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Signalling and Productivity Effects of Overeducation: Is It Really a Waste of Resources?

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Abstract

Overeducation raises concerns that governments may be overinvesting in education. To inform the debate, this paper studies the impact of overeducation on productivity. We advance the literature by considering that returns to overeducation may be due both to productivity and signalling effects. To disentangle both effects, we apply Wolpin's (1977) methodology and compare the rates of return of screened (employed) and unscreened (self-employed) workers. To overcome well-known endogeneity problems due to unobserved heterogeneity, we estimate a panel with individual and employment-status fixed effects. Our results show that signalling effects are relevant and that overeducation does not carry a productivity penalty.

Keywords: *Overeducation, signalling model, human capital model, unobserved heterogeneity.*

JEL classification: I20, J24, J31.

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1. Introduction

Over the past century, the world witnessed an unprecedented educational expansion. As a consequence, general levels of education surged in many parts of the world and are now much higher than ever before.[1] This has not just allowed these countries to reach higher than ever levels of material well-being but has also provided society with other benefits in terms of reduced crime, improved public health, lower mortality and greater political participation (Lochner, 2011).

Along with greater levels of education, however, came the so-called overeducation phenomenon. The concept of overeducation refers to the excess education of workers who have more education than is required by their job.[2] Its incidence in developed countries is widespread[3] and there are concerns that public investment resulting in overeducation may be a waste of resources, and hence that the public sector may be overinvesting in education.(e.g. Chevalier, 2003).[4] To the extent that years of education above the required level do not

[1] See for example Breen (2010) and Schofer and Meyer (2005).

[2] We use the terms 'overeducation'; 'overqualification' and 'surplus schooling' interchangeably.

[3] Leuven and Oosterbeek (2011) report that about 40% of workers could be currently overeducated. In our own samples, about one half and one third of Cypriot and British workers were overeducated, respectively.

[4] Besides, widespread educational mismatch generates concerns about the implied allocative inefficiencies and suggests that the education system is not doing a good job in allocating levels of education across workers.

increase productivity enough to compensate for their cost, public investment leading to overeducation will be inefficient and the argument in favour of reduced public investment in education will be reinforced. Research on the productivity effects of overeducation is therefore needed to inform the debate on the design of public education policies.

The objective of this paper is to contribute to that debate by shedding new light on the impact of overeducation on productivity. Using data from two European countries –Cyprus and the UK– from the periods 2005 to 2007 and 1991 to 2006, respectively, we test for two overeducation hypotheses: the Strong Overeducation Hypothesis (SOH), which suggests that overeducation does not increase productivity, and the Weak Overeducation Hypothesis (WHO), which claims that overeducation carries a productivity penalty.

A now large empirical literature studies the impact of overeducation on earnings. A consistent finding is that the returns to overeducation are positive but significantly smaller than those of required education. In the evidence summarised by Leuven and Oosterbeek (2011), for example, overeducation increased earnings on average half as much as required education. These results indicate that overeducated workers receive lower wages than equally educated ones who are correctly matched to their jobs, therefore supporting the WOH.[5]

One severe limitation of the overeducation literature is that no study (that we are aware of) considers the potentially confounding effects of returns to educational signals (Spence, 1973;

[5] This literature includes Duncan and Hoffman (1981); Daly et al. (2000), Groot (1996); Hartog and Oosterbeek (1988); Sloane et al (1999); Dolton and Vignoles (2000); Cohn and Ng (2000) and Lin and Wang (2000).

Arrow, 1973). The important implication is that we do not yet know whether the returns to overeducation identified by the previous literature are the consequence of increases in productivity and so part of the social returns to education as postulated by human capital theory, or just rewards to educational signals and so strictly private returns, as implied by signalling theory. The main contribution of our research is to provide for the first time estimates of the returns to over, required and undereducation *net of signalling effects*.

Signalling models study interactions marked by the presence of asymmetric information.[6] In a labour market context, employers cannot observe the ability and other relevant characteristics of potential employees. If education is less costly for high ability individuals (for instance because they incur lower effort costs), an equilibrium may exist where they acquire more education than lower ability competitors to signal their greater productivity to potential employers. These in turn are willing to pay more educated workers higher wages. Thus, like the human capital model, signalling theory offers a sensible economic explanation of the observed positive correlation between wages and schooling, one that does not require any impact of education on productivity. [7]

[6] Signalling models are basically equivalent to screening models and so we will use the terms 'siganlling' and 'screening' interchangeably. The difference is that while in signalling models workers move first choosing their educational level to signal their productivity to employers, in screening ones employers make the first move by choosing the educational level required for a job.

[7] Besides the human capital and signalling models, other existing labour market theories have been put forward to explain the emergence of and the returns to overeducation from an individual perspective or as an equilibrium phenomenon. These are career mobility theory, assignment theory and job competition theory. Moreover, several search models have

The idea that returns to educational signals could explain the positive returns to overeducation found by the literature is appealing. Inherent to the notion of overeducation is the existence of a level of education required to perform a job. If such a level of education exists, it is not clear that productivity should increase with education once it is reached. That is, further education may well be redundant. In contrast, additional years of completed education will still be sending a signal about the individual's hidden ability. Testing for the SOH implies testing for the idea that any positive returns to overeducation should be due to signalling.[8]

Taking signalling into account is also important to test for the WOH, since the existence of positive returns to educational signals would confound the returns to required and overeducation. Moreover, the value of required and overeducation signals, if positive, will most likely be different. The reason is that these signals provide two pieces of information to an employer: which level of education the person reached and whether she is applying to a

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recently been proposed in which overeducation emerges as an equilibrium phenomenon in settings with and without on-the-job search (e.g. Albrecht and Vroman, 2002; Dolado et al, 2009; Holzner and Launov, 2010). This literature (as well as the empirical one) has been reviewed by Leuven and Oosterbeek (2011). See also McGuinness (2006) and Tsang and Levin (1985).

