Educational mismatches and skills: New empirical tests of old hypotheses

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ABSTRACT

In this paper, we empirically explore how the often reported relationship between overeducation and wages can best be understood. Exploiting the newly published Programme for International Assessment of Adult Competencies (PIAAC) data (OECD 2013), we are able to achieve a better estimation of the classical ORU-model (Duncan and Hoffman, 1981), by controlling for heterogeneity of observable skills. Our findings suggest that 1) a considerable part of the effect of educational mismatches can be attributed to skills heterogeneity, and 2) that the extent to which skills explain educational mismatches varies by institutional contexts. These observations suggest that skills matter for explaining wage effects of education and educational mismatches, but the extent to which this is the case also depends on institutional contexts.

INTRODUCTION

In this paper, we empirically explore how the often reported relationship between overeducation and wages can best be understood. Exploiting the newly published data from the Programme for International Assessment of Adult Competencies PIAAC (OECD 2013), we are able to achieve a better estimation of the classical ORU-model (Duncan and Hoffman, 1981), by controlling for heterogeneity of observable skills. Our findings suggest that a considerable part of the effect of educational mismatches can be attributed to skills heterogeneity. Our observa-

tions further suggest that the extent to which skills explain wage effects of education and educational mismatches also depends on institutional contexts.

The incidence and wage effects of overeducation have been well-established by empirical studies (*cf*. Green, McIntosh and Vignoles, 1999; Groot and Maassen van den Brink, 2000; Hartog, 2000; Sloane, 2003; Quintini, 2011). Empirical analyses consistently show that (1) people who work in jobs for which they are overqualified earn less than workers who have the same level of education, but who work in jobs that require that level of education, and that (2) overeducated people earn more than people who work in equivalent jobs but have attained the level of schooling required for that job (Sicherman, 1991; Hersch, 1991; Garcia-Serrano and Malo-Ocana, 1996; Dekker, de Grip and Heijke, 2002; Sloane, 2003). Many papers have aimed to explain these stylized facts (Duncan and Hoffman, 1981; Hartog and Oosterbeek, 1988; Sloane et al. 1999; and McGuinness, 2006). Much of the debate has focussed on the question of whether the *match* between a worker's education and that required for his/her job has a distinct effect on productivity, in addition to the effect of education itself. Many authors have proposed theoretical reasons for believing that this may be the case, for example citing *job assignment theory* (Hartog, 1977; Sattinger, 1993; 2012). This theory proposes that, even if we accept that the skills obtained in education contribute positively to productivity in general, the extent to which workers can use those skills may depend to some extent on productivity limits imposed by job characteristics. For overeducated workers, job constraints may allow only a limited use of their skills, which in turn limits their productivity and consequently their wages. This would suggest that overeducated workers underutilise their skills and vice versa undereducated workers overutilise their skills.

However, research shows that educational mismatches and skill mismatches correlate only weakly (Allen and Van der Velden, 2001; Green and McIntosh, 2007; Quintini, 2011). Two explanations have been forward to explain the observed effects of educational mismatches and the weak relation with skills mismatches.

Heterogeneous skills theory (Allen and Van der Velden, 2001; Green and McIntosh, 2007) points out that considerable variation in skills exists within educational levels. If we accept that this is the case, it is likely that relatively high-skilled workers will tend to be sorted into more complex jobs that match their skills better than jobs that formally require their own level of education, while low-skilled workers will be sorted into less complex jobs that also provide a better match to their actual skill levels. According to this view, what has been labelled undereducation and overeducation may – in some cases at least – be only an adjustment by the market that shifts workers to jobs that in fact *better* match their capabilities than would jobs that formally require their own level of education. According to this view, it is the skills possessed by these workers, rather than the mismatch they nominally experience, that is driving the observed wage effects.

Allen and Van der Velden (2001) propose an alternative explanation for the wage effects of over- and undereducation and their weak relation to skills mismatches, namely that it is the result of *institutional regulation* of the labour market. In most countries there are labour laws

and institutions designed to protect the rights of workers in the labour market. In part at least, these laws and institutions have arisen in response to uncertainty as to what constitutes fair treatment. Because workers' skills and productivity can rarely be observed perfectly, pay rates will need to be established through some form of bargaining. It has been forcefully argued by scholars such as Spence (1973) that under such conditions employers aim to base a given worker's wages on perceived signals of the likely productivity of workers with given observable characteristics (such as specific educational qualifications) working in a comparable job, or performing comparable tasks. It is usually supposed that resorting to such signals will be a temporary measure that will quite quickly become unnecessary as information about the actual performance of the worker becomes available, but when labour laws and institutions become powerful it may be difficult to achieve this. When wage setting is strongly institutionalized, basing wages on proxies or signals such as the required education for a given job or the educational qualifications of the worker may become a permanent feature of wage setting processes rather than a temporary stopgap solution in lieu of better information. Similarly, labour laws in a country may restrict employers' ability to adjust wages to match performance, or to dismiss underperforming workers. If this is true, there may be substantial wage effects of educational mismatches that cannot be explained by individual productivity differences, whether due to differences in skills or to poor matching between actual and required skills. If so, we would expect to observe these 'unexplained' wage effects of educational mismatches to occur much more in situations where wages are more affected by institutional arrangements.

To date, the debate about which theory best explains the relationship between overeducation and wages has been hampered by data problems (Sloane, 2003). The most important problem is that there has been no large scale dataset that combines measures of both required education and skills. Quintini (2011) has attempted to use the International Adult Literacy Survey (IALS) for this purpose, but although this dataset includes good measures of skills, it lacks reliable data on required level of education. Other datasets simply lack good measures of skills, or are not large enough to cover institutional variation across different countries.

The recently conducted international large-scale assessment PIAAC provides reliable measurements of all the elements we need, i.e. wage, years of acquired and required schooling, as well as direct measures of key information processing skills. As such, these data allow us to better distinguish between the various theoretical explanations for the relationship between educational (mis)matches and wages than any previous data set. Although the measured skills are not the perfect measure of all relevant abilities, and much skills heterogeneity will plausibly remain unobserved, these data can be used to establish whether the relationships between wages and overeducation, undereducation and required education can partly be attributed to skills heterogeneity. Furthermore, the cross-national character of the data allows for exploring the role of labour market institutions.

In the next section, we formally deduce hypotheses from the abovementioned theories. More specifically, we seek to answer the following research questions:

1) To what extent are required education, overeducation and undereducation related to individual wages?

2) To what extent can the effects of required education, overeducation, and undereducation on individual wages be explained by individual differences in skills?

3) To what extent is there cross-national variation in the extent to which the relationship between wages on the one hand, and required education, overeducation, and undereducation on the other hand can be explained by skills heterogeneity?

4) To what extent is this cross-national variation related to differences in labour market institutions?

THEORY AND HYPOTHESES

In a significant expansion of the classic Mincerian wage function (Mincer, 1974), Duncan and Hoffman (1981) proposed a model that allows for distinguishing between individuals' attained level of education and the level of education required in their job. In this so-called ORU-model, it is possible to estimate the effects of overeducation *O*, required education *R* and undereducation *U* on wages. The ORU model stipulates a relationship between wages on the one hand, and overeducation, required education and undereducation, on the other hand. In a cross-national setting, the model specifications are of the general form:

$$lnW_i = \delta_O E^O{}_i + \delta_r E^r{}_i + \delta_u E^u{}_i + \boldsymbol{c'_i}\alpha + \boldsymbol{x'_i}\beta + \varepsilon_i \qquad [1]$$

in which *Wi* is the observed wage of individual *i*, $E^O{}_i$ is the number of years of overeducation, $E^r{}_i$ is the number of years of required education, and $E^u{}_i$ the number of years of undereducation. To account for unobserved heterogeneity between countries, we include a vector with country fixed effects dummies, denoted as ***c***. Furthermore, ***x*** is a vector that contains control variables, such as age and work experience, and ε_i is an idiosyncratic error term.

