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RETURNS TO COLLEGE OVER TIME: TRENDS IN EUROPE IN THE LAST 15 YEARS. STUCK ON THE PUZZLE.

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Returns to college over time: trends in Europe in the last 15 years. Stuck on the puzzle.*

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Abstract

While there has been intense debate in the empirical literature about the evolution of the college wage premium in the US, its evolution in Europe has been given little attention. This paper aims to investigate the evolution of the returns to higher education in 12 European countries from 1994 to 2009. In particular, it explores how does this evolution affect wage inequality and how it differs across age cohorts. The period of interest has seen higher education participation rate increasing dramatically: graduate supply considerably outstripped demand which ought to imply a fall in the premium. I use cross country variation in relative supply, demand and labour market institutions to look at their effects on the trend in the college wage gap. I address possible concerns of endogeneity of relative supply by an instrumental variable strategy. Results show a significant decline of college returns in countries with higher relative supply of skilled workers and a marked fall in college returns for recent cohorts for both men and women in all European countries. find evidence that both market and non market factors matter in explaining wage inequality. More specifically, the estimated growth in the wage gap appears negatively correlated to changes in relative supply and positively correlated with the relative demand index, in particular, in countries with higher relative supply of skilled workers, that present a stronger decline in the returns to college. Institutional constraints also matter.

JEL classification: J24, J31, D31, I 24

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1 Introduction

Beside being a decisive factor on individuals' earnings (Mincer, 1974), education is one of the main determinants of personal success and development (Jencks, 1979). Making higher levels of education attainable to everybody can be seen as a way of reducing income inequalities, improving economic growth (Krueger and Lindahl 2001; Bils and Klenow, 2000) and increasing general levels of welfare through positive externalities (Acemoglu and Angrist 2001; Milligan, Moretti, and Oreopoulos 2004 and Lochner and Moretti 2004). In the last two decades there has been a huge increase in the average years of attained education and the proportion of young people enrolled into higher education has significantly risen in all developed countries. Over the period 1990-2005, undergraduate enrolment has increased by almost 50 percent in Sweden, Finland and Denmark, and by over 30 percent in the UK, Ireland, Italy, Spain and Portugal thanks also to the European policies (i.e. Lisbon 2000). This "boom" in education can be interpreted as a supply shock to European labour market and it is likely it has substantially affected the structure of wage differentials. Investing in educational resources for disadvantaged families to provide equal access to successful early human development is fundamental, and we can look at these increasing rates as positive factors: certainly, a more educated society is a better one. However, it is important to investigate whether the increase in the education attainment, in particular, higher education, has affected equality. Higher education -post secondary education and college education, is an important political and social issue in developed countries and it is imperative to assess its return.

From an equality point of view, rising inequality in personal incomes is a well-observed phenomenon in many countries. Rising inequality can take two specific forms: more inequality within skill groups and across skill groups. Inequality within skill groups can be caused by increasing fragmentation of jobs, new technologies and reduced wage compression efforts of unions and governments. Inequality across skill groups is different: here the main determinants are supply and demand of skills. What is important is to pinpoint changing skill differentials, i.e. by educational groups, as these differentials are important incentives for skill formation, school enrolment and training efforts. In the US, skill differentials have increased a lot in the last two decades. Between 1961 and 1979, returns to a college education (compared to a high-school degree) have increased from 61% to 82% [1] , despite the huge increase in the number of college graduates. What happened in Europe is less clear. Rising returns have been observed for Portugal, Denmark and

[1] Katz and Murphy (1992)

Italy, constant returns have been found in the UK and Germany, and falling returns for Sweden and Austria (at the beginning of 2000). Unfortunately, the majority of these evidences are until the end of 1990s, and afterward the phenomenon has not been studied much. What is going on nowadays? Are the returns still increasing in a period which has seen sheer expansion of the demand of higher education, leading as well to the establishment of new institutions in many developed countries? It is reasonable to assume that changes in educational participation rates across cohorts are likely to imply changes in the ability-education relationship as well. If the ability composition changes, this can have an impact on estimated returns to education. Using the simple supply and demand framework, an increase in the supply of highly educated workers would cause a decline in their wages. The demand for college can be rising dramatically, but if the supply keeps up with the demand, college wages will not increase.

Furthermore, how can inequality be affected by these trends? There could be two possible ways of higher enrolment affecting wage inequality, going in two different directions:

1) Increasing the proportion of college educated workers puts more weights on a distribution of wages exhibiting higher mean and higher dispersion. This would increase wage inequality.

2) Increased skill heterogeneity may lower the average college wage premium, leading to lower wage inequality. Additionally, conditioned on a demand for highly educated workers which does not outstrip supply, the increased proportion of college-educated people puts downward pressure on the college wage premium, thus lowering wage inequality.

Still, the supply and demand framework alone, cannot account for empirical puzzles such as the one of the US. Thus, if these inequality trends are not primarily explained by market-driven changes in the supply and demand for skills, it is possible they can be clarified also by episodic institutional shocks. Changes in institutional factors such as the minimum wage have contributed to the evolutions in the wage differential between college and non-college educated workers.[2] Europe can be different in this case from the US: the presence of stronger institutions helped to moderate the changes in the European OECD countries.

This paper investigates the evolution of the returns to higher education and of the college wage premium in Europe over the last 15 years. I want to assess whether higher education pays in the labour market and to examine what is the trend in earnings inequality over the period under study. I explore along what dimension inequality is changing and what shifts in the

[2]See Fortin and Lemieux (1997) for a review of the effect of labor market institutions on the wage structure.

demand and supply and/or changes in wage setting institutions are responsible for the observed trend. Furthermore, I analyze if there are cross-country differences in returns to education, and whether they are mainly driven by international differences in labour-market settings, such as institutional features of wage formation, labour-market regulations, and the tightness of the labour markets. Or whether these differences are connected to the relative pervasiveness of public sector employment or to cross-country differences in levels of welfare-state protection.

As to my knowledge, this paper is the only recent study about the evolution of the returns to college and college wage premium in Europe, not focusing on just one specific country. An important contribution of this paper is that it can examine the returns to education in the long run, in recent years, in Europe, as well as investigate the directions and the drivers of change. The period I am focusing on is very compelling, since it is a period in which higher education participation rate increased dramatically: graduate supply considerably outstripped demand which ought to imply a fall in the premium. Hence, I contribute by assessing the pattern of the college wage premium as a result of the recent expansion in graduation rates, being able to look at the returns to different cohorts. I use cross country variation in relative supply, demand and labour market institutions to look at their effects on the trend in the college wage gap. Another novelty of this paper is that I address possible concerns of endogeneity of relative supply by an instrumental variable strategy, this is something that has never done in the literature before. I observe a significant decline of college returns in countries with higher relative supply of skilled workers and a marked fall in college returns for recent cohorts for both men and women in all European countries: wider relative supply lead to a decline in college wage premium. I find evidence that both market and non market factors matters in explaining wage inequality. More specifically, college wage premium appears negatively correlated to changes in relative supply and positively correlated with the relative demand index, in particular, in countries with higher relative supply of skilled workers, that present a stronger decline in the returns to college. Institutional constraints, such as minimum wage and unions also matter.

The paper is organized as follows. Section 2 and 3 present a review of the literature and the theoretical framework. Section 4 presents the data used and describes the raw trends in wage changes, education differentials and wage inequalities. Section 5 is dedicated to the empirical framework. Section 6 shows the results of the trends in between- and within-education group wage inequality and the potential explanations for these evolutions. Section 7 concludes.

2 Literature review

Increasing returns to education has always been linked to changes in wage inequality (Levy and Murnane 1992[3], Katz and Autor 1999). Many contributions in the literature have noticed a growing college wage premium over time. Greater college premium implies greater inequality. The underlying causes of increasing inequality are highly debated among labour economists. There are two leading explanations, skill biased technical change (SBTC) and labour market institutions.

Many empirical studies found the SBTC to be the driving force behind widening earnings inequality: this conclusion stems from the observation that the relative supply of high skilled workers and the skill premium can only increase together if the relative demand for high skilled workers increase as well.

Many studies, focusing on the US, have noticed a growing college wage premium but the role of the supply of college graduates in determining changes in the returns to a college education has not been explored much. Katz and Murphy (1992) analyze the wage movements over 25 years, from 1963 to 1987, in the US, concluding that the rising in the relative demand for more skilled workers is "a key component of any consistent explanation for rising inequality and changes in the wage structure over the last 25 years".[4] Furthermore, they identify the fluctuations in the college/high school differential over that period, in the combination of growth of both relative supply of college graduates and demand for more educated workers. More recently, Taber (2001) prefers an explanation based on an increase in the demand for unobserved skills rather than one based on an increase in the demand for skills accumulated in college. His work suggests that the observed rise in the college premium in the 1980s is just a reflection of the increase in the return to unobserved ability: "rising returns to unobservable skills correlated with education is the main explanation behind the increased education wage differentials".[5] However, Chay and Lee (2000) argue that the latter raise in unobserved ability accounts at most for 30 to 40 percent of the increase in the college premium. Similarly, Deschenes (2006)argues that most of the increase

[3]In an earlier contribution, Levy and Murnane (1992) present a set of hypotheses for explaining not only within-group inequality but also the growth of within-group variation over time. Their hypotheses include both supply and demand shifts for workers characteristics; the former consists in the changing characteristics of the labour force (including aptitude test scores, measures of ability to work with other people); as well as increasing returns to skill; the latter includes plant specific wage differentials within industry as well as changes in wage-setting institutions.

[4]Katz and Murphy (1992)

[5]Taber (2001).

in the college premium is due to an increase in the return to schooling.

This evidence that, over the last decades of the 20th century, the US faced a simultaneous expansion of both college graduates and returns to education contradicts with the general law of demand and supply. The basic rule would suggest indeed that the price of a graduate worker should decrease when increasing its supply. This inconsistency has generated a large body of literature (Murphy and Welch, 1989, Card and DiNardo 2002, among others). However, surprisingly, the additional observation of a general decline in real earnings at college and lower educational levels has been mostly ignored when understanding this paradox.

The study by Card and DiNardo (2002) is one of the firsts noticing a deceleration in the college wage premium, contrasting with the preceding decade. They provide evidence that increasing education can lower wage inequality. Card and Lemieux (2001), using a model with imperfect substitution of workers with similar education but belonging to different age cohorts, find that own cohort supply of college-educated graduates negatively impact the college wage premium: they show that the rise of the premium is confined to rise for younger workers which can be driven by falls in the growth of educational attainment that began with cohorts born in the 1950's.

Lemieux (2006) investigates the change in wage inequality and wage structure, showing that in the US, between 1973 and 2005, returns to post secondary school increased sharply whereas returns to lower levels of education remained unchanged. Using quantile regressions he shows that the return for post secondary education has increased more in upper quantiles (like the 90th).

On the other hand, other researchers have argued that skill biased technological change can not explain alone the increase in wage inequality during the '80s. Acemoglu (2003) argues that the relative supply and demand framework does not provide an entirely satisfactory explanation of the behaviour of skill premia across countries. Giving space to labor market institutions to play an important role in the story.

The alternative explanation attributes international differences in wage inequality across skill groups to differences in labor market institutions. Several explanations for the rise in wage inequality focus on changes in wage-setting institutions.[6]

'Institutions' are non competitive forces acting on the labour market, such as labor unions, minimum wage, product and labour market regulations, taxes and subsidies and social norms. All these factors can affect the shape of wage distribution, including earnings inequality.

The two institutions that have received more attention in the US are la-

[6]Bluestone and Harrison (1988) offer an extensive discussion of the possibilities.

bor unions and the minimum wage. DiNardo, Fortin, and Lemieux (1996) find that, in addition to supply and demand factors, also changes in labour market institutions -namely de-unionization and declining minimum wages - are important in explaining wage inequality. Lee (1999), using variation in the minimum wage across regions, shows that not only minimum wage is negatively correlated with rising inequality at the top end of wage distribution, but also it can explain much of the increase in the dispersion at the lower end of wage distribution. Goldin and Katz (2007) use a supply, demand and institutions framework to understand the returns to education in the US, in the past century, combining the usual supply-demand framework with institutional rigidities and alterations.

