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OVEREDUCATION AND EARNINGS IN CROATIA: EVIDENCE FROM PIAAC

Marija BEČIĆ
University of Dubrovnik, Faculty of Economics and Business, Dubrovnik, Croatia

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The aim of this paper is to identify the incidence of overeducation, its determinants, and its impact on workers' wages in Croatia. The analysis was conducted on a sample of respondents from Croatia using data from the 2022 and 2023 PIAAC survey. Overeducation was measured subjectively by comparing respondents' level of formal education with the level of education they themselves considered necessary for their work. A total of 30.3% of respondents stated that their work did not fully utilise their educational qualifications. To analyse the determinants of overeducation, the Heckman selection model was used to correct for possible bias in the sample due to the inclusion of only employed respondents. Area of education, experience, and business ownership were found to be statistically significant determinants of overeducation. The impact of overeducation on wages was assessed using a regression model, which found that overeducated employees earn statistically significantly less than colleagues with similar educational qualifications who perform jobs corresponding to their level of education.

Keywords: overeducation, earnings, Heckman selection model, Croatia

✉ Marija Bečić, University of Dubrovnik, Faculty of Economics and Business, Lapadska obala 7, 20000 Dubrovnik, Croatia. E-mail: marija.becic@unidu.hr

INTRODUCTION

The concept of overeducation, introduced by Freeman (1976), refers to a labour market disruption that occurs when an employee has more formal education than their job requires and the job does not fully utilise the knowledge and skills gained through education (Capsada-Munsech, 2017; Freeman, 1976).

Markussen et al. (2024) note that both educational attainment and labour market skill requirements have increased over time, but the rise in educational attainment has outpaced the increase in labour market requirements, leading to growing overeducation in the labour market. Measuring this phenomenon typically involves determining whether a person has more education than their current job demands. This can be assessed objectively, by comparing the individual's education level with official job requirements, or subjectively, through the individual's self-assessment.

In this study, overeducation is measured using a self-assessment approach, comparing individuals' attained level of education with the level they report as required for their current job. This choice is primarily determined by the structure of the PIAAC data and is consistent with a substantial body of international literature using similar measures (Belfield, 2000; Chevalier, 2003; McGuinness, 2006; McGuinness et al., 2018; Capsada-Munsech, 2019). However, the main limitation of this method is its susceptibility to bias from individual expectations, job satisfaction, and socially desirable responses, which can lead to overestimating the level of overeducation. While subjective indicators may reflect perceived skill underutilisation rather than strictly formal educational mismatch, they provide valuable insights into workers' own assessment of job – education fit and have been shown to capture economically meaningful differences in labour market outcomes.

The phenomenon of overeducation can be interpreted through several theoretical perspectives, each offering different empirical predictions. Human capital and career mobility theories view overeducation as a temporary mismatch that decreases with experience, whereas signalling and job competition theories predict a more persistent mismatch and a wage penalty associated with excess education. These perspectives motivate empirical analysis of the determinants of overeducation. Career mobility theory suggests that the probability of overeducation declines with work experience, while job competition and signalling models indicate that highly educated individuals and workers in less regulated segments of the labour market are more likely to experience persistent mismatch.

The most extensively studied consequence of overeducation in the labour market is its impact on workers' wages (Bauer, 2002). When comparing the wages of employees with the same level of education, where one is overeducated for their job, the evidence generally indicates that overeducation negatively affects earnings (Quintini, 2011; Groot & van den Brink, 2000). Overeducation results in significant wage losses for individuals and imposes costs on overall economic productivity, which may increase further if the trend towards higher education participation continues without a corresponding rise in suit-

able jobs (McGuinness, 2006). However, Plesca and Summerfield (2023) note that the economy can still benefit from higher education, even if this is not immediately apparent, showing that productivity increases by approximately 3% for every 1% rise in the proportion of overeducation. Regarding earnings, human capital theory predicts positive returns to education even in the presence of mismatch, whereas signalling and job competition theories suggest that excess education results in a wage penalty compared to equally educated but well-matched workers. These predictions are tested by estimating a wage equation that explicitly accounts for overeducation.