[8] Note that, provided those returns are positive, our SOH corresponds to the strong screening hypothesis applied to overeducation. The strong screening hypothesis states that productivity does not change with education and so that all returns to education are due to signalling effects (Psacharopoulos, 1979); the weak screening hypothesis, instead, that they are partly explained by productivity increases and partly by signalling effects (Spence, 1973; Arrow, 1973).

position that demands it or not. The latter bit of information should diminish the returns to overeducation as a signal and that could be (part of) the explanation of the gap in the rates of return to required and overeducation.

Another problem that flaws most of the overeducation literature is one of endogeneity: research on overeducation needs to control for the fact that workers do not choose their completed and required education randomly, especially because these choices are correlated with unobserved ability. However, although there are recent exceptions (e.g. Tsai, 2010; Dolton and Silles, 2008), most articles report OLS estimates which are afflicted by omitted variable (ability) bias.[9] These issues led Leuven and Oosterbeek (2011, p. 317) to conclude their review of the overeducation literature by stating that their "own reading of the evidence is that omitted variable bias is substantial and possibly explains the entire difference between returns to required schooling and overschooling and underschooling". Our research faces an additional challenge: because the approach we follow to disentangle productivity and signalling effects uses differences between groups of unscreened (self-employed) and screened (employed) workers, we also need to control for self-selection into the alternative employment statuses.

One possible strategy to deal with these econometric issues is to use Instrumental Variables. Nevertheless, IV models are particularly challenging in this area of research, for they require finding valid instruments for both completed and required education.[10] This severely limits its potential in overeducation research. Our approach instead takes advantage of the panel nature

[9] Measurement errors are another cause of concern for the overeducation literature. We comment on this question in section 4.

[10] In our case, moreover, we would also need to instrument for employment status.

of the British Household Panel Survey and estimates a model with individual and employment-status fixed effects for the British sample.[11] To the extent that unobservable individual-specific characteristics that may bias the OLS estimates do not change across time, they will not bias our fixed effects ones.

In order to estimate the returns to over, required and undereducation, we use the Duncan and Hoffman modified earnings equation (the so-called ORU specification). To examine whether signalling or productivity effects explain the positive returns to surplus education, we apply Wolpin's (1977) methodology, dividing our samples into two groups of screened and unscreened workers and then comparing their rates of return.

As predicted by Leuven and Oosterbeek (2011), we find no evidence of the existence of a productivity penalty to overeducation and that differences in earnings between overeducated and correctly matched workers identified by the previous literature are caused by a failure to control for ability bias: while our OLS estimates lend support to the SOH, once we control for unobserved heterogeneity the WOH is clearly rejected.

Results also indicate the existence of positive and different returns to required and overeducation signals. This suggests that raw rates of return cannot be relied upon to study the productivity effects of overeducation. Moreover, they reject both Thurow's (1979) job competition model, which requires the returns to overeducation and undereducation to be equal to zero, and the basic human capital model, which requires them to be identical. They

[11] Panel data are not available for the Cypriot sample and thus we cannot offer panel evidence for Cyprus..

are however consistent with an augmented version of the human capital model in which overeducation may substitute for other components of a person's human capital and also with the weak screening hypothesis.

The rest of the paper continues as follows. Section 2 explains our hypotheses and outlines the methodology we adopt to test for them. Section 3 describes our datasets and provides some descriptive statistics. We present our results in section 4. The final section concludes with a discussion of the implications of our findings.

2. Hypotheses and Methodology

Overeducation could be a cause of concern if the social returns to education were lower for workers who end up overeducated. Thus, the key questions are: Does overeducation increase productivity? Does it carry a productivity penalty with respect to required education? To answer these questions, we pose two overeducation hypotheses, which we label the *Strong* and the *Weak Overeducation Hypotheses* (SOH and WOH).

Hypothesis 1: Strong Overeducation Hypothesis. *Years of overeducation do not increase workers' productivity.*

Hypothesis 1 states that years of overeducation do not make workers more productive. Even if this hypothesis may seem extreme in the light of the available evidence, notice that the existence of positive returns to overeducation is not incompatible with the SOH. This hypothesis would still be true if those positive returns were the consequence of the signalling value of education, that is, if the strong *screening* hypothesis were true for years of

overeducation. Hypothesis 1 therefore tests whether the positive returns to overeducation pervasively found by the previous literature are just a consequence of signalling.

If the SOH is rejected then it is relevant to ask whether there exists a productivity penalty to overeducation, that is, whether the impact of education on productivity is weakened if a worker ends up in a job for which she is overqualified.

