional on the same field of study, country, gender, sector and occupation the returns to required schooling are higher than the returns to actual schooling. The fact that the measure of overeducation obtained from the CHEERS questionnaire is robust to all these different exercises is reassuring.

In this section we discuss how to interpret the rise of residual inequality among higher education graduates [23]. For this purpose we use the model exposed in section 3. If we assume that the production function is CES and there are unobservable skills that separate high and low education workers in two groups (high skills/low skills) inside each educational group we can write residual inequality as

$$\frac{w_{Hh}}{w_{Hl}} = \left(\frac{A_{Hh}}{A_{Hl}}\right)^{\rho} \phi_h^{-(1-\rho)}.$$

Taking logs in both side we obtain

22. For a summary of the literature on the earnings consequence of educational mismatch see Hartog (2000).

23. For a general view on the relationship between job match and the distribution of earnings see Sattinger (1993).

$$\ln \omega = \ln \left[\frac{w_{Hh}}{w_{Hl}} \right] = \rho \ln \left(\frac{A_{Hh}}{A_{Hl}} \right) - (1-\rho) \ln \phi_h,$$

where ϕ_h is the proportion of high unobservable skills among high education individuals and the ratio $\frac{A_{Hh}}{A_{Hl}}$ represents the relative productivity of higher education graduates with high unobservable level of skills over the low unobservable level of skills. Both variables are difficult to proxy in empirical exercises. We assume that the proportion of higher education workers in jobs that do not require higher education is an indication of low level of unobservable skills. This implies that we could approximate $1/\phi_h$ by the proportion of strongly overqualified higher education graduates (STRONG). We distinguish between different fields since, as we argued before, residual inequality has increased with independence of how we define the groups inside each educational level. In addition it is clear that the adaptability of graduates to technological shocks depends on their field. For instance computer science graduates or engineers may have a much higher adaptation level to the new technologies of the information and communication than graduates in humanities. Moreover in a situation of excess supply, probably caused by skill-biased technological change, graduates of particular fields might increasingly be forced to accept jobs that do not require the skills gained by university graduates. We assume that the market discriminates between high and low skills and, therefore, the low skills graduates of each field will end up being overqualified for their jobs (at least in nominal terms).

The question of how to approximate the relative productivity of high skills versus low skills workers is much more complicated. However, in principle, there should be a relationship between the skill-biased technical change that generates the between educational groups inequality and the productivity differentials of high and low skills workers among higher education graduates. We assume that the adaptability of workers to technological change, given the field of study [24], depends on the unobservable skills of workers, with independence of its educational level. As skill-biased technological change is increasing between educational groups inequality it is reasonable to assume that, if the relative supply of worker of each educational level change slowly, between groups inequality would be a good proxy for relative productivity (RELP). We proxy this variable by the relative wage of university graduates versus high school graduates. Therefore the basic regression takes the form

24. The stratification by field of study is not very common in this type of studies. See also Ingram and Neumann (2006).

$$\ln\left[\frac{w75}{w25}\right]_{ij} = \ln \omega_{ij} = \beta_1 + \beta_2 \ln(RELP_j) + \beta_3 STRONG_{ij} + u_{ij},$$

where i represents a field of study and j a country. In the last specification we also include a dummy variable for each field (EDU: education; ENG: engineering; LAW: law; MAT: computer sciences and math; MED: medical sciences; NAT: natural sciences; SOC: social sciences). The endogenous variables has been constructed by calculating the log of the ratio of the third quartile of wages over the first (75% wage over 25% wage), which is the usual way in which the literature measures wage inequality.

Table 5.1 confirms the interpretation we offered above. Residual inequality is wider the higher is the percentage of strong overeducation among the graduates of a field of study. The results also show that between groups inequality, measured by the college wage premium with respect to high education wages, has also a positive and statistically significant effect on residual inequality. We interpret this result as the effect of skill biased technological change on within educational group inequality. Table 5.1 also shows that the results are robust to the inclusion of field specific dummies.

