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Abstract:

Human Capital theory considers education as an investment. Thus, those individuals which invest in education, will have a higher productivity that somehow will imply higher job incomes. For the Spanish case, from the early 90s to the end of the twentieth century, there exist several works which analyse the returns to high education. However, during the last decade, there are practically any works on the subject, a fact that encouraged us to initiate the present work. Thereby, the objective of this article is to evaluate the returns to high education in Spain. For this purpose we make use of the Continuous Sample of Working Lives which contains information of the working life of more than 1.2 million people resident in Spain for a given year. The sample provides a large quantity of information related to the individual characteristics of the worker, to the job-contract and the nature of the job, and to the employer's characteristics. The use of this sample implies an advantage against previous work on the subject, given the large sample size and the information availability. The estimation of the returns to high education is done on the basis of the model proposed by Mincer (1979), and we apply to different estimation methods: Ordinary Least Squares and quantile regression methods. The analysis is carried out not only for the

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whole sample of workers, but also we distinguish by sex, firm size and by economic activity. Our results suggest that the wage of workers with high education is approximately a 53% higher than the wage of the rest of workers.

Key words: human capital, high education, wages, education returns, quantile regression, Continuous Sample of Working Lives.

Resumen:

La Teoría del capital humano considera la educación como un bien de inversión. De este modo, aquellos individuos que invierten en educación, verán incrementada su productividad, lo que se traducirá en un futuro aumento de sus rentas procedentes del trabajo. Para el caso de España, desde la década de los 90 y hasta finales del siglo XX existen diversos trabajos que analizan la tasa de rendimiento asociada a distintos niveles de educación. El objetivo de este artículo es evaluar la tasa de rendimiento asociada a la educación superior en España. Para ello, empleamos la Muestra Continua de Vidas Laborales que contiene la vida laboral correspondiente a más de 1,2 millones de personas residentes en España El uso de dicha muestra supone una ventaja frente a los estudios empíricos previos, dado el tamaño de la muestra y la gran cantidad de información disponible. La estimación de la tasa de rendimiento se realiza a partir del modelo propuesto por Mincer (1979) utilizando Mínimos Cuadrados Ordinarios y Regresión cuantílica. El análisis se realiza no solo para el total de trabajadores/as, sino que además se distingue por género, tamaño de empresa y sector de actividad. Los resultados obtenidos muestran que el salario percibido por los trabajadores/as con educación superior es de aproximadamente un 60% superior que el del resto de trabajadores/as.

Palabras Clave: capital humano, educación superior, salarios, tasa de rendimiento, regresión cuantílica, Muestra Continua de Vidas Laborales.

Introduction

Human capital plays a crucial role in economic growth and development. The economic models which analyze the relationship between human capital and economic growth suggest that knowledge and skills acquired by workers increase their productivity and their capacity to develop new technologies which, along with other factors, promote economic growth (Romer, 1989; Aghion, P and Howitt, P.1998; Lucas,1988).

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From a theoretical point of view, human capital is related to workers skills, abilities, attitudes and knowledge, which improve their contribution to the economic production process. The contribution of human capital to an economy, and in general to a society, is a multidimensional phenomenon which affects both the development of individuals and the development of the society as a whole. In this paper we analyse the effect of human capital on individuals, and more specifically on the returns to education. In this context, human capital is an intangible and nontransferable individual active, and given its qualitative nature, it must be measured using variables which incorporate one or several features of the human capital definition. One of the most used variables to proxy for an individual's human capital is the educational level, since it is assumed that during the educational process, the individuals develop their skills, abilities, etc, and acquire the knowledge which allows them to increase their contribution to the production process. On the basis of this definition, the theory of human capital was developed in the works, among others, of Becker (1962, 1964), Mincer (1958, 1974) and Schultz (1960,1963). In the theory of human capital, education is considered as an investment, and thus, those individuals which invest on human capital via education, will benefit from increased productivity and higher wages.

In this context, the present paper evaluates the economic returns to college education[1] or the skill premium in Spain, defined as the difference between the wage of a worker with college education and a worker with a level of education below college. This topic has been a matter of increased concern both, in the economic literature and in the political agenda, in a context where the number of people attending college education is largely increasing. Nevertheless, it remains a complex phenomenon since, eventhough a higher level of education is considered from a political point of view as a key issue to facilitate employability and employment prospects, there exist widespread skill mismatches among workers with college education in the Spanish labor market (Felgueroso, Hidalgo and Jiménez-Martín, 2010). Against this background, this paper presents several important features. First, the dataset use for our empirical analysis comes from the Continuous Sample of Working Lives (*Muestra Continua de Vidas Laborales*, hereinafter MCVL) which provides several pieces of information suited for our research, related to the workers' individual characteristics, to the job-contract and the nature of the job, and to the employers' characteristics for over 1.2 millions of

(1) Along the paper, we consider workers with high education, as those with college education or above. Thus hereinafter we refer to workers with a high level of education as workers with college education.

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workers. Thus, it offers solid guaranties for the representativeness of the results. Specifically we use the MCVL 2009 wave. While the dataset is also available for 2013, the selection of the 2009 wave is determined by two main reasons: on the one hand, although the effects of the international financial crisis beginning in 2008 on the Spanish labor market, mainly on unemployment, were already visible on 2009, their magnitude were not as high as on the years afterwards. On the other hand, the individual decision to invest on college education implies a cost-benefit analysis, where the benefit is the future expected economic returns. In this sense, the persistence of the economic crisis and the increase in the unemployment rate largely decreased the opportunity cost of attending college education and the expected economic returns to college education. Thus, once more, 2009 may be a more plausible year to analyse the economic returns to college education. Second, from an econometric point of view, we estimate the rate of return to college education from the specification of a traditional mincerian wage equation, which is estimated not only by Ordinary Least Squares (OLS), but also by quantile regression methods. This last methodology, allows us to obtain detailed information on the change of the rate of return to college education along different points of the wage distribution. Third, we also estimate the rate of return by gender, by firm size and by economic activity sector.