Concerning Europe, few are the studies on the evolution of college wage premium and skill differentials. The majority of the studies dealing with the returns to education in Europe focus on both standard returns to education and on single countries. Recent evidence of the impact of the increasing supply of graduates on their wage and their educational level are available for the UK (Walker and Zhu, 2008; Chevalier and Lindley 2009). In particular, Walker and Zhu (2008), are interested in how the college premium has varied across time, across subjects of study, across the wage distribution and across two different cohorts. They show that up to 2000 there is almost no evidence of declining returns to college following the surge in participation in higher education, however, beyond 2002 they find suggestive evidence of modestly declining wage premia for graduates. Furthermore, very few are the studies dealing with the relationship between wage inequality and education. Harmon, Oosterbeek, and Walker (2003), use UK data and find that the returns to schooling are higher for those at the very top of the wage distribution compared to those at the very bottom. Martins and Pereira (2004) have provided empirical evidence that in fifteen European countries during the mid 1990s, returns to education at the upper quantiles significantly exceeded those at lower quantiles, that is increasing education increases within wage inequality: in 15 European countries, more skilled workers (individuals receiving higher hourly wages conditional on their characteristics) are associated with a stronger education-related earnings increment. Leuven, Oosterbeek, and van Ophern (2004) use data on cognitive skills to look how well cross-country differences in supply and demand can explain differences in skill differentials. Concerning the institutional literature, Machin (1997) and Dickens, Machin, and Manning (1999) for the UK, find that, respectively, higher union density and higher minimum wages reduce wage inequality. Manacorda (2004), in Italy, and Edin and Holmlund (1995), in Sweden, find that wage setting institutions are important for wage inequality. Koeniger, Leonardi, and Nunziata (2007) , with panel data on institutions in OECD countries, assess the quan-

titative relationship between institutions and male wage inequality. Their findings show that labour market institutions matter: employment protection index, unemployment benefit, union density and the minimum wage are significantly negatively associated with wage inequality within countries. An interesting study combining SBTC and institutions is Brunello, Comi, and Lucifora (2000). They look at the evolution of the college wage gap in 10 European countries from the early to mid 1980s to the mid to late 1990s, finding significant cross country differences in the level and dynamics of the gap. In particular they find negative correlation between wage gap and relative supply and positive correlation both with the long run rate of productivity growth and with an index of between industry demand shocks. Among the relevant institutional factors, the find declines in union density, in the centralization of the wage bargain and in employment protection measures to have lead to a faster growth in the college wage gap. Barth and Lucifora (2006) investigates the effect on the wage structure of the boom in education in Europe, estimating a model with supply and demand for types of workers. Their findings suggest that the educational boom matched the demand shifts due to skill boas technical change, and they find no evidence supporting the hypothesis of skill erosion within college graduates.

3 Theoretical framework

Following the conventional conceptual framework of this literature[7], I model the relative wage dynamics as a combination of supply and demand factors and labour market institutions.

From a theoretical perspective there is the need to account separately for the relative wage of two types of workers. Consider an extended version of the CES production function with two labour inputs that are imperfect substitutes: low educated (or unskilled) and high educated (or skilled). Assume that firms in each economy use the following simple production function where output depends on employment:

$$Y_{ct} = e^{\phi_{ct}} N_{ct} \tag{1}$$

with Y being the total output produced, N the employment in efficiency units, c the country, t the time and ϕ a country and time specific productivity

[7]In their paper, Katz and Murphy (1992), used a demand and supply of skills framework to analyze the change in wage inequality over time. The same framework has then been used by Katz and Autor (1999), Goldin and Katz (2007) and Leuven, Oosterbeek, and van Ophern (2004) to look at differences in skills groups across countries. All these studies focus exclusively on demand side modeling

shock, a parameter denoting total factor productivity.

Employment is made by two groups of workers, skilled and unskilled labour, which are employed according to

$$N_{ct} = [(e^{\alpha_{lct}} L_{ct})^{\rho} + (e^{\alpha_{hct}} H_{ct})^{\rho}]^{\frac{1}{\rho}} \tag{2}$$

α is an efficiency parameter indicating the productivity of a particular type of worker (L,H) in country c at time t, it is an index of the technological efficiency of a worker as it is factor augmenting technical change parameter capturing changes in input quality over time. H_{ct}, L_{ct} are the quantities employed of college equivalent (skilled labour) and high school equivalent (unskilled labour).

It is assumed that the economy is at full employment, that means the total effective aggregate labor supply of each labor group is employed in the industries of the economy. Another assumption is that H_{ct}, L_{ct} are exogenous. That is the aggregate supply does not depend on its relative average wage.

$\rho = 1 - 1/\sigma$, is a time-invariant production parameter, where σ is the aggregate elasticity of substitution between labour inputs. The low quality and high quality workers are gross substitutes if $\sigma > 1$ and $\rho > 0$, whereas they are gross complements if $\sigma < 1$ and $\rho > 0$.

Skill neutral technological progress raises both $e^{\alpha_{lct}}$ and $e^{\alpha_{hct}}$ by the same proportion. Whereas, skill biased technical changes involve the increase of $\frac{e^{\alpha_{hct}}}{e^{\alpha_{lct}}}$

Competitive labour markets are assumed, so college equivalent and high school workers are paid their marginal products, then profit maximization with respect to N_{ict} (with $i = L, H.$) yields to

$$w_{ict} = e^{\phi_{ct} + \alpha_{ict}} \left[\frac{N_{ict}}{N_{ct}} \right]^{\rho - 1}$$

where w_{ict} is the real wage for labour input i in country c at time t.

In other terms, efficient utilization of different skill groups requires that the relative wages are equated to the relative marginal products.

The relative wage of high skill to low skill workers can be written as

$$w = \frac{w_{ct}^{H}}{w_{ct}^{L}} = \left(\frac{e^{\alpha_{hct}}}{e^{\alpha_{lct}}} \right)^{\frac{\sigma - 1}{\sigma}} \left(\frac{H_{ct}}{L_{ct}} \right)^{-\frac{1}{\sigma}} \tag{3}$$

which is equal to:

$$lnw = \rho \left(\frac{\alpha_{hct}}{\alpha_{lct}} \right) - \frac{1}{\sigma} ln \left(\frac{H_{ct}}{L_{ct}} \right) \tag{4}$$

The relative wage of different educational groups is generally used as a measure of between groups inequality. $\left(\frac{H_{ct}}{L_{ct}}\right)$ represents the relative supply of skilled versus unskilled labour, and $\left(\frac{\alpha_{hct}}{\alpha_{lct}}\right)$ the skill bias technological change. This can be rewritten as

$$ln\left(\frac{w_{ct}^{H}}{w_{ct}^{L}}\right) = \frac{1}{\sigma}\left[D_t - ln\left(\frac{H_{ct}}{L_{ct}}\right)\right] \tag{5}$$

where D_t indexes relative demand shifts which favor high skilled workers and it is measured in log quantity units.

Equation (4) can lead to a very simple and intuitive demand-supply interpretation. Given a skill bias technical change, the substitution effect is such that the skill premium increases when there is a scarcity of skilled relative to unskilled workers.

Consequently, $-\frac{1}{\sigma}$ represents the slope of the relative demand of skilled versus unskilled workers: the impact of changes in relative skill supplies on relative wages is inversely related to the magnitude of aggregate elasticity of substitution between two skill groups. That is, the greater is σ, the smaller is the impact of shifts in relative supplies on relative wages, that means the fluctuations in the demand shifts must be greater to be able to explain changes in the relative wages.

Relative demand changes can be due to shifts in product demand, SBTC and non-neutral changes in the relative changes in relative prices/quantities of non-labour inputs, so marginal productivity and elasticity.

The relative demand is shifted by the bias of the technological change:

$$\frac{\partial lnw}{\partial\left(\frac{\alpha_{hct}}{\alpha_{lct}}\right)} = \frac{\sigma - 1}{\sigma}$$

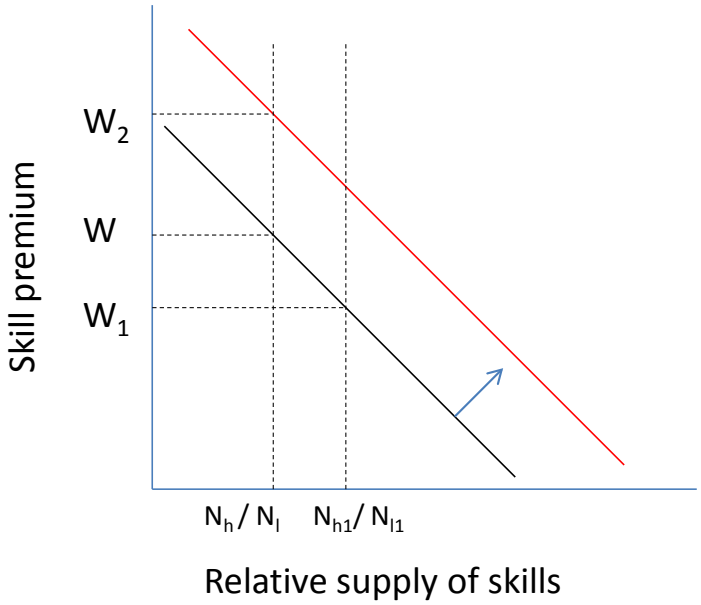
This means that, given the relative supply, if there is skill biased technological change (i.e. technological shock shifting the demand line outwards) the wage premium will increase.

Similarly, for a given "skill bias", $\left(\frac{\alpha_{hct}}{\alpha_{lct}}\right)$, an increase in the relative supplies $\left(\frac{H_{ct}}{L_{ct}}\right)$ lowers relative wages with elasticity σ.

Figure 1 shows how an increase in the supply (from N_h/N_l toN_{h1}/N_{l1}) reduces the skill premium (from w to w_1) and how a skill biased technological shock (outwards shift in the demand line), given the supply, increases the skill premium (from w to w_2).

Following the reasoning above, the evidence of a negative relationship between college premium and relative supply of skills in the recent period

Figure 1. Skill premium and relative supply of skills.



in Europe can be interpreted as an increase in the relative supply of college skills, under the assumption of stable demand's conditions.

The main assumption of this model is that the supply of skills is predetermined. This setting assume market clearing, meaning that there is no unemployment. This is an assumption that can be criticized, however this is standard in this literature. In short, there are the main forces that operates in this framework: the relative supply and the relative demand of more-educated workers. When these two forces fail in explaining the wage differentials, the pattern can be reconciled by institutional factors such as change in union density/strenght and wage setting policies. Labor market institutions, indeed, differently alter the outside option of skilled and unskilled workers thus affecting wage differential as well as relative labor demand.

Moreover, it is reasonable to assume that, in a period of accelerating education expansion, educational premia are likely to twist reducing inequality among young workers relative to the old (the opposite should be true if the education expansion is decreasing).[8] What is important in this framework, in addition to the level of educational supply, is its rate of change.

[8]The intuition is the following: when education levels are arising, younger cohorts are relative more educated than older, when education levels stagnate, this implies that the pattern of educational differentials across cohorts twists.

Assuming that there can be differences on the level of wages depending on age, that means that age cohorts are imperfect substitutes in production, a common way to combine them is as CES aggregate. In each country, we thus have:

$$H_t = (\sum_J \delta_j H_{jt}^{\eta})^{1/\eta}$$

and

$$L_t = (\sum_J \beta_j L_{jt}^{\eta})^{1/\eta}$$

with $\sigma_A = 1/(1-\eta)$ is the elasticity of substitution between different age cohorts, δ, β efficiency parameters assumed fixed, j indices the age groups and H_{jt}, L_{jt} are age groups specific supply by education in each time period.

The aggregate output is again function of total skilled and unskilled supply, and some technological parameter, simplifying (1) :

$$Y_{ct} = [e^{\alpha_{Hct}} H_{ct}^{\rho} + e^{\alpha_{Lct}} L_{ct}^{\rho}]^{\frac{1}{\rho}} \tag{6}$$

Under the general assumption the the economy is competitive and that wages are paid their marginal products[9], then

$$\frac{\partial Y_{ct}}{\partial H_{jct}} = \frac{\partial Y_{ct}}{\partial L_{ct}} \times \frac{\partial L_{ct}}{\partial L_{jct}}$$

Writing the relative wages of skilled versus unskilled workers in the same cohort, we get:

$$ln\left(\frac{w_{jct}^H}{w_{jct}^L}\right) = \left(\frac{\alpha_{hct}}{\alpha_{lct}}\right) + (\rho-\eta) ln\left(\frac{H_t}{L_t}\right) + ln\left(\frac{\beta_j}{\delta_j}\right) + (\eta-1) ln\left(\frac{H_{jct}}{L_{jct}}\right) \tag{7}$$

Therefore, the relative wage ratio for cohort j, depends on the age specific efficiency parameters β_j, δ_j and on the relative supply in the given cohort $\left(\frac{H_{jct}}{L_{jct}}\right)$, in addition to the technology parameters and the aggregate supply.