Hypothesis 2: Weak Overeducation Hypothesis. *Years of overeducation have a positive but smaller impact on workers' productivity than years of required education.*

To test for these hypotheses, we adopt the ORU specification proposed by Duncan and Hoffman (1981) and followed by most of the overeducation literature. The basic ORU regression equation is:

$$lnW_i = \alpha_R S_i^R + \alpha_O S_i^O + \alpha_U S_i^U + x_i'\beta + \epsilon_i \qquad (1)$$

where *ln W* is the log of the monthly wage of individual *i* and x_i is a vector of individual characteristics. Actual years of schooling (S^A) is decomposed into years of schooling required to perform a specific job (S^R) plus any surplus (S^O) or minus any deficit years of schooling (S^U). Hence, $S^A = S^R + S^O + S^U$. When the individual's actual schooling matches her required schooling (i.e. $S^A = S^R$), S^O and S^U are equal to zero. Overeducated individuals have a surplus over required years of schooling since their actual schooling level is above what is required by their job, $S^O = S^A - S^R > 0$, and $S^U = 0$. Finally, individuals whose actual schooling is less than the required years of schooling, have $S^U = S^R - S^A > 0$, and $S^O = 0$. In equation (1), α_R, α_O and α_U are the returns to required, over- and under-education.

We follow the approach proposed by Wolpin (1977) and adopted for example by Brown and Sessions (1999) to disentangle the productivity and the signalling effects of required, over and under education on earnings. The approach is based on the idea that signals are only relevant in a context of asymmetric information. It is only because employers cannot directly observe the productivity of candidates that they may use their educational investment as a signal of it. Therefore, while the returns to education of employed individuals may be rewarding both productivity gains and educational signals, those of self-employed workers are purely due to productivity gains. The approach thus proposes dividing the sample into subsamples of (screened) employed and (unscreened) self-employed individuals and comparing the returns to education investment across the two groups.

We first run OLS regressions of equation (1) for the pooled samples of UK and Cypriot workers, separately for employed and self-employed workers. The SOH, that is the hypothesis that surplus years of education do not increase productivity, will receive support from the evidence if the productivity parameter of years of education, δ_O, is not positive and statistically significant for the unscreened samples. The WOH, which says that overeducation increases productivity but less than required education, in turn requires $\delta_R > \delta_O > 0$, again for the unscreened samples.

OLS estimates assume that workers are homogenous with respect to unobservables, and are biased if this assumption is not satisfied. Thus, if any unobservable variable (such as ability) affects the choice of completed and required education and between employment and self-employment, the OLS estimates will be biased. To avoid these sources of bias we take advantage of the panel nature of BHPS and estimate a fixed effects model with individual and

employment-status fixed effects for the British sample. To the extent that the unobservable individual-specific characteristics that may bias the OLS estimates do not change across time, they will not bias our fixed effects estimates. In order to include employment-status fixed effects, we mix the samples of employed and self-employed workers. We accordingly modify equation (1) by adding four terms to the RHS, the employment-status dummy variable (which equals 1 for employees and 0 otherwise) and its product with each of the three educational variables. The inclusion of these slope-dummies in the regression equation allows us to estimate the difference in the returns to education between the screened and unscreened workers and to test for hypotheses 1 and 2.[12] Our panel regression equation is:

$$lnW_{it} = \gamma_i + \theta_E \delta_{it}^S + \alpha_1 S_{it}^R + \alpha_2 \delta_{it}^S S_{it}^R + \alpha_3 S_{it}^O + \alpha_4 \delta_{it}^S S_{it}^O + ... + x_{it}'\beta + \epsilon_{it} \quad (2)$$

where δ_S is the employment-status dummy, and γ_i and θ_E are the individual and employment status fixed effects. Again, the SOH will be rejected if years of overeducation have a positive and statistically significant impact on the earnings of self-employed workers, that is, if $\alpha_3 - \alpha_4 > 0$ in equation (2). In order to test for the WOH, we planned to perform a Likelihood Ratio test of the full (unrestricted) model given by (2) against a nested model which requires $\alpha_1 + \alpha_2 = \alpha_3 + \alpha_4$. This restriction imposes the productivity impact of an extra year of required education to be identical to that of an extra year of overeducation. In other words, it requires the impact of education on earnings minus its signalling value –i.e. the productivity effect– to be equal for required and overeducation. If the reduced model were rejected, the evidence would lend support to the WOH. Nonetheless, we finally did not need to carry out the test

[12] For reference, we also report the results of separate fixed effects regressions for employed and self-employed workers.

because we found that the returns to overeducation due to productivity gains were slightly larger for overeducation than for required education.