The rest of the paper is organized as follows. The second section presents a brief literature review of previous empirical works for the Spanish case. The third section presents a description of the database and a description of the sample. The fourth section shows the econometric results. The fifth section concludes.

Empirical literature review

The empirical works which estimate the rate of return to human capital for Spain are relatively recent, as compared to the existing international empirical literature, mainly due to the lack of appropriate databases for the analysis. The first empirical works for the Spanish case appear in the middle 80s, and the number of works has largely increased as new appropriate databases were available.

Table I shows the main characteristics of those empirical works which estimate the rate of return to human capital for Spain since the midd 90s. In each case we present the sample period, the group of workers under study, the database used in the analysis, and those variables included in the estimated model, where the variable in bold is the one used to

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estimate the rate of return to human capital. Also we present the estimated rates of return. As it can be appreciated there are two variables used to estimate the rates of return to human capital. The first variable is the number of years of education. In this case the rate of return must be interpreted as the wage increase, expressed as a decimal, associated to an additional year of education. For example, the estimated rate of return by Alba and San Segundo (1995) for the whole sample of workers (0.083) suggests that and additional year of education implies a wage increase of 8.3%. The second variable is a dummy variable which takes value one if the worker attended to college and zero otherwise. In this case the rate of return must be interpreted as the wage differential, expressed as a decimal, between a worker with college education and a reference worker with a certain level of education different from college. Usually, the reference workers are those with no education. For illustrative purposes, the rate of return estimated by Pijoan and Sánchez (2010), implies that the wage of a worker with college education is a 157% and a 147% higher than the wage of a worker without education for the period 1985-96 and for the year 2000 respectively.

Although the estimated rates of return in the different works are not fully comparable, as a consequence of methodological differences and the different databases used, it is possible to obtain some interesting common results. First, and as it can be appreciated, the estimated rates of return to college education suggest that the expected wage of a worker with college education may be twice the expected wage of a worker without education, after controlling for other factors that may explain wage differentials. Moreover, an additional year of education implies a wage increase between a 6% and 8%. Second, the rate of return to college education varies by gender. Specifically, the rate of return is higher for females than for males (Alba and San Segundo, 1995; Lassibille, 1998; Marcerano and Navarro, 2005). Third, there are also differences in the rate of return to college education among workers from the public and the private sector. Nevertheless, the only two works which analyse this differences obtain mixed results (Alba and San Segundo, 1995; Lassibille, 1998). Lastly, among the group of works which analyse the evolution of the rate of return along different time periods, the obtained results suggests that the rate of return to human capital have decreased mainly due to the large increase in the number of workers with high levels of education during the last decades (San Segundo , 1997; Abadie, 1997; Hidalgo, 2010; Pijoan and Sánchez, 2010).

TABLE I. Previous empirical literature on the rate of return to human capital.

Author	Sample	Database	Workers	Variables	Rate of return (college education)		
					Total	Males	Females
Alba and San Segundo (1995)	1990	EPA (2° TR)	Age 19-64	Elementary education Hight-school **College education** Age Age squared Worked hours	1.053 (total) 0,941 (employee) 1,410 (self-empl.) 0,732 (private s.) 0,811 (public s.)	1,002 (total) 0,854 (employee) 0,638(private s.) 0,739 (public s.)	1,118 (total) 0,103 (employee) 0,857 (private s.) 1,065 (public s.)
				Years of education Age Age squared Worked hours	0,083 (total) 0,081 (employee) 0,088 (self-empl.) 0,069 (private s.)) 0,066 (public s.)	0,077 (total) 0,073 (employee) 0,064 (private s.) 0,061 (public s.)	0,097(total) 0,098 (employee) 0,080 (private s.) 0,075 (public s.)
San Segundo (1997)	1981 1985 1986 1987 1989 1991 1994 1995	ECPF EPF	Males employee Age 16-64	Elementary education Middle high-school Hight-school **College education** Age Age squared Part-time job		1,111 (1981) 1,139 (1985) 1,100 (1986) 1,038 (1987) 1,038 (1989) 1,147 (1991) 1,004 (1994) 1,001 (1995)	
Abadie (1997)	1980-81 1990-91	EPF	Males employee Age 18-65	Elementary education Hight-school **College education** Age Age squared		0,8757 (1980) 0,7993 (1990)	
Lassibille (1998)	1990-91	EPF	Full-time workers Age 16-65	**Years of education** Age Age squared Urban zone Family conditions		0,093 (private s.) 0,046 (public s.)	0,118 (private s.) 0,070 (public s.)
Marcerano and Navarro (2005)	1994	PHOGUE	Age 16-64	Elementary education Middle high-school Hight-school **College education** Age Age squared	1,172	1,012	1,141 1,156 (< 40 years) 1,032 (> 40 years)
Hidalgo (2010)	1980-81 1990-91 2000-01	ECPF EPF	Self-employed Full-time Age 20-65	**Years of education** Age Age squared Family conditions Economic sector Gender	0,074 (1980-81) 0,064 (1990-91) 0,058 (2000-01)		
Pijoan and Sánchez (2010)	1985-00	ECPF EPF PHOGUE	Age 25-60	College Education	1,57 (1985-96) 1,47 (2000)		
Ferguson et al (2010)	2008	MCVL	Employee males, Age 25-55	Age Potential experience Contribution group	(ver referencia)		
Hanushek et al (2014)	2012	PIAAC	Age 16-65	Work experience Gender **Years of Education** **Education skills**	0.079 0.137 (calculus) 0.105 (reading)		

Source: own elaboration

Notes: ECPF = Continuous Survey of Households Budgets. EPA = Active Population Survey. EPF = Basic Survey of Housholds Budgets. MCVL = Continuous Sample of Workig Lives. PHOGUE = European Union Households Panel. PIAAC = Programme for the International Assessment of Adult Competencies.

