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Educational and Skills Mismatches: Unravelling Their Effects on Wages Across Europe

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Keywords Educational Mismatch, Skills Mismatch, Wages, European Survey
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Abstract

This paper is among the firsts to investigate the impact of overeducation and overskilling on workers' wages using a unique pan-European database covering twenty-eight countries for the year 2014, namely the CEDEFOP's European Skills and Jobs (ESJ) survey. Overall, the results suggest a wage penalty associated with overeducation. When interacting educational mismatch with skills mismatch into apparent overeducation and genuine overeducation, the results suggest that the highest wage penalty is reached for workers that are both overeducated and overskilled.

Keywords: Educational mismatch; Skills mismatch; Wages; European survey.
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1. General Background

It is undeniable that the level of education has increased significantly in advanced industrial countries in recent years (Barro and Lee, 2013). In the last decade, the European Union faced a massive increase in tertiary educational attainment and met its target of having at least 40% tertiary graduates aged between 30-34 (European Commission, 2019). More precisely in 2019, the share of 30 to 34 year-olds having successfully completed tertiary education was evaluated at 40.7%, compared to 32% in 2009. Simultaneously, the level of requirements for jobs has also risen (Green, 2007), leading researchers to investigate how these two evolutions are related to each other (Korpi and Tahlin, 2009). If the level of education of workers does not rise at the same rate as the one required by jobs, educational mismatch may arise (Freeman, 1976) and represents the difference between the level of education of a worker and the level of education required for her/his job. A mismatched worker may thus be overeducated if her/his level of education is higher than the one required to perform her/his job, or undereducated in the reverse case. Focussing on the first situation, the European Commission (2017) shows that overeducation is an important and growing phenomenon that concerned on average 40.2% of workers in the EU28 countries over the years 2002-2016.

Most empirical studies on the impact of overeducation on wages consistently find the same two results: (i) those workers suffer a wage penalty in comparison with equally-educated employees working in jobs that match their levels of education; (ii) they get a wage premium in comparison with those working in the same jobs but possessing a level of education that actually matches the requirements for those jobs (Duncan and Hoffman, 1981; Cohn and Khan, 1995; Sloane et al., 1999 ; Allen and Van der Velden, 2001; Bauer, 2002; McGuinness, 2006; Lindley and McIntoch, 2010; Leuven and Oosterbeek, 2011; Bender and Heywood, 2011).

Nevertheless, overeducation may not reflect workers' real competencies on the job, and any current evidence that addresses the effect of overeducation on wages as such may therefore be biased. Indeed, overeducated workers may possess the required level of skills needed to perform their jobs, and overeducation does not necessarily imply overskilling (Pellizzari and Fichen, 2013; Pecoraro, 2014; McGuinness et al., 2018). Since workers may also differ when comparing their informal skills acquired through experience, on-the-job training, or even thanks to their innate ability (Chevalier, 2003; Verhaest and Omey, 2009; Chevalier and Lindley, 2009), one solution to mitigate such bias consists in refining the definition of educational mismatch by making educational and skills mismatches interact. Some studies have proposed

alternative measures in order to better account for heterogeneity in workers and jobs[1], with a common main result that the wage impact of overeducation is overestimated in studies that assume equally educated workers to be homogenous in their human capital endowment (Chevalier, 2003; Chevalier and Lindley, 2009; Green and Zhu, 2010; Mavromaras *et al.*, 2013; Pecoraro, 2014; Pecoraro, 2016; Caroleo and Pastore, 2017).

The originality of this paper lies in the fact that we deepen these literature insights. More precisely, this paper investigates whether interactions between overeducation and overskilling mitigate the historically known wage penalties, at European level, by relying on subjective measures of overeducation and overskilling. We therefore postulate that overeducation is then either *apparent* or *genuine* according to whether overeducated workers are properly skilled or overskilled. Our main contribution is threefold. First, we statistically compute the number of years of overeducation, apparent overeducation and genuine overeducation, allowing us to measure the magnitude of the impact of mismatch variables on wages. Second, we take advantage of a unique pan-European dataset, the European Skills and Jobs (ESJ) survey, covering all the EU28 member states. Thirdly, we take into account potential endogeneity in the relationships by implementing a two-stage least squares (2SLS) estimation strategy besides the more classical ordinary least squares (OLS), which has, to our knowledge, never been used before in this context.