Rearranging, equation (7) can be rewritten as:

[9]Efficient utilization of skill groups further requires that relative wages across skill groups are equated with relative marginal products.

$$ln\left(\frac{w^H_{jct}}{w^L_{jct}}\right) = \left(\frac{\alpha_{hct}}{\alpha_{lct}}\right) - \frac{1}{\sigma} ln\left(\frac{H_t}{L_t}\right) + ln\left(\frac{\beta_j}{\delta_j}\right) - \frac{1}{\sigma_A}\left[ln\left(\frac{H_{jct}}{L_{jct}}\right) - n\left(\frac{H_{ct}}{L_{ct}}\right)\right] \tag{8}$$

4 Data and aggregate trend

4.1 Dataset

I use a unique dataset, harmonizing the European Survey of Income and Living Condition (EU-SILC) and European Community Household Panel (ECHP), to assess the returns to college and wage inequality in Europe from 1994 to 2009. This paper is not the first one using ECHP and EU-SILC as a single data source.[10]

The EU-SILC is a collection of timely and comparable multidimensional microdata covering EU countries, starting in 2004, and conducted yearly until now (data available until 2009), for a total of six waves. It is based on nationally representative samples, which collects comparable cross sectional and longitudinal micro data on income poverty and social exclusion and contains information on income, housing, material deprivation, labour, health, demography and education.

The ECHP, precursor of the EU-SILC, started in 1994 and ended in 2001, thus consisting of eight waves. In the first wave in 1994, about 60,000 nationally representative households with approximately 130,000 individuals aged 16 years and over were interviewed in the 12 participating member states.[11]

One advantage of these data is that I have an overall period of 15 years in which I can observe a total of 12 European countries: Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Portugal and United Kingdom. For each country in the sample, I only consider the sub-sample of individuals who reside in the country of birth (more than 94 percent of the total in 2009).

The reference sub-sample focuses on native male and female employees between 25 and 50 years old and are working. This age framework allows me to compare the youngest college graduates with their non-graduates counterparts and to avoid selection bias due to retirement and pensions.

[10] See for example Massari et al. (2012) and Goos et al.(2009)

[11] Austria, Finland and Sweden joined the ECHP project in 1995, 1996 and 1997, respectively. Sweden, Luxembourg and the Netherlands have to be excluded from the analysis because required information is missing.

I use net annual earnings in the reference sub-sample of all wage and salary workers in the public and private sector. All measures of wages in the paper are adjusted and deflated using the Purchasing Power Parity PPP (base Euro 15=1) to take into account different cost of living and to allow for comparison among years.

To avoid bias from incorrect income data (outliers), I omit all employees whose net wages are below the minimum contribution level of the social Security System or above a certain threshold.

I define skilled workers whose with at least some higher education (i.e. tertiary or post secondary non tertiary education).

The two surveys record differently information about schooling and sometimes not even consistently through time. ECHP only displays information about the highest earned qualification, and provides an education variable in three levels: 3 broad levels (low -middle-high skills= low, secondary, college. They correspond to 0-2, 3 and 4-6 ISCED levels respectively. EU-SILC contains information on both earned qualifications (highest ISCED level achieved) and on ages at which individuals left school.

The construction of a consistent variable recording the entire length of the education path of workers across countries is problematic because of differences in schooling systems across the countries, and the lack of a record in the data. Because data on the actual years of schooling are not recorded in the survey, the measure of years of schooling used in these countries is a derived one. I have calculated the total number of years of education obtained by individuals in the following way: age in which the worker ended highest general education course minus starting education age according to the country of origin. Certainly this measure is problematic, it may introduce substantial bias since it can not take into account non-binding time frames for university degrees, or individuals dropping out of some degree, without finishing, to start a different one.

In order to keep the analysis as consistent as possible, the classification criterion applied is the highest educational qualification which is common to all countries and whose information is available in all datasets.

Therefore the three educational groups are defined as follows:

1) Low (primary or lower) education;

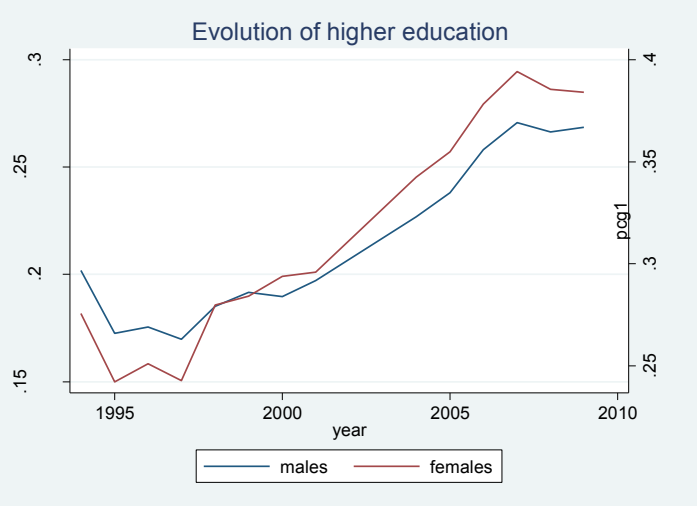
2) Intermediate (secondary) education;

3) High (post secondary-tertiary) education.

The advantage of this variable with respect to years of education is that it accounts for different duration of analogous school cycles.

In both the dataset there is no information about actual work experience or years of work interruption. Therefore, in the regressions I use potential experience conventionally defined as in Autor et a. (2008): Min{Age – Years

Figure 2. Evolution of Higher education



of schooling- the age at which children start school; age-16}

The college wage premium is defined as the ratio of wage rates between college and high school graduates.

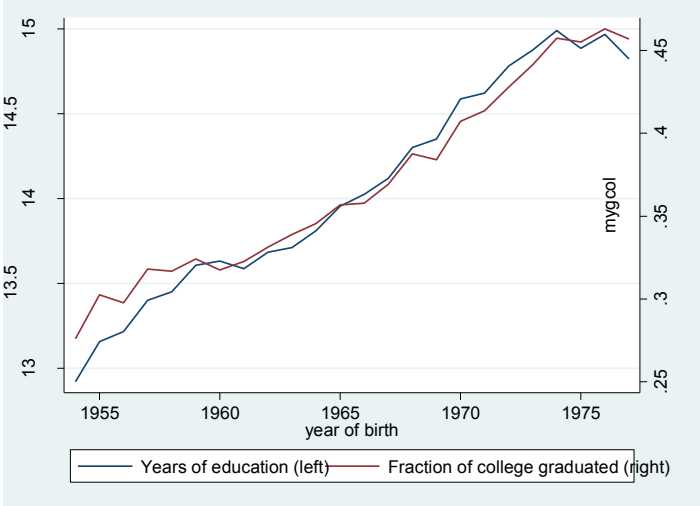
To control for aggregate labor supply and demand conditions, I use data from the OECD, EUKLEMS and ILO.[12] In particular, for the supply index, I use OECD data on the relative skill endowment, measured in terms of educational attainment. For the demand index I use data from EUKLEMS on the share of hours worked by skill workers relative to low skill workers. The institutional data are provided by OECD and ILO. These are yearly data which do not depend on the skill level, measuring wage bargaining institutions, strictness of employment protection legislation, minimum wage, union density and public sector employment.

4.2 Descriptive statistics

Tertiary education attainment more than doubled in most European countries, over the last decades. The strong increase in participation rates in Europe is evident: Figure 2 shows the evolution of higher education (post secondary and college) in Europe over the last 15 years. In particular, it shows the percentage of people aged 20-50 achieving post secondary education from 1994 to 2009. The trend is strongly increasing for both men and women, with women presenting a more marked increase. The slight decline

[12]Detailed information can be found in the data appendix A1.

Figure 3. Increasing trend in higher education by cohorts



in 2008 and 2009 can be due to the fact that some interested people may still be in education.

Figure 3 shows the recent history of the percentage of each cohort currently undertaking higher education. The figure confirms the increasing trend in education attainment in Europe over time, showing that the average years of education achieved and the fraction of college graduates have increased by age cohorts. For people born in 1955 the average number of years of education completed was almost 13.5 year, and the percentage of higher educated of that cohort was 30%; these numbers are almost 15 and 45% for the 1975 cohort.

The sample I am using differs by countries in population and income shares of each educational group. Over the period, mean real income by educational group changed differently across countries and educational groups. However, the trends in the education patterns (generally increasing) are pretty similar in many European countries. Namely, I differentiate between countries with high (initial) relative supply of graduates and countries with low (initial) relative supply of graduates, measured at the beginning of the period. Denmark, Finland, Ireland, Spain, France and Belgium are countries that were experiencing high percentage of people achieving higher education in the '90s. On the other hand, countries, such as Italy, the UK, Portugal, Germany, Greece and Austria, had lower graduate rates at the beginning of the period analyzed. These countries are divided according to the ratio of college graduates over high school graduates. This is a measure of the relative supply of graduates in each country. Looking at the values of this ratio

in 1994, I divide into two regions: high and low relative supply of graduates countries. Countries characterized by a lower stock of high educated individuals experienced even higher growth in attainment levels, thus suggesting a catching-up phenomenon.

These aggregate patterns hide significant heterogeneity across countries.These two set of countries are thus very likely to have faced different evolutions in the educational attainment, as well as different evolution (different saturation times) of the demand for these type of workers. Additionally, these two set of countries differ for different level and degrees of labour market institutions.

Table 1. Descriptive statistics.

	High relative supply		Low relative supply	
	ECHP	EUSILC	ECHP	EUSILC
Panel A: Males				
College	35.44%	34.24%	16.92%	24.78%
Secondary	34.77%	42.79%	39.28%	43.75%
Low	29.79%	22.97%	43.80%	31.47%
Years edu	12.73	13.76	12.15	12.94
Log wage	9.58	10.01	9.21	9.73
Panel B: Females				
College	44.97%	45.55%	23.13%	34.80%
Secondary	33.87%	39.13%	41.44%	42.87%
Low	21.16%	15.32%	35.43%	22.33%
Years edu	13.19	14.52	12.54	13.42
Log wage	9.29	9.73	8.94	9.43

In table 1 descriptive statistics of education and income in different regions and by different years are shown. The percentage of people achieving different degrees, together with the average years of education achieved and the log of wages are shown for both men and women in the two regions: high and low relative supply countries.

As said before, the recent rapid expansion of higher education rates, has some shadows. Firstly, to assess whether the increase in participation was beneficial or not, it would be interesting to answer the following question: Has this increase in highly educated people flooded the labour market that the wage premium for higher education has been significantly reduced? A closely related issue is the possibility that this expansion has digged deeper into the distribution of students' abilities given the possibility to weaker and less able students to access higher education, thus resulting in less productive graduates than the ones of earlier cohorts. Moreover, a concern about school

and teacher quality can arise. Indeed, this can be caused by a reduction in the average productivity of the recent cohorts of graduates as well.

All this points would suggest that the recent expansion may have resulted in lower returns in particular at the bottom of the wage distribution where less able individuals might be expected to be concentrated.

4.3 Relative wage changes and education differentials

From the descriptive table in the appendix -see table A1, it is evident that younger cohorts have, on average, lower real wage rates, reflecting a combination of both age differences and of the overall decline in average real earnings in Europe. Older male and female cohorts have higher earnings with respect to younger cohorts, however this can be a consequence of the life-earning profile. An interesting feature of Table A1 relates to the differences across cohorts in educational attainment. Average education displays a rising inter-cohort trend for the cohorts born before 1950, followed by a decline for those born in the 1950s and early 1960s. This pattern is documented and analyzed by Card and Lemieux (2001).

