Higher Education Expansion, Human Capital Externalities and Wages: Italian Evidence within Occupation

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VERY PRELIMINARY AND NOT FOR CIRCULATION

May 15, 2011

Abstract

The Italian system of higher education has recently experienced a process of radical transformation. The so-called 3+2 university reform reflects a big increase in the supply of college graduates that has attracted the attention of policy makers and fostered the debate on the size of human capital externalities. Using the 2009 Italian Labour Force Survey and incorporating a measure of graduate density within each occupation, in this article, we explore whether the social returns to education exceeds the private return and less educated workers gain more than college educated workers from spillovers associated with higher college share in their relative occupation. The OLS results clearly indicate that increases in graduate density have positive effects on wages and that the effect is larger for less educated workers, also controlling for potential confounding factors. However, the concentration of college workers across occupations is such that we may have a potential endogeneity problem. In order to recover a causal interpretation and to isolate the effect of graduate density, we employ an IV strategy exploiting the lagged demographic and occupational structure and the variation in the introduction of 3+2 courses at regional level. Merely, IV estimates largely indicate that the size of spillovers is significantly increased with respect to standard OLS results. Indeed, we estimate that a 1% increase in the college share within occupation raises wages by 0.9-1.3% for male and female, respectively. The effect is further larger for less educated workers.

JEL Classification: J0, E2

Keywords: human capital externalities, university reform, graduate density.

1 Introduction

The Italian system of higher education has recently experienced a process of radical transformation in order to create an harmonization of the structure of university programmes and to introduce a credit system that facilitates the integration of tertiary education among European countries. The so-called "3+2" university reform has introduced in Italy a two-tier system providing two options, a shorter and more vocation-oriented three year course (Laurea breve) and a second two-year degree for highly qualified professions (Laurea magistrale). This reform reflects a huge increase in the supply of college graduates that has attracted the attention of policy makers and has fostered the debate over the labour market performance of the new university graduates.

Intuitively, the recent expansion of graduates might increase the job competition between graduates workers, partially reducing their relative wage premium if the rise in graduates supply outstrips any rise in demand for graduates' skills (as evidenced in the literature about the "3+2" university reform). In other words, a portion of new graduates will be crowded into jobs that do not require high skills, replacing less educated workers and experiencing lower wages. Conversely, human capital theory suggests that a high graduate density might imply a positive spillover effect on productivity, thus raising their wages. Indeed, the empirical literature has shown that wages and employment in a geographic area are positively affected by the local stock of human capital (Rauch, 1993; Glaeser and Marè, 2001; Moretti, 2004b; Dalmazzo,and DeBlasio, 2007). The topic of human capital externalities (and partially of educational externalities) has a long and old tradition in economic research (Marshall, 1890), and has inspired several theoretical contributions on the fact that an individual private decision to invest in own human capital may create external benefit on others. For instance, Lucas (1988) has emphasized that the interaction between skilled and unskilled workers is a way of spread of knowledge and raise the productivity. Additionally, new growth theory suggests that externalities from education reflect one of the main source of economic development and the spatial concentration of skills creates a positive productivity spillovers, favouring the introduction of new technologies which make for firms more profitable to invest in areas (or in occupation) where the fraction of college educate workers is higher (Acemoglu, 1996).

Moreover, there are also non-pecuniary positive externalities as well as the

reduction of crime (Locker and Moretti, 2004), the quality of neighbourhood (Shapiro, 2006), health and the increase of civic participation (Milligan, Moretti and Oreopoulus, 2004).

Nonetheless the relevant role of human capital externalities in shaping economic performance is theoretically accepted, much less is known about the empirical size of the external (or social) return to education with the exception of the US labour market which provides mixed results.

Intuitively, human capital externalities could represent a crucialelement to assess the efficiency of public subsidies to private education, largely motivated by the recent expansion in the tertiary education in Italy. Additionally, economic theory predicts a positive effect of an increase in graduate density on the wage of low-skilled workers that goes through imperfect substitution and spillover effect (or human capital externalities). Specifically, the idea that exists significant external effects from increased individual educational attainment might be relevant and the size of the human capital externalities reflects a fundamental element to identify whether the expansion of higher education in Italy could represent an important mean to improve labour market prospects in the recent financial crisis.

In order to inform policy decisions about the supply of public higher education, there is a need to investigate the forces influencing the demand for college educated workers. Along this direction, the economic literature has discussed the topic of optimal level of college degree supply and has analyzed the relationship between higher education supply and the degree of college skills demand in the labour market. Specifically, a different branch of literature (Gottschalk and Hansen, 2003; McGuiness and Bennett, 2007) has investigated employment of college educated workers in the non-college occupations in order to understand whether changes in supply skills meets changes in the demand for college graduates .

In this article, we would like to explore whether in Italy social returns to education exceeds private returns and whether less educated workers could gain from human capital externalities associated with higher graduate density in their relative occupation. Doing this, we exploit the earning information included for the first time in the 2009 Italian Labour Force Survey (ILFS) and incorporate a measure of graduate density within each occupation into the wage equation.,In fact, we are able to compare the wages of otherwise similar workers employed in occupations with different share of graduate workers and to test to what extent human capital externalities could affect positively the labour market outcomes for other workers in the same occupations. Interestingly, this paper generalizes the standard approach in estimating the social return to education, exploiting as main source of variation the occupational heterogeneity in the share of college

educated workers. This approach is consistent with a standard demand and supply framework. It identifies whether the concentration of college workers across occupation increases job competition among graduates, lowering their relative wages (Longhi and Brynin, 2006) or, alternatively, whether a rise in the college skills within occupations produces positive externalities on wages, both for non-graduates and graduates workers.

However, the concentration of graduate workers across occupations (i.e. the graduate density) is such that we may have some potential endogeneity problems that could bias the true effect of human capital externalities. Indeed, workers likely sort into labour market based on employment and wages opportunities, and the highly skilled are likely to be the most mobile and seek out occupations with high labour market outcomes. Explicitly, those occupations which pay higher wages may attract more college workers and experience a rise in their average education levels.

Both to solve this problem and to isolate the effects of exogenous increases in graduate density, we use an instrumental variables technique. Merely, we use two instruments that predict the share of college workers in an occupation but uncorrelated with wages. First, we use the lagged demographic and occupational structure as literature on human capital externalities does standard (Moretti, 2004b; Dalmazzo and De Blasio, 2007). Specifically, we use the 1999 LFS to calculate the share of workers aged between 15 and 24 in each region and occupation. We have decided to take the 1999 demographic and occupational structure because in that year was ratified and introduced the Bologna Process (the 3+2 university reform) which has deeply modified the structure of higher education system in Italy, replacing the old four/five years traditional degree with a two-tier articulation of the system. To build the second instrument, we exploit the variation in the introduction of the 3+2 university reform, that reached its implementation stage in the academic year 2001/2002, but because of the autonomy left to each university the passage to the new system was gradual.. Therefore, we use the administrative data provided by the CNVSU (Centro Nazionale di Valutazione degli Studi Universitari) for the academic year 1997/98- 2005/6 to create the percentage of 3+2 courses at regional level introduced until academic year 2006/2007. Then we interact this measure with the share of workers aged between 15 and 24 in each region and occupation.