Now, we allow for differentiation between education and skills. We expand Equation [1] with a vector of direct observations of skills, denoted as ***s***. Now, the model reads:

$$lnW_i = \delta_O E^O{}_i + \delta_r E^r{}_i + \delta_u E^u{}_i + \boldsymbol{c'_i}\alpha + \boldsymbol{x'_i}\beta + \boldsymbol{s'}\gamma + \varepsilon_i \qquad [2]$$

In Equation [2], the wage returns of skills are denoted by *γ.* Note that we do not assume that an individual's education and skills are uncorrelated. On the contrary, we expect that education, but also control variables like age and work experience affect skills, but that conditional on these variables, skills can be quite heterogeneous. By including the skills in the ORU model, we will be able to see whether skills affect wages over and above their effect through education.

As described earlier, previous findings show that:

$\delta_r > \delta_o > |\delta_u| > 0$ [3]

The basic idea of this paper is that the various theories that have been put forward make different predictions about the extent to which these parameters are driven by individual skills differences, and about their cross-national variability. In the remainder of this section, we will formally derive such hypotheses. In order to do so, we will specify two (nested) specifications of Equation [2], one in which skills are not controlled for, and a second specification in which skills are controlled for. For reasons of clarity and precision, we describe the various hypotheses in logical terms, and will treat the two specifications as two different conditions under which the same model will yield different predictions. Under the first specification, all skills variables are restricted to zero, so that $\boldsymbol{s} = \mathbf{0}$. Note that under this specification, Equation [2] collapses to the standard ORU model described in Equation [1]. Under the second specification, we put no restrictions on the skills variables in Equation [2], so that $\boldsymbol{s} \neq \mathbf{0}$.

Based on these specifications, we can formulate the following formal hypotheses based on the heterogeneous skills theory. In its strongest form, the heterogeneous skills theory leads to the following prediction:

Hypothesis 1 (strong):

$\delta_r = \delta_o = |\delta_u| = 0$ &

$\gamma > 0$

In words: after controlling for skills, we expect no significant effect of required education, overeducation or undereducation on wages, while we do expect skills to have an effect. Note that testing this hypothesis would require that we observe all relevant skills, which is highly improbable, if not impossible. Under these conditions, a weaker version of this hypothesis is more realistic. Such hypothesis states that a significant part of these effects is explained by *observed* skills. In that case the absolute values of δ_r, δ_o and δ_u are significantly lower in Equation [2] than in Equation [1].

Hypothesis 1 (weak):

$(\delta_r \mid \mathbf{s} > 0) < (\delta_r \mid \mathbf{s} = 0)$ &

$(\delta_o \mid \mathbf{s} > 0) < (\delta_o \mid \gamma = 0)$ &

$(\delta_u \mid \mathbf{s} > 0) < (\delta_u \mid \mathbf{s} = 0)$ &

$\gamma > 0$

To answer research questions 3 and 4, we will consider Equations [1] and [2] separately for each country. The country estimates of γ in Equation [2] will provide us with an estimate of the

extent to which skills affect wages in the different countries and comparing δ_r, δ_o and δ_u in Equations [1] and [2] can indicate the extent to which skills explain the wage returns to over-education, undereducation and required education in each country. So, let ζ_r^c be the proportion of the wage returns to required education explained by skills in country c, ζ_o^c be the proportion of the wage returns to overeducation explained by skills in country c, and ζ_u^c be the proportion of the wage returns to undereducation explained by skills in country c. Furthermore, δ_r^c is the effect of required education on wages in country c, δ_o^c is the effect of overeducation on wages in country c, δ_u^c is the effect of undereducation on wages in country. Then, it follows that:

$$\zeta_r^c = ((\delta_r^c \mid \mathbf{s} = 0) - (\delta_r^c \mid \mathbf{s} > 0)) / (\delta_r^c \mid \mathbf{s} = 0) \quad [4a]$$

$$\zeta_o^c = ((\delta_o^c \mid \mathbf{s} = 0) - (\delta_o^c \mid \mathbf{s} > 0)) / (\delta_o^c \mid \mathbf{s} = 0) \quad [4b]$$

$$\zeta_u^c = ((\delta_u^c \mid \mathbf{s} = 0) - (\delta_u^c \mid \mathbf{s} > 0)) / (\delta_u^c \mid \mathbf{s} = 0) \quad [4c]$$

To answer research question 4 we can then estimate the following equations

$$\gamma_C = \lambda_0 + \lambda_S LMPI_C + \varepsilon_C \quad [5a]$$

$$\zeta_r^c = \lambda_0 + \lambda_r LMPI_C + \varepsilon_C \quad [5b]$$

$$\zeta_o^c = \lambda_0 + \lambda_O LMPI_C + \varepsilon_C \quad [5c]$$

$$\zeta_u^c = \lambda_0 + \lambda_U LMPI_C + \varepsilon_C \quad [5d]$$

in which $LMPI_C$ is the index of labour market protection legislation in country c and ε_C is an idiosyncratic error term. The parameter λ_0 is an intercept, λ_S is the relationship between labour market protectionism and the wage returns to skills by country, denoted by γ_C. Parameters λ_r,

λ_O and λ_U denote the relationship between labour market protectionism and the extent to which wage returns to required education, overeducation and undereducation are explained by skills. Following the previous discussion on institutional theory, we can predict that:

Hypothesis 2:

(2a) $\lambda_S < 0$ &

(2b) $\lambda_O < 0$ &

(2c) $\lambda_r < 0$ &

(2d)$\lambda_u < 0$

In words: we expect the country-specific effects of skills on wages to be negatively related to the country's LMPI: in countries with stronger labour market institutions, skills have less effects on wages (hypothesis 2a). Moreover we expect that the country-specific proportion of the effects of required education, overeducation and undereducation that is explained by skills to be negatively related to the country's LMPI (hypotheses 2b-d). In countries with stronger labour market institutions, education related wage differentials are less related to skills.

DATA AND MEASUREMENTS

The data we use for the analyses come from the PIAAC survey, collected by the OECD (2013a) in 24 highly industrialized countries. The survey is designed to provide valid and reliable estimates of adults' competences in key information-processing skills, to identify proficiency differences between sub-groups of the population, to understand development, maintenance and use of skills, as well as to determine the impact of proficiency levels on life chances (OECD, 2013b). National samples contain over 5000 adults between the age of 16 and 65. Respondents were interviewed using computer assisted personal interviews, although for the testing pencil-and-paper data collection strategies were also used. Respondents were given assessment tests designed to directly measure their cognitive skills on various domains.

More specifically, these tests measured numerical and literacy skills, as well as respondents' capacity to solve problems in technology-rich environments. The data also hold information on respondents' non-cognitive skills, on key demographic and socio-economic background characteristics, as well as on skills use in the work place and at home. The survey is cross-culturally and cross-nationally valid.

To prepare the data for our analyses, we have made a number of selections. Details are to be found in the Appendix. First, we only selected males who were employed fulltime. This was based on the reported number of usual working hours per week. Fulltime workers are defined as workers with a minimum of 36 working hours per week. To avoid outliers, we excluded everybody reporting more than 80 working hours per week. We excluded those who were self-employed, people who served in the armed forces, as well as unpaid family workers. To avoid outliers in the wage distribution we excluded the top and bottom one percent in each country. We excluded France and Russia, as these data were not yet available as well as Australia. The working sample consists of some 1200 cases in most countries. In Canada the sample existed of some 6069 cases, from which we took a random sample of 20%, resulting in N_{Canada}=1190 cases to reduce possible bias due to oversampling of Canadian respondents. Missing values were deleted listwise. The total working sample contains N=26322 respondents from 21 countries.