Figure 4. Evolution of college wage premium

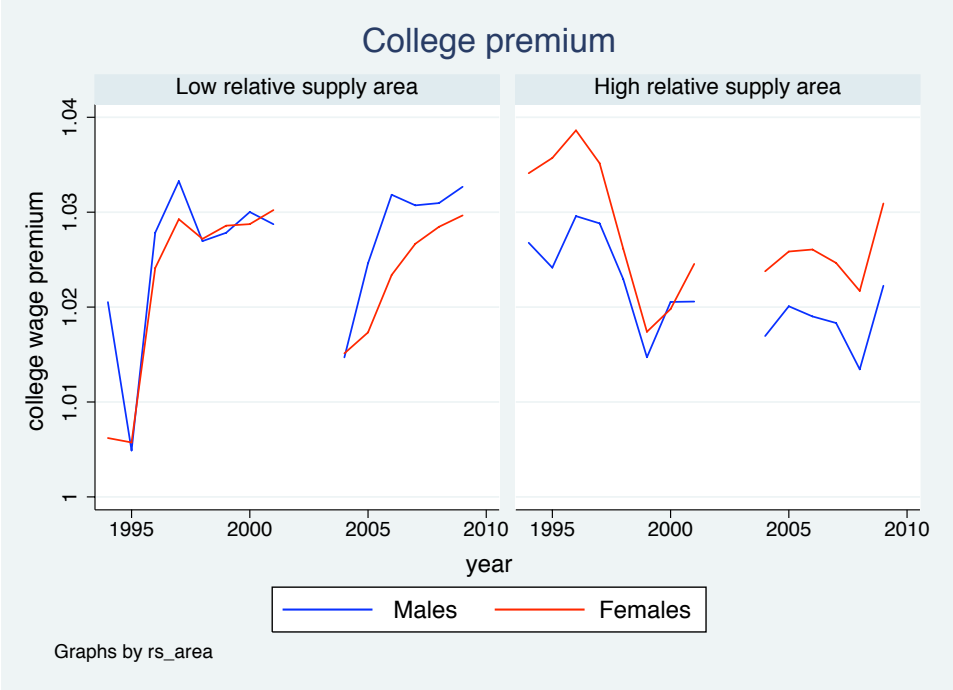
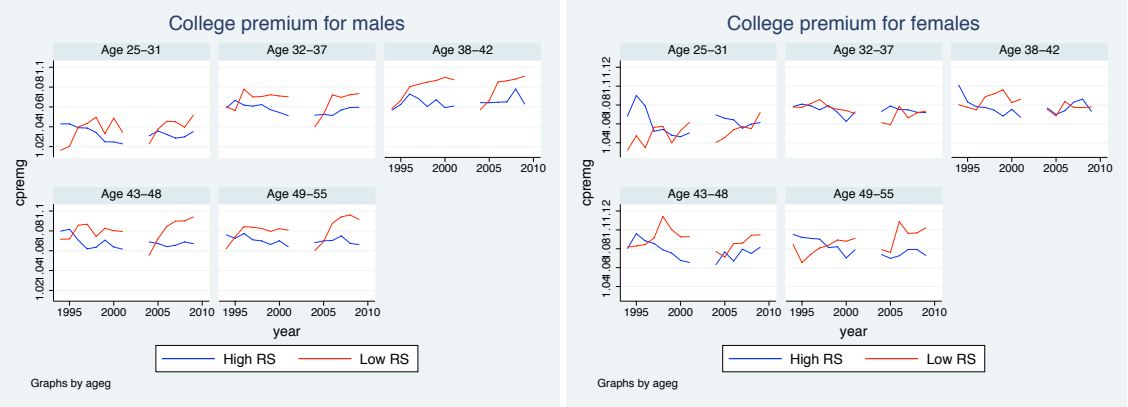


Figure 4 show that college wage premium has evolved very differently among countries with high and low relative supply of graduates. College

Figure 5. Evolution of college wage premium by age cohorts



wage premium is calculated as the ratio between the log wage of college graduates and high school graduates. The level of the college wage premium is always positive, being a measure of the higher rewards for the more educated, with high relative supply countries falling down heavily over time and low relative supply countries experiencing a growing trend. The trend is very similar for men and women in both set of countries. The pattern observed in the high relative supply countries would suggest that the huge influx of college graduates has saturated the demand for this type of workers, reducing continuously their potential comparative advantage, and generating in this way people that, despite having a degree, are not that different from their high school graduate peers. This is not the case in low relative supply countries: it seems to be the case that in this set of countries there is still an unsaturated demand for skilled workers.

Nevertheless, the evolution over time of the college wage premium can be due to both, different dynamics of cohort-specific relative wages, and changes in the composition of employment by cohort. This means that the relative wage can vary across cohorts and, more specifically, younger cohorts can experience higher wage gaps. For this reason, it is interesting to look at the evolution of the college premium by different cohorts. In figure 5 individuals are grouped by level of educational attainment, cohort and country.

The figure on the left shows the cohorts evolution for men. Quite interestingly, the differences between cohorts and regions are striking: firstly younger cohorts are always showing much lower premia with respect to the oldest ones. Additionally, high relative supply countries are showing a declining college premia over time for each cohort considered, on the contrary, the low relative supply countries are experiencing an increasing trend. The situation is less evident for females: only the oldest cohorts in low relative

supply countries the premium is increasing and is higher than in high relative supply countries.

4.4 Wage Inequality

As Ashenfelter and Rouse (2000) state ''The school is a promising place to increase the skills and incomes of individuals. As a result, educational policies have the potential to decrease existing, and growing, inequalities in income''.[13]

This line of thought carries with it the presumption that new highly educated cohorts will benefit from such levels' traditionally high returns. However, this approach does not consider whether such levels are characterized by reasonably concentrated or disperse returns. If the latter situation turns out to be the most representative, then one should acknowledge the existence of potential problems relating to within-levels inequality of educational policies intended to fade wage dispersion. Moreover, the scarce evidence available suggests that ''differences in the extent of earnings inequality among high income countries are heavily influenced by rewards for educational attainment''.[14]

Table 2 shows the trend, in the microdata, the age (experience) premium and the education premium, both measures of between-wage inequality. The former is the ratio between the earnings of 'younger' (25-30) and 'older' (45-50) workers, the latter is the ratio of the earnings of university graduates to the earnings of high school graduate. Concerning the age premium, Panel A, for countries with high relative supply, specifically for males with college degree, the trend is slightly increasing, although it is decreasing for non college degrees and for both categories in countries with low relative supply. For females both with and without college education, in both regions, the evolution is more stable even if declining in high relative supply countries and increasing in the low relative supply area. The trend in the education premium, Panel B, seems to be pretty stable for females in low relative supply countries, decreasing for both men and women of different age groups in high relative supply of graduates countries and increasing, for the old age cohorts, in low relative supply countries.

4.5 Labour market institutions

Institution is a system of laws, norms or conventions resulting from a collective choice, and providing constraints or incentives which alter individual

[13] Ashenfelter and Rouse (2000, p. 111)

[14] Sullivan and Smeeding (1997).

Table 2. Between group inequality: Age and education premia.

	High relative supply		Low relative supply	
	ECHP	EUSILC	ECHP	EUSILC
Panel A: Age premium				
MALES				
college	2.04	2.25	1.67	1.50
non college	2.15	1.90	1.60	1.48
FEMALES				
college	1.92	1.72	1.49	1.62
non college	2.19	1.93	1.85	1.61
Panel B : Education premium				
MALES				
Age <=28	1.24	1.14	1.25	1.36
Age 29-34	1.43	1.25	1.50	1.44
Age 35-49	1.54	1.45	1.68	1.69
Age 40-45	1.60	1.58	1.62	1.77
Age 45+	1.67	1.64	1.69	1.75
FEMALES				
Age <=28	1.38	1.32	1.24	1.37
Age 29-34	1.45	1.36	1.38	1.42
Age 35-49	1.50	1.41	1.45	1.46
Age 40-45	1.54	1.47	1.59	1.56
Age 45+	1.62	1.55	1.53	1.63

choices over labor and pay. Institutions create a wedge between the value of the marginal job for the firm and the wage. Traditionally in the literature, the institutional features that are considered important for wage formation are: unions and bargaining institutions, wage regulation and welfare benefits, and labour market policies. A common finding of the studies that have investigated the effects of institutions on wage dispersion is that the interactions between supply, demand and institutions can take several routes altering both the between as well as the within structure of wages (see for example, Brunello, Comi, and Lucifora (2000) and Barth and Lucifora (2006)).

In investigating the evolution of wage inequality, I use institutions as another potential explanation of the trend in the college wage gap.[15] I use union density as a measure of wage bargaining institution. The data on Employment Protection Legislation index the set of rules and procedures governing the treatment of dismissals of workers employed on a permanent basis. Statutory minimum wage is conventionally defined as the ratio be-

[15]Detailed information on institutional data used in the empirical analysis can be found in appendix A1.

tween the official minimum wage and the median wage.[16] Table A2 contains summary statistics of the institutional variables.

It is necessary to have time varying information on institutions. Indeed, the effects of institutions in regulating wages might change over time because of market deregulation, depletion of workers' guarantees, deunionisation and decentralisation of collective bargaining.

Generally, institutions are pretty stable, in the sense that do not change much over time. However, in the period analyzed there has been sufficient labour market related reforms. The two regions analyzed differ by institutional settings as well. Namely, countries with higher relative supply of graduates seem to be also more protective: the employment protection index is higher, as well as the union density and the minimum wage. And countries with lower relative supply are the ones which implemented more reforms during the period. All the differences are significant. These countries present lower inequality (lower Gini coefficient), and slightly higher employment rate. Concerning the demand of graduate workers, there is a lot of heterogeneity across countries, however on average it seems that there are no big differences among the two regions. Reforms actually implemented in EU countries in recent years with the goal of fighting unemployment did not increase or reduce employment protection or increased the generosity of unemployment benefits for everybody.

5 Empirical framework

In the empirical exercise, I first take a long run perspective and analyze the effect of having college or high school degrees on the net wages over time. In order to obtain some simple evidence on the form of the relationship linking earnings and schooling, I estimate an unrestricted regression of log wage on a set of dummy variables for each schooling level available in the data. To investigate the potential sources of inequality I estimate regression models for the college wage gap that extend the basic specification in equation 5. I address the issue of the potential endogeneity of relative supply in the college wage premium equation with an IV strategy. Furthermore, I run quantile regression estimates to address the relation between schooling and wage inequality. Quantile regressions are used to consider the differences through income distributions in education premia between different groups of individuals.

[16] It is to be noticed that not all the countries in our sample have an official minimum wage: Austria, Germany, Denmark, Finland and Italy do not have an official minimum wage.

5.1 Returns to college

In the first part of the empirical analysis I focus on the evolution of returns to college over time. Ordinary least squares methods are applied to standard Mincerian earnings function where the education variable, instead of being measured by the number of years of education completed, takes the form of set of dummy variables indicating the type of degree completed. The equation of interest becomes the following:

$$Y_{icat} = \alpha + \beta_1 College_{icat} + \beta_2 Secondary_{icat} + \beta_3 EXP_{icat} + \beta_4 EXP^2_{icat} + \lambda_{at} + \theta_{ct} + \gamma_c + \tau_t + \chi_a + u_{icat}$$

for the individual i, in country c, of the cohort a, measured at time t. where $College_{icat}$ or $Secondary_{icat}$ are dummies indicating whether having completed college or high school degree, the baseline is no degree.

Looking at different cohorts, allowing them to be imperfect substitutes in production, since the education variables vary in term of education quality-value, across states and over time, I collapse the individual level data at the cohort level, country, survey year. The aggregation of single birth year cohorts into 7-year birth cohorts ensures large enough samples when the cohorts are followed on a year-to-year basis. Moreover, this definition is fine enough to group individuals who attended elementary and secondary school together, and that were subjected to similar influences from the educational and economic environments (for example school quality and expected gains to an additional year of education). I work with the cell means of the log annual net earnings and the other variables (weighted by the corresponding cell sizes), to explore whether there are differences among people of the same age in different points in time.

The cell level model on which cohort estimates are based on is the following:

$$\bar{y}_{cat} = \alpha + \beta_1 E\bar{D}U_{cat} + \beta_2 \bar{X}_{cat} + \mu_{ct} + \lambda_{at} + \theta_t + \gamma_c + \chi_y + u_{cat} \qquad (9)$$

where $E\bar{D}U$ is a vector containing the dummies variable for different degrees. To account for group specific error components, I cluster standard errors at country, gender and wave level.

5.2 The sources of rising inequality

In section 3 I have presented the theoretical model on which I draw to analyze the leading proximate causes of overall and between-group wage inequality.

Taking the supply, demand and institutions framework to the data, recalling from equation (5)

$$lnw = \rho \left(\frac{\alpha_{hct}}{\alpha_{lct}} \right) - \frac{1}{\sigma} ln \left(\frac{H_{ct}}{L_{ct}} \right) \tag{10}$$

This equation suggests an explanation of relative wage movements made of both market factors and institutional factors.

Supply is assumed to be observable, the unknowns are the elasticity of substitution and the skill bias technical change that can be both seen as demand shifts. As frequently done in the literature, to control for changes in the demand conditions, I proxy the shift D_{ct}, with a demand index [17], time trends and a measure of technology -R&D intensity.[18]

The idea is that all these measures increase relative productivity in the skill intensive sectors, I thus expect a positive coefficient in my estimations.