Our expected results might reflect the significant heterogeneity of the Italian labour market. On the one side, the recent expansion of higher education might partially reduce the college wage premium in a period in which the demand has been significantly reduced by the downturn in the economic cycle. On the other hand, the diffusion of college workers could have a positive spillover effects for less educated workers, raising productivity and favouring the sorting

of more able workers in the relative occupation. We also control for the effect of the recent great recession, computing unemployment measure that are region, gender and age specific in order to account for the possible different effect that the financial crisis might have in Italy.

The OLS main estimates clearly indicate that an increase in graduate density has positive effects on wages and that the effect is substantially similar for male and female workers, even controlling for potential confounding factors (respectively 0.453 and 0.388). Replicating the analysis for different education groups, as expected, we find that the size of human capital externalities are larger for less educated workers. Obviously, these results do not necessarily suggest the presence of a spillover effect but might indicate the existence of an imperfect substitution between college and non-college workers. However, the effect is positive also for college graduates, therefore indicating that the spillover effect is larger than standard supply effect.

Finally, employing the IV strategy to correct the possible endogeneity of the fraction of college educated workers, significantly modifies the results. Merely, IV estimates largely indicate that the size of spillovers is significantly increased with respect to standard OLS results. Indeed, we estimate that a 1% increase in the college share within occupation raises wages by 0.9-1.3% for male and female, respectively. The effect is further larger when we replicate the empirical exercise for different educational groups.

The paper is structured as follows. Section 2 discusses the related literature and motivation of this work. Section 3 presents the data and provides some preliminary descriptive evidence while in section 4 we describe our estimation strategy. Section 5 reports the empirical results and finally, section 6 draws the conclusions.

2 Related literature

Economic literature has extensively addressed the topic of optimal level of college graduate supply in order to avoid losses in efficiency for society and give an indication to policy makers about the public provision of higher education. One stream of the literature has debated whether there are relevant external effects of the college share on individuals' wages even after controlling for individual educational attainments and other demographic characteristics. Theoretically, human capital externalities are defined as the difference between the social and private return to education, (Lange and Topel, 2006; Moretti, 2004). An alternative is offered by exploring the over-education problem, that is the employment of college graduates in the so called non-college occupation (McGuiness, 2006,

Pryior and Schaffer, 1997; McGuiness and Bennett, 2007).

The majority of literature on human capital externalities focus on the effect on wages or wage growth at geographical level. External effect of college share may affect wages for two reasons: first, according the standard neoclassical model, human capital externalities are due to the hypothesis of imperfect substitution between high educated and low educated workers in the production process. An increase in quantity of educated workers will increase the marginal productivity of low educated, and if they will be paid at their marginal products, imperfect substitution will cause the wage of high skill workers to fall with the rise in the share of high skilled workers (e.g. Moretti, 2004; Cicconi and Peri, 2006). The second source of spillovers is a sort of learning coming from interaction with high skilled workers (Glaser and Marè, 2001; Moretti 2004b). This kind of externalities is positive for all workers, but the effect may be different across type of workers.

For unskilled workers both two effects increase their wages, while the impact of an increase of supply of educated workers on their own wages is determined by two competing forces: standard supply effect makes the economy move along a downward sloping demand and spillovers that raise the productivity. So the final effect depends on how large are the spillovers effects.

The differences in the relative number of educated workers may also be driven by differences in the relative demand. There are some factors (advanced technologies or skill-biased technological change) that arise the productivity of educated workers and so their demand. Interestingly, workers move to occupation with higher wages and the average education raises. The wage of high educated worker is higher because of their higher productivity, while the wage of unskilled workers is higher because of complementarities (Acemoglu, 1996).

The empirical literature on local human capital externalities is still few. Results are mixed, they depend on geographical level considered (state versus cities) and the measure of schooling (average years of schooling versus tertiary education level). A number of studies find that wages are affected by the share of educated individuals living in a particular geographical area, after controlling for individual education, experience and demographic characteristics. But whether there is some causality, it is less clear. Some studies use IV technique to try to isolate the causal effect of an increase in average education levels.

Moretti (2004b), for example, using US data on metropolitan areas finds that an increase of 1% share of college graduates raises individual wages in the range between 0.4% for college graduates and 1.9 for high-school graduates and high-school drop-outs. He use as instruments lagged city demographic structure and the presence of a land-grant college. Alternatively, Acemoglu and Angrist (2000) find small or not significant coefficients for external returns to education. They

use Child Labour Law and compulsory attendance laws are used as instruments to point out the real social returns. The use of these instruments could be the reason why they find small size of spillovers. Indeed, these laws affect primarily the lower part of the distribution of educational attainments. This partially explains the reason why authors find low size of human capital externalities and moreover they use state as geographical local measure , while Rosenthal and Strange (2008) show that the positive geographical effect of knowledge spillovers decreases beyond 5 miles.

Dalmazzo and De Blasio (2007) on Italian data show that average human capital measured at local labour market area is positively correlated with wages. Their results range from 2-3 percent point. Recently researches show human capital externalities at firm levels on wages (see Cerejera da Silva, 2003, Moretti, 2004, Canton, 2009, Bratti and Leombruni, 2010).

For Italy; Bratti and Leombruni (2010) explore local level human capital in each firm in Manufacturing at provincial level. They show a positive correlation between wages and local human capital especially to white collars. They use also IV technique with lagged change in university supply of manufacturing related courses and its interactions with 20 years lagged demographic structure.

Some evidence suggest that local level of human capital has positive effects on labour force participation of woman and reduce unemployment for both women and men. It has been claimed that the external effect is larger for unskilled worker (Winters, 2010).

Starting from thecontribute written by Shaw (1984) on the important role of occupational investment in wage determination, literature shows the importance of occupational specificity in the acquired work experience. There is some evidence that individual wages are affected by occupational experience more than either firm or industry tenure. It seems that occupation-specific effect affects wages, in particular it seems consistent with occupational specificity of human capital Kambourouv and Monovskii, 2008). This is consistent with occupational specificity of human capital. Similarly on British data Zangadelis (2008) point out the occupational experience role in determining wages.