3. Data

Our analysis focuses on two countries from the European Union: Cyprus and the UK. These countries are particularly interesting cases to study overeducation because of the large proportion of graduates they produce. Both are among the top ten European countries with the highest percentage of individuals with tertiary education both for people between 30 and 34 years of age (Fig.1) and between 25 and 64 years of age (Fig. 2).[13]

The empirical analysis uses data from the Cyprus Statistics on Income and Living Conditions Survey (CY-SILC) and from the British Household Panel Survey (BHPS). *CY-SILC* is part of the European Union Statistics on Income and Living Conditions (EU-SILC) survey performed by Eurostat. It provides data on wages, poverty, living conditions, housing conditions, social exclusion, educational levels, health status, employment status and other socio-economic variables both at the household and individual level.[14] The data collection for

[13] This is especially true of Cyprus. The latest Statistics of Education report that 79% of high school graduates continued their studies beyond secondary education in the 2009/2010 academic year (Statistical Service of Cyprus, 2011**)**

[14]For further information visit:

http://epp.eurostat.ec.europa.eu/portal/page/portal/income_social_inclusion_living_conditions/introduction

CY-SILC is conducted by CYSTAT, the Statistical Service of the Republic of Cyprus, and three waves are available for analysis (corresponding to 2005, 2006 and 2007).[15]

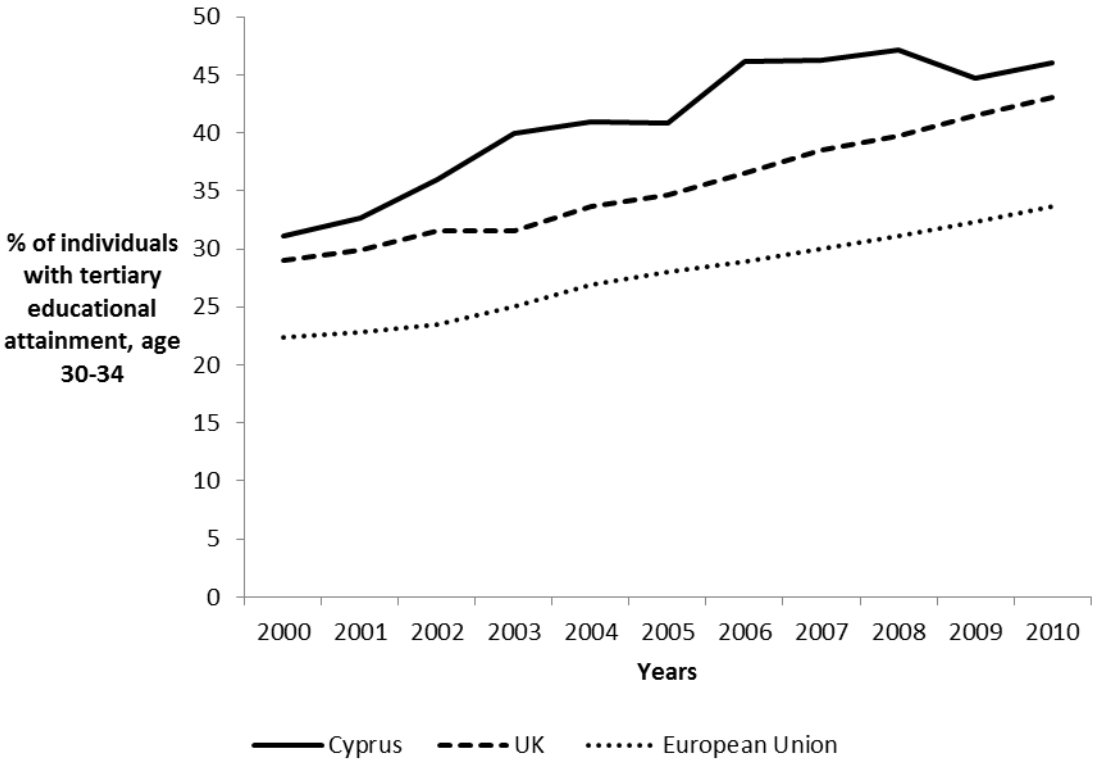

Fig. 1: Percentage of individuals with tertiary education for age-range 30-34 from 2000-2010. Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database. Accessed on 12/03/2012.

[15] We were not able to construct a panel with the data from Cyprus since personal identification numbers are not the same across survey dates.

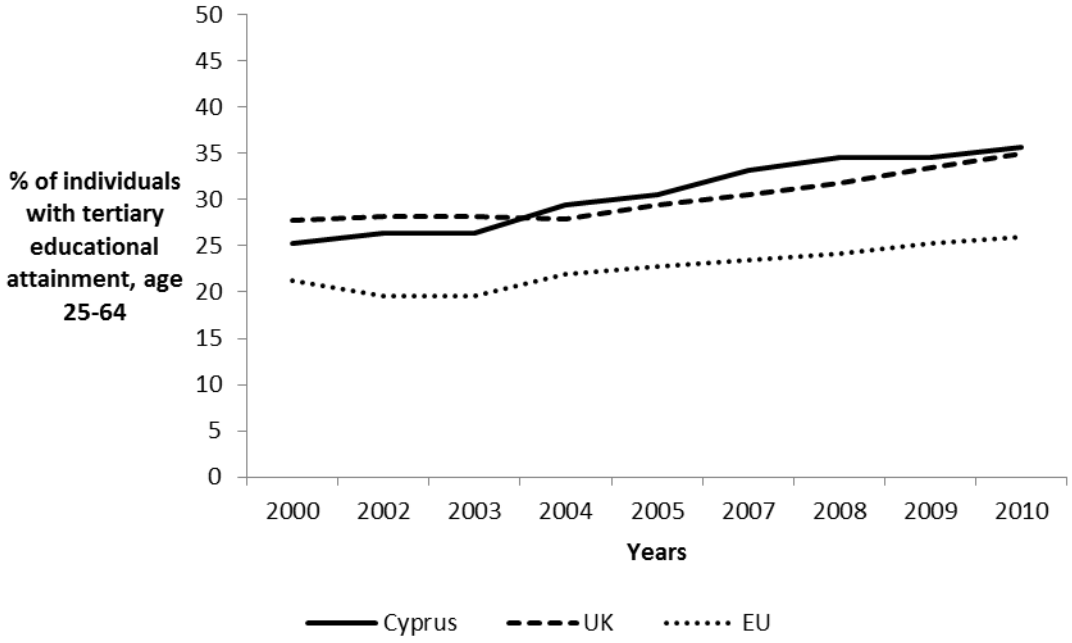

Fig. 2: Percentage of individuals with tertiary education for age-range 25-64 for years 2000-2010. Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database : Accessed on 12/03/2012