The educational structure in Croatia has improved considerably since the early 2000s, with the proportion of highly educated people rising to around 30 per cent (Matković, 2011). Following the Republic of Croatia's accession to the EU, emigration of young, well-educated individuals to member states offering better employment opportunities has increased. Overeducation can motivate migration, especially among the highly educated, who seek better opportunities for professional development, higher earnings, and greater social advancement of their skills (Czaika & de Haas, 2017). Barrett and Duffy (2008) show that overeducation in the home country acts as a "push" factor for migration. This makes Croatia a particularly interesting case for analysing educational mismatch and its labour market consequences.

The aim of this paper is to empirically examine theoretical predictions using recent PIAAC data for Croatia, first by analysing the determinants of overeducation while accounting for selection into employment, and then by assessing whether overeducation is associated with a wage penalty among employed workers. The research question arising is: what are the determinants of overeducation in Croatia, which elements are important in determining overeducation, and is overeducation associated with a wage penalty? To guide the empirical analysis and to more clearly link the theoretical framework with the econometric results, the following hypotheses are formulated:

H1: Overeducation is associated with individual characteristics and is more likely among women, younger individuals, and those with higher levels of education.

H2: Overeducation is related to job and firm characteristics and is less likely in the public sector, in smaller firms, and in full--time employment, where job requirements tend to be more clearly defined.

H3: Overeducated workers earn lower wages than equally educated workers whose jobs match their qualifications.

The paper adopts an integrated approach, analysing the prevalence of overeducation, its determinants, and its effects on wages. Its contribution is the application of the selection model to the analysis of overeducation determinants, accounting for employment selection, and the use of subjective, indirect measures of educational mismatch consistent with the structure of PIAAC data and existing literature. Finally, the paper provides new evidence on the effect of overeducation on wages in Croatia, showing that workers with excess education earn less than equally educated workers whose jobs match their qualifications.

The paper is organised as follows. The next part sets out the theoretical framework, followed by a review of previous research. The fourth part of the paper describes the research methodology, and the fifth part presents the results of the statistical analysis and their discussion. The paper ends with concluding remarks.

THEORETICAL FRAMEWORK

In the context of human capital theory (Schultz, 1961; Becker, 1975), the level of education is positively related to worker productivity. Within this framework, overeducation may occur when individuals initially accept jobs below their formal education level to gain work experience and firm-specific skills. Career mobility theory predicts that overeducation is a temporary phenomenon that decreases as workers gain experience and move to better-matched positions (Sicherman & Galor, 1990). According to signalling theory (Spence, 1973), education primarily signals individuals' abilities rather than directly determining productivity. When information is imperfect, employers use educational credentials to rank job applicants, which may prompt individuals to pursue higher levels of education to enhance their labour market prospects. Consequently, workers may acquire excess education without securing jobs that fully utilise their qualifications, resulting in persistent overeducation and lower wages compared to equally educated but well-matched workers.

From the perspective of job competition theory (Thurow, 1975), overeducation occurs when the supply of highly educated workers exceeds the number of high-skill jobs, forcing individuals to accept positions with lower educational requirements. As wages are determined by job characteristics rather than individual qualifications, excess education is not rewarded, resulting in persistent mismatch and a wage penalty. Job assignment theory (Sattinger, 1993) combines human capital and job competition models. It assumes that good jobs are limited and that wages depend partly on the job and partly on

workers' human capital. Overeducation arises because wages are determined by both individual education and job characteristics, not by only one of these factors. Assignment and job-matching approaches conceptualise overeducation as an equilibrium outcome resulting from imperfect matching between workers' educational attainment and job requirements (Sattinger, 1993; Hartog, 2000). In such contexts, wage outcomes depend not only on individual characteristics but also on the educational requirements of the job, providing a direct theoretical rationale for analysing educational mismatch and its wage effects.