Table 1. Descriptive statistics

	Minimum	Maximum	Mean	Std. Deviation
Numeracy skills	80,39	420,24	284,34	47,11
Literacy skills	78,86	415,64	281,20	42,92
Monthly wage (US$)	512,90	213198,31	3490,01	3497,65
Required education	0	22	12,93	3,13
Overeducation	0	18	0,89	1,78
Undereducation	0	14	0,51	1,27
Age	16	65	40,64	11,72
Work experience	0	55	19,87	12,18
Number of working hours per week	36	80	43,89	7,53
1st generation migrants	0	1	0,08	0,27
1.5 generation migrants	0	1	0,01	0,09
2nd generation migrants	0	1	0,02	0,13
2.5 generation migrants	0	1	0,05	0,21
Remigrants	0	1	0,01	0,09
LMPI	0,85	3,11	2,11	0,56

N= 26322 Source: PIAAC.

Measurements

Below, we will discuss the measurement of the variables we use in detail. An overview of descriptive statistics of all the variables in our model is given in Table 1.

Wages: as our dependent variable, we use the natural logarithm of the monthly wage, adjusted for purchasing power parity to account for cross-national differences. Respondents in the top and bottom 1% on this variable in each country are omitted from the analyses to avoid outliers. Monthly wages in our data set range from USD 513 to USD 213198. The mean wage is USD 3490.

Educational attainment is measured in PIAAC in the nominal number of years respondents spent in formal education. The measure is derived from the reported highest level of education in national education systems, converted into nominal years of schooling by the PIAAC consortium and country experts (OECD, 2013b).

Required education: the PIAAC questionnaire contains a question asking respondents what education level they thought was required for their current jobs. Verbatim, this question was: *"If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?".* Based on the answers respondents gave to this question and information about national education systems, this was converted into cross-nationally comparable measure of nominal years of formal education needed to get the job (OECD, 2013b). The measure ranges from 0 to 22 years, with a mean of 12.9 years.

Overeducation: our measure is derived from the measures of respondents' educational attainment and the education level required for their job. We use the operational definition of overeducation common in this line of literature, and define overeducation as the extent to

which individuals have attained an educational level that is higher than is required for the job they have. More formally, let overeducation be E^O, required education in years of schooling be E^R, and respondents' educational attainment in years of schooling be E^A. Also, let $E^O \geq 0$. Then, we can define the extent of overeducation as:

$E^O = E^A - E^R$ if $E^A > E^R$ and

$E^O = 0$ if $E^A \leq E^R$

Undereducation: Our measure of undereducation follows a similar reasoning. Undereducation is defined as the extent to which individuals have attained an educational level that is lower than is actually required for the job they have. More formally, let undereducation be E^U, and restrict $E^U \geq 0$. Then, we can define the extent of undereducation as:

$E^U = E^R - E^A$ if $E^R > E^A$ and

$E^U = 0$ if $E^R \leq E^A$

Skills: PIAAC contains measures of three types of skills, i.e. literacy skills, numeracy skills, and skills related to problem solving in technology-rich environments (OECD, 2013b). All three skills measures are constructed using adaptive testing and plausible values are calculated using Item Response Theory (IRT). The tests on problem solving in technology rich environments were only presented to people who reported that they had at least some computer experience, were willing to take the computer-based assessment and had at least minimum levels of computer abilities. Including these tests would non-randomly reduce our sample size with almost 33%. We therefore restrict ourselves to the measurements of numeracy and literacy to operationalise skills. As the skill proficiencies of literacy and numeracy are highly correlated (r = 0.905) we only use numeracy for the main analysis and literacy for the robustness check. The OECD (2013b) defines numeracy as "the ability to access, use, interpret and communicate mathematical information and ideas in order to engage in and manage the mathematical demands of a range of situations in adult life." The tests of numeracy measure how well respondents are able to use mathematical information to solve problems that might actually occur in real life. Numeracy is measured with 10 plausible values.We use the first of the reported plausible values as an indication of the numeracy skills of individuals.

Age: we control for life-cycle variation in wages by including respondents' age in years. We also include a quadratic term, to account for the non-linearity of the relationship between age and wages.

Work experience: we also control for the effects work experience has on wages, by including the total numbers of years respondents reported to have had paid work during their lifetime. Here too, we include a quadratic term.

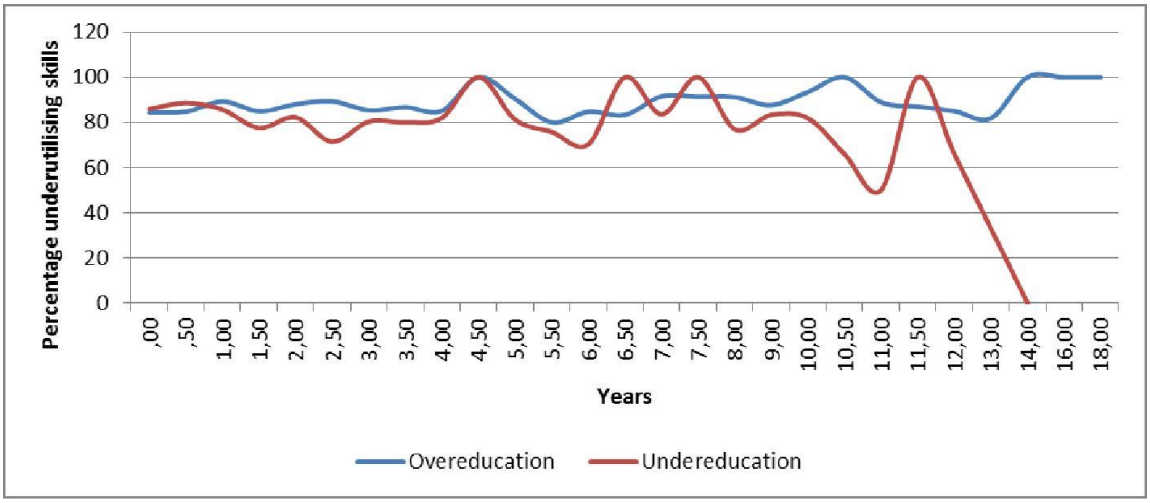
Working hours: Although we select people working fulltime (defined as 36 hours or more), there is still considerable variation in number of working hours. Therefore we control for the number of hours individuals work per week in their current job. As indicated above, we excluded respondents reporting to work more than 80 hours per week to avoid outliers. The mean number of hours worked is 43,89.

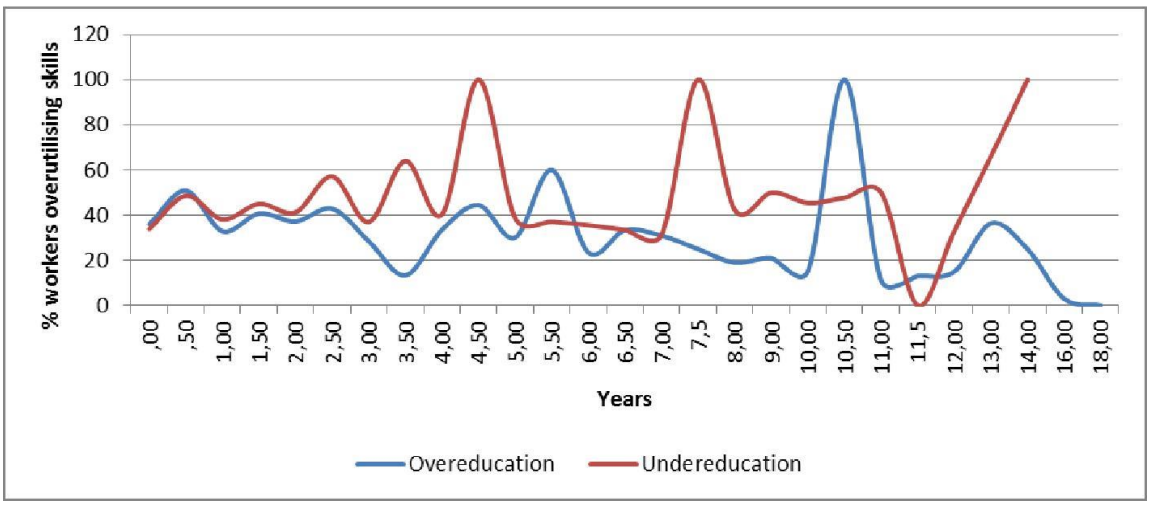
Immigration status: we use dummies to distinguish first generation immigrants (both parents and respondent were foreign born), 1.5 generation immigrants (respondent and one parent foreign born, one parent born in test country), second generation immigrants (both parents foreign born, respondent born in test country), 2.5 generation immigrant (respondent and one parent born in test country, one parent foreign born), and remigrants (i.e. respondent foreign born, both parents non-foreign born). People without an observed history of migration are the reference category.