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Database and sample description

The Continuous Sample of working lives and simple selection

The Continuous Sample of Working Lives (MCVL), provided by the Spanish Ministry of Labor and Social Security, is a micro-level dataset built upon Spanish administrative records. By means of a simple random sampling system, it consists of a representative sample (4% - 1.2 million individuals) of the population registered with the Social Security administration over the sampling year (2009 in our case). The sample includes workers, but also pension earners, and recipients of unemployment benefits.

The identification process of those workers with college education was carried in two steps. First, and attending to the available information from the census data in the sample for the level of education, we selected all individuals with college education or a higher level of education. However, the information on education from the census data may be outdated in some cases, so that a particular worker with college education may appear with a lower level of education. Thus, in a second step, and attending to the available information from the contribution group of each worker, we selected all those individuals from group 1 (Engineers, Graduates and Senior Management), independently from their educational level in the census to correct the downward bias in the educational attainment level.

The variables used in the estimation process of the rate of return to college education are the following:

- Individual characteristics: gender, age, Autonomous Community (NUTS 2 region) and country of birth.
- Job and firm characteristics: type of work contract, job length, firm size and age, economic sector, public or private sector.
- Wage[2]: gross annual wage.

In order to obtain an homogeneous sample, we selected only employed individuals with a full-time contract, aged between 16-64 years

(2) We have considered only, monetary perceptions of employees. The MCVL database provides wage data for the Common Tax System Territory, and thus, there is no available data on wages for workers residing in the Autonomous Community of Navarra and Vasque Country.

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and enrolled in the general regime of the social security administration[3]. Since wage data comes from the fiscal dataset[4] attached to the MCVL, we discarded self-employed workers due to the lack of information on income. Also, we only included in the sample those workers that were able to maintain a unique job along 2009 and that earned an annual labor income above the national minimum wage in Spain (8,376 €). Moreover, we discarded workers from the agricultural sector and workers residing in the autonomous cities of Ceuta and Melilla, due to their low representativeness in the sample.

After applying the above filters, and deleting records with missing data, our final sample consists of a total of 248,427 workers, of which 34,407 are workers with college education (13.8%) while the rest of workers have a level of education below college. This percentage is similar to the ones observed in the Spanish Active Population Survey (EPA) from the National Institute of Statistics, where for 2009, a 14.8% of employed workers had a college education or above.

Sample description

Table II and III present the individual and job characteristics of the workers in the whole sample respectively. We also present these characteristics dividing the sample in two groups: workers with college education and workers with a level of education below college.

As it can be appreciated, females represent a 38% of the total sample. In the sample of workers with college education, females represent a 45% and a 36.9% in the sample of workers with a level of education below college. Attending to the sample distribution by age, a high percentage of workers with college education (45.7%) are between 30 and 39 years old. Also, the percentage of workers with college education increases with age, reaching a maximum value for the group of workers between 35 and 39 years old, after which the percentage of workers with college education decreases and remains stable in the groups of workers between 55 and 59 years old and 60 to 64 years old.

(3) More then 80% of workers in Spain are enrolled in the general regime.
(4) The fiscal dataset reports the total annual taxable labor income per worker.

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TABLE II. Individual characteristics of workers in the sample, (2009)

Distribution by:	Workers with collegue education			Workers with below college			Total	
	nº (1)	% (2)	% (3)	nº (1)	% (2)	% (3)	nº (1)	% (2)
Gender								
Males	18.928	55,0	12,3	135.136	63,1	87,7	154.064	62,0
Female	15.479	45,0	16,4	78.884	36,9	83,6	94.363	38,0
Total	34.407	100,0	13,8	214.020	100,0	86,2	248.427	100,0
Age								
16-24	147	0,4	1,6	9.729	4,5	98,4	9.876	4,0
25-29	3.720	10,8	12,7	25.477	11,9	87,3	29.197	11,8
30-34	7.825	22,7	17,8	36.187	16,9	82,2	44.012	17,7
35-39	7.911	23,0	18,5	34.844	16,3	81,5	42.755	17,2
40-44	5.555	16,1	14,8	31.949	14,9	85,2	37.504	15,1
45-49	4.026	11,7	12,3	28.690	13,4	87,7	32.716	13,2
50-54	2.871	8,3	10,8	23.826	11,1	89,2	26.697	10,7
55-59	1.636	4,8	9,0	16.588	7,8	91,0	18.224	7,3
60-64	716	2,1	9,6	6.730	3,1	90,4	7.446	3,0
Total	34.407	100,0	13,8	214.020	100,0	86,2	248.427	100,0
Foreign nationality (4)	855	2,5	7,1	11.230	5,2	92,9	12.085	4,9

Notes: (1) number of observations (2) percentage over total distribution by column, (3) percentage over total distribution by row, (4) foreign nationality excluding those individuals from the European Union, United States and Canada.
Source: own elaboration on the basis of the MCVL 2009.

Attending to the data on job length, there are not significant differences in the distribution of workers between those with college education and those with a level of education below college (see Table III). However there exists a positive relationship between the firm size and the share of workers with college education. Thus, the percentage of workers with college education is larger in large firms. In very small firms (micro-firms), the percentage of workers with college education is only of 8.8%, while in large firms the share of workers with college education is 20.2%.