TABLE 5.1: Residual inequality and educational mismatch

	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	0.36	(14.4)	-1.98	(2.15)	-1.99	(2.13)
STRONG	0.70	(2.98)	0.87	(3.43)	0.93	(3.12)
LRELP			0.45	(2.54)	0.45	(2.45)
EDU					0.05	(0.71)
ENG					-0.01	(1.18)
LAW					0.11	(1.46)
MAT					0.00	(0.06)
MED					0.05	(0.68)
NAT					0.07	(0.96)
SOC					0.06	(0.87)
R^2	0.11		0.23		0.30	
N	78		70		70	

Note: Dependent variable: log(w75/w25) by field and country.

In section 3 we argue that the increase of unemployment among higher education graduates could be the consequence of higher education graduates working in the low education segment of the labor market, where unemployment is increasing as a consequence of skill biased technological change. That would imply a positive relationship between overeducation and unemployment by country and field of study, conditional on the extent of skill biased technological change. Notice that in the model the stronger the skill biased technological change the higher the relative unemployment of low education versus higher education workers. The relative unemployment data (RUNEMP) is taken from the OECD. Therefore the basic regression for unemployment is

$$UNEMP_{ij} = \beta_1 + \beta_2 \ln(RUNEMP_j) + \beta_3 STRONG_{ij} + u_{ij}.$$

Table 5.2 shows the results of this estimation. As expected the higher the relative unemployment of a country the higher the unemployment of the higher education graduates by field of study and country. More importantly, the results show that level of strong overeducation has a very large effect on unemployment by field and country. This implies that the interpretation of the theory is reasonable: the graduates of a particular field that are in excess supply would end up, with high probability, working in a job for which they are overeducated or even unemployed.

TABLE 5.2: Unemployment and educational mismatch

	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	0.01	(2.43)	-0.01	(0.99)	-0.04	(2.13)
STRONG	0.40	(7.26)	0.39	(7.32)	0.45	(3.12)
RUNEMP			0.04	(2.87)	0.06	(2.45)
EDU					0.00	(0.45)
ENG					0.00	(0.48)
LAW					0.03	(1.70)
MAT					0.01	(0.74)
MED					0.02	(1.23)
NAT					0.01	(0.85)
SOC					0.04	(2.79)
R^2	0.41		0.46		0.60	
N	78		78		78	

Note: Dependent variable: unemployment by field and country.

6. Conclusions

THIS working paper reviews some alternative theories relevant for the explanation of the increasing incidence of wage inequality. Most of the literature has tried to find an explanation for the large increase in inequality between educational groups during the last twenty years. We search for explanations of the increase in the other component of inequality: residual, or within educational group, inequality. One of the reasons why residual inequality has not been the subject of many studies is the difficulty to find a detailed dataset that helps to address this issue. We use the CHEERS database to explain residual inequality among college graduates across ten European countries and eight fields of study. First of all we show that the use of our indicator of overeducation produces results that are robust to the usual finding of the literature in terms of its relationship with skill underutilization and job satisfaction. The empirical results show that the extent of overeducation and a proxy for skill biased technological change can explain, at least partly, the cross-country residual inequality observed in the data.

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*ABOUT THE AUTHOR**

JOSÉ GARCÍA MONTALVO holds a PhD in economics from Harvard University. He is professor of economics at Pompeu Fabra University, Barcelona and research professor at the Instituto Valenciano de Investigaciones Económicas (Ivie). Currently the director of the master's program in economics of the Barcelona Graduate School of Economics and the master's in advanced studies of the Graduate Program in Economics, Finance and Management (GPEFM) at Pompeu Fabra University, he is also a consultant for the Inter American Development Bank and the World Bank. He has published eight books and more than 50 articles in journals such as the *American Economic Review, The Review of Economics and Statistics, The Journal of Business and Economic Statistic, The European Economic Review, Journal of Development Economics* and *Applied Psychology*, among others.
E-mail: jose.garcia-montalvo@upf.edu

Any comments on the contents of this paper can be addressed to José García Montalvo at jose.garcia-montalvo@upf.edu.

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España
Tel.: +34 91 374 54 00
Fax: +34 91 374 85 22

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