In summary, human capital theory sees such a disruption as a short-term adjustment in the labour market, whereas theories such as signalling (Rodrigues & Guest, 2024; Spence, 1973) or job competition (Isopahkala-Bouret et al., 2021; Thurow, 1975) consider this phenomenon a long-term problem. Previous studies suggest that overeducation may be associated with lower job satisfaction, higher rates of shirking, absenteeism, and increased turnover, which may have broader implications for labour market efficiency (Pan et al., 2025; Bedemariam & Ramos, 2021; Peiro et al., 2010; Battu et al., 2000; Büchel, 2002; Quinn & Baldi de Mandilovitch, 1975).

These theoretical predictions directly motivate the empirical strategy adopted in the paper, which first analyses the determinants of overeducation while accounting for selection into employment, and subsequently examines the wage effects of educational mismatch.

LITERATURE REVIEW

The rapid expansion of tertiary education has changed the composition of labour market entrants, while the structure of available jobs has not necessarily adjusted at the same pace (Markussen et al., 2024). This has led to educational mismatch and overeducation. Consequently, much research has focused on the measurement, determinants, and consequences of overeducation. McGuinness et al. (2018) found that overeducation increased or remained unchanged in almost all EU countries between 2001 and 2011, a trend also confirmed in Poland for 2006–2014 (Baran, 2024).

The literature distinguishes between objective and subjective approaches to measuring overeducation (Belfield, 2000). Cross-country evidence confirms substantial variation in the incidence of overeducation depending on the measurement strategy, with subjective methods often producing higher estimates (Capsada-Munsech, 2024; Capsada-Munsech, 2019; McGuinness et al., 2018; Verhaest & Omey, 2006; Chevalier, 2003). Objective indicators suggest relatively moderate rates in several European countries, such as Denmark (11%; Nielsen, 2011)

and Belgium (24%; Karakaya et al., 2007), while subjective measures often indicate a considerably higher prevalence, reaching around 40–50% in countries such as the United Kingdom, France, Japan, Italy and Poland (Dolton & Siles, 2003; Di Pietro & Urwin, 2006; Johnes, 2019; Palczyńska, 2021).

As expected, people with higher levels of education are at greater risk of being overeducated, as confirmed by Cultrera et al. (2025), who found that between 20% and 33% of PhD holders in Europe are overeducated. Empirical studies consistently identify age and labour market experience as key factors, with younger and less experienced workers more likely to accept jobs below their educational level (Bečić, 2014; Baran, 2024). This pattern is often interpreted as evidence of career mobility, where workers initially accept mismatched positions to gain experience and later move into better-matched jobs (McGuinness, 2006). Gender differences have also been widely documented, with women showing a higher probability of overeducation than men (Charalambidou & McIntosh, 2021), especially among those with young children (Baran, 2024), suggesting that family-related constraints may limit access to well-matched jobs. Büchel and van Ham (2003) were among the first to highlight the importance of accounting for labour market entry processes by using the Heckman selection model, showing that family background significantly affects employment probabilities and, indirectly, the risk of overeducation. Similarly, Nieto and Ramos (2017) apply Heckman's correction to distinguish between formal qualifications and actual skills, demonstrating the relevance of unobserved individual heterogeneity in shaping overeducation outcomes across institutional contexts.

Different approaches yield similar results when analysing the impact of overeducation on workers' wages. Mandrone et al. (2022) studied the Italian labour market and found that overeducation significantly lowers wages, while Cultrera et al. (2025) also note that overeducated doctoral graduates face a considerable wage penalty (between 15% and almost 30%) compared to their well-matched colleagues. Dolton and Vignoles (2000) estimate that the penalty in the form of lower wages for overqualified workers is between 4% and 17%. Battu et al. (1999) estimated the average decline in returns six years after graduation to be between 11% and 17%. Caroleo and Pastore (2018) use the Heckman framework to obtain more accurate estimates of the wage effects of overeducation, arguing that neglecting selection leads to biased penalty estimates.