TABLE III. Job and firm characteristics, (2009).

Distribution by:	Workers with collegue education			Workers with education below college			Total	
	nº (1)	% (2)	% (3)	nº (1)	% (2)	% (3)	nº (1)	% (2)
Type of contract								
Permanent or open-ended	29.369	85,4	13,3	191.553	89,5	86,7	220.922	88,9
Temporary	5.038	14,6	18,3	22.467	10,5	81,7	27.505	11,1
Total	34.407	100,0	13,8	214.020	100,0	86,2	248.427	100,0
Job lenght								
Between1 y 5 years	22.327	64,9	15,1	125.202	58,5	84,9	147.529	59,4
Between 6 y 10 years	7.670	22,3	12,1	55.942	26,1	87,9	63.612	25,6
More than 10 years	4.410	12,8	11,8	32.876	15,4	88,2	37.286	15,0
Total	34.407	100,0	13,8	214.020	100,0	86,2	248.427	100,0
Firm size (4)								
Micro-firm	5.223	15,3	8,8	54.065	25,5	91,2	59.288	24,1
Small firm	6.854	20,1	10,6	57.666	27,2	89,4	64.520	26,3
Medium firm	8.744	25,6	15,6	47.311	22,4	84,4	56.055	22,8
Large firm	13.306	39,0	20,2	52.603	24,9	79,8	65.909	26,8
Total	34.127	100,0	13,9	211.645	100,0	86,1	245.772	100,0
Firm age								
Below 6 years	5.745	16,7	13,7	36.156	16,9	86,3	41.901	16,9
Between 6 and 10 years	7.028	20,4	14,3	42.070	19,7	85,7	49.098	19,8
Between 11 and 20 years	8.992	26,1	12,7	61.763	28,9	87,3	70.755	28,5
Between 21 and 30 years	4.620	13,4	12,5	32.337	15,1	87,5	36.957	14,9
Between 31 and 40 years	2.243	6,5	12,3	15.938	7,4	87,7	18.181	7,3
More than 40 years	5.773	16,8	18,3	25.707	12,0	81,7	31.480	12,7
Total	34.401	100,0	13,9	213.971	100,0	86,1	248.372	100,0
Economic sector								
Industry and manufacturing	4.371	12,7	8,5	47.217	22,1	91,5	51.588	20,8
Construction	1.573	4,6	6,9	21.307	10,0	93,1	22.880	9,2
Trade	3.853	11,2	7,9	45.191	21,1	92,1	49.044	19,7
Transport	1.221	3,5	8,3	13.541	6,3	91,7	14.762	5,9
Hotels and restaurants	460	1,3	3,9	11.393	5,3	96,1	11.853	4,8
Information and communic.	3.650	10,6	30,3	8.412	3,9	69,7	12.062	4,9
Financial and business act.	10.076	29,3	23,9	32.049	15,0	76,1	42.125	17,0
Public administration	2.090	6,1	17,1	10.128	4,7	82,9	12.218	4,9
Education	3.195	9,3	37,3	5.365	2,5	62,7	8.560	3,4
Health service	3.177	9,2	19,0	13.523	6,3	81,0	16.700	6,7
Other services	741	2,2	11,2	5.894	2,8	88,8	6.635	2,7
Total	34.407	100,0	13,8	214.020	100,0	86,2	248.427	100,0

Notes: (1) number of observations (2) percentage over total distribution by column, (3) percentage over total distribution by row, , (4) micro-firm= 1-10 workers, small firm = 11-50 workers, Medium firm = 51-250 workers, Large firm = more than 100 workers.
Source: own elaboration on the basis of the MCVL 2009.

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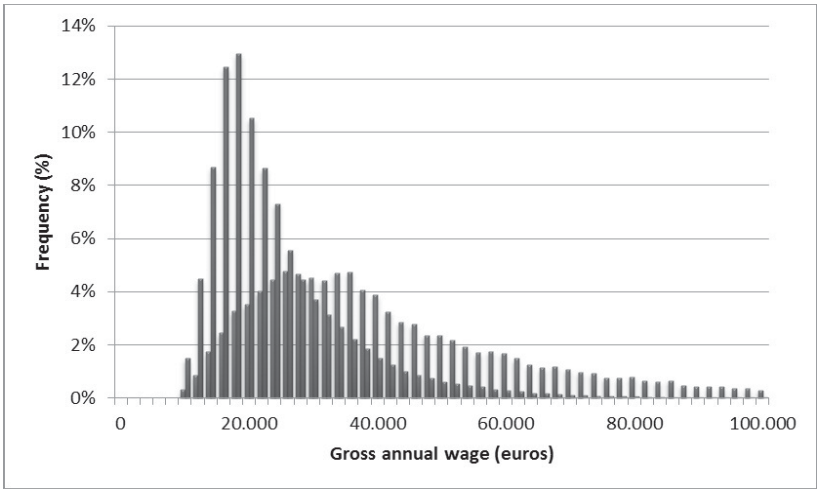
Figure I plots the gross annual wage distribution for the workers of the sample. The wage distribution for workers with college education is presented in blue while the wage distribution for workers with an educational level below college is presented in red. As it can be observed from the figure, the wage distribution of workers with a level of education is skewed right while the wage distribution of workers with college education is wider and more spread out. As expected, the distribution of workers with college education presents a larger dispersion and higher median values. Specifically, the median of the wage for workers with college education and for workers with a level of education below college is 36,744 euros and 19,811 euros respectively. Thus, the annual wage of a worker with college education is a 54.1% higher than the annual wage of a worker with a lower level of education

Also, the interquartile range, defined as the difference between the upper and lower quartiles, is 29,111 euros and 11,585 euros for the sample of workers with college education and for the sample of workers with education below college respectively, indicating the large differences in the dispersion of the wage distribution between both groups of workers.