In order to compute our interest variables, the ESJ survey first provides two questions allowing to define a worker as overeducated:

- What is the highest level of education or training (ISCED_Qualification) that you have completed?
- What is the level of education or training (ISCED_Qualification) needed to *get* your job?

A worker is then defined as overeducated if her/his level of education or training is above the level of education that is required *to get* her/his job.

[1] Note that some authors decide to investigate overskilling *besides* overeducation, separately. These studies globally show that both overeducation and overskilling are associated with wage penalties, but also that the wage penalty associated with overeducation is higher than the one associated with overskilling (Allen and van der Velden, 2001; Mavromaras *et al.*, 2009; McGuinness and Byrne, 2014). They also find that overskilling matters the most in the workers' satisfaction determination or in their propensity to implement on-the-job search (Allen and van der Velden, 2001; Mateos-Romero and Salinas-Jiménez, 2018), and that severely over-skilled migrant workers (with language differing from the host country) suffer a higher pay penalty (Mavromaras *et al.*, 2009). McGuinness and Byrne (2014) focus on immigration and, using data on fifteen European countries, show that higher rates of wage penalties are found for male over-skilled migrants, whereas over-education matters the most for female migrants.

Next, the ESJ survey also provides questions allowing us to compute the overskilling situation :

- What is the highest level of education or training (ISCED_Qualification) that you have completed?
- What is the level of education or training (ISCED_Qualification) needed to *do* your job?

A worker is then defined as overskilled if her/his level of education or training is above the one required *to do* (*i.e.*, to perform) her/his job.

This way of doing has been followed by other researchers such as Dolton and Silles (2008) for UK graduates, or more recently by Caroleo and Pastore (2017) for Italian graduates or by McGuinness et al. (2018) for European workers. As mentioned above, one main source of originality lies in the fact that we are able to compute the magnitude of overeducation and overskilling by relying on precise information on the level of attained (*i.e.*, completed) education and skills of the worker together with the requirements *to get* (required education) and *to do* (required skills) the job. To do so, we associate each attained level of education and skills with a given number of equivalent years of education, by relying on the following rule: ISCED_1 is equivalent to primary education (6 years of education); ISCED_2 relates to lower secondary education (9 years of education); ISCED_3 is equivalent to upper secondary education (12 years of education); ISCED_4 to post-secondary non-tertiary education (14 years of education); ISCED_5 to first stage of tertiary education (16 years of education); and finally ISCED 6 relates second stage of tertiary education (17 years of education). *In fine*, comparing the number of years of attained education (skills) of a worker with the one required to get (to do) the worker's job gives us the number of years of overeducation (overskilling).

The next Section lays out the wage equation model, and Section 3 describes the data. The results are presented in Section 4 and Section 5 concludes.

2. Methods

In order to first investigate the wage effects of overeducation, we rely on the following extended version of the Mincer wage equation model that is widely used in the existing literature (Chevalier, 2003; Frenette, 2004; Dolton and Silles, 2008; Green and Zhu, 2010, Pecoraro, 2014; Kracke et al., 2018):

$$\ln w_i = \alpha_0 + \alpha_1 OverEduY_i + \alpha_2 X_i + \varepsilon_i \quad (1)$$

with:

(a) $OverEduY_i$ is the number of years of overeducation of the worker *i*, computed as the difference between the number of years of education or training of the worker *i* and the number of years of education or training needed to get the worker *i*'s job if >0, 0 otherwise.

(b) X_i is a vector of control variables: length of studies, *i.e.* the attained level of education of the worker *i*, field of education, gender, age, tenure, type of contract (*i.e.*, part time or not, indefinite term contract or not), sector of activity, size of the firm in which the worker *i* is employed, and the country in which the establishment is located.

(c) ε_i is the error term.