Empirical evidence for Croatia is largely outdated and limited, especially regarding nationally representative microdata and integrated analyses that simultaneously examine the incidence, determinants, and earnings consequences of overeducation. Bečić (2014) reports persistent overeducation in

Croatia based on Labour Force Survey data from 1998 to 2010. Matković (2011) highlights the difficult transition of young graduates into the labour market, suggesting structural and institutional barriers to securing well-matched employment. A study by Obadić and Oršolić (2012), using a Zagreb sample, finds that approximately one-third of highly educated workers surveyed consider themselves overqualified, with mismatch in communicative and other skill domains being prevalent and linked to personal characteristics. This paper contributes to the literature by addressing these gaps using recent PIAAC data and an empirical strategy that jointly analyses selection into employment and the wage effects of educational mismatch.

DATA AND METHODS

The study is based on the data set of the Programme for the International Assessment of Adult Competencies (PIAAC), which was collected in 2022 and 2023. PIAAC provides a valuable collection of data on people's education, skills and work experience on a sample of at least 4500 respondents aged 16 to 65 in each country. The key advantage is the methodological standardisation of data collection and coding, which ensures variable consistency and a high level of comparability between Croatian data and data from other countries. The representativeness of the PIAAC sample is ensured through a multi-stage weighting procedure. Baseline weights, calculated as the reciprocal probability of selection, are adjusted by a non-response factor and calibrated to key population parameters (age, gender, education) to reduce bias. This methodological framework enables generalisation of results to the adult population while minimising the standard error of estimation. Statistical data processing was performed using the SPSS and Stata software packages.

To measure overeducation in this paper, indirect self-assessment is used. Subjective methods rely on the employee's self-assessment of how much they use their formal training in their work. Individuals may be asked directly whether they are overeducated for their job, known as direct self-assessment. Alternatively, employees may be asked for their opinion on the minimum level of education required for their job. In this paper, the assessed required level of education is compared with the employee's actual level of education to determine whether they are overeducated. Responses to the PIAAC questionnaire item "What level of formal education is required for your job?" were compared with responses to "What is the highest qualification you have obtained?". Overeducation is identified when the level of education attained is higher than that required for the job, and a dummy variable was created that takes the value 1 for overeducated individuals. Subjective

methods based on employees' self-assessment of whether they are overeducated are subject to various forms of bias. For example, individuals may overestimate or underestimate the educational requirements of their job due to social desirability or personal expectations, which can lead to misclassification (Capsada-Munsech, 2019).

The determinants of overeducation in the labour market include individual characteristics of employees (such as age, gender, and level of education), structural labour market conditions, and a mismatch between the supply of and demand for certain qualifications (Mrnjavac & Bečić, 2014). To investigate the determinants of overeducation in relation to socio-economic characteristics, the Heckman selection model was used. This model is applied in economics when analysing a phenomenon within only a subset of the population. For example, overeducation is examined among the employed rather than the unemployed, although the unemployed can also be considered overeducated, as they do not use the skills and knowledge acquired through education at all. In this context, the results may be biased because the employed are likely to differ from the non-employed. The Heckman model consists of two stages: in the first stage, the probability that someone is included in the sample (i.e., that they are employed) is modelled. The key component of the model is this selection equation, which must include at least one variable not included in the outcome equation. Following previous research (Büchel & van Ham, 2003; Caroleo & Pastore, 2018), the variables included in the selection equation are gender, age, educational attainment, and family background characteristics which can be crucial for the decision to accept a job, such as the presence of a spouse and children in the household.

$$\text{Prob (employ} = 1)_i = \gamma_0 + \gamma_1 \text{gender}_i + \gamma_2 \text{age}_i + \\ + \gamma_3 \text{education}_i + \gamma_4 \text{spouse}_i + \gamma_5 \text{children}_i + u_i$$

In the second stage, the main outcome is modelled, adjusting for selection bias. In this way, the Heckman model provides more accurate estimates, even if the sample is not fully representative. The equation is:

$$\text{Prob (OE} = 1)_i = \beta_0 + \beta_1 \text{gender}_i + \beta_2 \text{experience}_i + \\ + \beta_3 \text{area\_of\_study}_i + \beta_4 \text{public\_sector}_i + \beta_5 \text{firm\_size}_i + \\ + \beta_6 \text{job\_type}_i + \beta_7 \lambda_i + \varepsilon_i$$

The dependent variable is the probability of being overeducated in the workplace, while the independent variables are gender, experience, area of education, and workplace characteristics such as ownership, firm size and type of job. The variables included in the model are listed in Table 1.