3 Data and descriptive statistics

The empirical analysis has been carried out using the Italian Labour Force Survey (LFS) as primary data source. The LFS is a household survey provided quarterly by the National Statistical Office (Istat) since 1959 and represents the principal data source for assessing the Italian labour market. It collects a range of information on labour market status and other socio-economic and job-related characteristics of a large sample representative of the Italian population

on a quarterly basis (e.g. Ceccarelli et al, 2007).

The survey is conducted quarterly through a two stage sample design with stratification: about 1300 municipalities are sampled at the first stage, and about 70.000 households at the second one. The LFS follows a rotating scheme according to which each household is interviewed for two successive quarters, and then again for two other consecutive waves after two quarters of interruption, for a total of four times.[1] Explicitly, the 50 per cent of the sample is kept constant between two consecutive rounds. In other words, the LFS has a natural longitudinal dimension with people followed up to fifteen months, but the linkage of individual records across surveys can be problematic, because of the lack of an individual-specific identifier and because of reporting errors in the household identifier.

In this article, we use data relative to the four pooled waves of 2009. This data reports respondents' current labour market status and their educational attainment, including for the first time the net wage earned by employees. Merely, the inclusion of the earnings information allows to explore whether the social return to education exceeds the private return at occupational level and to identify the presence of human capital externalities in the Italian labour market. We select a sample of all those employees aged 15-59 who are not currently full-time students. Specifically, we exclude employees over the age of 59 in order to avoid possible conflating issues related to retirement decisions. We also do not include self-employed workers for whom the net earned wages are not reported. Moreover, those individuals with missing values on relevant variables or lying in the first or last percentile of the net monthly wage have been excluded from the sample.

Our dependent variable is the log of monthly wage, net of taxes and social security contributions, excluding the additionally monthly salaries such as the 13th and 14th month salaries and bonuses and special emoluments (e.g. productivity bonuses, special overtime and other special compensations). The other main variable of interest is the stock of human capital at the occupational level. Explicitly, we compute the graduate density as the share of graduate employees in each occupation defined at the 3-digit classification code, defining the following index:

$$\text{grad}\, uate\_share = \frac{\text{grad}\, uate_o}{(\text{grad}\, uate_o + non\, \text{grad}\, uate_0)}$$

where $\text{grad}\, uate_0$ is the number of college workers in each occupations and $non\, \text{grad}\, uate_o$ is the number of non college workers in each occupation. Practi-

[1] Practically, for each year the survey collects information on at least 300,000 households, which represent around 800,000 individuals (1.4% of total national population) distributed over 1,351 municipalities (out of 8,000).

cally, the measure of graduate density varies from 0 to 1. The summary statistics of the main variables used in the paper are reported in table 1.

In order to isolate the exogenous variation of the 3+2 university reform on the distribution of college share across occupations, as secondary data source, we exploit the administrative dataset kindly provided by CNVSU that spans for the academic years 1998/99 – 2005/2006. This data represents a rich source of information at the level of each single university (or even at faculty level), reporting the number of male and female graduates in the old and new system at college level, the number of new 3+2 courses introduced at faculty level in each academic year in the sample, the percentage of college students that obtain a degree within the legal duration provided by the program curriculum attended, the number of female and male students enrolled in the first year of an university programme, distinguishing between the Laurea degrees and the first (and second) level degrees introduced by the 3+2 reform. Specifically, we are able to build the share of 3+2 courses created at faculty level after the introduction of the university reform and to this extent to use this measure as an index of the variation in HE supply.

4 Empirical strategy

This paper examines whether the social return to education exceeds the private return and analyzes the impact that graduate density might have on individual wages. Specifically, we exploit the occupational heterogeneity of college workers' distribution as a main source of identification, using variation in the share of college workers across three-digit occupation. In practice, the novelty of this approach consists in the comparison of wages for those workers with similar individual and job-related characteristics, who are employed in occupations with different share of college workers.

Explicitly, as stated in this literature (e.g. Moretti, 2004b; De Blasio and Dalmazzo, 2007; Bratti and Leombruni, 2010) we exploit a traditional Mincerian (log) wage equation augmented with a term for the college density within each occupation at three-digit classification code. The regression specification is

$$\log(w_{ij}) = \alpha + X_i\beta + \%\,\mathrm{col}\,lege_j\delta + Z_j\gamma + \epsilon_{ij}$$

where w_{ij} is the monthly net wage, X_i is a vector of individual observable characteristics, including the educational attainment of each individual, $\%\,\mathrm{col}\,lege_j$ reflects the graduate density in each 3-digit occupational group while Z_j is a vector of occupational characteristics that may be correlated with the average graduate density within occupation. Practically, our coefficient of in-

terest is δ, which capture the impact of graduate density on average wages after controlling for private return to education. Note that we do not include occupational fixed effects since our measure of college share is fixed for each occupation j over time. Conversely, in order to avoid serial correlation within occupation, we use robust standard errors clustered at each occupational level, defined at the 3-digit classification code. Therefore, we exploit the heterogeneity in the fraction of highly educated workers within occupation and the relative effect on individuals' wages as the main source of variation to estimate human capital spillovers. However, there might be some threats to the validity of our empirical strategy and this obviously poses a challenge for isolating the causal effect of average human capital on wages.

First, workers likely sort into the labour markets based on employment and wage opportunities and thus college graduates might be not randomly distributed across occupations. Indeed, the highly skilled individuals are likely to be the most mobile and seek out jobs with better career prospects. Namely, there might be an omitted-variable bias that arise from the correlation between individual ability and average human capital in each occupation. In practice, it can be argued that individuals observed in occupations with higher average human capital are those workers with better unobserved ability. This may reflect an occupational sorting by ability and the fact that more educated workers can choose to work in occupations that remunerate better their observed and unobserved skills, thus corroborating the idea that occupational attainment is largely endogenous.[2]

Second, there might be a problem of reverse causality. Intuitively, occupations paying higher wages are likely to attract better educated workers and therefore to experience a rise in the average level of human capital. In this case, high wages cause the rise in the college share in each occupation and not vice-versa. Precisely, the other main source of the omitted-variable bias concerns the unobserved heterogeneity across occupations due to demand and supply shocks related to the fraction of college workers. Substantially, the implications are that occupation-specific productivity shocks might partially drive the variation in the share of graduate workers. Namely, several factors captured by the error term in the wage equation might bias the estimates of human capital externalities due to a correlation with the relative supply of college graduates in each occupation. Secondly, the error term may also be capture unobserved differ-

[2]It has also been argued that the composition of individuals living in a given area may influence their allocation across different occupations through their preferences parameters or job competition among graduates (Longhi and Brynin, 2006). For instance, a large share of female graduate workers in a region may increase the competition for a job in the public sector or in those occupations where female college workers can reconcile childcare responsibilities with market involvement.

ences in preferences among college and non college workers, which implies that the assumption of no correlation between the graduate density in an occupation and the error term can be violated. Intuitively, the standard OLS estimates may be biased and the conditional correlation of wages and graduate density will confound the two directions of causality.