Country fixed effects: we control for unobserved heterogeneity between countries by including country dummies. Austria is the reference category.

Labour Market Protection Index (LMPI): As a measurement of the flexibility of labour markets, we use the Labour Market Protection Index, calculated by the OECD (2009) in OECD and selected non-OECD countries in 2008. This index is designed to measure cross-national differences in the extent to which workers in various countries are protected by employment protection legislation. It has a country-level mean of 2.10, and ranges from 0.85 (USA) to Spain (3.11). A higher score means a higher level of employment protection.

Figure 1. The relationship between self-reported underutilizing and overutilization of skills and objective overeducation and undereducation





NALYSES AND RESULTS

Before we start with the actual analyses, Figure 1 shows the relation between educational mismatches and skills mismatches. In this figure, skills mismatches are proxied by the answers to the following two questions in the PIAAC questionnaire: *"Do you feel that you have the skills to cope with more demanding duties than those you are required to perform in your current job?"* and *"Do you feel that you need further training in order to cope well with your present duties?"*. The answer *"yes"* to the first question is commonly taken as an indication of underutilisation of skills and the answer *"yes"* to the second question is commonly taken as an indication of overutilisation of skills (OECD, 2011). Note that the two questions are not mutually exclusive and respondents can and do report positive answers to both.

Figure 1 shows that a large proportion of workers report to have some underutilisation of skills: on average 84%. Although the proportions slightly higher for overeducated workers and lower for undereducated workers , the relation is in fact quite weak, as has been reported before (Allen and Van der Velden, 2001; Green and McIntosh, 2007; Quintini, 2011). The same applies for the indicator of overutilization. On average some 35% report that additional training would be needed to better perform their current duties. This proportion is as expected somewhat higher for undereducated workers and lower for overeducated workers, but the differences are small.

Arguably these questions are only weak indicators of possible skill mismatches, due to their subjective nature. That is the very reason why we resorted to using objective test scores in the first place. In Table 2 we present the analyses using test scores as proxies for worker's skills.

Table 2. ORU model: regression required education, overeducation and undereducation on log-earnings

	Model 1			Model 2		
	B	Beta	Sig.	B	Beta	Sig.
Intercept	5,838		***	5,588		***
ORU						
Required education (δ_r)	,080	,432	***	,067	,361	***
Overeducation (δ_o)	,033	,103	***	,024	,073	***
Undereducation (δ_u)	-,021	-,046	***	-,013	-,028	***
Numeracy skills (γ /100)				,144	,124	***
Controls						
Age	,027	,544	***	,027	,541	***
Age^2	-,000	-,525	***	-,000	-,504	***
Work experience	,017	,362	***	,016	,330	***
Work experience^2	-,000	-,226	***	-,000	-,201	***
Number of working hours per week	,011	,142	***	,011	,141	***
natives (reference)						
1st generation migrants	-,108	-,050	***	-,059	-,028	***
1.5 generation migrants	-,037	-,005		-,024	-,004	
2nd generation migrants	,000	,000		,016	,004	
2.5 generation migrants	,009	,003		,015	,006	
Remigrants	-,050	-,007		-,046	-,007	

	Model 1			Model 2		
	B	Beta	Sig.	B	Beta	Sig.
Country fixed effects Austria (ref)						
Belgium	,069	,025	***	,065	,023	***
Canada	,119	,043	***	,142	,051	***
Cyprus	-,174	-,052	***	-,150	-,045	***
Czech Republic	-,694	-,239	***	-,676	-,233	***
Denmark	,271	,118	***	,269	,117	***
Estonia	-,496	-,196	***	-,494	-,195	***
Finland	,053	,020	***	,044	,016	**
Germany	,002	,001		,017	,007	
Ireland	-,014	-,004		,036	,012	*
Italy	-,211	-,066	***	-,183	-,057	***
Japan	-,076	-,030	***	-,080	-,031	***
Korea	-,176	-,069	***	-,134	-,053	***
Netherlands	,029	,010		,037	,013	*
Norway	,211	,083	***	,223	,087	***
Poland	-,713	-,311	***	-,676	-,295	***
Slovak Republic	-,767	-,268	***	-,751	-,262	***
Spain	-,221	-,074	***	-,193	-,064	***
Sweden	,067	,024	***	,054	,020	***
United Kingdom	,003	,001		,017	,007	
United States	,128	,040	***	,166	,051	***
Adjusted R^2	0,594			0,604		

Source: PIAAC *** p < .001 ** p <.01 * p < .05.

In Model 1 we follow the classical Duncan and Hoffman (1981) ORU model, stipulating a relationship between overeducation, required education and undereducation and wages. The specifications estimated here are of the general form described in Equation [1]. In Model 2 we estimate an extended version of this model by including the numeracy skills. This model follows Equation [2].

The results of Model 1 are in line with previous findings. First, the relationship between required years of schooling and wages is positive. The strength of the relationship (δ_r=0,080) indicates that each additional year of required schooling, yields a wage premium of some 8%. The effect of overeducation is less than half that size, with an estimate of (δ_O=0.033). Having more education than is required for the job pays off but not as much as the years of required education for that job. Each additional year of education yields a wage premium of some 3%. Undereducation is negatively related to wages (δ_U=-0.021) The absolute effect size is as expected smaller than the effect size of overeducation. Each year of undereducation yields a wage penalty of some 2%.

In Model 2, the proficiency score on numeracy skills is added to the model. Numeracy skills (γ = 0.144) are positively related to wages. If we compare the standardized effects, the effect size

(standardised parameter = 0.124) is around one third of the effect of required education ((standardised parameter = 0.361). Compared to Model 1, the relationship between required education and wages is reduced with 16% to δ_r=0.067. We can also see that the effect of over-schooling is reduced with 28% to δ_o =0.024. Differences in numeracy skills account for 38% of the effect of underschooling as observed in Model 1.

How do these findings bear on the hypotheses we formulated? The strong version of the heterogeneous skills theory predicted that, after controlling for skills, there would be no residual effect of required education, overeducation and undereducation on wages. That is clearly not the case. However, the results do clearly show that a significant part of all three effects can be explained by skills, suggesting that the weaker version of the heterogeneous skills theory is supported by the data. There are however three additional remarks that are highly relevant here.

Firstly, it must be noted that we do not observe all skills that are relevant in theory, and that by design, we cannot exclude the possibility that the relationship between overeducation and skills would be further reduced if we would be able to control for the now unobserved skills. In other words, our test of the heterogeneous skills theory is a highly conservative one.

Secondly, the expectation that it would be possible to explain *all* the wage variance that is related to required education, overeducation and undereducation presupposes that employers are perfectly informed about all the relevant skills and other productive attributes of workers. We deem this unrealistic. In practice, it is very plausible that there is at least some uncertainty, and as a consequence there will be some tendency to assign wages based on observable features of workers and jobs rather than entirely on actual productive skills. Consequently, even if we possessed the perfect knowledge that most employers lack, in the form of a precise measurement of all relevant skills, the strong version of the heterogeneous skills theory is unlikely to be fully confirmed. There will be some residual effect indicating that people are rewarded partly based on easily observable features such as education and job titles.

This leads directly on to the third point, which is that we would expect the size of this residual effect to depend to a large extent on the particular institutional arrangements that prevail in a country. In countries in which wage setting is largely a matter that is decided between employer and employee, with little regard needing to be paid to laws and institutions designed to protect workers' rights, we would expect the residual effect to be quite small and largely transient. However, in countries in which protectionist labour market laws and institutions play an important role, we would expect the residual effect to be far larger and more permanent. This is precisely the point of our second hypothesis, and it is to this that we now turn.