Variable	Description	Values	
OE	Overeducation – examinee having the level of education higher than required by job	0 1	not overeducated overeducated
Age	Age of examinee		Age
Gender	Gender	0 1	Male Female
Education	The highest level of education obtained by examinee	1 2 3	Low education Medium education High education
Area of study	Area in which examinee finished the highest level of education	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Economics, business and administration Law Health Welfare Social and behavioural sciences Journalism and information Information and communication technologies Natural sciences, mathematics, statistics Engineering and manufacturing Construction Agriculture, forestry, fisheries and environmental studies Personal and community services Security and transport Education and teacher training Humanities, languages and arts
Work_ experience	Work experience needed to get the current job	1 2 3 4 5 6	None Less than a month 1 to 6 months 7 to 11 months 1 or 2 years 3 years or more
Public_ sector	Sector in which examinee works	0 1	Other Public sector
Firm_size	Number of people working for employer	1 2 3	Less than 50 employees From 50 to 250 employees More than 250 employees
Job_type	Type of the work arrangement	0 1	Full time Part time
Employ-ment	Examinee being employed	0 1	Not employed Employed
Spouse	Living with spouse or partner	0 1	No Yes
Children	Having children in the household	0 1	No Yes

TABLE 1 Variables in the model Source: PIAAC

The effects of overeducation on employees' wages are usually estimated using the model developed by Mincer (1974), which includes the number of years of education as an independent variable. However, in this paper, due to the nature of the data, a different modified equation is used, which includes a dummy variable for overeducation and shows only the presence of the mismatch and its impact on wages, but not the intensity implied by each year of overeducation. The selection equation of the Heckman model remains unchanged from the previous model, while the outcome equation is:

$$\begin{aligned}\ln Earnings_i = {} & \alpha_0 + \alpha_1 gender_i + \alpha_2 age_i + \alpha_3 higheducation_i + \\ & + \alpha_4 manufacturing_i + \alpha_5 construction_i + \alpha_6 retail_i + \\ & + \alpha_7 transport_i + \alpha_8 accommodation_i + \alpha_9 information_i + \\ & + \alpha_{10} finance_i + \alpha_{11} small\_firm_i + \alpha_{12} OE_i + \alpha_{13} \lambda_i + \varepsilon_i\end{aligned}$$

The dependent variable is the natural logarithm of monthly earnings. The independent variables gender, age and OE are the same as in the previous model, while the other independent variables included are shown in Table 2.

TABLE 2
Variables in the wage regression equation

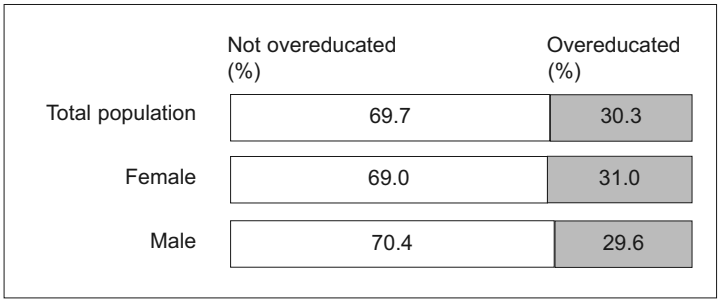
Variable	Description	Values
High education	Dummy variable indicating that the individual has a high level of education	0 Other 1 High education
Manufacturing	Dummy variable indicating that the individual is working in manufacturing	0 Other 1 Manufacturing
Construction	Dummy variable indicating that the individual is working in the construction sector	0 Other 1 Construction
Retail	Dummy variable indicating that the individual is working in the wholesale and retail sector	0 Other 1 Retail
Transport	Dummy variable indicating that the individual is working in transportation and storage	0 Other 1 Transportation and storage
Accommodation	Dummy variable indicating that the individual is working in accommodation and food service activities	0 Other 1 Accommodation and food service activities
Information	Dummy variable indicating that the individual is working in information and communication	0 Other 1 Information and communication
Finance	Dummy variable indicating that the individual is working in financial and insurance activities	0 Other 1 Financial and insurance activities
Small_firm	Dummy variable indicating that the individual is working in a firm with less than 50 employees	0 Other 1 Less than 50 employees