For instance, the expansion of an industry adopting high-technology in one occupation may attract high-skilled workers or the increasing impact of technology progress (that is skill-biased) could influence educational decision of individuals and favouring a higher access to higher education. This might imply that the correlation between the error term of wage equation and the fraction of college workers at occupational level is different from zero. The intuitive sign of this correlation is positive (i.e. positive productivity shocks induce a higher fraction of college graduate), thus the OLS results would be biased downward.

Along these lines, however, one could argue that the endogeneity bias might seem to be quite serious when considering geographic variation in college share, since local wages are likely to be an important factor influencing college workers location choices.[3]

Alternatively, endogenous choices are probably less relevant along the occupational dimension, as individuals are not able to freely choose to enter any occupation, but are limited by their skills. For this reason, at least in the short-time, before they can experience training, college workers' occupational choices may be relatively independent of occupational wages. However, endogeneity will still be a problem if the traditional assumption that the aggregate preferences of workers are constant across and within occupations in the standard demand and supply models is basically unrealistic. Indeed, the educational and occupational decisions of new entrants in the labour market might primarily be related to the employment and wage outcomes observed in the occupational labour market. As obviously stated by the related literature (e.g. Longhi and Brynin, 2010; Zangelidis, 2008), occupational mobility is more restricted and often requires a large and costly investment in training, greatly reducing the capability and extent to which each worker can respond to changes in the occupational wage structure. Therefore, equilibrium may only be restored by modifying the occupational decisions of new labour market entrants. Disequilibrium across occupations will therefore be more persistent than disequilibrium across local/regional labour market, and the impact of college share more readily apparent.

In order to recover a causal interpretation of the results and to isolate the true effect of the college share on wages, the endogeneity of the graduate density

[3] As extensively discussed in the empirical literature on human capital externalities that investigates the relationship between the local average human capital and wages in an areas, region or state.

can be tackled in several ways. Drawing from the Moretti's (2004b) approach, we employ an IV strategy using two instruments that predict the share of college workers in an occupation but at the same time are uncorrelated with occupation specific productivity shocks (which affect wages).

As commonly proposed in the literature on human capital externalities, we use lagged demographic and occupational structure. Specifically, we use the 1999 LFS micro-data to calculate the share of workers aged between 15 and 24 in each region and occupation. We would expect that this share is uncorrelated with the unobservable component of wages in 2009 but negatively correlated with the fraction of college educated workers within occupation ten years later in the 2009. Indeed, given the structure of university degrees in the 1999 and the long graduation time that characterized the Italian university system, we would like to observe few college graduates in this age group. Practically, a higher share of workers in the age group between 15 and 24 years in the 1999 corresponds to a lower share of college educated workers aged between 25 and 34 ten years later. We have decided to take the 1999 demographic and occupational structure because in that year the 3+2 university reform, the so-called Bologna Process, has ratified and introduced in Italy with the law 509. This reform aims at replacing the existent university system with the European model in order to achieve a greater degree diversification. Merely, the 3+2 reform provided a unitary two-tier system in which students could enrol into a 3 years of general courses and then decide to continue with a 2 years of specialisation courses. This two-tier structure has replaced the old four or five years traditional degrees. The university reform reached its implementation stage only in the academic year 2001/2002. However the financial and teaching autonomy left to each university has motivated a gradual passage to the new system in Italy and a wide variation in the timing of the introduction of the new 3+2 courses by university (and therefore by region).

To build the second instrument we use administrative data from CNVSU for the academic year 1997/98- 2006/7 which includes information at the level of single university on the number of "3+2" course introduced in each academic year and then aggregated at regional level. Then we create the percentage of the 3+2 courses at regional level introduced until academic year 2006/2007. Indeed students enrolled until this year that earn a first level degree during the legal duration of the course can be observed on labour market in the 2009 as a college worker. Finally, we interact this share of 3+2 courses by region with the share of workers aged between 15 and 24 in each region and occupation in the 1999.[4]

[4] As extensively discussed by Bosio and Leonardi (2011), this instrument is valid under the assumption that universities which introduce "3+2" courses more rapidly do so irrespectively of the relative labour market performance of their students. For instance, we would be worried if the universities with the best (or worst) performance for their students were also the same

This measure reflects our second instrument to correct the omitted-variable bias due to individual and occupational unobserved heterogeneity. In practice, the expansion of college supply due to the introduction of Bologna Process in Italy may represent an exogenous source of variation in the college share within occupation. Indeed, our second instrument might capture and isolate the impact of increase in higher education supply on the labour market decision of the younger cohort in our sample. Intuitively, the reduction in legal duration (from four/five years for old degree to three years for first level degree) may increase the enrolment at university for the younger individuals after the high school graduation and therefore reduce labour market participation. On the other hand, after the reform graduation is obtained at younger age and thus we can observe at the margin an increase in the college share for workers aged between 15 and 24, given that individuals may earn a first level degree at the age of 22 years.[5] Substantially, when we employ the IV approach, we are left with a variation in the relative fraction of college educated workers that is solely due to the share of workers aged between 15 and 24 by region and occupation ten years before and its interaction with the portion of 3+2 courses on total university courses in the academic year 2006/2007 in each region. Additionally, this variation in uncorrelated with current occupations-specific productivity shocks. In conclusion, this should allow the identification of the unbiased relationship across occupations between the share of college educated workers and individuals' wages.[6]

5 Empirical results

In this section, we first discuss the OLS estimates of the social return to education pooling all education groups together. Secondly, in order to gauge whether this average estimated effect is homogenous or not, we replicate the same analysis separately for different educational groups. Third, we provide some robustness check on our measure of graduate density within occupation. Lastly, to recover a causal interpretation of the results on social return to education, we discuss the results from the IV specification.

that introduced the reform quicker (or slower) because this would mean that the instrument is not orthogonal to the dependent variable of interest (in this case wage outcome).

[5] Practically, we might consider those as the "marginal and more able students" that exogenously increase the share of college educate workers in the younger age group in our sample, a sort of LATE interpretation of the IV approach.

[6] In order to satisfy the exclusion restriction, we also include other controls that might be capture the impact of occupation-specific shocks on the college share . Specifically, we consider the log of employment for each occupation and the specific unemployment rate by region, gender and age group in 2009. This may control for cyclical variation in the labour market performance that could be a main source of bias, given the recession experienced in this year.