Table 3. ORU model by country: the returns to skills, the returns to required education, overeducation and undereducation on ln(earnings) and the proportion of effects explained by skills

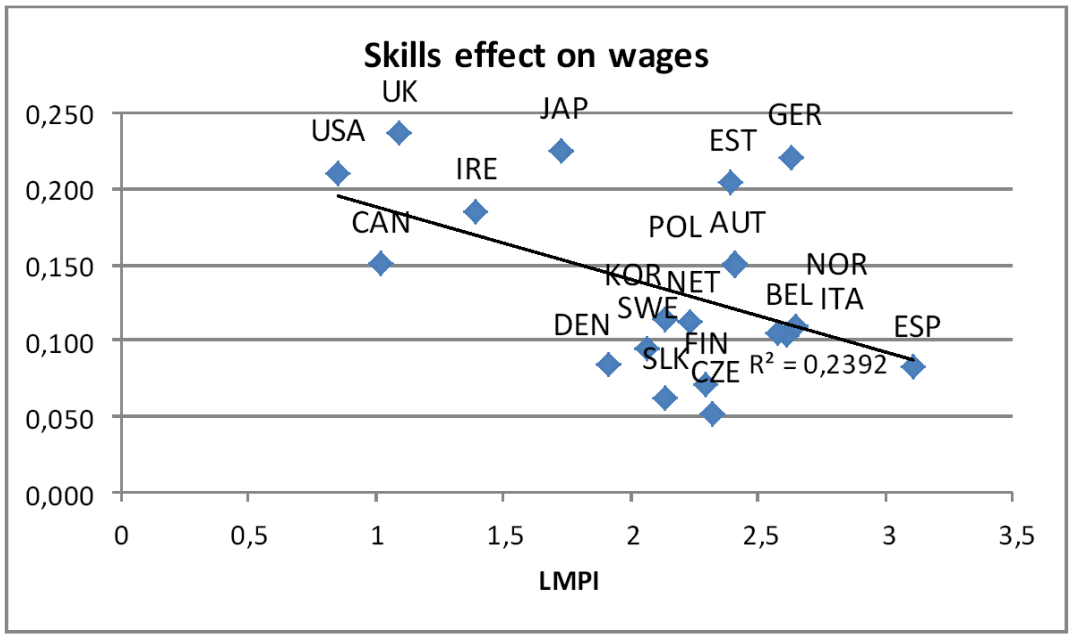
	γ	$\%\,\delta_r^a$ interpeted by γ	$\%\,\delta_o^a$ interpeted by γ	$\%\,\delta_u^a$ interpeted by γ
Austria	0,151	14	14	36
Belgium	0,104	17	18	30
Canada	0,151	21	27	29
Cyprus	0,053	4	11	11
Czech Republic	0,052	6	8	13
Denmark	0,084	11	23	93
Estonia	0,205	24	58	100[$]
Finland	0,071	9	16	9
Germany	0,221	22	40	91
Ireland	0,186	19	35	32
Italy	0,105	13	32	26
Japan	0,226	21	66	51
Korea	0,114	11	18	14
Netherlands	0,112	12	27	25
Norway	0,109	16	22	22
Poland	0,149	19	34	45
Slovak Republic	0,061	5	7	100
Spain	0,082	9	22	9
Sweden	0,095	15	33	36
United Kingdom	0,237	21	46	42
United States	0,211	23	60	29

Source: PIAAC *** p < .001 ** p <.01 * p < .05.[$]Suppressor effect

Based on institutional theory, we posited the hypothesis that the extent to which individual skills affect wages over and above the effects of required education, overeducation and undereducation is larger in countries in which employment protection is lower. Moreover we hypothesized that the extent to which skills can explain the relationship between required education, overeducation and undereducation on the one hand and wages on the other hand is larger in countries in which employment protection is lower. To test these hypotheses, we examined cross-national variation in the effects of skills on wages and on the proportion of the wage effects of required education, overeducation and undereducation that can be attributed to skills. To establish this proportion for each country, we ran the model specified in Equation [2] separately for each country.

In the first column of Table 3, we present the wage effects of skills in each country according to Equation [2]. Table A2 in the Appendix presents the full models. There is indeed considerable cross-national variation in the effect of numeracy skills on wages, ranging from a low 0.052 in Czech Republic to a high 0.237 in the United Kingdom.

Figure 2. Country-level relationship between labor market institutions and the effect of numeracy skills of earnings



Source: PIAAC

Figure 2 presents the country-level relationship between labour market protection and the wage returns to numeracy skills. On the x-axis of the graph, we have ordered countries according to the extent to which employees enjoy legal labour market protection. The OECD index combines information about laws that protect workers against firing, but also about the extent to which labour unions can participate in collective bargaining processes, and is thus a very broad and general measure. On the y-axis the countries are ordered based on the effect of numeracy skills on wages. The figure shows that the wage returns to skills are indeed lower in countries with a stronger labour market protection.

Columns 2-4 of Table 3 present information about country differences in the extent to which skills explain the correlation between wages and required years of schooling, overeducation and undereducation. The table shows that again large cross-national variation exists. In the US (23%), Germany (22%), Estonia (24%), the UK (21%), Japan (21%), and Canada (21%), skills are important explanations for the returns to required education. In contrast, in Cyprus (4%), Czech Republic (6%) and Slovak Republic (5%), skills contribute much less to the explanation of the relation between required education and wages. In the US (60%), Japan (66%), and Estonia (58%), skills explain (nearly) all of the returns to overeducation, whereas in Cyprus, Slovak Republic and the Czech Republic barely any of this effect is explained by skills. In Estonia and the Slovak Republic the undereducation effect is fully explained by skills and also in Denmark (93%), Japan (51%) and the United Kingdom (42%) the proportion of the wage effect of undereducation that is explained by skills is very high. On the other hand the proportion of the wage effect of undereducation that is explained by skills is very low in Finland (9%), Cyprus (11%), Czech Republic (14%), Korea (14%) and Spain (9%).

Figure 3: Relationship between labor market protection in countries and the extent to which effects of required education, overeducation and undereducation on log-earnings in these countries are explained by skills