Note that, as mentioned by Pecoraro (2014), equation (1) can be seen as a test for human capital theory, according to which educational requirements for a job do not influence workers' wages, as they are solely driven by workers' characteristics. In order to validate human capital theory, overeducated workers should earn the same wage as their peers in jobs that match their level of education so that each additional year of overeducation should have no impact on wages, that is $\alpha_1 = 0$. However, in the case of a rejection of human capital theory, wages would be determined by job requirements, so that returns to overeducation should be negative and significant, that is $\alpha_1 < 0$. Such models used in the literature mainly show that overeducated workers suffer from a wage penalty in comparison with workers similarly educated but working in jobs that match their levels of education. This outcome is more in line with the assignment model than standard human capital theory (Dolton and Vignoles, 2000 ; McGuinness, 2006 ; Leuven and Oosterbeek, 2011).

Our second equation investigates the impact of the interaction between overeducation and overskilling on wages, where the measurement of overeducation from equation (1) is replaced by a vector of interaction variables including both types of mismatch in the same equation:

$$\ln w_i = \beta_0 + \beta_1 AppOverEdu_i + \beta_2 GenuineOverEdu_i + \beta_3 X_i + \varepsilon_i \qquad (2)$$

with:

(a) $AppOverEdu_i$ represents apparent overeducation, when the worker *i* considers herself/himself as overeducated and properly skilled for her/his job. The associated coefficient gives us the impact of an additional year of overeducation for a worker being properly skilled for her/his job.

(b) $GenuineOverEdu_i$ represents genuine overeducation, where the worker *i* considers herself/himself as overeducated and overskilled. The associated coefficient gives us the impact of an additional year of overeducation for a worker being overskilled for her/his job.

In this equation, apparently overeducated and genuinely overeducated workers are compared with each other in situations where they were not mismatched in terms of education and skills.

Equations (1) and (2) have first been estimated by the ordinary least squares method (OLS). The OLS estimator with standard errors robust to heteroscedasticity and serial correlation is based on the cross-section variability between workers. Relying on OLS supposes that our mismatch variables are not correlated with unobserved variables (that could also explain wages) such as innate ability or family background. If this assumption is not satisfied, OLS estimates are biased and inconsistent due to endogeneity. Put differently, statistical inference is not permitted. Surprisingly, this important issue is rarely addressed in the mismatch literature. In order to control for such potential bias, we implement the two-stage least squares method (2SLS) using three key instruments (namely, willingness to work close to home, preference for leisure, and preference for self-learning) as IVs.

3. Materials

The European Center for the Development of Vocational Training (CEDEFOP) commissioned Ipsos in spring 2014 to carry out the first pan-European survey on skills mismatch. The European Skills and Jobs survey was conducted by telephone or online on 48,676 employees aged between 24 and 65, coming from the 28 European member states.

[Insert Table 1 about here]

The analyses conducted in this article face some restrictions relating to the data. For instance, workers were asked to report their gross monthly wage during the interviews, and some of them refused to do so. Also, workers who did not report their educational and/or skills level had to be skipped from the data. This leads to a final sample of 23,123 exploitable observations.

Descriptive statistics of these observations are presented in Table 1. As far as education is concerned, 0.4% are primary educated, 7.3% lower secondary educated, followed by 25.2% who have attained upper secondary education, 11.1% post-secondary educated, 48.3% who are tertiary educated at the first level, and 7.7% tertiary educated at an advanced level. Concerning

mismatch variables, 26.4% of the workers consider themselves as overeducated, with mean years of overeducation evaluated at 0.9 year. Concerning skills mismatch, 28.9% of workers estimate they possess some skills in surplus and are thus overskilled. Interactions between educational mismatch and skills mismatch show that 2.5% of the sample is apparently overeducated (*i.e.* overeducated but properly skilled) and that 23.6% of the workers are genuinely overeducated (*i.e.* overeducated and overskilled). Finally, 44.7% of workers are female, 41.3% have more than 10 years of tenure, 13.5% work in part-time jobs, and the majority works in SMEs (*i.e.* firms with less than 250 workers).