The BHPS is carried out by the Longitudinal Studies Centre of the Institute for Social and Economic Research (ISER). It is an annual household survey, starting in 1991, where all household members above the age of 16 are interviewed. Data are available at the individual and household level. The BHPS is a multi-purpose survey and collects data on demographics, education, labour history, employment, occupations, financial management, family life, ethnicity, health, income, psychological characteristics and other variables.[16] In this paper we use data from 1991 to 2006.

An important decision to adopt in any study about overeducation concerns the definition and measurement of required schooling. We define required schooling as 'the minimum

[16]More details are available at:

http://www.iser.essex.ac.uk/survey/bhps/documentation/volume-b-codebooks/index-terms

educational level one should have to be employed in a given occupation'.[17] That is, we assume that the minimum level of education required to enter a given job is a suitable measure of required schooling.

There are three main approaches to determine the level of required schooling: (i) the *job analysis approach*, where specialists determine an occupation's required schooling (Rumberger, 1987); (ii) the *realised-matches approach*, where the mean or mode years of schooling of individuals in the same occupation is used (Verdugo and Verdugo, 1989; Kiker et. al., 1997); and (iii) the *self-assessment approach*, where the survey directly collects information from interviewees about their current job's required years of schooling (Duncan and Hoffman, 1981).

To measure the required level of education in Cyprus, we followed the job analysis method. We obtained the relevant information from different professional organisations which are responsible for monitoring the qualifications of individuals in each occupation.[18] We used the two-digit classification of the International Standard Classification of Occupations (ISCO-88). For each occupation, we contacted the corresponding professional organisation either by phone or through the organisation's website. Additionally, when possible, this information

[17] For example, in Cyprus a lawyer must hold a BA degree and one extra year of professional training via the Cypriot barrister scheme. Anything above that is considered as overeducation.

[18] For example, ETEK is the umbrella organisation for all Engineers in Cyprus covering occupations like architecture, civil, electrical and chemical engineering.

was verified through the 'Database of regulated professions in the EU Member States, EEA countries and Switzerland'.[19]

The job analysis approach is not available for the UK. Furthermore, the BHPS does not ask individuals about the years of schooling required for their main occupation. Therefore, we adopted the modal (realised-matches) approach instead.[20] We classified occupations of individuals using the most disaggregated classification of the Standard Occupational Classification (374 unit groups). Then for each wave, separately, we found the mode years of schooling per occupation and constructed the required years of schooling variable.

The variables of interest were derived, where possible, in the same way for the two samples. We categorised the *educational level* of every individual using the International Standard Classification of Education 1997 (ISCED-97).[21] For Cyprus, we converted the level of education or schooling cycle completed into equivalent years of schooling for each individual. In turn, the BHPS contains an ISCED variable which we used for the UK. We used gross earnings as a proxy for *income* for both employed and self-employed individuals and the Cyprus and UK samples. As for the *work experience* variable, we were able to use information on the actual experience of the individual, instead of an artificially constructed

[19]For further information visit:
http://ec.europa.eu/internal_market/qualifications/regprof/index.cfm?action=professions&profession=&id_country=&letter=A#top

[20] As Hartog (2000) puts it, 'the choice is dictated by data availability: you use what is available'.

[21] For further information visit:
http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm

labour market experience variable using age as a proxy, as it is conventionally done in empirical applications. Each person in the CY-SILC survey was asked *"how many years have you been working in a paid job"*. Actual experience levels could be determined as well using BHPS' extensive information on the individual's working life histories.

Year and industry dummy variables and other controls were also included in the regression equations. Using the general categories of the Statistical Classification of Economic Activities (Rev 1.1), we created twelve industry dummy variables. For Cyprus, we were also able to control for gender, marital status and health status. All these controls were included for the UK analysis too. Furthermore, taking advantage of the richer content of the BHPS, in that context, we also controlled for ethnic origin and for the number of children the individual had.[22]

Farmers, individuals in the army force[23] and students were excluded from the Cypriot sample. Restricting the analysis to those who reported their earnings and individuals between the ages of 16-65, a total of 12,336 individuals constitute our sample for Cyprus. Likewise, students and individuals in the army force were excluded from the British sample, leaving a total of 91,465 individuals.

[22] Ethnic origin is not relevant for Cyprus since the population represented in CY-SILC is ethnically homogeneous.

[23] In Cyprus, males have to serve two years of compulsory army services after they finish school. Individuals interviewed during this period are excluded from the sample.

Tables 1 to 4 provide basic summary statistics.[24] Among other things, table 1 shows that females received on average lower wages than males, and that males held more surplus education than females.