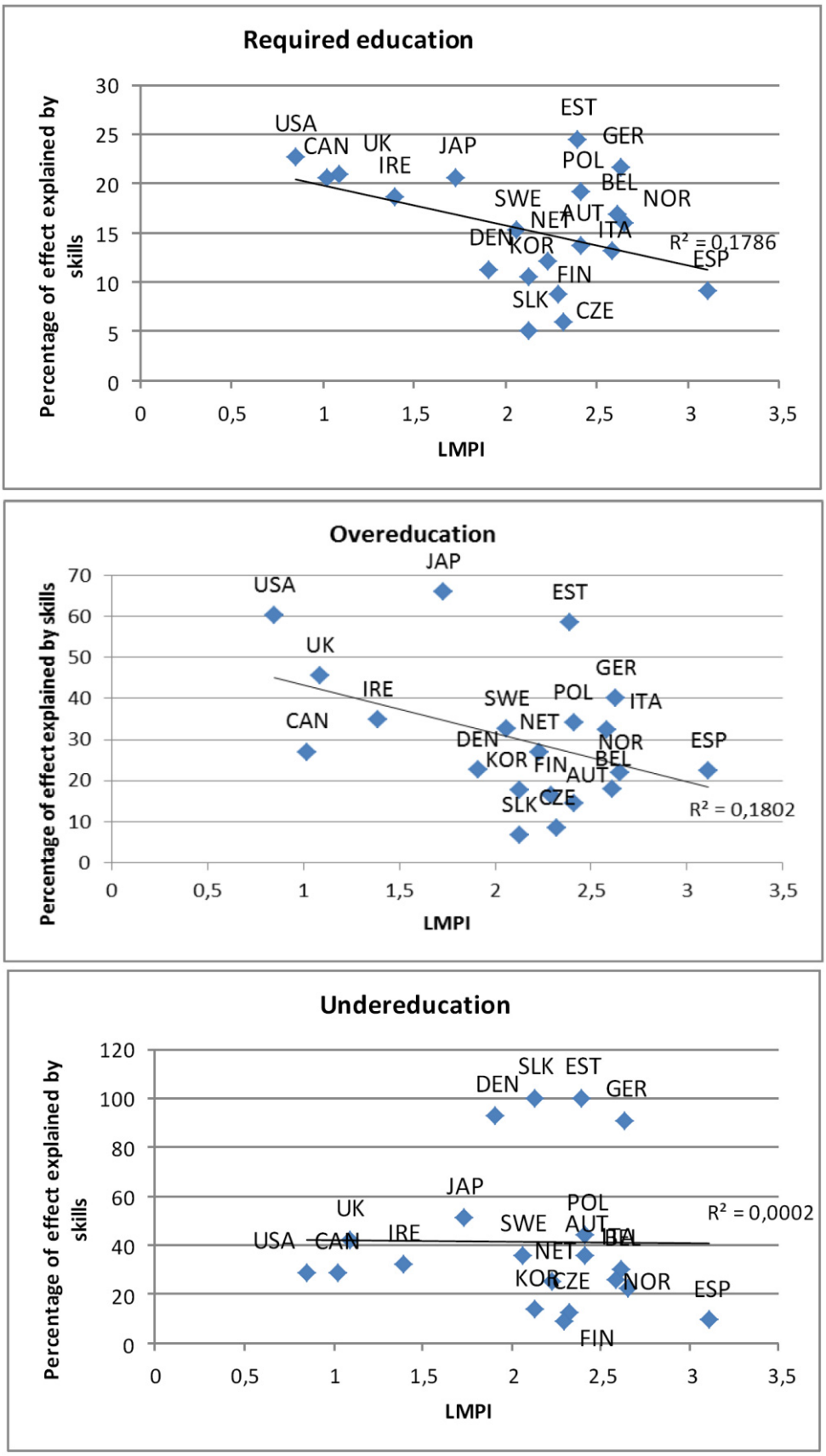


Figure 3 shows how labour market protection in countries is related to the extent to which wage effects of required education, overeducation and undereducation are explained by skills. On the x-axis of the graph, we have ordered countries according to the extent to which employees enjoy legal labour market protection. On the y-axis the countries are ordered based on the extent to which the relationship between required education (top panel), overschooling (middle panel) and underschooling (bottom panel) can be explained by individuals' skills.

In the top panel of Figure 3 we can see that the extent to which the wage effects of required education are explained by skills is somewhat stronger in the low LMPI countries than in the strong LMPI countries. The middle panel of Figure 3 shows a somewhat stronger negative relationship between employment protection and the extent to which skills can explain the relationship between overeducation and wages, which is in line with the institutional hypothesis. It indicates that in strong LMPI countries the wage effects of overeducation are less driven by skills than in low LMPI countries. Furthermore, the overall proportions that are explained in each country are higher and the relation is somewhat stronger than is the case for required education.

The lower panel of Figure 3 shows that there is no relation between LMPI and the extent to which the wage effect of undereducation is explained by skills. Nonetheless, we note that a large part of the effect of undereducation is related to skills, and this holds for many countries. This reflects the situation that undereducation only occurs when people have the skills to master the job in question, which again supports the heterogeneous skills theory.

Figure 3 suggests two things. First, the effects of overeducation are more strongly related to skills than is the case for required schooling, for both low and high LMPI countries. Second, even in strong LMPI countries some of the wage effects of required education are explained by underlying differences in skill levels. Taking into account that this is a conservative estimate of the effect of skills, the real explanatory effect of skills in these countries might be much higher. This could reflect the fact that in collective bargaining one of the arguments for assigning higher wages to higher educational levels is because of the presumed higher skills levels.

CONCLUSIONS AND DISCUSSION

In this paper, we have aimed to shed further light on explanations for the well-established relationship between overeducation and earnings. Using new empirical data (PIAAC, OECD, 2013), we were able to estimate the classical ORU-model while controlling for heterogeneity of observable skills. This allowed us to address four research questions.

First, we asked to what extent required education, overeducation and undereducation are related to individual wages. Our findings are in line with earlier studies that show that overeducated workers earn less than workers who have the same level of education, but work in jobs that require their level of education, and overeducated workers earn more than people who work in equivalent jobs but have attained the level of schooling required for that job.

Secondly, we asked to what extent the effects of required education, overeducation, and undereducation on individual wages can be explained by individual differences in skills. Our anal-

yses show that skills heterogeneity contributes considerably to the explanation of educational mismatch. The effect of numeracy skills on wages explains some one-sixth of the wage effect of required education, and little under one-third of the wage effects of overeducation and undereducation. Considering that we only use one measure of one observable skill, these effects are in fact quite high. One can easily imagine that much more could be explained if we could have measured all relevant skills. At least we can conclude that part of the educational mismatches is just apparent and do not necessarily imply that worker's skills are heavily underutilised or overutilised. The incidence of undereducation and overeducation in these cases can be interpreted as an adjustment by the market that shifts workers to jobs that in fact *better* match their capabilities than would jobs formally requiring their own level of education. The significance of skills is also illustrated by the fact that even in strong LMPI countries some of the wage effects of required education are explained by underlying differences in skill levels. Again taking into account that this is a conservative estimate of the effect of skills, the real explanatory effect of skills in these countries is likely to be higher. This seems to suggest that even in a situation of collective bargaining one of the arguments for assigning higher wages to higher educational levels is because of the presumed higher skills levels.

In our third and fourth research questions, we asked to what extent there is cross-national variation in the extent to which the relationship between wages on the one hand, and required education, overeducation, and undereducation on the other hand can be explained by skills heterogeneity, and to what extent this cross-national variation is related to differences in labour market institutions? We clearly observe that in all countries, a considerable part of the wage effects of over- and undereducation is explained by heterogeneous skills. Notwithstanding this clear support for the heterogeneous skills theory, we also find some support for the institutional theory, which predicted that the extent to which skills can explain the wage effects of required education, overeducation and undereducation will depend strongly on the institutional context. In countries with weak labour market protection, we find stronger direct effects of skills on wages and in these countries a larger proportion of the observed wage effects can be accounted for by skills. By contrast, where labour market protection is strong, skills have a weaker direct effect on wages and account for relatively little of the wage effects of required education, overeducation and undereducation. It is hard to find an alternative explanation for these observed effects of labour market institutions. All countries in question are highly developed and although there may be differences in economic conditions, it is not immediately clear why numeracy skills affect wages strongly in countries like Canada, Japan and the United Kingdom and so low in Italy or Cyprus. It is unlikely that some omitted skill variable might be responsible for this. That would assume that for example in country X wages are strongly related to skill A and in country Y it would be strongly related to skill B, with little or no correlation between skill A and B. That seems quite unlikely, and we think that it is plausible to infer from our findings that the extents to which individual skills affect wages is constrained by the institutional arrangements.

We conclude that these observations make plausible that skills do matter in explaining wage effects of education and educational mismatches, but that the extent to which this is the case also depends on institutional contexts.