The coefficient next to the overeducation dummy variable is usually negative, indicating that overeducation lowers wages. This negative coefficient can be explained by the fact that employees are compared with others who have the same level of education but are appropriately matched in the labour market. Cohn and Kahn (1995) point out that the negative sign of the dummy variable for overeducation does not mean that each year of overeducation brings a negative return, but only that the return is lower than for people with the same education who are adequately employed in the labour market.

RESULTS AND DISCUSSION

The incidence of overeducation measured subjectively in the Croatian sample is shown in Figure 1.

➲ FIGURE 1
Overeducation in Croatia



The previous figure shows that 30.3% of examinees reports that their work does not fully utilise the skills and knowledge they have acquired through education. This finding is like that of Palczyńska (2021) for Poland, who also used self-assessment of educational match. As previous studies suggest, the level of overeducation in Croatia is higher than that found using objective measures, which was around 10% (Bečić, 2014). However, it appears that Croatians feel less overeducated than the inhabitants of the G7 countries, as Johnes (2019) found overeducation rates of around 50% in the UK, Japan, France, and the USA, 42.5% in Germany, and 34% in Italy. The second part of the figure shows that the proportion of women among the overeducated is higher than that of men, which is consistent with previous findings in other countries (Baran, 2024). This is partly attributed to the greater burden of family commitments, with women more likely to choose jobs offering greater flexibility, even if these are below their qualifications. Table 3 provides results of the probit analysis of overeducation determinants in Croatia. The analyses were performed using the main weighting variable (SPFWT0) and 80 replication weights (SPFWT1–SPFWT80) with the Balanced Repeated Replication method with Fay's coefficient of 0.5, using the Stata svy procedure.

TABLE 3
Heckman selection model results

Probit model with sample selection		
	Number of observations	3378
	Population size	1.911.699
	F(26, 3344)	5.38
	Prob > F	0.000

Dependent variable – OE	Coef.	Std. err.	t	Sig.
Gender	0.010	0.081	0.13	0.898
Work experience (Reference category: No experience)				
Less than a month	0.467**	0.147	3.17	0.002
1 to 6 months	-0.268**	0.086	-3.10	0.002
7 to 11 months	-0.360**	0.127	-2.84	0.005
1 or 2 years	-0.664***	0.092	-7.25	0.000
3 years or more	-0.611***	0.116	-5.25	0.000
Area of study (reference category: Economics, business and administration)				
Law	-0.138	0.231	-0.60	0.551
Health	-0.239*	0.142	-1.67	0.094
Welfare	0.262	0.391	0.67	0.503
Social and behavioural sciences	0.106	0.249	0.43	0.670
Journalism and information	-0.086	0.363	-0.24	0.814
Information and communication technologies	-0.069	0.189	-0.37	0.713
Natural sciences, mathematics, statistics	-0.385*	0.203	-1.90	0.058
Engineering and manufacturing	-0.047	0.114	-0.41	0.682
Construction	-0.059	0.156	-0.38	0.707
Agriculture, forestry, fisheries and environmental studies	0.220	0.163	1.35	0.176
Personal and community services	-0.089	0.104	-0.85	0.393
Security and transport	-0.050	0.137	-0.36	0.716
Education and teacher training	-0.549***	0.186	-2.95	0.003
Humanities, languages and arts	0.065	0.232	0.28	0.781
Public_sector	-0.252***	0.077	-3.26	0.001
Firm size (reference category: less than 50 employees)				
From 50 to 250 employees	-0.050	0.085	-0.58	0.560
More than 250 employees	-0.214	0.115	-0.19	0.852
Job type (reference category: full time job)				
Part time	0.184	0.191	0.96	0.335
Const	-0.129	0.203	-0.64	0.524
Selection regression, dependent variable: employment				
Gender	-0.156***	0.055	-2.86	0.004
Age	-0.024***	0.003	-8.64	0.000
Education (ref. category: Low)				
Medium	2.248***	0.161	14.0	0.000
High	2.965***	0.167	17.73	0.000
Spouse	0.423***	0.086	4.92	0.000
Children	0.535***	0.088	6.09	0.000
Const	-1.391***	0.187	-7.45	0.000
Athrho	-0.552***	0.160	-3.46	0.001
Rho	-0.502	0.119		