5.1 Baseline standard OLS results

This section presents the standard OLS estimates of the relationship between the relative fraction of college workers in each occupation and the inidividuals' wages. Estimation results summarized in table 2 report the baseline OLS estimates on the social return to education, respectively for males and females. Our starting specification in column 1 includes the graduate density measured at occupation level and other traditional wage determining factors such as a set of dummies for individual educational attainment, labour market experience and its square, age group dummies, marital-status and part-time dummy. We also include region fixed effects in order to largely capture the traditional differences among regional labour markets in Italy. Otherwise, our measure of human capital within occupation might pick up the impact of other local characteristics or institutions that are correlated with the graduate density. Practically, given the inclusion of the individual controls described above, the results can be interpreted as the external effects of human capital at occupational level. Additionally, standard errors in all specifications are clustered at occupational level.

What emerges is that the share of college workers positively affects individual wages. Indeed, in the first column of table 2 the estimated OLS coefficient for male (for female) is 0.449 (0.465), statistically significant at 1%. This implies that a 1 per cent increase in the share of workers with a college degree is predicted to increase individual wage with around 0.4%.

Table 2 also reports the results for additional specifications which include alternative individual and occupational-level explanatory variables, potentially correlated with our measure of graduate density. Indeed, the exclusion of several confounding wage determining factors could introduce a spurious correlation between average human capital within occupation and individual wage. In column 2, we add sector and firm size dummies in order to better capture the heterogeneity among industries and firm size. In practice, the empirical literature has largely emphasized the presence of inter-industry wage differentials (Du Cajo et al., 2010) in European countries, consistent with rent-sharing mechanisms and more likely in industries with firm-level collective agreements. Additionally, the sector dummies might control for the endogenous matching between workers and firms in high-wage sectors (Dalmazzo and De Blasio, 2007). Alternatively, firm size dummies capture the relation between wages and employer size, extensively discussed in literature.[7] As expected, the inclusion of sector and firm size

[7] Explicitly, we add 12 dummies variable for capturing each sector effect in our sample (e.g. agriculture, mining, manifacturing, construction, transport and communications, finance, public service, education and health, others public service, wholesale and tourism) and 5 dummies for firm size (under 10, 11-15, 16-49, 50 -249, above 250)

dummies leaves the positive effect of graduate density substantially unchanged for females, while the coefficient is slightly higher for males. Column (3) controls for the type of contract, including a dummy equal to one if the worker is employed with a temporary contracts. An extensive recent literature has analyzed the cost of the flexibility, indicating that individuals with a temporary contract earn systematically a lower wage with respect to their permanent counterpart, largely in the lower bottom of the earning profile. However, the inclusion of a dummy for temporary contract does not modify the results on social return to education. Column (4) add a control for the specific tenure in the current job that may reflect a proxy for the occupational tenure. Indeed, a recent stream of literature (Zangelidis, 2008; Kambourov and Manovskii, 2009) has argued that occupational tenure has a relevant role for wage growth. Merely, Kambourov and Manovskii (2009) find that, ceteris paribus, 5 years of occupational tenure are consistent with an increase in wages around 12-20%. Differently, the inclusion of tenure in our specification reduces very slightly the coefficient for social return to education, both for males and females. Finally, in column (5) we include a set of variables at occupational level that might be correlated with the fraction of college educated workers in each occupation.[8] The OLS estimates for college share are slightly lower after the inclusion of these occupational controls both for females and males.

The effect for females in the last specification is lower than for men. It has not so surprising, when we take into account that in Italy only more qualified women significantly participate to the labour market, so the pool of female workers in the labour market are highly selected sample and therefore the effect on average could be lower than for males. Summarizing, we find a positive association between graduate density within occupation and wages, also controlling for a set of potential confounding factors. This suggests the presence of a human capital spillover at occupational level, implying that a 1% increase in the graduate density corresponds to a rise in wages around 0.4%, with a slightly lower effect for females.

5.2 OLS estimates by educational group: imperfect substitution or human capital spillovers?

Next, we examine the OLS estimates of the impact of college share by educational level. Obviously, the positive correlation between our measure of graduate density and wages does not necessarily indicate the presence of a positive spillover, as widely emphasized in literature (e.g. Moretti, 2004b; Ciccone and

[8] Specifically, we include the distribution by age, by sector and by firm size in each occupation in order to control for potential confounding factors at occupational level that might bias the estimates of human capital externalities.

Peri, 2006). Indeed, it may be driven by composition effect. The standard theoretical model for human capital externalities indicates that the social return to education is the sum of two effects: the imperfect substitution or composition effect related to a shift in the graduate density and the spillover effect. Merely, if workers with different level of education are imperfect substituted, the expected effect of human capital externalities is larger for low educated workers and if spillover is stronge enough, the coefficient is positive, but smaller, for college educated workers. Estimation results are summarized in table 3. We separate individuals into four groups by education: 1) those with primary school or less; 2) those with a lower secondary education; 3) those with a high-school degree and 4) those with a college degree. These results include all individual and occupational controls described in the previous section. The estimates in table 3 are generally consistent with the expectation that less educated workers gain the largest human capital externalities as in Moretti (2004b). In column (1) we note that the estimated OLS coefficients for social return to education are around 0.690 and 0.593, respectively for lower secondary and high school workers. The effect is statistically significant at 1% . If we look at the estimated coefficient for college educated workers, we find a positive and statistically significant effect around 0.296. It can be argued that the positive spillovers effect is large enough to offset the standard negative supply effect and to generate a positive wage gain in occupations with higher graduate density. Fortunately, this results largely confirms the existence of human capital spillovers. In column (5) we control also for occupational-level possible confounding factors and the results clearly indicate a partial reduction in the size of human capital externalities (around 0.553 and 0.486) for lower secondary and high school education level, while an increase for college graduates. This might reflect the fact that sorting effects are very important. In practice, the baseline OLS specification in column (1) does not control for potential factors that are related to human capital externalities, differently for college and non-college workers.

5.3 Robustness check on the graduate density measure

In order to gauge the robustness of the relationship between the graduate density and wages, we report estimates from several specifications exploiting alternative measures of graduate density. Estimation results are summarized in table 4 both for females and males. In each Panel we reports the relative estimates for a standard and an extended specification. Practically, the standard specification controls only for individual-level characteristics that might be related with the graduate density (i.e. the column (4) in table 2), while the extended specification also includes controls at occupational level (i.e. the column (5) in table 2).