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APPENDIX A1: SELECTIONS

	N
	155156
Excluding non-respondents	151692
Selecting men	71988
Selecting employed	43263
Selecting fulltimers	35635
Excluding students, interns, military personnel	32819
Reweighting Canada	27974
Listwise deleting missings	26322

APPENDIX A2: COUNTRY-LEVEL ANALYSES

		Model 1		Model 2	
		b	***p***	***b***	***p***
Austria	Intercept	5,697	,000	5,455	,000
	Required education	,084	,000	,072	,000
	Overeducation	,047	,000	,040	,000
	Undereducation	-,007	,398	-,005	,582
	Age	,019	,049	,016	,095
	Age^2	,000	,282	-9,085E-05	,425
	Work experience	,016	,004	,017	,003
	Work experience^2	,000	,003	,000	,005
	Number of working hours	,014	,000	,014	,000
	1st generation migrants	-,140	,000	-,077	,006
	1.5 generation migrants	-,016	,884	-,007	,950
	2nd generation migrants	-,013	,827	,011	,843
	2.5 generation migrants	,003	,939	,015	,687
	Remigrants	,153	,491	,164	,451
	Numeracy			,151	,000
Belgium	Intercept	6,464	,000	6,386	,000
	Required education	,066	,000	,055	,000
	Overeducation	,045	,000	,037	,000
	Undereducation	-,013	,040	-,009	,151
	Age	-,002	,824	-,007	,494
	Age^2	,000	,202	,000	,086
	Work experience	,019	,001	,020	,000
	Work experience^2	,000	,000	,000	,000
	Number of working hours	,012	,000	,012	,000
	1st generation migrants	-,012	,744	,031	,394
	1.5 generation migrants	,024	,846	,042	,726
	2nd generation migrants	,044	,522	,065	,337
	2.5 generation migrants	,006	,870	,007	,854
	Remigrants	,007	,935	,009	,909
	Numeracy			,104	,000
Canada	Intercept	5,535	,000	5,317	,000
	Required education	,085	,000	,067	,000
	Overeducation	,053	,000	,039	,000
	Undereducation	-,028	,002	-,020	,025
	Age	,030	,003	,032	,002
	Age^2	,000	,004	,000	,005

		Model 1		Model 2	
		b	*p*	*b*	*p*
	Work experience	,021	,000	,018	,001
	Work experience^2	,000	,011	,000	,023
	Number of working hours	,016	,000	,016	,000
	1st generation migrants	-,168	,000	-,125	,000
	1.5 generation migrants	,090	,606	,060	,726
	2nd generation migrants	-,003	,963	,003	,958
	2.5 generation migrants	,023	,632	,025	,589
	Remigrants	-,191	,144	-,181	,159
	Numeracy			,151	,000
Cyprus	Intercept	5,682	,000	5,572	,000
	Required education	,071	,000	,068	,000
	Overeducation	,017	,060	,015	,096
	Undereducation	-,033	,000	-,030	,001
	Age	,033	,019	,033	,018
	Age^2	,000	,082	,000	,074
	Work experience	,023	,001	,022	,001
	Work experience^2	,000	,004	,000	,006
	Number of working hours	,005	,001	,005	,001
	1st generation migrants	-,074	,109	-,067	,151
	1.5 generation migrants	-,060	,460	-,062	,446
	2nd generation migrants	,070	,712	,047	,806
	2.5 generation migrants	-,066	,476	-,065	,481
	Remigrants	,111	,117	,107	,129
	Numeracy			,053	,075
Czech Republic	Intercept	6,130	,000	6,075	,000
	Required education	,078	,000	,073	,000
	Overeducation	,038	,000	,035	,000
	Undereducation	-,019	,105	-,016	,159
	Age	-,005	,698	-,007	,577
	Age^2	-9,642E-05	,531	-6,862E-05	,657
	Work experience	,031	,000	,032	,000
	Work experience^2	,000	,005	,000	,004
	Number of working hours	,005	,000	,005	,000
	1st generation migrants	,048	,471	,060	,363
	1.5 generation migrants	-,069	,636	-,079	,591
	2nd generation migrants	,049	,608	,048	,615
	2.5 generation migrants	-,025	,540	-,023	,578
	Remigrants	-,159	,400	-,166	,380
	Numeracy			,052	,051
Denmark	Intercept	6,043	0,000	5,916	0,000
	Required education	,068	,000	,060	,000
	Overeducation	,025	,000	,019	,000
	Undereducation	-,004	,500	,000	,961
	Age	,032	,000	,032	,000
	Age^2	,000	,000	,000	,000
	Work experience	,008	,015	,007	,035
	Work experience^2	-9,461E-05	,095	-7,739E-05	,169
	Number of working hours	,015	,000	,015	,000
	1st generation migrants	-,107	,000	-,070	,000
	1.5 generation migrants	-,020	,715	-,005	,933
	2nd generation migrants	,033	,695	,062	,457
	2.5 generation migrants	,036	,335	,037	,312
	Remigrants	-,160	,058	-,155	,063

		Model 1		Model 2	
		b	*p*	*b*	*p*
	Numeracy			,084	,000
Estonia	Intercept	4,891	,000	4,569	,000
	Required education	,072	,000	,055	,000
	Overeducation	,018	,050	,007	,417
	Undereducation	-,005	,664	,002	,882
	Age	,055	,001	,051	,001
	Age^2	-,001	,000	-,001	,000
	Work experience	,013	,136	,013	,141
	Work experience^2	-9,887E-06	,957	-2,002E-05	,912
	Number of working hours	,020	,000	,021	,000
	1st generation migrants	-,036	,462	-,012	,804
	1.5 generation migrants	-,129	,376	-,148	,305
	2nd generation migrants	-,072	,119	-,047	,302
	2.5 generation migrants	-,085	,033	-,060	,130
	Remigrants	,000	,999	-,026	,862
	Numeracy			,205	,000
Finland	Intercept	6,086	,000	5,911	,000
	Required education	,061	,000	,056	,000
	Overeducation	,034	,000	,028	,000
	Undereducation	-,014	,008	-,013	,015
	Age	,013	,126	,014	,095
	Age^2	,000	,150	,000	,122
	Work experience	,023	,000	,022	,000
	Work experience^2	,000	,000	,000	,000
	Number of working hours	,017	,000	,017	,000
	1st generation migrants	-,179	,000	-,137	,003
	1.5 generation migrants	,518	,041	,558	,027
	2nd generation migrants	-,371	,144	-,281	,267
	2.5 generation migrants	-,002	,971	,014	,827
	Remigrants	,033	,684	,026	,747
	Numeracy			,071	,000
Germany	Intercept	5,182	,000	4,858	,000
	Required education	,117	,000	,092	,000
	Overeducation	,047	,000	,028	,001
	Undereducation	-,018	,050	-,002	,856
	Age	,040	,000	,040	,000
	Age^2	-,001	,000	,000	,000
	Work experience	,011	,051	,009	,108
	Work experience^2	-7,668E-05	,499	-3,457E-05	,754
	Number of working hours	,010	,000	,010	,000
	1st generation migrants	,034	,304	,074	,020
	1.5 generation migrants	-,007	,941	,043	,661
	2nd generation migrants	,090	,032	,102	,012
	2.5 generation migrants	-,024	,433	-,027	,360
	Remigrants	,294	,101	,231	,186
	Numeracy			,221	,000
Ireland	Intercept	5,267	,000	5,071	,000
	Required education	,085	,000	,069	,000
	Overeducation	,026	,001	,017	,025
	Undereducation	-,044	,000	-,030	,001
	Age	,038	,009	,034	,018
	Age^2	,000	,033	,000	,069
	Work experience	,022	,001	,021	,001
	Work experience^2	,000	,068	,000	,064
	Number of working hours	,013	,000	,013	,000