FIGURE I. Gross annual wage distribution by level of education, 2009.



Notes: blue = workers with college education, red = workers with education below college.
Source: own elaboration on the basis of the MCVL 2009.

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Econometrics results

In this section, and on the basis of human capital theory, we estimate the rate of return to college education in Spain, in order to study how the Spanish labor market values a high level of education.

Our first specification to estimate the rate of return to college education is the following wage equation, based on the traditional model proposed by Mincer (1979):

$$LnW_i = \beta_0 + \beta_1 CE_i + \beta_2 Age_i + \beta_3 Age_i^2 + u_i \quad (1)$$

where W_i is the gross anual wage of worker "*i*", CE_i is a dummy variable that takes value 1 if worker "*i*" has college education and zero otherwise, and u_i is the error term which is normally distributed as $N(0,s_u^2)$. The variables Age_i and Age^2_i are measured in years, and are included in order to proxy for the effect of labor experience on wages, and to control for a possible convexity effect. Our coefficient of interest β_1 measures the relative difference, expressed as decimals, between the expected wage of a worker with college education and the expected wage of a worker with a level of education below college. That is, if the expected annual wage for a worker with a level of education below college is W^{BC}, the expected annual wage for a worker with college education and with similar characteristics would be:

$$W^{CA} = \exp\{\ln W^{CMB} + \beta_1\} = W^{CMB} \exp\{\beta_1\} \quad (2)$$

Since we can state that $\exp\{\beta_1\} \approx 1+\beta_1$ for values of β_1 near zero, the relative difference in expected wage between workers with different levels of education can be calculated as follows:

$$\frac{W^{CE} - W^{BC}}{W^{BC}} \times 100 \approx \frac{W^{BC}(1+\beta_1) - W^{BC}}{W^{BC}} \times 100 = \beta_1 \times 100 \quad (3)$$

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The rate of return to college education

The estimation results by OLS of equation (1) are shown in Table IV, where besides the variables previously mentioned, we include other explanatory variables that may be relevant to explain wage differences. The inclusion of these variables tries to avoid the presence of estimation bias as a consequence of omitted relevant variables. The included variables are gender, age, job length, nationality, economic sector, firm size, type of contract (permanent or temporary), public or private sector, and the Autonomous Community where the worker lives.

All estimated coefficients are statistically significant at the 5% level and have the expected sign. The level of education and the labor experience, proxied by age, have both a positive effect on wages and there is convexity in the labor experience and wage relationship, given the negative and significant parameter on the age squared variable.

Table V shows the estimation results of equation (1) using quantile regression methods, for the 50^{th} quantile. This methodology presents at least two advantages over the OLS estimation method. First, it allows us to estimate the rate of return to college education at different points of the wage distribution and not only at the mean, and to study whether there exists significant differences in the rate of return to college education at the extreme points of the wage distribution. Second, the quantile regression allows us to obtain more robust results. On the one hand the estimation results are not affected by atypical values. On the other hand, it is a solution to the possible presence of heteroscedasticity in the wage equation, due to the fact that wage dispersion may be higher for higher levels of education and labor experience, in which case the estimation by OLS may present problems of inconsistence.

The estimation results reveal several interesting issues. First, the results on Table IV show a high goodness-of-fit for the estimated models. The coefficient of determination (R^2) suggests that the model accounts for a relatively high proportion of the variability in wages. Specifically, the model explains a 43% and a 39% of the wage variability in the male and female specification respectively. Second, the estimated rate of return to college education is lower when the equation is estimated by quantile regression methods. In fact, the estimation results by OLS for the rate of return to college education indicates that the expected wage of a worker with college education is a 53% higher than the expected wage of a worker with a level of education below college. For males and females,

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the estimated rate of return is 58% and 45% respectively. The estimation results by quantile regression methods for the 50th quantile indicate that the rate of return to college education for the whole sample of workers is 51%. For males and females, the estimated rate of return is 56% and 46% respectively[5].

TABLE IV. Wage equation estimation results, OLS.

Variable	All workers		Males		Females	
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
Constant	8,7581	0,0113	8,8125	0,0142	8,9049	0,0177
College education	0,5266	0,0030	0,5776	0,0042	0,4550	0,0040
Male	0,1869	0,0017				
Age	0,0301	0,0006	0,0330	0,0007	0,0285	0,0009
Age squared	-0,0003	0,0000	-0,0003	0,0000	-0,0003	0,0000
Firm age	0,0743	0,0010	0,0628	0,0013	0,0925	0,0015
Foreign nationality	-0,1867	0,0030	-0,1962	0,0038	-0,1615	0,0047
Permanent contract	0,0554	0,0025	0,0734	0,0032	0,0267	0,0039
Public sector	0,0689	0,0037	0,0267	0,0057	0,1233	0,0049
Firm size	0,0647	0,0004	0,0739	0,0006	0,0511	0,0006
Economic activity						
Construction	0,0391	0,0028	0,0365	0,0031	0,1197	0,0079
Trade	-0,0719	0,0024	-0,0504	0,0030	-0,0875	0,0043
Transport	-0,0227	0,0034	-0,0367	0,0038	0,0477	0,0081
Hotels and restaurants	-0,1199	0,0031	-0,1606	0,0043	-0,0687	0,0048
Information and communication	0,0925	0,0043	0,0814	0,0054	0,1161	0,0071
Financial and business act.	0,0574	0,0028	0,0549	0,0037	0,0684	0,0046
Public administration	-0,0719	0,0038	-0,1330	0,0052	0,0043	0,0059
Education	-0,0350	0,0046	-0,1684	0,0073	0,0584	0,0062
Health service	-0,0581	0,0037	-0,0858	0,0067	-0,0278	0,0050
Other services	-0,1395	0,0046	-0,1152	0,0068	-0,1614	0,0066
N° of observations	248.427	-	154.064	-	94.363	-
F-statistics	5.152	-	3.266	-	1.962	-
(p-value)	0,0000	-	0,0000	-	0,0000	-
R^2	0,4248	-	0,4289	-	0,3943	-
Breusch-Pagan	15.887	-	11.494	-	4.500	-
(p-value)	0,0000	-	0,0000	-	0,0000	-