Table 1:
Sample Means and Standard Deviations by gender

Variables	CYPRUS			UK		
	All	**Males**	**Females**	**All**	**Males**	**Females**
Log Earnings	9.169	9.405	8.902	6.918	7.203	6.617
	(0.840)	(1.064)	(0.848)	(0.808)	(0.677)	(0.825)
Required	11.63	11.55	11.72	12.07	12.12	12.01
Education	(3.525)	(3.489)	(3.564)	(3.387)	(3.431)	(3.337)
Surplus	1.955	2.066	1.829	1.109	1.221	1.139
Education	(2.636)	(2.657)	(2.606)	(2.149)	(2.249)	(2.143)
Deficit	0.818	0.936	0 .685	0.888	0.997	0.892
Education	(1.648)	(1.729)	(1.541)	(2.045)	(2.151)	(2.038)
Experience	18.49	20.53	16.19	21.34	21.41	21.28
	(11.91)	(12.73)	(10.51)	(12.82)	(12.79)	(12.85)
Age	40.47	41.21	39.62	38.69	38.79	38.58
	(11.58)	(11.99)	(11.06)	(11.80)	(11.96)	(11.62)
Married	0.724	0.742	0.703	0.7266	0 .737	0 .715
	(0.446)	(0.437)	(0 .456)	(0.446)	(0.440)	(0.451)
White				0.936	0 .922	0.951
				(0.244)	(0.367)	(0.215)
N	12,336	6,540	5,796	9,1465	47,284	44,181

Table 2 displays the distribution of workers across the three education categories, disaggregated by gender for the two surveys. Around one half and one third of the samples were overeducated in Cyprus and the UK, respectively, while a larger proportion of UK

[24] It should be noted that earnings are recorded in Euros for Cyprus whereas they are given in British pounds for the UK.

individuals were employed in well-matched jobs (44% compared to 25% in Cyprus).[25] A slightly greater proportion of males than of females were overeducated in both countries, whereas the latter were more likely to be employed in a job that matched their educational qualifications.

Table 2:
Incidence of Over- Under and Required Education for Males and Females in Cyprus and UK

	CYPRUS			UK		
Variables	Full Sample	Males	Females	Full Sample	Males	Females
Overeducation (%)	50.11	50.86	49.28	31.93	32.76	31.04
Undereducation (%)	24.72	27.77	21.29	23.76	25.35	22.06
Required Education (%)	25.16	21.38	29.43	44.31	41.89	46.89
N	12,336	6,540	5,796	91,465	47,284	44,181

Table 3 contains information on the incidence of overeducation by educational qualifications. In Cyprus, university graduates were the most likely to be overeducated. By contrast, in the UK a majority of the overeducated individuals held higher-vocational certificates[26].

Finally, table 4 disaggregates this information by race for the UK. In that context, non-white individuals were more likely than whites to be employed in a job for which they were overeducated. Furthermore, for the non-whites sample, women were more likely to be

[25] These differences could be explained by the way we measure required schooling. Cohn and Khan (1995) found that overeducation is lower when the realised matches methodology (mean or mode) instead of a subjective measure is used.

[26] This is an interesting result which deserves separate investigation beyond the scope of the current study.

overeducated or adequately educated than men. Additionally, white females were more likely to be employed in jobs for which they held deficit education than non-white females.[27]

Table 3:

Incidence of Overeducation by educational qualifications in Cyprus and UK

	CYPRUS	UK
Variables	Full Sample	Full Sample
Primary or 1st stage of basic education (%)	2.12	2.09
Lower Secondary or 2nd stage of basic education (%)	6.46	11.11
Upper Secondary Education (%)	36.19	26.25
Post-secondary non-tertiary Education Higher Vocational (%)	3.62	32.51
Tertiary education: first stage (%)	50.71	20.49
Tertiary education: Second stage (%)	0.94	7.55
N	12,336	91,465

Table 4:
Descriptive Statistics on Over- Under- and Required Education by Race (BHPS)

	UK					
	Whites			**Non-whites**		
Variables	Full Sample	Males	Females	Full Sample	Males	Females
Overeducation (%)	31.66	32.72	30.52	42.20	38.36	46.78
Undereducation (%)	23.56	25.00	22.04	22.48	27.53	16.45
Required Education (%)	44.78	42.28	47.44	35.32	34.11	36.77
N	88,505	45,674	42,831	2,960	1,610	1,350

[27] This could all be explained by labour market discrimination, a hypothesis which we leave to study in further research.

4. Results

Tables 5 and 6 provide the results of our estimations. Table 5 presents the OLS estimates for the two pooled samples and the groups of screened and unscreened workers, while table 6 presents the fixed effects estimates for the UK sample.[28]

Let us first comment on the OLS results. For both the Cypriot and the UK samples, we find that the returns to years of overeducation received by self-employed workers are not significantly different from zero. As we explained earlier on, these returns cannot include the impact of signalling and are thus an estimate of the productivity effect of education. Therefore, our OLS estimations lend support to the SOH, showing no evidence that overeducation increases productivity. They instead suggest that the (otherwise small) observed positive impact of years of overeducation on earnings is due to signalling. They are thus consistent with the strong screening hypothesis being true for overeducation.