		Model 1		Model 2	
		b	*p*	*b*	*p*
	1st generation migrants	-,125	,000	-,102	,003
	1.5 generation migrants	-,061	,446	-,065	,400
	2nd generation migrants	,081	,630	,068	,680
	2.5 generation migrants	-,003	,968	-,017	,796
	Remigrants	-,108	,143	-,123	,087
	Numeracy			,186	,000
Italy	Intercept	5,518	,000	5,314	,000
	Required education	,062	,000	,054	,000
	Overeducation	,019	,007	,013	,070
	Undereducation	-,024	,000	-,018	,004
	Age	,035	,002	,035	,001
	Age^2	,000	,001	,000	,002
	Work experience	,020	,000	,017	,001
	Work experience^2	,000	,244	,000	,407
	Number of working hours	,014	,000	,014	,000
	1st generation migrants	,002	,967	,028	,558
	1.5 generation migrants	-,128	,267	-,134	,241
	2nd generation migrants	,178	,442	,231	,313
	2.5 generation migrants	,056	,441	,066	,362
	Remigrants	,008	,928	,014	,879
	Numeracy			,105	,000
Japan	Intercept	5,901	,000	5,511	,000
	Required education	,090	,000	,071	,000
	Overeducation	,021	,001	,007	,242
	Undereducation	-,032	,002	-,016	,122
	Age	,015	,220	,013	,279
	Age^2	,000	,395	-9,408E-05	,479
	Work experience	,048	,000	,045	,000
	Work experience^2	-,001	,000	-,001	,000
	Number of working hours	,003	,005	,003	,001
	1st generation migrants				
	1.5 generation migrants	,266	,208	,262	,201
	2nd generation migrants				
	2.5 generation migrants	,080	,356	,101	,227
	Remigrants	-,088	,808	-,121	,731
	Numeracy			,226	,000
Korea	Intercept	5,193	,000	5,025	,000
	Required education	,087	,000	,078	,000
	Overeducation	,032	,000	,026	,000
	Undereducation	-,051	,000	-,043	,000
	Age	,069	,000	,067	,000
	Age^2	-,001	,000	-,001	,000
	Work experience	,025	,000	,025	,000
	Work experience^2	,000	,055	,000	,035
	Number of working hours	,000	,649	,000	,724
	1st generation migrants	-,193	,025	-,118	,178
	1.5 generation migrants				
	2nd generation migrants				
	2.5 generation migrants	,026	,812	,024	,828
	Remigrants	,064	,640	,092	,501
	Numeracy			,114	,000
Netherlands	Intercept	4,838	,000	4,725	,000
	Required education	,097	,000	,085	,000
	Overeducation	,034	,000	,025	,002
	Undereducation	-,023	,000	-,017	,003

		Model 1		Model 2	
		b	*p*	*b*	*p*
	Age	,062	,000	,059	,000
	Age^2	-,001	,000	-,001	,000
	Work experience	-,003	,509	-,003	,524
	Work experience^2	5,131E-05	,619	5,664E-05	,579
	Number of working hours	,013	,000	,013	,000
	1st generation migrants	-,159	,000	-,112	,002
	1.5 generation migrants	-,040	,624	-,020	,807
	2nd generation migrants	-,029	,761	-,009	,925
	2.5 generation migrants	,104	,009	,107	,006
	Remigrants	,136	,284	,170	,176
	Numeracy			,112	,000
Norway	Intercept	6,159	,000	6,018	,000
	Required education	,067	,000	,056	,000
	Overeducation	,040	,000	,031	,000
	Undereducation	-,027	,000	-,021	,001
	Age	,025	,000	,023	,001
	Age^2	,000	,001	,000	,002
	Work experience	,012	,003	,010	,008
	Work experience^2	,000	,021	,000	,044
	Number of working hours	,015	,000	,015	,000
	1st generation migrants	-,156	,000	-,095	,000
	1.5 generation migrants	-,039	,609	-,026	,734
	2nd generation migrants	-,068	,421	-,033	,695
	2.5 generation migrants	,035	,306	,041	,229
	Remigrants	-,092	,181	-,089	,191
	Numeracy			,109	,000
Poland	Intercept	5,526	,000	5,235	,000
	Required education	,073	,000	,059	,000
	Overeducation	,033	,000	,022	,001
	Undereducation	-,027	,002	-,015	,086
	Age	,012	,248	,015	,122
	Age^2	,000	,070	,000	,037
	Work experience	,026	,000	,024	,000
	Work experience^2	,000	,004	,000	,005
	Number of working hours	,011	,000	,011	,000
	1st generation migrants				
	1.5 generation migrants	,206	,451	,233	,387
	2nd generation migrants	,181	,164	,173	,178
	2.5 generation migrants	,056	,379	,042	,499
	Remigrants	,140	,608	,162	,549
	Numeracy			,149	,000
Slovak Republic	Intercept	5,408	,000	5,277	,000
	Required education	,099	,000	,094	,000
	Overeducation	,067	,000	,063	,000
	Undereducation	,002	,932	,003	,897
	Age	,006	,769	,007	,727
	Age^2	,000	,394	,000	,388
	Work experience	,020	,071	,019	,092
	Work experience^2	,000	,283	,000	,309
	Number of working hours	,011	,000	,011	,000
	1st generation migrants	,076	,782	,086	,753
	1.5 generation migrants	,129	,480	,132	,470
	2nd generation migrants	-,069	,692	-,069	,693
	2.5 generation migrants	,079	,272	,077	,286
	Remigrants	-,047	,787	-,041	,811

		Model 1		Model 2	
		b	*p*	*b*	*p*
	Numeracy			,061	,146
Spain	Intercept	5,995	,000	5,862	,000
	Required education	,068	,000	,062	,000
	Overeducation	,021	,000	,016	,006
	Undereducation	-,033	,000	-,030	,000
	Age	,036	,001	,035	,001
	Age^2	,000	,001	,000	,002
	Work experience	,009	,081	,009	,095
	Work experience^2	-5,522E-05	,611	-4,013E-05	,711
	Number of working hours	,003	,040	,004	,025
	1st generation migrants	-,145	,000	-,119	,002
	1.5 generation migrants	-,068	,380	-,042	,589
	2nd generation migrants	-,286	,137	-,290	,130
	2.5 generation migrants	,006	,939	,022	,796
	Remigrants	,002	,985	,014	,897
	Numeracy			,082	,001
Sweden	Intercept	6,539	,000	6,349	,000
	Required education	,067	,000	,057	,000
	Overeducation	,027	,000	,018	,012
	Undereducation	-,013	,030	-,008	,164
	Age	-,006	,443	-,005	,553
	Age^2	,000	,262	9,151E-05	,326
	Work experience	,020	,000	,020	,000
	Work experience^2	,000	,000	,000	,000
	Number of working hours	,014	,000	,014	,000
	1st generation migrants	-,059	,011	-,011	,640
	1.5 generation migrants	-,041	,721	-,026	,819
	2nd generation migrants	,022	,652	,033	,506
	2.5 generation migrants	,022	,457	,020	,492
	Remigrants	-,084	,427	-,032	,763
	Numeracy			,095	,000
United Kingdom	Intercept	4,687	,000	4,276	,000
	Required education	,118	,000	,094	,000
	Overeducation	,034	,000	,018	,015
	Undereducation	-,027	,006	-,015	,101
	Age	,044	,001	,049	,000
	Age^2	,000	,004	-,001	,001
	Work experience	,012	,084	,009	,190
	Work experience^2	,000	,140	,000	,376
	Number of working hours	,018	,000	,017	,000
	1st generation migrants	-,083	,019	-,018	,610
	1.5 generation migrants	-,021	,850	-,031	,772
	2nd generation migrants	,021	,717	,076	,173
	2.5 generation migrants	,025	,542	,050	,200
	Remigrants	-,078	,434	-,086	,367
	Numeracy			,237	,000
United States	Intercept	4,845	,000	4,701	,000
	Required education	,117	,000	,090	,000
	Overeducation	,036	,001	,014	,186
	Undereducation	-,066	,000	-,047	,001
	Age	,053	,000	,051	,000
	Age^2	-,001	,002	,000	,004
	Work experience	,004	,609	,003	,737
	Work experience^2	-6,820E-05	,651	-6,669E-05	,651
	Number of working hours	,013	,000	,012	,000

		Model 1		Model 2	
		b	*p*	*b*	*p*
	1st generation migrants	-,068	,157	-,013	,790
	1.5 generation migrants	,151	,398	,153	,380
	2nd generation migrants	-,067	,417	-,052	,519
	2.5 generation migrants	-,013	,859	-,012	,867
	Remigrants	-,101	,542	-,103	,523
	Numeracy			,211	,000

Source: PIAAC