Notes: an asterik (*) indicates that the parameter is not statistically significant at the 5% level. s.t. = standard errors robust to heteroscedasticity. F-statistics = test statistic for the null hypothesis that all estimated parameters are equal to zero. Breusch-Pagan = test statistic for the null hypothesis of homoscedasticity, Breusch and Pagan (1979). All regressions include regional dummy variables to control for the Autonomous Community (NUTS2 region) of the workers residence.

(5) These results are consistent with the results obtained by previous empirical works for the Spanish case, eventhough they are not directly comparable. In our case, the estimated rate of return to college education indicates the difference between the expected wage of a worker with college education and the expected wage of a worker with a level of education below college. In the previous empirical works, the estimated rate of return to college education indicates the difference between the expected wage of a worker with college education and the expected wage of a worker with no education.

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TABLE V. Wage equation estimation results, quantile regression (50th quantile).

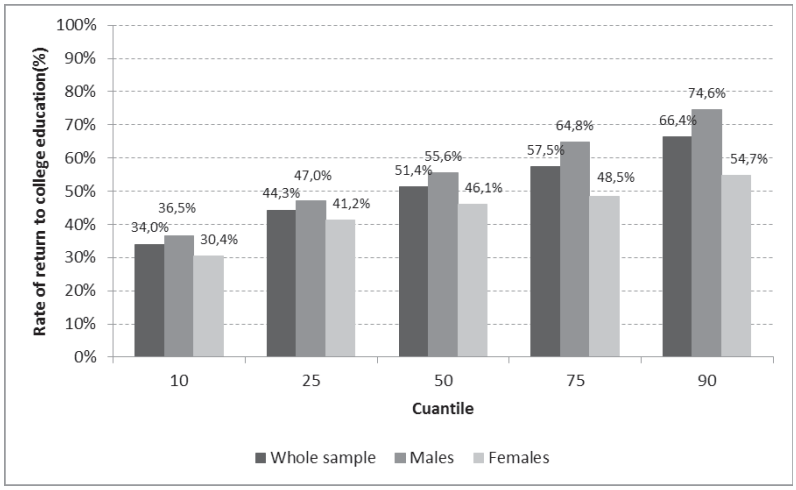
	All workers		Males		Females	
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
Constant	8,8728	0,0101	8,9555	0,0166	9,0198	0,0216
College education	0,5140	0,0035	0,5558	0,0048	0,4610	0,0051
Male	0,1703	0,0018				
Age	0,0242	0,0005	0,0254	0,0008	0,0222	0,0010
Age squared	-0,0002	0,0000	-0,0002	0,0000	-0,0003	0,0000
Firm age	0,0740	0,0009	0,0614	0,0013	0,0937	0,0015
Foreign nationality	-0,1469	0,0031	-0,1484	0,0047	-0,1292	0,0053
Permanent contract	0,0393	0,0024	0,0507	0,0038	0,0223	0,0050
Public sector	0,0651	0,0042	0,0158	0,0055	0,1300	0,0050
Firm size	0,0672	0,0005	0,0782	0,0006	0,0495	0,0006
Economic activity						
Construction	0,0275	0,0032	0,0244	0,0031	0,1199	0,0094
Trade	-0,0779	0,0023	-0,0574	0,0035	-0,0868	0,0044
Transport	-0,0062	0,0029	-0,0185	0,0035	0,0524	0,0069
Hotels and restaurants	-0,0945	0,0032	-0,1395	0,0042	-0,0386	0,0049
Information and communic.	0,1130	0,0048	0,1019	0,0067	0,1348	0,0086
Financial and business act.	0,0537	0,0032	0,0558	0,0043	0,0593	0,0046
Public administration	-0,0412	0,0040	-0,0984	0,0059	0,0416	0,0078
Education	-0,0118	0,0055	-0,1348	0,0087	0,0923	0,0071
Health service	-0,0586	0,0044	-0,0505	0,0071	-0,0363	0,0053
Other services	-0,1353	0,0053	-0,0654	0,0074	-0,1899	0,0072
N° of observations	124.214	-	77.032	-	47.182	-
R^2	0,2597	-	0,2662	-	0,2461	-

Notes: an asterik (*) indicates that the parameter is not statistically significant at the 5% level. s.t. = standard errors robust to heteroscedasticity, through bootstrap. F-statistics = test statistic for the null hypothesis that all estimated parameters are equal to zero. Breusch-Pagan = test statistic for the null hypothesis of homoscedasticity, Breusch and Pagan (1979). All regressions include regional dummy variables to control for the Autonomous Community (NUTS2 region) of the workers residence.