Consider next the results for the screened sample of employed workers. We find estimates of the impact of the three categories of education *on earnings* that are broadly consistent with the previous overeducation literature.[29] The estimated returns to required and over-education are positive and statistically significant, the latter being several times greater than the former. In Cyprus, the returns to required and overeducation are 10.3% and 1.0% respectively, while

[28] Besides, table A1 in the Appendix reports FE results of equation (2) for the UK samples of female and male workers. These results are consistent with those presented in table 6.

[29] See footnote 3.

the equivalent UK estimates are 9.6% and 3.5%. Also as expected, years of undereducation yield a negative return of 5.9% for the Cypriot sample, and of 4.6% for the UK one.[30]

To sum up, our OLS results show that years of overeducation provide only a modest return and that such return is fully due to signalling. These results suggest that overeducation may indeed imply a waste of resources for society. As we explained in section 2, however, the OLS results are flawed by omitted variables and selection issues. Controlling for unobservables is especially important in our study, as we face the additional challenge of workers self-selection into the alternative employment statuses. Our preferred specification therefore controls for unobserved heterogeneity including individual and employment-status fixed effects. The results are presented in the last column of Table 6.[31]

The FE results portray a radically different picture of the consequences of overeducation. Notice first that we obtain a statistically significant estimate of the return to surplus schooling equal to 5.6%. Thus, we find evidence of a positive impact of overeducation on productivity and so we reject the SOH.

[30] The results about the impact of required education on earnings constitute evidence on the signalling model. Although the strong screening hypothesis is rejected, the results constitute evidence in favour of the weak screening hypothesis. As a matter of fact, signalling effects are substantial: we obtain that almost a third and more than half of the returns to required education are due to signalling effects for the Cypriot and the UK samples, respectively.

[31] For reference, table 6 also contains the results of separate FE regressions for the samples of employed and self-employed UK workers. Because they do not correct for self-selection into employment status the results are probably biased.

Table 5
Productivity and Signalling Effects: Pooled OLS with robust standard errors
(LHS variable: log of wage)

	Cyprus		**UK**	
	Employed	Self-Employed	Employed	Self-Employed
	(1)	(2)	(1)	(2)
Required Schooling	0.103 (0.002)***	0.071 (0.020)***	0.096 (0.007)***	0.050 (0.004)***
Surplus Schooling	0.010 (0.002)***	0.005 (0.029)	0.035 (0.001)***	0.004 (0.005)
Deficit Schooling	-0.059 (0.004)***	-0.043 (0.030)	-0.046 (0.001)***	-0.023 (0.005)***
Experience	0.060 (0.0018)***	0.022 (0.035)	0.034 (0.001)***	0.029 (0.004)***
Experience2	-0.001 (0.000)***	-0.001 (0.001)	-0.000 (0.000)***	-0.000 (0.000)***
Male	0.453 (0.011)***	0.593 (0.160)***	0.595 (0.004)***	0.70 (0.025)***
Health status	0.082 (0.016)***	0.425 (0.183)***		
Whites			0.033 (0.012)***	0.089 (0.047)***
R^2	0.50	0.36	0.44	0.17
N	12,157	173	81,400	9,972
F-statistic	1,094.51	11.89	2,555.63	59.24

Notes: Robust standard errors are in parentheses. Significance is denoted by: ***p<0.01, ** p<0.05.

Consider next the WOH. We need to compare the returns to required and overeducation for the group of unscreened, self-employed workers. If the former were found to be significantly greater than the latter, the evidence would support the WOH. Nonetheless, although the total return to overeducation is lower than that of required education, we find that overeducation has a slightly larger impact on productivity than required education: the rates of return to overeducation and required education net of signalling effects are, respectively, 5.6% and 5.4%. The reason is that the returns to overeducation signals that we obtain are much smaller

than those to required education signals (1.8% versus 3.8%). That is to say, we find that the gap between the total returns to required and overeducation is due to the smaller signalling value of overeducation. The evidence provided by our FE estimation therefore rejects the WOH as well and so we find no evidence that overeducation raises productivity less than required education. Furthermore, the total rate of return to overeducation displays a sharp increase (from 3.5% to 7.4%), although it remains below the returns to required schooling (9.2%).[32]

A plausible explanation of the difference between our OLS and FE results is the existence of negative correlation between unobserved ability and overeducation. As Sicherman (1991) argues, less able individuals are more likely to be employed in a job in which they are overeducated. Indeed, there is substantial evidence showing that overeducation is negatively correlated to different measures of ability.[33] The result suggests that such correlation biases the OLS estimates of the returns to overeducation downwards.

It is worth noting that the evidence we present is inconsistent with the job competition model proposed by Thurow (1979), which requires the returns to overeducation and undereducation to be equal to zero, and with the basic human capital model, which requires them to be identical. It is however consistent with an augmented version of the human capital model in

[32] Moreover, the estimate of the return to required education is slightly below its OLS counterpart (9.2% versus 9.6%) and is consistent with previous estimates of returns to education in the UK (Harmon et al. 2000). The return to required education signals is however smaller (3.8% versus 5%) and so the estimate of the productivity return to required education is now higher (5.4% versus 4.6%).

[33] This evidence is summarised by Leuven and Oosterbeek (2011).

which overeducation may substitute for other components of a person's human capital (in our case unobserved ability). Likewise, it is consistent with the weak screening hypothesis. From a different standpoint, our results confirm the importance of controlling for unobserved heterogeneity for research on overeducation.