First, in panel A we include the square of graduate density to capture any possible non-linear effects in the association between college share and wages. Indeed, we can expect possible non-linear spillovers effects with the low educated workers that might benefit more than proportionally from the rise in graduate density in their occupation. For instance, this may happen if the expansion of higher education has favoured the adoption of new and more advanced technologies in several occupations. Otherwise, it can be argued that over a certain level the increase in the fraction of graduates workers does not necessarily produce any wage gain for low educated workers, thus indicating an increasing but concave relationship (e.g. Bratti and Leombruni, 2010). As expected, our results show that the gain from college educated workers gain up to a certain point and then the effect is decreasing. Indeed, the square of graduate density is negative both for females and males. Alternatively, for female, the change from 0.913 to 0.711 coefficient is indicative that sorting effects are very interesting. Merely, the inclusion of the occupational-level controls reduces the coefficient associated with college share to almost 20% of the value found in the standard specification. This means that a relevant portion of the relationship between graduate density and wage is due to omitted occupational characteristics. Second, in panel B we include in our measure of graduate density also self-employed workers in order to test whether the inclusion of jobs typically undertaken by the self-employed modifies the main results. The estimates clearly indicate that the human capital externalities are higher for males than form female (0.361 vs. 0.407), but in line with the previous results. Third, we replicate the same analysis but considering graduate density at 1-digit classification code and the results are basically unchanged.

Lastly, in panel D we use several splines rather than a continuous measure in order to have a more flexible measure of the impact of graduates' concentration on wages. Our reference category is the fraction of college educated workers between 0 and 5 per cent. For female the estimated coefficient is not statistically significant for the first spline, while the effect is then positive and increasing with the share of graduates. Moreover, the inclusion of occupational-level variable further reduces the size of the human capital externalities for the last two splines. Alternatively, for males the estimated coefficients are positive and increasing over the entire range of graduate density. In other words, male workers seem to gain more from the concentration of college educated workers in their relative occupations, also for lower level of graduate density.

5.4 Instrumental variable results

One problem with OLS estimates is that they do not take into account individual and occupational unobserved heterogeneity that might be correlated both with the college share and the unobserved components of wages. Therefore, in order to recover a causal interpretation, we employ an IV strategy. As described earlier, we would expect that our instruments are correlated with the fraction of college educated workers in each occupation and uncorrelated with the unobservable components of wages. Indeed, the share of workers aged between 15 and 24 in each region and occupation ten year before[9] is expected to be negatively correlated with the college share within occupation in our primary LFS data. Merely, before the introduction of the 3+2 university reform, in the age group 15-24 we do observe a number of college workers near to zero, given that duration of degree was at least four years. Therefore, a higher share of workers in those age group in 1999 reduces the graduate density in each occupation for workers aged between 25 and 34 ten years later. Additionally, we interact this instrument with the share of 3+2 courses on the total university courses at regional level in order to capture the interaction between demographic structure of labour force in the 1999 and the variation in the higher education supply between 1999 and 2006.

IV results on social return to education do obviously have a causal interpretation as long as it is reasonable to argue that, after controlling for individual and occupational characteristics, the relationship between college share and wages is solely due to the correlation between the fraction of college educated workers and our instruments.

Before discussing the estimated effect of college share on wages from the IV approach, we briefly examine the results from the first stage regression reported to test whether our instruments are sufficiently correlated with our endogenous variable. The F-tests for the significance of the excluded instrument for male pass the threshold value of 10, ie. The rule of thumbs suggested in the literature on weak instruments.[10]

The first stage estimates suggest that the two instruments, respectively the share of workers aged between 15 and 24 in each region and occupation in 1999 and its interaction with the share of 3+2 courses on the total university courses at regional level in 2006, are significant predictors of the college share, mainly

[9] We choose this year given that in the 1999 has been introduced the law for the 3+2 university reform.

[10] The weaker F-test results for female might indicate that their labour market participation decision are largely endogenous and thus might be necessary to include a control for sample selection bias or to build gender specific instrument that are more able to capture the impact on lagged demographic and occupational structure on the fraction of college share within occupation for female workers.

for male workers.

The IV estimates summarized in tables 5 and 6 largely indicate that the social return to education on wages is significantly increased relative to the standard OLS results in tables 2 and 3. Specifically, table 6 provides the IV results both for male and female. Columns (1-2) and (4-5) report the estimates using the two instruments separately and then columns 3 and 6 report those with two instruments jointly used. In column (1) the estimated coefficient for social return to education is around 0.924, while for female in column (4) the effect is significantly larger, around 1.371. The spillovers effects appear generally stable across different specifications and indicate that the human capital externalities obtained with an IV approach is clearly higher for female workers. Indeed, while the OLS estimates indicate a social return of education of 0.453 for male (0.388 for female), the IV male coefficient is indicatively the double. For female the variation in size using the IV is also larger. Additionally, the IV results are insensitive to the instruments adopted and this might be as a good signal of the exogeneity of our instruments.

Table 7 replicates the same empirical exercise for each educational group in order to compare the IV estimates with those reported in table 3 using an OLS approach. As before, the IV coefficients on social return to education are significantly larger for all educational groups. Particularly, the magnitude of the coefficients are more than triple for high-school and lower-secondary workers, therefore indicating that a growing share of college educated workers can improve the wage prospects also for less educated workers. Additionally, the IV estimates for college workers suggest that the spillover effects seem to be large enough (with respect to traditional supply effect) to produce a positive impact on wages in occupations with a higher fraction of college educated individuals. Merely, this means that at occupational level the concentration of skill may positively affect wages, strengthening further the impact of occupation tenure on the wage growth (Kambourov and Manovski, 2009)

When IV estimates exceed OLS estimates, this could be interpreted as a positive correlation between the unobserved heterogeneity and the college share. Therefore, not controlling for endogeneity bias underestimates the true effect of human capital externalities on individual monthly wage. This result is in line with the standard literature on returns to education (Card, 1999; Currie and Moretti, 2003) which generally finds larger effects using the IV approach with respect to standard OLS.

6 Conclusion

During the last decade, higher education has considerably expanded in Italy as consequence of the 3+2 university reform aimed to achieve a greater degree diversification with the introduction of a two-tier system and to integrate the European model within the Italian university system. Merely, the 3+2 university reform reflects a big increase in the supply of college educated workers. Intuitively, the expansion of higher education might increase the job competition among graduates workers, lowering their relative wage premium if the rise in the graduate supply outstrips any rise in demand for college skills. Conversely, human capital theory indicates that a higher graduate density might imply a positive spillover effect on productivity and wages.

In order to inform policy makers about the efficiency of public subsidies to private education, there is a need to investigate the forces influencing the demand for college educated workers into the labour market. Intuitively, this need might be even more relevant given the deep recession experienced by Italian labour market after the financial crisis that might permanently have modified the traditional pattern in terms of employment and wage performance of graduates and non-graduates.

The goal of this paper is a first attempt to estimate whether the social return to education exceeds the private return and whether the less educated workers gain from human capital externalities related to a higher fraction of college educated workers, exploiting the variation across occupations. Specifically, social return is defined as the sum of private and external returns, where external return measures the effect of an increase in the share of college educated workers in a city, state (occupation) on wages minus the effect due to private returns to education (Lange and Topel, 2006; Moretti, 2004b).