4. Results

Table 2 displays the estimation results of equations (1) and (2). The second column presents the results of the first equation and focuses on the impact of years of overeducation on wages. The adjusted R-squared reaches 45%, which is much higher than in the existing literature, where it stands at around 15%. This is most probably due to the richness of our dataset, which allows us to control for a wider range of workers' characteristics. What's more, the estimates show that each additional year of overeducation leads to a wage penalty of 6.67%[2] in comparison with similarly educated individuals working in a matching situation. This gives support to the idea of a wage penalty associated with overeducation, but not to simple human capital explanations of wages. The third column of Table 2 relies on equation (2) and shows that all types of interactions are associated with wage penalties. More precisely, they suggest that an additional year of overeducation among apparently overeducated workers is associated with a 4.1%[2] wage penalty, which is lower than the 6.9%[2] penalty for a year of overeducation among genuinely overeducated workers[3]. As in Green and Zhu (2010) or Pecoraro (2014), the impact of being both overeducated and overskilled is thus estimated to be more negative than being overeducated but properly skilled. These differences, measured in terms of earnings' penalties, reinforce the idea that skills heterogeneity matters significantly when analysing the impact of overeducation on wages.

When taking into account endogeneity in the relationships, the results of the 2SLS estimator are presented in columns 4 and 5. They confirm, in column 4, the wage penalty associated to overeducation. More precisely, one additional year of overeducation leads to a 18.1%[2] wage

[2] The effect of each variable in percentage is calculated as $e^{\beta_i} - 1$, given the log-linear form of the estimated equation.

[3] The rejection of the null hypothesis that regression coefficients (when comparing apparent overeducation and genuine overeducation) are equal gives support to that statement.

drop in comparison with similarly educated individuals working in a matching situation[4]. Including skills mismatch in the relationship (column 5) shows that the pay penalty associated with apparent overeducation remains significant with a 6.9%[2] penalty for each additional year of apparent overeducation. However, it shows that the highest pay penalty is associated to genuine overeducation (17.9%[2] pay penalty for one year increase in the level of genuine overeducation, *i.e.* both overeducation and overskilling)[3].

[Insert Table 2 about here]

To assess the soundness of the 2SLS approach, we performed four diagnosis tests. The results of these tests are reported at the bottom of Table 2. The first-stage estimates suggest that our IVs are not weak, as shown by the Kleibergen-Paap rk Wald *F* statistic for weak identification. That is, the *F* statistic is higher than 10, for both equation (1) and (2).[5] Moreover, we can reject the null hypothesis that our first-stage equation is under-identified as the Kleibergen-Paap rk *LM* statistic is found to be highly significant for both equations. Next, to examine whether our instruments fulfil the exogeneity condition, we computed bivariate correlations between our IVs and our dependent variable. Our findings, available on request, show that all correlation coefficients are very small (between 3% and 7%) and support the assumption that our IVs are fairly exogenous with respect to gross monthly wages. Concerning the quality of our instruments, we find that the *p*-values associated with the Sargan-Hansen's *J* over-identification test are equal to 0.156 and 0.103 for equation (1) and (2), respectively, which suggests that our instruments are valid. Finally, as regards the Durbin-Wu-Hausman endogeneity test, the *p*-values associated with the Chi-squared statistics are equal to 0.007 and 0.010, for equation (1) and (2), respectively.[6] These results suggest that the null hypothesis of no endogeneity should be rejected. The estimates thus indicate that our main explanatory variables are endogenous and that our instrumentation strategy is necessary.

[4] Note that a one year increase in the level of overeducation implies more than doubling the current situation (descriptive statistics show 0.85 mean year of overeducation), which could explain such high penalties.
[5] As suggested by van Ours and Stoeldraijer (2011), we rely on the standard "rule of thumb" that weak identification is problematic for *F* statistics smaller than 10.
[6] The Durbin-Wu-Hausman test is based on the difference of two Sargan-Hansen statistics: one for the equation in which the mismatch variables treated as endogenous, and one in which they are treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary.

5. Discussion

Educational mismatch is an important and growing phenomenon in Europe, and workers are found to be more and more educated, which results in a risk for workers to be allocated to jobs that do not match their level of education. A range of authors however argue that education does not reflect the real competencies of workers on the job (Chevalier and Lindley, 2009; Verhaest and Omey, 2009). This leads researchers to investigate the skills mismatch phenomenon where workers are considered as possessing (or not) the skills needed to perform their job (Mavromaras *et al.*, 2007; OECD, 2011; Caroleo and Pastore, 2017).