Table 6:
Productivity and Signalling Effects: Fixed effects estimation(LHS variable: log of wage)

	Employed	Self-Employed	All
Required Schooling (S_R)	0.092 (0.002)***	0.055 (0.022)**	0.054 (0.003)***
S_R · Employed			0.038 (0.003)***
Surplus Schooling (S_O)	0.074 (0.002)***	0.043 (0.022)**	0.056 (0.004)***
S_O · Employed			0.018 (0.003)***
Deficit Schooling (S_U)	-0.081 (0.002)***	-0.048 (0.022)**	-0.065 (0.004)***
S_U · Employed			-0.014 (0.004)***
Experience	0.091 (0.001)***	0.074 (0.009)***	0.090 (0.001)***
Experience2	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
Married	0.058 (0.006)***	0.083 (0.048)	0.062 (0.007)***
R^2	0.28	0.13	0.19
N (indivduals)	16,792	2,054	18,846
N (Observations)	81,402	10,063	91,465

Notes: The estimation equations include industry dummies, number of children and training.
Significance is denoted with: *** p<0.01, ** p<0.05.

A literature that controls for unobserved heterogeneity to study overeducation is starting to emerge. The results are still mixed and so the evidence it provides is not yet conclusive. For instance, results in Bauer (2002) and Tsai (2010), as ours, suggest that the penalty to

overeducation vanishes once unobserved heterogeneity is controlled for. On the other hand, those of Dolton and Vignoles (2000) reach the opposite conclusion. An interesting avenue for further research in the area implies trying to correct for the effects of potential measurement errors.[34] Tsai (2010) and Dolton and Silles (2008) control for unobserved heterogeneity and measurement errors but again find opposing evidence.

5. Conclusion

With the objective of contributing to the debate on the nature and scale of public intervention in education markets, this paper studied the impact of overeducation on the productivity of workers from two European countries: Cyprus and the UK. We posed and tested for two overeducation hypothesis, which we named the Strong and the Weak Overeducation Hypotheses. The former claims that overeducation does not raise productivity, while the latter says that it raises productivity less than required education. Our analysis advanced the literature by taking into account the signalling value of education, to the best of our knowledge for the first time. To that end, we applied Wolpin's (1977) methodology and disentangled the signalling (and so the productive) value of required and overeducation by subtracting the rates of return of unscreened (self-employed) workers from those of screened (employed) workers.

Our pooled OLS estimates lent support to the SOH for both the Cypriot and the UK samples. We found small positive returns to overeducation but also that these were the consequence of the signalling value of education and not of productivity gains. However, these results are

[34] Given the difficulties to measure overeducation it is likely that measurements are done with error.

flawed by the usual econometric issues found in the overeducation literature (omitted variable bias and self-selection into completed and required education) and by the additional problem of self-selection into employment status.

To overcome these problems, we estimated a panel data model which controlled for unobserved heterogeneity by including individual and employment-status fixed effects. The FE results portrayed a radically different picture of the consequences of overeducation. First, we found that rates of return to overeducation increased sharply, and argued that this is possibly due to the negative correlation between unobservable ability and overeducation, since such correlation, which biases the OLS estimates downwards, does not affect the Fixed Effects ones. Second, the SOH was rejected, that is, we found evidence of a positive impact of overeducation on productivity. Finally, we found no evidence of the existence of a productivity penalty to overeducation. The different signals provided by required and overeducation turned out to be key for this result. We found that rates of returns are higher for required education than for overeducation. But we also found that the returns to the educational signals provided by required education are higher too. The resulting difference in the productivity impact of required and overeducation was negligible or negative. Our preferred specification thus rejected the WOH.

We believe our results are important for two main reasons: on the one hand, because they suggest that the productivity penalty to overeducation may be negligible if it exists at all. On the other hand, and from a different viewpoint, because they indicate that the signalling value of education affects the returns to required and overeducation and therefore that raw rates of return cannot be relied upon to study the productivity effects of overeducation. The challenging econometric problems facing research on overeducation make us keep a note of

caution. The robustness of our results to the presence of measurement errors, alternative econometric methodologies, tests of the screening hypothesis and definitions of overeducation should be confirmed by further research.

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Appendix

Table A1:
Productivity and Signalling Effects: Fixed effects estimation
LHS variable: log of wage

	Males	Females
Required Schooling	0.051 (0.004)***	0.044 (0.005)***
S_R · Employed	0.027 (0.003)***	0.055 (0.005)***
Surplus Schooling	0.053 (0.005)***	0.043 (0.006)***
S_O · Employed	0.015 (0.004)**	0.027 (0.006)***
Deficit Schooling	-0.057 (0.005)**	-0.065 (0.007)***
S_U · Employed	-0.010 (0.004)**	-0.021 (0.007)***
Experience	0.094 (0.002)***	0.087 (0.002)***
Experience2	-0.001 (0.000)***	-0.001 (0.000)***
Married	0.063 (0.010)***	0.024 (0.010)**
R^2	0.20	0.22
N (Observations)	47,284	44,181

Notes: The estimation equations include industry dummies, number of children and training. Significance is denoted with: *** p<0.01, ** p<0.05, * p<0.1