Practically, we investigate this topic by comparing the wages of otherwise similar individuals who work in occupation with a different share of college workers, using 2009 Italian LFS.

The OLS estimates clearly indicate that an increase in the graduate density within occupation has a positive effect on individuals' wages. Indeed, we found that the wage gain associated with human capital externalities is 0.453 and 0.388 respectively, for males and females. The results are robust to the inclusion of possible confounding factors into the wage equation measured both at individual and occupational level. We also replicate the analysis for different educational group and, as expected, the positive effect is larger for less educated workers. Obviously, this might reflect imperfect substitution between college and non-college workers and not a spillover effect. Interestingly, the positive effect of college share on graduates' wages clearly suggest that the spillover effect is

substantially larger than the standard negative supply effect. However, our measure of graduate density across occupation might suffer from a possible endogeneity bias. In order to recover a causal interpretation and to isolate the exogenous effect of human capital externalities, we employ an IV approach. The IV estimates largely indicate that the size of spillovers is significantly increased with respect to standard OLS results. Indeed, we estimate that a 1% increase in the college share within occupation raises wages by 0.9-1.3% for male and female, respectively. The effect is further larger for less educated workers.

Summarizing, our results endorse the relevant presence of positive human capital externalities at occupational level, suggesting that policies aimed at expanding higher education in Italy could significantly improve labour market prospects both for graduates and non-graduates workers and represent an important source to exit from the current recession. Moreover, the investment in higher education may further strengthen the role of occupational-specific human capital in the wage growth and to reinforce the condition for an increasing demand for college skills on the labour market.

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Table 1: Summary statistics

	Observations	Mean	S.D.
Month wage (ln)	116721	7.03	0.40
Female	116721	0.43	0.49
Temporary	116721	0.12	0.33
Education			
Primary school	116721	0.05	0.22
Lower school education	116721	0.34	0.47
High school	116721	0.46	0.50
Tertiary	116721	0.14	0.34
ISCO1	116721	0.02	0.13
ISCO2	116721	0.08	0.27
ISCO3	116721	0.20	0.40
ISCO4	116721	0.13	0.34
ISCO5	116721	0.15	0.36
ISCO6	116721	0.18	0.38
ISCO7	116721	0.11	0.32
ISCO8	116721	0.12	0.32
ISCO9	116721	0.006	0.08
North-east	116721	0.30	0.46
North-west	116721	0.26	0.44
Centre	116721	0.17	0.38
South	116721	0.17	0.38
Islands	116721	0.08	0.28
Age:			
15-24	116721	0.04	0.19
25-34	116721	0.20	0.40
35-44	116721	0.34	0.47
45-54	116721	0.32	0.47
55-59	116721	0.09	0.29
Tenure (months)	116721	118.73	107.70
Graduate density	116721	0.142	0.22
Graduate density,			
Between 0-5%	116721	0.49	0.50
Between 5-10%	116721	0.16	0.36
Between 10-30%	116721	0.21	0.40
Over 30%	116721	0.13	0.34
Occ-age15-24	116721	0.06	0.05
Occ-age25-34	116721	0.22	0.06
Occ-age35-44	116721	0.32	0.04
Occ-age45-54	116721	0.30	0.07
Occ-age55-59	116721	0.09	0.04

Table 2: OLS results on the social return to education, by gender

	(1)	(2)	(3)	(4)	(5)
	PANEL A: MALE				
Graduate share	0.449	0.497	0.490	0.481	0.453
	(0.091) ***	(0.074)***	(0.072)***	(0.071)***	(0.068)***
Reference: primary or less					
Lower secondary	0.084	0.069	0.065	0.059	0.052
	(0.012) ***	(0.008)***	(0.007)***	(0.007)	0.007
High school	0.168	0.138	0.134	0.125	0.113
	(0.022)***	(0.017)***	(0.016)***	(0.016)***	(0.012)***
College	0.2435	0.217	0.216	0.217	0.204
	(0.026)***	(0.023)***	(0.022)***	(0.021)***	(0.019)***
R squared	0.3429	0.3744	0.3849	0.3914	0.4113
N. obs.	66536	66536	66536	66536	66536
	PANEL B: FEMALE				
Graduate share	0.465	0.441	0.435	0.407	0.388
	(0.122) ***	(0.105)***	(0.101)***	(0.095)***	(0.057)***
Reference: primary or less					
Lower secondary	0.124	0.091	0.088	0.075	0.055
	(0.021)***	(0.016)***	(0.015)***	(0.014)***	(0.013)***
High school	0.261	0.201	0.194	0.172	0.121
	(0.032)***	(0.027)***	(0.025)***	(0.022)***	(0.021)***
College	0.315	0.257	0.252	0.244	0.198
	(0.038)***	(0.031)***	(0.029)***	(0.026)***	(0.026)***
R squared	0.494	0.5262	0.5348	0.5489	0.5662
N. obs.	50185	50185	50185	50185	50185
Region dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	No	Yes	Yes	Yes	Yes
Firm size dummies	No	Yes	Yes	Yes	Yes
Temporary contract	No	No	Yes	Yes	Yes
Tenure	No	No	No	Yes	Yes
Occupational means	No	No	No	No	Yes

Note: Dependent variable is the log net month wage. All the regressions include a constant term, age, age squared, experience, experience squared, tenure, tenure squared, educational attainment dummies, region dummies, marital status; firm size dummies, sector dummies, part-time dummy, temporary contract and tenure. Occupational means are added progressively. Robust and clustered standard errors are reported in parenthesis. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 3: Human capital externalities and wages, by education groups

	(1)	(2)	(3)	(4)	(5)
	PRIMARY OR LESS				
Graduate share	0.598	0.624	0.612	0.598	0.670
	(0.180)***	(0.126)***	(0.126)***	(0.119)***	(0.121)***
Rsquared	0.4291	0.4709	0.4738	0.4802	0.4899
N. obs	6453	6453	6453	6453	6453
	LOWER SECONDARY				
Graduate share	0.690	0.675	0.654	0.618	0.553
	(0.076)***	(0.065)***	(0.064)***	(0.062)***	(0.077)***
Rsquared	0.4462	0.4706	0.4773	0.4841	0.4959
N. obs	39585	39585	39585	39585	39585
	HIGH SCHOOL				
Graduate share	0.593	0.582	0.573	0.544	0.486
	(0.110)***	(0.090)***	(0.008)***	(0.083)***	(0.064)***
Rsquared	0.4084	0.4725	0.4819	0.4933	0.5097
N. obs	54434	54434	54434	54434	54434
	COLLEGE				
Graduate share	0.296	0.332	0.335	0.328	0.393
	(0.117)**	(0.084)***	(0.081)***	(0.078)***	(0.107)***
Rsquared	0.4084	0.4442	0.4552	0.4628	0.5341
N. obs	16249	16249	16249	16249	16249
Region dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	No	Yes	Yes	Yes	Yes
Firm size	No	Yes	Yes	Yes	Yes
Temporary contract	No	No	Yes	Yes	Yes
Tenure	No	No	No	Yes	Yes
Occupational means	No	No	No	No	Yes