Relying on the European Skills and Jobs (ESJ) survey, the first pan-European survey on skills mismatch, this paper investigates the wage effects of new and more precise measurements of mismatch. Whereas most of the current investigations rely on educational background of workers only, this paper challenges education and skills by interacting overeducation with overskilling in two specific situations: (i) the apparent overeducation (*i.e*. being overeducated but properly skilled and (iii) the genuine overeducation (*i.e.* being both overeducated and overskilled). Taking into account the skills mismatch phenomenon besides the more classical educational mismatch allows to account for workers' heterogeneity in their skills, making it one of the first papers using the ESJ survey to evaluate the effect of overeducation and overskilling on wages from a European perspective. We also deepen the analysis by computing the magnitude of wage effects of mismatches in terms of additional years of overeducation, apparent overeducation and genuine overeducation. Finally, we are among the first to test for the existence of a potential endogeneity bias associated to education and skills mismatch variables.

Our best estimates first show that overeducated workers *ceteris paribus* earn less than their opposite numbers in jobs matching their level of education. More precisely, we find on the bases of 2SLS estimates, that each additional year of overeducation leads to a wage penalty of around 20% among EU countries. Yet, this penalty is found to vary substantially on whether overeducation coincides with overskilling. One year of overeducation among workers that are properly skilled (*i.e.* apparently overeducated) leads to a non-negligible wage penalty of 6.9%. But the penalty for genuine overeducation is more than doubled (17.9%). These estimates, robust to endogeneity, are of concern in several respects. First, descriptive statistics show that genuinely overeducated workers represent a large group of mismatched workers in EU. On average this category encompasses more than 20% of the workforce. Obviously, this is quite costly from a worker's perspective. But the cost of mismatch is also likely to be huge for the economy overall. Recent papers show indeed that wage effects of educational/skills mismatch

reflect (to a large extent) differences in productivity among workers. Put differently, they indicate that overeducated/skilled workers would create much more value added if they were doing a job matching their education/skills. Along those lines, our estimates suggest that a better allocation of resources in the economy (*i.e.* notably through a decrease in the incidence of genuinely overeducated workers) could improve overall productivity significantly. Improving the quality of job-workers matches in EU countries thus appears to be a key challenge not only from a worker's perspective but also for the economy at large.

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Table 1. Descriptive Statistics of Selected Variables

Variables	Mean	Std. Dev.
Level of attained education (% of workers)		
Primary education	0.39	6.23
Lower secondary education	7.30	26.01
Upper secondary education	25.21	43.42
Post-secondary education	11.10	31.42
Tertiary education first level	48.26	49.97
Tertiary education advanced level	7.74	26.72
Attained education (on average, in years)	14.30	2.37
Overeducation		
Percentage of workers	26.35	44.06
Years of overeducation	0.85	1.68
Overskilling		
Percentage of workers	28.92	0.45
Interaction between educational and skills mismatches		
Apparently overeducated (in % of workers)	2.51	15.64
Genuinely overeducated (in % of workers)	23.64	42.49
Workers with 10 years or more of tenure (%)	41.27	49.23
Women (%)	44.70	49.72
Share of workers < 30 years	43.97	49.64
Share of workers between 30 and 49 years	43.24	49.54
Share of workers > 49 years	12.77	33.38
Part-time (%)	13.50	34.17
Firm size (in %)[a]		
Micro (between 1 and 9 workers)	20.01	40.01
Small (between 10 and 49 workers)	28.17	44.98
Medium (between 50 and 249 workers)	25.97	43.85
Large (>250 workers)	24.18	42.82
Not mentioned	1.67	12.84
Sector (%)		
Agriculture, horticulture, forestry or fishing (A)	1.68	
Supply of gas or electricity, mining or quarrying (B+D)	1.91	
Supply, management or treatment of water or steam (E)	0.99	
Manufacturing or engineering (C)	13.63	
Construction or building (F)	5.32	
Retail, sales, shop work or whole sale (G)	9.49	
Accommodation, catering or food services (I)	2.92	
Transportation or storage (H)	5.52	
Information technology or communication services (J)	6.48	
Financial, insurance or real estate services (K+L)	5.44	
Professional, scientific or technical services (M)	7.26	
Administration and support services, including public (N+O)	12.34	
Services relating to education or health (P)	18.24	
Cultural industries (arts, entertainment or recreation) (R)	1.96	
Social and personal services (Q)	5.86	
Other	0.96	
Number of observations		23,123

[a] According to the European standard definitions of a medium and small firm.