To check which are the potentially relevant institutional factors, I include controls for union density, minimum wage, employment protection, Gini index and a measure of the public sector employment.[19]

The model I estimate is the following:

$$ln \left(\frac{w_{ct}^{H}}{w_{ct}^{L}} \right) = \gamma_0 + \gamma_1 D_{ct} + \gamma_2 ln \left(\frac{H_{ct}}{L_{ct}} \right) + \gamma_3 X_{ct} + \tau_t + \mu_c + \varepsilon_{ct} \tag{11}$$

where X_{ct} is a vector of labour market institutions and γ_2 provides an estimate for $1/\sigma$. I control for country fixed effects, time fixed effects and interaction between country and time fixed effects, as well. To get efficient estimates standard errors are clustered at country, cohort and wave level.

Since the focus of this paper is on which is the role of the supply in the evolution of college wage premium, I will conduct separately the analysis for the two set of countries. Certainly, the evolution of the relative supply trend has differed in the two set of countries, therefore, I expect differences in the growth of the college wage premia as well. The model above suggests

[17] This demand index is similar to the demand index used by Katz and Murphy (1992) which is based on the changes in the relative employment.

[18] Ratio of R&D expenditure over value added in the manufacturing sector measured every year in each country.

[19] Detailed information on the sources of the institutional data is contained in the Appendix A1.

that the competitive wage of a particular type of worker depends positively on the average rate of technical change (α)- meaning a positive effect on the wage ratio of SBTC, negatively on their relative supply change and positively on their relative product -demand shift (that is associated to the technical change).

Concerning institutional factors, the effect is quite complex. The impact of institutions is generally concentrated in specific parts of the wage distribution. Institutions may affect wage differentials in various ways, depending as well on the elasticity of labour supply and across demographic groups. Moreover, institutions have different effects across industries by changing the incentives for capital investment. and thus affecting indirectly wage inequality. In turn, all the institutions I am exploring tend to compress wages. They improve the outside option of employers or unions more for low skilled groups, strengthening their bargaining position and compressing the skill wage differentials. Concerning unionism, unions increase the wage rates of their members above the level they would achieve in the absence of representation, thus they would favor the low skilled workers inducing inequality to decline. The problem with this argument is that it ignores the effects of union wage policy on non-union wages. If a set of jobs usually performed by a particular type of labour is unionized and the employer forced to pay higher wages, the supply of labour to all other jobs done by that type of labour will increase together with a reduction in wages. Therefore, it is not clear if the average wage for the group rises or falls with the increase in union representation. Additionally, it can be that workers with white collar jobs, at the higher end of the wage distribution are very unionized - for example, this is the case of some professional orders in Italy, leading thus to an unclear effect of unions on the wage premium. Minimum wage is another institution which mostly concerns lower skilled workers: a binding minimum wage increases the relative wages of unskilled, thus reducing wage inequality. Minimum wage can impact the wage distribution in several ways: firstly, avoiding employment of workers with productivity lower than the minimum wage. Secondly, preventing firms from pushing down wages for workers with low bargaining power and reducing the heterogeneity at the bottom. Additionally, a minimum wage increase leads to an increase in wages for workers paid at the minimum wage level, a weaker increase for workers with wages slightly above the minimum wage (spill-over effects) and little or no effect on high-paid workers (Charnoz, Coudin, and Gaini, 2011). In summary, the presence of a statutory minimum wage by setting an explicit threshold for the lowest wage rate paid tends to reduce wage dispersion. Thanks to its regressive nature, such measure is likely to have a stronger effect at the bottom of the wage distribution rather than at the top. Employment protection policies are of-

ten associated with a more compressed wage structure. Following Boeri and Jimeno (2005), I expect Employment protection to protect unskilled workers more than skilled workers, having thus a negative effect on the wage ratio. There is a potential trade-off between EPL and unemployment benefit which may be explained by conflicting interests of insiders-outsiders and low-high skilled. More educated labour force leads to more unemployment policies and less job protection, that is why I assume that EPL is a more favourable measure for low skilled workers.

In turn, accepting the hypothesis that the effects of institutions on the outside option of workers are mostly in favor of the unskilled, then I expect a negative effect of the aggregate institutional measures on the relative wage.

In addition to this standard set of labour market institutions, I add a measure of the public sector pervasiveness -relative percentage of the population working on the public sector. Public sector employment is perceived as safer and offering more benefits, for this reason, more risk averse individuals sort into public sector employment.[20] However, it seems to be the case that workers at the lower tail of the wage distribution benefit more from public sector employment than workers at the upper tail of the wage distribution. Actually, there is evidence that there can be a wage penalty for highly qualified employees - see for example (Melly, 2005). The idea is that public sector employment may have acted to offset the widening wage inequality seen in recent years and to narrow the college wage premium.

I also control for type of contract: whether full time or part time contract and whether permanent or fixed term employment. These are measures that are somehow related with job stability and job protection and can thus be relevant in assessing wage inequality. Since it is plausible that both market and institutional factors alter the wage distribution both across skill groups and across age groups, data are aggregated by country, year of the survey and age group.

This model, including cross country differences in the role of labour institutions, does a reasonable job accounting for trends in skill premium, however some questions rest unsolved. [21]

The main general concern of this model is that relative skill supply are predetermined, thus labour supply of each group is inelastic. In particular nowadays, this assumption may not hold. In this sense, a first issue to address is, indeed, the one of immigration. It is likely that, since immigrants,

[20]This is shown to be the case in Germany by (Pfeifer, 2011)

[21]First of all, is technology or relative supply really exogenous? There could be, indeed, trade induced demand or a supply-induced demand. Another potential issue that should be consider is the polarization/ non-monotonicity of jobs. The phenomenon for which middle skilled group is losing demand to both high and low skilled.

on average, are less educated than natives, changes in immigration flows during years affected the relative skill supplies, having as well an impact on college wage premium. Hence, it is important to understand how much of the change in skill supplies have come from changes in immigration and how much is stemming from changes in the native population. The first and most common presumption is that immigration greatly increases the premium to skill, as immigrants increase the supply of less educated people. However, following the reasoning of Goldin and Katz (2009), immigration is found (in the US) not to be so relevant in determining the relative skill supplies having a modest impact on the wage premium. The main reason can be found in the change of the educational distribution of more recent migrants: in the recent period immigrants can be distributed at both the very top or the very bottom of the educational ladder.[22] To avoid problems stemming from the possible misreporting of educational information about migrants, I select my sample on native people. However, in many European countries, in particular in many countries belonging to the subgroup of the "low relative supply countries" - i.e. Spain, Italy, UK, migration is a very important and massive phenomenon, it is possible, that it has an effect on the relative supply of college graduates and thus on college wage premium.[23]

Previous literature focuses on the relation between relative supply and college wage premium without considering the potential endogeneity of the relative supply. Without taking this issue into consideration, there is the risk that OLS estimation of the effect of relative supply on college wage premium is inadequate ($\hat{\gamma}_2$ is biased). Theoretically, the bias is negative ($\operatorname{plim}_{n\to\infty} \hat{\gamma}_2 < \gamma_2$) if the errors are negatively correlated or if relative supply is measured with error, and positive otherwise. The assumption that the relative supply of workers is predetermined is plausible in the very short run. Whereas, it is reasonable to think that, in long run, the fraction of workers that chooses to become more educated responds both to innovations that increase the relative demand for more educated labour and to innovations increasing ability premia.

From the individual point of view, given the existing set of possibilities to access education, a worker choose whether to undertake education and to

[22]Goldin and Katz (2007), they found that immigration had only a minor impact on the growth in the relative supply of the college graduates and a moderate impact on the high school graduates workers relative to the supply in the 1980-2005 period.

[23]To be sure my results, even if related only to native people, are not biased by the high proportion of migrants existing in some countries, I control for yearly immigration rate by country, and this does not change much the results. Additionally, as a further robustness check, I have controlled for relative migration (i.e. share of college graduate migrants over non-college graduates migrants.) for the countries for which these date are available. Results are in line with previous findings.

which extent, according to which choice yields him higher lifetime earnings (i.e. according as well to the relative wages he/she expects). Thus, a significant relationship between education attainment, hence relative supply, and some individual outcome may simply result from some unobserved heterogeneity determining both variables. Similarly, the concern can refer to some unobserved country-specific factor that shifts the relative demand for skilled workers, leading to higher relative wages and higher relative employment and confounding the estimation of the inverse substitution elasticity. To overcome these concerns, I use as instrumental variables for the aggregate relative supply ratio, data on the reforms affecting the university system. In particular, I use measures of university autonomy and access, and information on student financing such as financial support.[24] This empirical strategy exploits the differences across countries in the accessibility to tertiary education that are due to changes in institutions and legislations.

5.3 Evolution of wage inequality: quantile regressions.

Quantile regression models allow to characterize the entire conditional distribution of the dependent variable and they allow me to investigate if returns to higher education—and the evolution over time—are dissimilar at different quantiles of the distribution.

This method becomes very useful to investigate the progress of the impact of schooling on within-levels wage inequality. Quantile regressions are able to compare returns to secondary education and to college for the skilled and unskilled workers, conditional on their schooling and experience.

The quantile regression model is the following:

$$lnw_i = x_i\beta_\theta + u_{\theta i} \tag{12}$$

With $Quant_\theta(lnw_i|x_i) = x_i\beta_\theta$

Where $x_i$and β_θ are the vector of exogenous variables and the vector of parameters respectively.

$Quant_\theta$ indicates the $\vartheta_j th$ conditional quantile of ln$w$ given x. The $\vartheta_j th$ regression quantile,$0 < \vartheta_j < 1$, is the solution of the following minimization problem:

[24]The data used have been kindly provided by Daniele Checchi, Elena Meschi and Michela Braga, who in Braga, Checchi, and Meschi (2011) have constructed a dataset on school reforms occurred in the last century in 18 countries in Europe. See appendix A1 for details about the data.

$$min_{\beta \in R^k} \left\{ \sum_{i:lnw_i \geq x_i\beta} {}_{\theta i}\theta |lnw_i - x_i\beta_\theta| + \sum_{i:lnw_i < x_i\beta} {}_{\theta i}(1-\theta)|lnw_i - x_i\beta_\theta| \right\}$$

That can be also written as:

$$min_{\beta \in R^k} \left\{ \sum_i \rho_\theta |lnw_i - x_i\beta_\theta| \right\}$$

with $\rho_\theta(\varepsilon)$ is the check fuction defined as $\rho_\theta(\varepsilon) = \theta\varepsilon$ if $\varepsilon \geq 0$ or $\rho_\theta(\varepsilon) = (\theta - 1)$ if $\varepsilon < 0$.

Basically, this technique provide pictures of different points of a conditional distribution. Since it is very informative knowing if the relationship between the regressors and the independent variables varies across its conditional distribution, this methodology has been used in the returns to education literature to assess the possible impact of schooling upon inequality, through its within-levels inequality component. The rationale goes as follows: If the earning increments that stem from schooling (a certain degree) were the same across the wage distribution, then this would mean that schooling (the degree) would not impact upon within-levels wage inequality. This is a consequence of the fact that distributions of wages conditional on different levels of schooling (degree) would differ only on their locations and not on their dispersions. However, it may be the case that these dispersions do indeed vary across educational levels, thus resulting in an impact of schooling upon the wage distribution, through its within-levels channel. I will test this last possibility by using quantile regression estimates of different returns for different degrees.

The empirical results are obtained regressing:

$$lny_i = \alpha_\theta + \beta_{\theta 1} College_i + \beta_{\theta 2} Secondary_i + \delta_{\theta 1} EXP_i + \delta_{\theta 2} EXP^2 + u_i \quad (13)$$

where θ is the quantile being observed.

6 Results

In this section the results of the empirical analysis are shown. In the first two subsections I will present the evidences of the evolution of the returns to college, general and by age cohorts. The third subsection deals with

the potential sources of inequality. Finally, the last subsection repeats the analysis using quantile regressions in order to focus on the evolution of within inequality.