Note: Dependent variable is the log net month wage. All the regressions include a constant term, age, age squared, experience, experience squared, tenure, tenure squared, educational attainment dummies, region dummies, marital status; firm size dummies, sector dummies, part-time dummy, temporary contract and tenure. Occupational means are added progressively. Robust and clustered standard errors are reported in parenthesis. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 4: Human capital externalities and wages, different measure of graduate density

	(1)	(2)	(3)	(4)
	FEMALE		MALE	
	Standard	Extended	Standard	Extended
	PANEL A			
Non linearities				
Graduate	0.911	0.713	0.955	0.977
	(0.146)***	(0.195)***	(0.156)***	(0.158)***
Graduate density^2	-0.556	-0.361	-0.573	-0.596
	(0.219)**	(0.201)*	(0.217)***	(0.174)***
R squared	0.5544	0.5674	0.3984	0.4169
N. obs.	50185	50185	66536	66536
	PANEL B			
Graduate density (including also self-employed)	0.398	0.361	0.450	0.407
	(0.089)***	(0.054)***	(0.067)***	(0.066)***
R squared	0.5484	0.5653	0.3876	0.4084
N. obs	50185	50185	66536	66536
	PANEL C			
Graduate density (at 1-digit classification)	0.400	0.346	0.470	0.423
	(0.089)***	(0.055)***	(0.067)***	(0.070)***
R squared	0.5479	0.5663	0.3923	0.4122
N. obs	50185	50185	66536	66536
	PANEL D			
Graduate density in splines (0-5% reference category)				
05– 10%	0.012	0.050	0.099	0.145
	(0.045)	(0.040)	(0.032)***	(0.035)***
10-30 %	0.133	0.118	0.147	0.181
	(0.016)***	(0.035)***	(0.018)***	(0.025)***
30+ %	0.253	0.209	0.337	0.358
	(0.031)***	(0.060)***	(0.036)***	(0.042)***
R squared	0.5513	0.5648	0.3988	0.4172
N. obs	50185	50185	66536	66536
Region dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Firm size	Yes	Yes	Yes	Yes
Temporary contract	Yes	Yes	Yes	Yes
Tenure	Yes	Yes	Yes	Yes
Occupational means	No	Yes	No	Yes

Note: Dependent variable is the log net month wage. All the regressions include a constant term, age, age squared, experience, experience squared, tenure, tenure squared, educational attainment dummies, region dummies, marital status, firm size dummies, sector dummies, part-time dummy, temporary contract and also tenure. Occupational means are included in the extended specification. Robust and clustered standard errors are reported in parenthesis. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 5: Human capital externalities and wages, IV estimates by gender

	(1)	(2)	(3)	(4)	(5)	(6)
	MALE			FEMALE		
College share	0.924	0.930	0.947	1.391	1.402	1.376
	(0.185)***	(0.184)***	(0.180)***	(0.555)**	(0.567)**	(0.541)**
Instruments for college share						
Employed 15-24 in 1999	X		X	X		X
(by region and occupation)						
Employed15-24*share 3+2		X	X		X	X
courses in each region						
First-stage						
Employed 15-24 in 1999	-0.692		2.039	-0.374		-0.831
(by region and occupation)	(0.133)***		(0.951)**	(0.171)**		(0.869)
Employed15-24*share 3+2		-0.914	-3.568		-0.482	0.593
courses in each region		(0.173)***	(1.239)***		(0.224)**	-1.195
R squared	0.392	0.392	0.391	0.518	0.517	0.519
F-test instruments	26.80	27.70	17.05	4.75	4.63	3.38
	p-value (0.000)	p-value	p-value	p-value	p-value	p-value
		(0.000)	(0.000)	(0.031)	(0.033)	(0.037)
Other controls at occupational level	Yes	Yes	Yes	Yes	Yes	Yes
N. obs.	66168	66168	66168	49959	49959	49959

Note: Dependent variable is the log net month wage. All the regressions include a constant term, age, age squared, experience, experience squared, tenure, tenure squared, educational attainment dummies, region dummies, marital status; firm size dummies, sector dummies, part-time dummy, temporary contract, tenure and occupational means. Robust and clustered standard errors are reported in parenthesis. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 6: Human capital externalities and wages, IV estimates by education group

	(1)	(2)	(3)	(4)	(5)	(6)
	TERTIARY			HIGH SCHOOL		
College share	0.774	0.773	0.772	1.171	1.179	1.193
	(0.262)***	(0.263)***	(0.265)***	(0.263)***	(0.265)***	(0.269)***
Instruments for college share						
Employed 15-24 in 1999 (by region and occupation)	X		X	X		X
Employed15-24*share 3+2 courses in each region		X	X		X	X
R squared	0.527	0.527	0.528	0.485	0.484	0.483
F-test instruments	6.56	7.18	6.65	20.84	20.73	10.76
	p-value	p-value	p-value	p-value	p-value	p-value
	(0.011)	(0.008)	(0.001)	(0.000)	(0.000)	(0.000)
N. obs	16685	16685	16685	54132	54132	54132
	LOWER SECONDARY			PRIMARY OR LESS		
College share	1.909	1.928	2.018	2.013	1.891	1.259
	(0.803)**	(0.796)**	(0.770)***	-2.281	-2.139	-1.620
Instruments for college share						
Employed 15-24 in 1999 (by region and occupation)	X		X	X		X
Employed15-24*share 3+2 courses in each region		X	X		X	X
R squared	0.457	0.456	0.450	0.476	0.479	0.489
F-test instruments	4.55	4.67	3.41	1.80	1.89	2.14
	p-value	p-value	p-value	p-value	p-value	p-value
	(0.035)	(0.032)	(0.036)	(0.182)	(0.172)	(0.123)
N. obs.	39463	39463	39463	6447	6447	6447
Other controls at occupational level	Yes	Yes	Yes	Yes	Yes	Yes

Note: Dependent variable is the log net month wage. All the regressions include a constant term, age, age squared, experience, experience squared, tenure, tenure squared, educational attainment dummies, region dummies, marital status, firm size dummies, sector dummies, part-time dummy, temporary contract, tenure and occupational means. Robust and clustered standard errors are reported in parenthesis. * significant at 10%, ** significant at 5% and *** significant at 1%.