Figure II plots the estimated rates of return to college education at different points of the wage distribution. As it can be noted, there exists a positive relationship between the rate of return to college education and the wage level, since the rate of return increases for higher quantiles of the wage distribution. This positive relationship suggests a larger wage dispersion among workers with college education than for those with a lower level of education. The expected wage of a male worker with college education is a 36.5% higher than the expected wage of a male worker with an educational level below college in the lower tail (10th

quantile) of the distribution, and increases considerable to a 74.6% in the upper tail (90th quantile) of the distribution. For females, the relative difference in expected wages between females workers with college education and the rest of female workers is 30% in the lower tail of the distribution (10th quantile) and increases to 54.7% in the upper tail of the wage distribution (90th quantile). Also, the rate of return to college education shows some convexity along the wage distribution. For higher wage levels, the relative difference in expected wages for workers with similar characteristics but a different educational level incresases, but in a lower magnitude. Lastly, it can be appreciated that differences in the rate of return to college education by gender are larger for higher wage levels.

FIGURE II. The rate of return to college education (%) along the wage distribution.



For the rest of explanatory variables included in the wage regression, the firm age, having a permanent or open-endend contract, working in the public sector and the firm size show a positive relationship with wages. However, those workers with foreign nationality have a lower expected wage once we control for other worker and firm characteristics. The parameter on permanent contract suggests a wage difference of 0.05

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log points between a worker with a permanent contract and a worker with a temporary job. This difference is larger for males than for females workers. The parameter estimates on the public sector variable indicates a wage difference of 0.06 log points between a worker from the public sector and a worker from the private sector. This difference is far larger for females workers than for males workers. For females, the estimation results suggest a wage difference of 0.13 log points between a female worker from the public sector and a female worker from the private sector, a difference that is almost six times the observed difference for males. Attending to the firm size, an additional worker implies a wage difference of 0.06 log points for the whole sample of workers, and a difference of 0.07 and 0.05 log points for the males and females sample respectively.

The rate of return to college education by firm size and economic activity sector

In order to analyse the differences on the rate of return to college education by firm size, we specify the following equation:

$$\begin{aligned} LnW_i = {} & \beta_1 MIF_i + \beta_2 SF_i + \beta_3 MF_i + \beta_4 LF_i \\ & + \beta_5 CE_i \times MF_i \\ & + \beta_6 CE_i \times SF_i \\ & + \beta_7 CE_i \times MF_i \\ & + \beta_8 CE_i \times LF_i \\ & + \beta_9 Age_i + \beta_{10} Age^2{}_i + u_i \end{aligned} \qquad (4)$$

where again, CE_i is a dummy variable that takes value 1 if worker "*i*" has college education and zero otherwise, MIF_i, SF_i, MF_i and LF_i sare dummy variables that take value one if worker "*i*" is employed by a micro-firm (1-10 workers), a small firm (11-50 workers), a medium firm (51-250 workers) and a large firm (more than 250 workers) respectively, and zero otherwise.

Additionally, equation (5) allows us to estimate the rate of return to college education by economic activity sector:

$$\begin{aligned} LnW_i = {} & \beta_1 MA_i + \beta_2 CONS_i + \beta_3 MS_i + \beta_4 NMS_i \\ & + \beta_5 CE_i \times MA_i \\ & + \beta_6 CE_i \times CONS_i \\ & + \beta_7 CE_i \times MS_i \\ & + \beta_8 CE_i \times NMS_i \\ & + \beta_9 Age_i + \beta_{10} Age^2{}_i + u_i \end{aligned} \qquad (5)$$

where MA_i, $CONS_i$, MS_i and NMS_i are dummy variables that take value on if worker "*i*" works in the industry and manufacturing sector, in construction, in market services and in non-market services respectively and zero otherwise. In both equations, u_i is the error term which is normally distributed as $N(0,s_u^2)$.

In equation (4), the estimated parameters β_5, β_6, β_7 and β_8, indicate the relative difference, expressed as decimals, between the expected wage of a worker with college education and the expected wage of a worker with an educational level below college in the four different firm sizes considered respectively. Similarly, in equation (5) the estimated parameters β_5, β_6, β_7 and β_8, indicate the relative difference, expressed as decimals, between the expected wage of a worker with college education and the expected wage of a worker with an educational level below college in the four different economic activity sectors respectively. The estimation results of equation (4) and (5) are presented in Table VI and VII respectively.

Attending to the results in Table VI for the whole sample of workers, a positive relationship is observed between the rate of return to college education and the firm size. For micro-firms, the estimated rate of return to college education is 49%, a percentage that increases to 56% for large firms. This positive relationship is also observed for the sample of female workers. For micro-firms, the estimated rate of return to college education of female workers is 41%, and increases to 55% for large firms. However, for the sample of male workers the relationship between the rate of return to college education and firm size is not at all clear. For micro-firms, the rate of return is almost 59%. For small and medium firms the rate of return is 61%, while for large firms the rate of return is 57%. In general terms, the estimation results show evidence of a positive relationship between the expected wage of a worker with

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college education and the firm size[6]. This result corroborates the presence of the so called employer size-wage effect as detailed in Brown and Medoff (1989). Also, a similar result for the Spanish case can be found in the work of Bover *et al* (2001). These authors point out the presence of several factors behind the employer size-wage effect. Specifically the authors suggest that larger firms tend to employ a larger number of workers with college education, are more capital intensive, pay higher wages in order to reduce monitoring costs, etc.

TABLE VI. Wage equation estimation results by firm size, OLS.