6.1 Returns to college results

Table 3 shows the results for each region and each dataset, separately for males and females. In this table year effects are shown. Panel A of table 3 covers the period from 1994 to 2001, ECHP dataset, whereas panel B covers the period from 2004 to 2009, EU-SILC data. All results stem from from separate regressions for men and women of the log annual net wage on education categories, a quadratic in experience, interactions between education and time, country and time, country, time and age cohorts fixed effects (See section 5). Errors are clustered at country, cohort and wave level. The baseline education category is low educational attainment (i.e. ISCED level 1-2). The log of wages of each education group presents trends which differ across the education groups, gender and regions. In general, simple returns to post secondary education have continuously decreased over time for both males and females. The decline is significant and more marked for high relative supply countries: earnings premia for both males and females present downward trends in high relative supply countries. Furthermore, the fall is much clearer in the first half of the period analyzed (1994-2001) for both men and women. However, this is relative to low educated people. When considering the college wage premium - the difference between college and secondary school graduates, to have an idea of its evolution, returns to secondary school should be considered as well. Concerning the evolution of secondary[25] school degree, it seems that, on average, with the exception of women in low relative supply countries, the returns to secondary school degree have remained quite stable over the period analyzed. This can be seen as a confirmation of the observation of the declining college wage premia in high relative supply countries. The inequalities between education groups-adjusted for the level of experience- are therefore decreasing over the period. This decline in between-education group inequalities can be observed by examining the degree premiums relative to no degree (see Figure 4). For women the decline is less evident but it is still noticeable in high relative supply countries: college returns are declining significantly, even more strongly than for men, in the first half of the period, while this decline is less strong in the second half (EU-SILC data). For women in low relative supply countries, it seems that the returns to both college degree and secondary schooling are more or less stable across waves. One interpretation of these OLS estimates is that the relative

[25]coefficients are omitted for simplicity, but the full table is available upon request.

supply of college workers is responsive to relative wages. However,these estimates may suffer from bias associated with omitted ability bias which is traditionally thought to bias the schooling coefficient. Individuals may indeed differ in their inherent ability, and this would create an upward bias in the OLS estimates of returns to education. Some evidence can be found in the literature that ability bias almost cancels out the bias associated with measurement error in schooling but there is a worry, in this context, that one or both of these sources of bias may be changing differently over time.

Table 3. OLS estimates of the returns to higher education for workers aged 20-55 (1994-2009).

Panel A: ECHP				
	(1)	(2)	(3)	(4)
	MALES		FEMALES	
VARIABLES	High relative supply	Low relative supply	High relative supply	Low relative supply
college	0.370***	0.366***	0.531***	0.465***
	(0.029)	(0.032)	(0.037)	(0.041)
secondary	0.178***	0.166***	0.284***	0.324***
	(0.019)	(0.021)	(0.034)	(0.033)
College 1995	0.019	-0.041	0.029	-0.009
	(0.038)	(0.044)	(0.051)	(0.054)
College 1996	-0.015	-0.048	-0.033	-0.069
	(0.036)	(0.040)	(0.046)	(0.051)
College 1997	-0.033	-0.049	-0.038	-0.000
	(0.036)	(0.041)	(0.045)	(0.053)
College 1998	-0.068*	-0.037	-0.081*	0.041
	(0.037)	(0.043)	(0.046)	(0.055)
College 1999	-0.072*	-0.038	-0.141***	0.033
	(0.037)	(0.042)	(0.049)	(0.054)
College 2000	-0.109***	-0.032	-0.137***	0.016
	(0.036)	(0.045)	(0.046)	(0.055)
College 2001	-0.118***	-0.022	-0.111**	0.055
	(0.035)	(0.043)	(0.046)	(0.053)
Observations	62,512	51,885	51,166	36,950
R-squared	0.429	0.507	0.314	0.371
Panel B: EUSILC				
college	0.306***	0.304***	0.458***	0.433***
	(0.021)	(0.023)	(0.027)	(0.027)
secondary	0.118***	0.170***	0.180***	0.298***
	(0.021)	(0.014)	(0.024)	(0.020)
College 2005	-0.026	0.044	-0.004	0.023
	(0.028)	(0.033)	(0.037)	(0.038)
College 2006	-0.044	0.021	-0.021	0.012
	(0.027)	(0.031)	(0.032)	(0.039)
College 2007	-0.061**	0.021	-0.017	-0.036
	(0.030)	(0.032)	(0.036)	(0.035)
College 2008	-0.087***	0.027	-0.057	-0.025
	(0.030)	(0.033)	(0.038)	(0.034)
College 2009	0.002	0.001	-0.005	0.040
	(0.025)	(0.031)	(0.033)	(0.035)
Observations	57,688	63,947	50,808	52,047
R-squared	0.354	0.357	0.266	0.241

Notes: each regression contains country fixed effects, year fixed effects, controls for age cohorts, interactions country and cohorts. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

6.2 Cohorts returns

Changes in college/high school wage gap have diverged a lot over the last decades according to different age/experience groups. Drawing on Card and Lemieux (2001), to the extent that workers with similar education but different age/experience are imperfect substitutes in production, it is reasonable to expect age cohort specific relative supply to have an impact on the evolution of the college wage premium by age/experience. For this reason, to estimate the existence of cohort effects, I run different regressions for the college wage premium by different experience groups.

As said before, among the reasons behind the drop in the returns to college education (and education in general) there are demand and supply explanations, together with a non market one, that is a combination of institutional factors and economic cycle. Looking from the firm side, it is known that there is a reduced human capital investment after financial recessions: hiring on temporary contracts, offering no on-the-job training, lower education wage premia, lower incentives to investment also in formal education. Since in 2007 there has been the beginning of the financial crisis, it is reasonable to expect a massive drop in the wages for people entering the labour markets around this wrong moment, they somehow represent a lost generation.

To look at the evolution of the returns to college by cohorts in different points in time, I take the microdata, collapse them into cells defined by birth cohort, country and wave, separately by gender, weight by cell sizes, and estimate the college premium by cohort group. Table 4 and 5 provide a breakdown by cohort and by survey for the two regions analyzed, allowing the college premium to vary by cohort groups.

I split across three cohort groups in two subsample periods corresponding to the two datasets: People aged 43-50, the old, the middle aged: 34-42, and the young aged 25-33. I contrast these groups with the corresponding age balanced birth cohort groups in the EU-SILC subsample period 2004-2009, observed ten years later than individuals in the first period, who were born ten years later -i.e. at the same age as their 1994-2001 subsample counterparts). It is clear that the simple analysis portrayed above masks important changes by cohort and region. Firstly, it is noticeable that returns are always lower, in absolute terms, for the young and higher for the old, no matter the region with high or low relative supply of graduates. Furthermore, there is evidence that returns have declined over time for older graduates in countries with high relative supply of graduates, for younger workers, returns to college are significantly lower than for the older workers, however they seem to be increasing over time. The coefficient of the returns to college for the EU-SILC dataset is higher and significantly different from the same

coefficient measured 10 years earlier. However, also secondary school returns have increased quite a lot for the young, leading to an overall negative effect on the college wage premium. Vice versa, returns have hardly changed for both graduates and non graduates in region with lower relative supply of workers.

Table 4. The returns to higher education by cohorts. High relative supply countries.

	(1)	(2)	(3)	(4)	(5)	(6)
	Age 25-33		Age 34-42		Age 43-50	
VARIABLES	ECHP	EUSILC	ECHP	EUSILC	ECHP	EUSILC
college	0.268***	0.478***	0.477***	0.314***	0.502***	0.0927
	(0.0567)	(0.0946)	(0.0470)	(0.0905)	(0.0406)	(0.102)
secondary	0.163***	0.326***	0.168***	0.0741	0.114**	-0.0144
	(0.0586)	(0.0639)	(0.0513)	(0.0708)	(0.0537)	(0.0620)
gender	0.248***	0.237***	0.392***	0.383***	0.422***	0.360***
	(0.00978)	(0.0110)	(0.00810)	(0.00934)	(0.00865)	(0.00879)
Observations	918	720	918	720	816	640
R-squared	0.843	0.929	0.869	0.939	0.870	0.930
T-test of differences between College Eusilc and Echp						
[p-value]	[0.053]		[0.000]		[0.000]	
T-test of differences between Secondary Eusilc and Echp						
[p-value]	[0.056]		[0.082]		[0.112]	

Notes: each regression includes controls for experience and experience suqared, country dummies and year dummies. Clustered country by wave and year of birth standard errors within parentheses and p-values within brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 5. The returns to higher education by cohorts. Low relative supply countries.

	(1)	(2)	(3)	(4)	(5)	(6)
	Age 25-33		Age 34-42		Age 43-50	
VARIABLES	ECHP	EUSILC	ECHP	EUSILC	ECHP	EUSILC
college	0.318***	0.206*	0.668***	0.612***	0.655***	0.487***
	(0.109)	(0.122)	(0.0872)	(0.122)	(0.0821)	(0.172)
secondary	0.220***	0.196***	0.300***	0.447***	0.506***	0.583***
	(0.0707)	(0.0699)	(0.0574)	(0.0796)	(0.0666)	(0.0859)
gender	0.240***	0.195***	0.335***	0.358***	0.336***	0.339***
	(0.0116)	(0.0147)	(0.0105)	(0.0105)	(0.0101)	(0.0112)
Observations	666	522	666	522	592	464
R-squared	0.888	0.929	0.902	0.928	0.894	0.930
T-test of differences between College Eusilc and Echp						
[p-value]	[0.483]		[0.006]		[0.370]	
T-test of differences between Secondary Eusilc and Echp						
[p-value]	[0.808]		[0.000]		[0.466]	

Notes: each regression includes controls for experience and experience suqared, country dummies and year dummies. Clustered country by wave and year of birth standard errors within parentheses and p-values within brackets. *** p<0.01, ** p<0.05, * p<0.1

6.3 The sources of raising inequality

Certainly, the different evolutions of wage distributions are also driven by different labour market structures in the countries analyzed, and to the dissimilar interactions between economic shocks and institutions. To investigate the proximate causes of the inequality, I regress the college wage premium on a set of variables including proxy for demand and supply and some institutional indicators. The idea is to identify which are the main drivers and whether they act in different way in different set of countries. The estimation results are presented in table 6 and 7, for high and low relative supply of graduates countries, respectively. All the standard errors are clustered by country, age cohort and wave to allow for any possible correlation in the unobservables of individuals of the same age in the same country.

Results show that together with demand and supply factors, also institutions can matter. The first column of tables 6 and 7 uses the original specification of Katz and Murphy (1992) with only relative demand and supply measures included as explanatory variables. In what follows, I add in

each column some measure of institutional constraints. In column 2, I add controls for minimum wage, employment protection legislation and union density. Column 3 includes a dummy indicator for having a full time contract, column 4 incorporates an alternative measure of the relative demand-R&D intensity. Finally, in the last column, I add the Gini index and the percentage of people working in the public sector. While in both regions, the coefficients for the relative supply variable are the ones expected, i.e. negative and significant, this is not the case for the relative demand index. The coefficient of the relative supply indicator is slightly higher in countries with lower supply of graduates (-0.008 vs. -0.014). In addition to this, countries with high relative supply of skilled workers present a higher and more significant relative demand indicator. Concerning the relative demand, high relative supply countries have positive and significant coefficients, although very low. Also using an alternative measure of demand (R&D intensity) gives the same result. This result is consistent with a naive SBTC story. This suggest that, despite the higher increase in the supply, these countries have still "space" for skilled workers since there is still a role for the relative demand to push their premium. For countries with lower relative supply, none of the demand measures appear to be a significant determinant of wage inequality.[26] The negative and significant coefficient of the dummy for male (gender) is not surprising. It is well known indeed that on average, there is much more selection for women into education rather than for men. A higher college wage premium for women is a common finding in the literature.

A compelling explanation for the evolution of between and within group wage inequalities is the role of institutions. The institution constraints' coefficients are expected to have mainly a negative sign which would suggest that these policies affect unskilled more that skilled workers. Minimum wage is not a significant determinant of wage inequality in high relative supply countries, whereas it is the case in countries with lower relative supply of graduates. A one percent increase in the minimum wage lowers the college wage premium by around 3%. Employment protection legislation is significantly and negatively correlated with wage inequality in low relative supply countries but it looses significance in high relative supply countries. Union density does not seem to matter in high relative supply of graduates countries, however, although with a very low coefficient, it is negatively and significantly correlated with wage premium in low relative supply countries. Full time

[26]To compare these results with others in the literature, referring to Autor, Katz, and Kearney (2008), I also included a time trend as a proxy for the demand for high skilled workers: a positive coefficient would be interpreted as a sign of SBTC. What I find is that the sign is not always positive neither significant, confirming the lower effect of the demand in contrast to the relative supply.

contracts seem to be good instruments to reduce wage inequality, in particular in high relative supply countries. Employment in public administration is negatively and significantly correlated with wage inequality, however the effect is slightly higher in low relative supply of graduates countries, countries in which the percentage of public employment is lower.