Table 2. Education Mismatch, Skills Mismatch, and Wages (OLS estimates, 2014)

Dependent variable	Gross Monthly Wage (ln)			
	OLS		2SLS	
	Educational mismatch (1)	Educational and skills mismatch (2)	Educational mismatch (1)	Educational and skills mismatch (2)
Over-education (in years)	-0.069***		-0.200***	
	(0.004)		(0.048)	
Apparent overeducation[a] (in years)		-0.042**		-0.072***
		(0.012)		(0.049)
Genuine overeducation[b] (in years)		-0.071***		-0.197***
		(0.004)		(0.049)
Length of Studies				
Lower secondary education (dummy)	0.079	0.077	0.084	0.076
	(0.078)	(0.078)	(0.078)	(0.077)
Upper secondary education (dummy)	0.290***	0.286***	0.398***	0.373***
	(0.076)	(0.076)	(0.086)	(0.083)
Post-secondary education (dummy)	0.377***	0.367***	0.568***	0.522***
	(0.079)	(0.079)	(0.106)	(0.099)
Tertiary education first stage (dummy)	0.585***	0.585***	0.762***	0.743***
	(0.078)	(0.078)	(0.101)	0.099)
Tertiary education advanced stage (dummy)	0.777***	0.778***	0.994***	0.977***
	(0.081)	(0.081)	(0.113)	(0.112)
Other control variables[c]	YES	YES	YES	YES
Sig. model (p-value)	0.000	0.000	0.000	0.000
Adjusted R-Squared	0.45	0.45	0.42	0.42
Underidentification test[d]:				
p-value Kleibergen-Paap rk LM statistic			0.000	0.000
Weak identification test[e]:				
Kleibergen-Paap rk Wald F statistic			45.13	46.70
Overidentification test[f]:				
p-value of Sargan-Hansen J statistic			0.156	0.103
Endogeneity test[g]:				
p-value associated with Chi-squared statistic			0.007	0.010
Number of firm-year observations	23,123	23,123	23,123	23,123

Notes: Robust standard errors are reported between brackets.

***, **, * significant at the 1, 5 and 10% level, respectively.

[a] Apparent overeducation means being overeducated (in years) but properly skilled (dummy variable).

[b] Genuine over-education means being over-educated (in years) and over-skilled (dummy variable).

[c] Are included in the vector of control variables, besides the length of study representing the attained level of education: the experience on the job computed as years of tenure, the fact of being part of the class of workers that is younger than 30 and older than 49 years, respectively. Are also included the gender (women), working part-time (or not) as well as working under infinite term contracts (or not), the study field of the worker (14 dummies), the country where the worker operates (28 dummies), the sectorial affiliation of the firm in which the worker operates (16 dummies), and size of the firm (*i.e.*, the number of workers gathered in 4 dummies). [d] The Kleibergen-Paap rk LM statistic for under-identification tests whether the equation is identified, i.e. whether the excluded instruments are all relevant. The null hypothesis in this test is that the equation is under-identified. [e] Kleibergen-Paap rk statistic for weak identification is a Wald F statistic testing whether the excluded instruments are sufficiently correlated with the endogenous regressor. The null hypothesis is that the instruments are weak. According to the standard 'rule of thumb', weak identification is problematic for F statistics smaller than 10 (as suggested by van Ours and Stoeldraijer (2011)). [f] The Sargan-Hansen J statistic tests the null hypothesis that the instruments are valid, i.e. uncorrelated with the error term. [g] The Durbin–Wu–Hausman endogeneity test is based on the difference of two Sargan-Hansen statistics: one for the equation in which firm-level mismatch variables are treated as endogenous, and one in which they are treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary, i.e. mismatch variables can actually be considered as exogenous.