Variable	All workers		Males		Females	
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
Micro-firm	8,7781	0,01132	8,8045	0,01406	8,7342	0,01732
Small firm	8,9321	0,01143	8,9545	0,01422	8,8831	0,01742
Medium firm	9,0579	0,01154	9,1072	0,01438	8,9763	0,01756
Large firm	9,1699	0,01156	9,2633	0,01441	9,0762	0,01758
CE×Micro-firm	0,4935	0,00815	0,5887	0,01208	0,4149	0,00975
CE×Small firm	0,5362	0,00666	0,6169	0,00924	0,4646	0,00874
CE×Medium firm	0,5409	0,00583	0,6154	0,00810	0,4843	0,00740
CE×Large firm	0,5634	0,00485	0,5681	0,00660	0,5502	0,00656
Age	0,0387	0,00060	0,0395	0,00073	0,0396	0,00091
Age squared	-0,0003	0,00001	-0,0003	0,00001	-0,0004	0,00001
N° of observations	245.772	-	152.399	-	93.373	-

Notes: an asterik (*) indicates that the parameter is not statistically significant at the 5% level. s.t. = standard errors robust to heteroscedasticity.

(6) From equatio (4), the expected wage of a worker with college education in a micro-firm, small firm, medium firm and large firm, can be calculated respectively as: $\exp\{\beta_1+\beta_5\}$, $\exp\{\beta_2+\beta_6\}$, $\exp\{\beta_3+\beta_7\}$, $\exp\{\beta_4+\beta_8\}$.

TABLE VII. Wage equation estimation results by economic activity sector, OLS.

Variable	All workers		Males		Females	
	coefficient	s.e.	coefficient	s.e.	coefficient	s.e.
Industry and manufacturing	8,8657	0,0120	8,8817	0,0150	8,7765	0,0188
Construction	8,8058	0,0119	8,7819	0,0149	8,8450	0,0198
Market services	8,7958	0,0118	8,8394	0,0149	8,7572	0,0182
Non-market services	8,7561	0,0121	8,7927	0,0154	8,7932	0,0185
CE×Industy and manufacturing	0,6705	0,0085	0,7205	0,0102	0,6108	0,0136
CE×Construction	0,6348	0,0152	0,7454	0,0178	0,3755	0,0246
CE×Market services	0,6130	0,0045	0,6867	0,0061	0,5188	0,0060
CE×Non-market services	0,5555	0,0050	0,5735	0,0080	0,5296	0,0064
Age	0,0467	0,0006	0,0477	0,0008	0,0466	0,0010
Age squared	-0,0004	0,0000	-0,0004	0,0000	-0,0005	0,0000
N° of observations	248.427	-	154.064	-	94.363	-

Notes: an asterik (*) indicates that the parameter is not statistically significant at the 5% level. s.t. = standard errors robust to heteroscedasticity.

The reported estimation results in Table VII, indicates that the expected wage of a worker with college education is higher in the industry and manufacturing sector, followed by the construction sector and the market services sector. However, for females workers with college education, the expected wage is notably higher in the market services sector than in construction. The rate of return to college education for male workers is higher in the construction sector, followed by the industry and manufacturing sector, the market services sector and the non-market services. For females workers with college education, the highest rate of return is found in the industry and manufacturing sector.

Conclusions

The present article analyses the rate of return to college education in Spain, making use of the Continuous Sample of Working Lives (2009

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wave) which contains information of the working life of more than 1.2 million people resident in Spain for a given year. The estimation of the rate of return is based on the traditional wage model proposed by Mincer (1979), a model that we estimate by OLS and by means of quantile regression methods. The analysis is carried out for the whole sample of workers and by gender, firm size and economic activity sector.

From the previous literature review for the Spanish case, and as we corroborate in this paper, it is obvious that college education has a clear positive effect on wages. However, this positive relationship has changed over time (San Segundo , 1997; Abadie, 1997; Hidalgo, 2010; Pijoan and Sánchez, 2010), and the evidence suggests the presence of important differences by gender, wage level, economic activity sector, firm size, etc.

The econometric results show, that the rate of return to college education in Spain implies that the expected wage of a worker with college education is a 53% higher than the expected wage of a worker with an educational level below college, after controlling for several factors that may influence wages. This result corroborates the findings of previous empirical works, where a positive relationship is observed between the level of education of a worker and its expected wage, as suggested by Human Capital Theory (Becker 1962 and 1964); Mincer 1958 and 1974; Schultz 1960 and 1963). Contrary to the findings in several previous works (Alba and San Segundo, 1995; Lassibille, 1998; Marcerano and Navarro, 2005), our results suggest that the rate of return to college education is higher for males (58%) than for females (46%), eventhough the share of working women with college education (16.4%) is higher than the share of working males with college education (12.3%). However, these differences by gender in the rate of return to college education, could be explained by differences in the labor market participation rate between males and females, and other factors that we were unable to control for in our econometric specifications. The estimation results by quantile regression methods, suggest that the rate of return to college education is lower in the lower tail of the wage distribution (34%, 10^{th} quantile) than in the upper tail of the distribution (66%, 90^{th} quantile). Moreover, the differences in the rate of return to college education by gender, increase along the wage distribution. We also found a positive relationship between the rate of return and the firm size, measured by the number of workers.

Lastly, from the economic activity perspective, the highest rate of return to college education is found in the industry and manufacturing sector for the whole sample of workers, followed by the construction sector, the market services sector and the non-market services sector. For female workers, the highest rate of return to college education is found in the industry and manufacturing sector, while the lowest rate of return is found in the construction sector. In contrast, for male workers the highest rate of return to college education is found in the construction sector, while the lowest rate of return is found in the non-market services.

Our results highlight the important role of education on expected wages. Other works and several databases for the Spanish labor market show also the relevance of education on employability. Nevertheless, the reform of the employment training system in Spain, requires better policies for anticipating and matching labor market and skills needs, in order to avoid the so called phenomenon of overqualification and to improve the relatively poor results of the actual system.

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