Consequently, it emerges that increases in the minimum wage, in full time contracts and employment protection also provide a valid explanation for the decrease in within-inequalities for the less-educated workers and the decreasing trend in lower-tail inequality over the period, regardless of educational level. Eventually, in addition to the supply and institutions story as an explanation for the declining evolution in college premium, another possible one is the economic cycle. Even if it has been shown that, during the Great Recession (2008-2009), there has been a much larger labor market response in the US rather than in Europe, the crisis has affected European labour market as well . Unemployment could also be a part of the story, as argued in Autor, Katz, and Kearney (2008): selection into unemployment could shift to the right the distribution of unobserved skills and of wages. However, adding unemployment rate and relative unemployment of skilled to unskilled people to the wage inequality regression does not change remarkably the results.[27]

As already said, this model is doing a good job in capturing the general trend, however it suffers for a potential endogeneity problem. Assessing the potential endogeneity of the relative supply, that is the relative share of the labour force with tertiary education relative to the share of the labour force with high school diploma, I instrument relative supply using the set of tertiary education institutions. Table 8 shows first stage estimates of the IV strategy for the relative supply: relative supply is regressed on the indicators measuring the variation in the tertiary education reforms, measured five years before. The underlying assumption is that, in order for these reforms to take action, being implemented, and to affect the relative supply, it take an average of five years.[28] Therefore, the level of tertiary education in a particular year, in a specific country is deemed to be affected by the level of institutional set-up of tertiary education five years before.

In all specifications, the instruments are shown to be good explanatory variables for aggregate relative supply, in both the two set of countries, as they are mostly significant at any conventional level. However the size and the relevance of the used instruments differs in the two set of countries. At the bottom of the table, we report the F-statistic of the excluded instrument. It oscillates between 20 and 120, well above the conventional threshold of 10 for

[27]Results are omitted but are available upon request.

[28]For this reason the sample observed is partially reduced a delimited to 2005, since the data on the tertiary education institutions arrive up to 2005.

Table 6. The college wage premium, age groups. High relative supply countries.

	(1)	(2)	(3)	(4)	(5)
Relative Supply	-0.00824***	-0.00933***	-0.0104***	-0.0101***	-0.00947***
	(0.00225)	(0.00251)	(0.00253)	(0.00252)	(0.00251)
Relative Demand	0.00997*	0.0133*	0.0109	0.00448	0.00718
	(0.00459)	(0.00662)	(0.00665)	(0.00691)	(0.00903)
gender	-0.00196***	-0.00198***	-0.00174***	-0.00168***	-0.00171***
	(0.000193)	(0.000198)	(0.000218)	(0.000217)	(0.000217)
Log Minimum Wage		-0.0111	-0.00954	-0.00528	0.0170
		(0.00917)	(0.00915)	(0.00919)	(0.0123)
EPS		0.000116	0.000111	-0.000237	0.000369
		(0.000441)	(0.000440)	(0.000450)	(0.000529)
Union density		-0.0000505	-0.0000444	-0.0000344	-0.00000639
		(0.0000327)	(0.0000327)	(0.0000326)	(0.0000342)
Full time			-0.00299**	-0.00319**	-0.00246*
			(0.00114)	(0.00113)	(0.00115)
R&D man.				0.000487**	0.000709***
				(0.000153)	(0.000168)
Gini					-0.00886
					(0.0112)
Public Emp.					-0.0385*
					(0.0157)
Observations	795	795	795	795	795
R^2	0.342	0.345	0.351	0.360	0.368

Notes: Controls for country and year fixed effects. Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7. The college wage premium, age groups. Low relative supply countries.

	(1)	(2)	(3)	(4)	(5)
Relative supply	-0.0145***	-0.0117**	-0.0105**	-0.0103**	-0.0105**
	(0.00372)	(0.00380)	(0.00385)	(0.00385)	(0.00386)
Relative demand	0.00325	0.00608*	0.00609*	0.00580	0.000960
	(0.00278)	(0.00296)	(0.00295)	(0.00296)	(0.00348)
gender	-0.00229***	-0.00224***	-0.00209***	-0.00209***	-0.00212***
	(0.000154)	(0.000152)	(0.000174)	(0.000174)	(0.000173)
Log Min wage		-0.0328***	-0.0312***	-0.0300***	-0.0224*
		(0.00774)	(0.00778)	(0.00783)	(0.00877)
EPS		-0.000825	-0.000791	-0.00103*	-0.00116*
		(0.000477)	(0.000477)	(0.000509)	(0.000561)
union density		-0.000170**	-0.000135*	-0.000178*	0.0000591
		(0.0000595)	(0.0000626)	(0.0000701)	(0.000114)
Full Time			-0.00151	-0.00149	-0.00119
			(0.000850)	(0.000850)	(0.000859)
R&D man.				-0.000327	-0.0000930
				(0.000241)	(0.000288)
Gini					-0.0135
					(0.00853)
Public emp.					-0.0693*
					(0.0284)
Observations	620	620	620	620	620
R^2	0.425	0.446	0.449	0.451	0.458

Notes: Controls for country and year fixed effects. Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

strong instruments. Therefore, there should be no concerns about potential biases in the second stage due to the use of weak instruments.

The second stage results for high relative supply countries and for low relative supply countries are presented in table 9 and 10, respectively. I compare OLS and IV estimates of the college wage premium, where I replace relative supply with a set of instruments measuring country variation in the institutional set-up characterizing tertiary education. More specifically, column 1 and 2 show the baseline (Katz and Murphy) specification where college wage premium is regressed on a demand index and on a supply index. Columns 3 and 4 add labour market institutions such as minimum wage, EPS and union density as additional controls.[29] In all cases the estimated IV coefficient of relative supply are negative, strongly significant and larger in magnitude than the OLS. According to these estimates, the OLS coefficient of relative supply is -0.07 in the preferred specification in high relative supply countries, and -0.017 in countries with low relative supply of graduates. The IV estimates are substantially larger in both the set of countries and the specifications (-0.011 and -0.036 respectively for high and low relative supply countries), implying a positive bias. The Cragg-Donald Wald F-statistics confirms that instruments are strong predictors of the relative supply as we already know from the regressions in Table 8. Additionally, in the IV estimates, the sign and the significance of the coefficients of the labour market institutions are very close to what has been found in the original OLS estimates. The most relevant institution is the minimum wage in countries with lower relative supply of graduates, this has a negative and significant effect - of a very similar size of the OLS one, on the college wage premium. A few conclusions can be drawn from these set of estimates. First, there is clear empirical evidence that being exposed to higher relative supply of graduates has caused a reduction in the college wage premium, that is the relative advantage of the relatively higher educated people. Second, the comparison between OLS and IV estimates suggest that the OLS estimates are upward biased.

6.4 Quantile regressions results

The divergence of the upper and the lower tail wage inequality and the convexification of the returns to education is a puzzle.

To look at the inequality within educational groups, in particular, college, I run quantile regressions. As already said in section 5, this technique allows me to look at different earning advantages of college degree at different

[29]The richer specification -i.e. the one including the other controls used in the OLS estimations, such as the Gini coefficient, public employment, R&D intensity and full time contract, has been omitted since these variables do not appear relevant.

Table 8. Relative supply equation: 1st stage

	High Relative Supply Countries		*Low Relative Supply Countries*	
Expansion of uni. accessibility	0.128^{***}	0.090^{***}	0.020^{***}	0.024^{***}
	(0.013)	(0.015)	(0.005)	(0.006)
Selectivity in uni. access	-0.020^{**}	-0.000	0.055^{***}	0.052^{***}
	(0.006)	(0.008)	(0.004)	(0.005)
Financial support	-0.027^{**}	-0.031^{***}	0.035^{***}	0.040^{***}
	(0.009)	(0.009)	(0.002)	(0.003)
Size of grant	0.076^{***}	0.062^{***}	-0.029^{***}	-0.022^{***}
	(0.006)	(0.007)	(0.004)	(0.004)
Loan to grant component	-0.034^{***}	-0.020^{*}	-0.036^{***}	-0.044^{***}
	(0.010)	(0.010)	(0.004)	(0.004)
Interest rate	-0.062^{**}	-0.083^{***}	0.034^{***}	0.042^{***}
	(0.020)	(0.019)	(0.008)	(0.008)
Index of university autonomy	0.056^{***}	-0.009	0.053^{***}	0.067^{***}
	(0.014)	(0.020)	(0.012)	(0.016)
Year FE	*No*	*Yes*	*No*	*Yes*
R-squared	0.332	0.429	0.665	0.695
Observations	545	545	450	450
F-stat	38.19	24.81	125.29	61.58
F-stat p-value	0.000	0.000	0.000	0.000

Notes. The dependent variable is relative supply of graduates. All regressions include a full set of year dummies. Robust standard errors in parenthesis. One star means 5% significantly different from zero, two stars 1%, three stars 0.1%.

Table 9. Assessing the endogeneity bias- High relative supply countries

	Baseline model		*+ Labour Market Institutions*	
	OLS	*IV*	*OLS*	*IV*
Relative Supply	−0.000	0.003	−0.007*	−0.011*
	(0.002)	(0.004)	(0.003)	(0.005)
Relative Demand	0.005***	0.005***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
gender	−0.002***	−0.002***	−0.002***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Minimum Wage			0.003	0.003
			(0.005)	(0.005)
EPS			−0.000	−0.000
			(0.000)	(0.000)
Union Density			−0.000***	−0.000***
			(0.000)	(0.000)
Cragg-Donald Wald F statistic		39.695		73.143
R^2	.277	.276	.311	.310
N	545	545	545	545

Notes: The dependent variable is college wage premium. Relative supply is instrumented by a set of indicators measuring tertiary education reforms: selectivity in university access, expansion of university access, financial support, increase grant size, loan component to grant component, interest rate and an index of university autonomy. All regressions include a full set of year, country and age cohort dummies. Robust standard errors in parenthesis. One star means 5% significantly different from zero, two stars 1%, three stars 0.1%.

Table 10. Assessing the endogeneity bias- Low relative supply countries

	Baseline model		*+ Labour Market Institutions*	
	OLS	*IV*	*OLS*	*IV*
Relative Supply	-0.018^{***}	-0.020^{***}	-0.017^{***}	-0.036^{**}
	(0.003)	(0.003)	(0.005)	(0.011)
Relative Demand	0.003^{***}	0.003^{***}	0.006	0.008^{*}
	(0.000)	(0.000)	(0.004)	(0.004)
gender	-0.002^{***}	-0.002^{***}	-0.002^{***}	-0.002^{***}
	(0.000)	(0.000)	(0.000)	(0.000)
Minimum Wage			-0.025^{**}	-0.027^{**}
			(0.010)	(0.010)
EPS			0.000	0.000
			(0.000)	(0.000)
Union Density			-0.000	-0.000^{*}
			(0.000)	(0.000)
Cragg-Donald Wald F statistic		230.866		17.596
R^2	.386	.385	.413	.3963
N	450	450	450	450

Notes: The dependent variable is college wage premium. Relative supply is instrumented by a set of indicators measuring tertiary education reforms: selectivity in university access, expansion of university access, financial support, increase grant size, loan component to grant component, interest rate and an index of university autonomy. All regressions include a full set of year, country and age cohort dummies. Robust standard errors in parenthesis. One star means 5% significantly different from zero, two stars 1%, three stars 0.1%.

deciles of the income distribution, so allowing to look at changes in wage distributions and heterogeneity of the skill premia.

Figure 6. Within group inequality -higher education. Quantile regressions

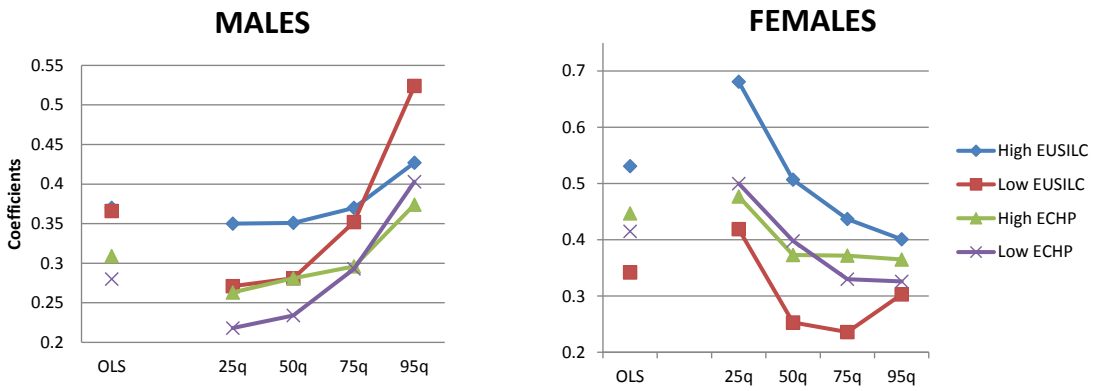


Figure 8 displays the log wage premium estimates for college degree for males and females in the two regions in the two dataset.[30] The premia of the high-skilled workers have increased for males over the distribution. For males, both in high and low relative supply countries, it is possible to notice a rise in upper tail inequality. Hence, despite the increase in the access to education, inequality is still increasing in both set of countries, however this increase is declining over time, especially for counties with higher relative supply. The gap between ECHP and EU-SILC estimates is reducing over time. Looking at the same estimates, focusing on the returns to secondary school, the increase in inequality is is much less marked (see figure A1). This is in line with previous findings (i.e. Martins and Pereira (2004)) who fund increasing wage inequality within higher educated. This pattern is not observed for women, for them within-education group inequalities are decreasing over the distribution. Decreases are typically stronger for women in high relative supply countries. In particular, college returns are decreasing over the distribution and over time in low relative supply countries, for both college and secondary school degree. For countries with higher relative supply returns to both degree are still decreasing over the distribution but are slightly increasing over time. This is quite reasonable thinking of the fact that for women there is much more selection into education.

[30]The same figure for high school graduates is shown in the appendix A2, Figure A1.

7 Conclusions

There has been much debate about the contribution of the increase of higher education participation to the widening wage inequality in the US. However, this has been less explored in Europe.

This paper aims at analyzing changes in the wage premium associated with a degree using a large European dataset obtained harmonizing two different sources. More specifically, I am interested in how the college premium evolved across time, across the wage distribution and across cohorts. I try to offer some insights into this topic by looking at the supply and demand for skills -in particular of graduates over time. I allow different education types to yield different returns in order to assess whether the decline in the returns to education is limited to specific skill groups. I analyze the effects of the recent strong increase in the value of the participation rates on returns to college and inequality in Europe, using cross country variation in relative supply, demand and labour market institutions to look at their effects on the trend in the college wage gap. I investigate the sources of inequality looking at both supply/demand and institutional components. As a final extension, to get a more comprehensive picture, I go through the inequality within education groups: quantile regressions allow me to look at the earning advantage of additional years of schooling at different deciles of the income distribution.

Although the literature does not provide much evidence that, on average, the college premium has shown any significant trend changes in recent years, despite the large increase in the participation rates and in the flow of graduates into the labour market, my results show that there has been a fall in returns in the recent years, in particular for youngest cohorts, for both men and women. This fall has been more marked in countries with higher supply of skilled workers. I use harmonized micro data from two different sources (ECHP and EU-SILC) to construct a dataset which covers 15 years. I divide the countries into two different subgroups: countries with high relative supply of graduates at the beginning of the period analyzed (1994) and countries with low relative supply of graduates. The reason why I am doing so is that I argue the two set of countries, facing different evolution in the relative supply over time, have faced different evolutions in the college wage premium as well. Empirically, I find some evidence of a significant decline of college returns in countries with high relative supply of graduates and a marked fall in returns for recent cohorts for both men and women in all European countries. This decline is less evident in countries with low relative supply of graduates. A potential explanation of these findings is indeed the increase in the educational attainment over the period. The fall in the skill premium is intuitively the first outcome of a classic supply and demand effect. In par-

ticular, in high relative supply countries, i.e. countries with higher supply of skilled workers, it could be that the demand was not able to compensate for the increase in labour supply of skilled workers. To check for this I have looked at the potential sources of wage inequality, including supply and demand factors as well as institutional indicators. I address possible concerns of endogeneity of relative supply by an instrumental variable strategy. The estimates reveal important effect of the increased relative supply of the declining college wage premium. Additionally, institutional constraints such as Employment Protection Legislation, minimum wage and union density are relevant in explaining inequality. Finally, there is some empirical evidence on the role of education in reducing income inequality is not univocal. The main policy implication of these findings is that increasing accessibility to tertiary education in Europe, not only can lower the disparities among different education groups but it can, as well, lower the premia, possibly by the implied changes in ability composition across education groups.

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Appendix

A1: Data Appendix

Supply Index: This index is created from OECD data. It is a measure of relative supply and it is calculated for each gender in country, yearly, as the ratio of college graduates to non-college graduates (ISCED 5/ISCED 3). skilled workers.

Demand Index: This index is created from EU-KLEMS data. It is a measure of relative demand and it is calculated for each country, yearly, considering hours worked by high-skilled persons engaged (share in total hours) by industries relative to hours worked by middle skilled workers.

R&D intensity: Data ar drawn from the OECD-STAN database which provides information on imports, R&D and value added in the manufacturing sector from 1973-2009. Using these data I manage to build a proxy for technology using data on total manufacturing for R&D and value added for all countries.

Minimum Wage: This is the ratio of the statutory minimum wage to the median wage in each country. It is provided by the OECD. Germany, Denmark, Finlad and Italy have no statutory minimum wage.

Employment Protection Legislation (EPS): The employment protection legislation consist on a set of norms and procedures followed in case of dismissal of redundant workers. Act as deterrent: it protects workers with permanent contracts from the risk of early termination of their employment contract Decisions involve also third parties, the legitimacy of a layoff ultimately depends on court ruling. EPS is a strongly redistributive institution. It protects those who already have a job, notably a permanent contract in the formal sector. Unemployed individuals and workers with temporary contracts suffer in the presence of strict EPS for permanent contracts. The former experience longer unemployment spells, while the latter are caught in a secondary labor market of temporary contracts. The OECD indicators of employment protection are synthetic indicators of the strictness of regulation on dismissals and the use of temporary contracts. These indicators are compiled from 21 items covering three different aspects of employment protection: Individual dismissal of workers with regular contracts, additional costs for collective dismissals and regulation of temporary contracts. Range {0, 6} increasing with strictness of employment protection.

Net Union Density: Union density expresses union membership as a proportion of the eligible workforce. Normally, union density rates are standardized by the calculation of union membership as a proportion of the wage and salary earners in the same year (preferably on the basis of some annual average year data). The data are updated from the ILO website.

Public Sector employment: Data are collected from the laborsta.ilo.org website (ILO). These are data covering all employment of general governmental sector plus employment of publicly owned enterprises and companies. It covers all persons employed directly by those institutions. Based on this data, I compute an index of "public sector employment" by calculating the percentage of public employees over total working population, yearly, by country.

To address any further concern regarding the presence of endogeneity, I then implement an IV strategy. The potentially endogenous relative supply variable is instrumented using the "tertiary education institutional set-up" variables. Data are taken from Braga, Checchi, and Meschi (2011) and contains information about student financing and univesity autonomy and selectivity. For details about the construction of the indicators and the sources of the information they use see the paper available at: http://ftp.iza.org/dp6190.pdf

A2: Additional tables and figures

Table A1: Descriptives by cohorts

	MALES				FEMALES			
	High relative supply		Low relative supply		High relative supply		Low relative supply	
	ECHP	EUSILC	ECHP	EUSILC	ECHP	EUSILC	ECHP	EUSILC
Age<=28								
College	27.18%	23.27%	5.80%	14.36%	40.52%	40.66%	12.49%	30.37%
Secondary	40.76%	49.16%	40.60%	47.92%	40.84%	44.55%	47.89%	47.34%
Low	32.06%	27.56%	53.60%	37.72%	18.63%	14.79%	39.62%	22.29%
Years of edu.	12.12	12.76	11.02	11.99	12.79	13.85	11.83	13.04
Log wage	9.02	9.48	8.78	9.19	8.86	9.33	8.62	9.08
Age 29-34								
College	39.07%	43.88%	20.42%	29.00%	53.24%	58.47%	27.33%	42.62%
Secondary	35.12%	39.34%	39.95%	44.00%	31.57%	32.65%	42.58%	39.65%
Low	25.81%	16.78%	39.63%	26.99%	15.20%	8.88%	30.09%	17.73%
Years of edu.	13.09	14.71	12.90	13.48	13.86	15.67	13.51	14.31
Log wage	9.59	9.98	9.26	9.65	9.32	9.68	8.95	9.39
Age 35-49								
College	37.64%	39.99%	21.12%	28.36%	46.56%	49.58%	26.79%	36.41%
Secondary	33.49%	40.99%	39.42%	42.15%	33.64%	37.82%	40.22%	42.36%
Low	28.87%	19.02%	39.46%	29.49%	19.80%	12.60%	32.99%	21.23%
Years of edu.	12.94	14.37	12.65	13.30	13.53	15.08	12.86	13.68
Log wage	9.75	10.12	9.38	9.85	9.42	9.75	9.05	9.46
Age 40-45								
College	37.60%	34.12%	21.23%	27.48%	43.40%	42.11%	27.58%	34.43%
Secondary	32.51%	42.32%	38.94%	41.41%	31.12%	40.68%	36.52%	41.87%
Low	29.89%	23.56%	39.83%	31.12%	25.48%	17.20%	35.90%	23.70%
Years of edu.	12.84	13.71	12.35	13.11	13.04	14.32	12.32	13.27
Log wage	9.84	10.15	9.45	9.94	9.47	9.83	9.13	9.55
Age 45								
College	37.51%	31.65%	22.79%	24.80%	39.36%	37.91%	29.11%	30.88%
Secondary	29.37%	41.13%	35.66%	43.64%	29.91%	39.42%	32.57%	43.25%
Low	33.12%	27.22%	41.55%	31.56%	30.73%	22.67%	38.32%	25.86%
Years of edu.	12.74	13.43	9.51	9.98	12.57	13.76	12.28	12.91
Log wage	9.91	10.21	47.95	48.05	9.52	9.88	9.22	9.62

Table A2:Institutions by country

Country	Gini coefficient	Unemp. Rate (%)	Emp. Rate(%)	Relative supply	Relative demand	R&D Intensity	Emp. protection	Union density	Minimum wage	Wage compression	Pb.Emp(%)
Austria	0.25	4.16	69.14	0.08	0.19	5.63	2.09	34.52	0.00	3.16	13.12
Belgium	0.28	8.40	59.32	0.13	0.28	6.53	2.36	51.51	0.53	2.30	23.17
Germany	0.28	9.25	65.95	0.13	0.14	7.24	2.37	23.06	0.00	3.02	11.87
Denmark	0.22	5.34	74.95	0.20	0.12	7.60	1.55	72.35	0.00	2.48	33.66
Spain	0.29	15.60	56.67	0.21	0.68	2.30	2.98	15.74	0.43	3.34	15.96
Finland	0.25	10.68	66.56	0.15	0.77	8.43	2.05	73.63	0.00	2.31	27.49
France	0.28	10.10	62.27	0.20	0.22	9.27	3.02	7.94	0.57	2.90	24.23
Greece	0.32	9.63	58.01	0.15	0.53	0.89	3.16	25.75	0.48	3.24	21.83
Ireland	0.35	7.03	62.91	0.17	0.23	2.90	2.43	34.46	0.34	3.62	16.21
Italy	0.31	9.79	54.95	0.12	0.12	2.37	1.01	36.39	0.00	2.83	16.83
Portugal	0.36	6.53	67.13	0.09	0.77	0.95	3.56	21.61	0.51	4.98	12.89
United Kingdom	0.35	5.96	70.65	0.18	0.24	6.26	0.69	29.21	0.30	3.36	19.91

Table A3: Institutions by region

	Low relative supply		High relative supply	
	ECHP	EUSILC	ECHP	EUSILC
Gini coefficient	0.31	0.31	0.29	0.29
Unemployment rate (%)	8.29%	7.36%	11.68%	7.92%
Employment rate (%)	62.27%	64.41%	62.13%	67.48%
Relative supply	0.09	0.13	0.16	0.20
Relative demand	0.33	0.37	0.34	0.38
R&D intensity	2.47	3.92	5.24	7.03
Employnent protection	2.41	1.86	2.45	2.23
Union density	31.06	27.86	35.77	39.21
Miinimum wage	0.21	0.10	0.31	0.34
Wage compression	3.60	3.18	2.93	2.93
Public employment	15.74%	14.87%	23.80%	22.78%
Permanet contract	78.44%	88.63%	75.56%	87.82%

Figure A1: Returns to secondary school, Quantile regressions