Note: ***$p < 0.01$, **$p < 0.05$, *$p > 0.1$

The parameter athrho is statistically significant at the 1% level, indicating that selection bias is pronounced and justifies the use of the Heckman model.

The table above shows that age, gender, educational level, living with a spouse or partner, and having children are all statistically significant for the likelihood of employment, which is a prerequisite for being overeducated in the workplace. Living with a spouse or partner may provide additional logistical support, which can make employment easier or more difficult depending on the context. Having children also has an impact, as parents must often juggle work and family life, which can limit employment opportunities. The level of education has a direct impact on employability, as higher education often leads to more and better-paid opportunities. The strong influence of education on employability, together with the observed incidence of mismatch, aligns with human capital and signalling theories, which suggest that individuals invest in higher education to improve their labour market position.

Some areas of education have a statistically significant impact on the probability of overeducation. This may be because some fields offer a clearer path to the labour market and more stable jobs, while others provide a broader but more uncertain range of opportunities. This highlights the importance of better linking the education system to the labour market and encouraging students to make informed choices.

It turned out that the public sector is less likely to generate subjective overeducation. The public sector has stricter regulations, clearly defining the pay scale and formalised recruitment procedures, which often specify the level of education required for the job. This reduces the risk of someone being hired "below their level of education". On the other hand, private companies often have more complex internal structures and different reasons for hiring highly qualified staff for positions that may not require their full expertise – be it for reasons of flexibility, reputation or because the tasks evolve quickly. In the private sector, the lack of education can be compensated for by other elements of human capital, but also, excess education most often represents a lack of experience, training or simply an employer's assessment that the individual has a low level of competence.

The lower likelihood of overeducation in the public sector and the variation across fields of study strongly support assignment and job-matching theories, which state that educational requirements and wages are largely determined by job characteristics, reducing mismatch where recruitment and job definitions are more formalised. The coefficients for the variable representing the work experience required to obtain a job are all statistically significant, and the negative sign for

the indicators for more experience means that the probability of overeducation decreases with experience, which goes in favour of mobility theories.

The results of the Heckprobit model provide partial empirical support for H1 and support for H2. Overeducation is associated with individual characteristics such as age and education level, confirming that certain groups are more exposed to mismatch in the labour market, but not with gender. At the same time, the lower likelihood of overeducation in the public sector, smaller firms, and more clearly structured employment arrangements supports the hypothesis that job and firm characteristics play an important role in shaping the incidence of overeducation.

As mentioned in the literature review, earnings are often associated with overeducation, i.e., such workers often earn less than those with the same level of education. The results of outcome regression of the earnings model with the OE dummy and considering other control factors such as gender, age and sector are shown in Table 4. The estimates were calculated considering the complex design of the PIAAC sample, using sample weights and BRR replication weights with Fay correction (Fay = 0.5). Standard errors are therefore adjusted for the stratified and clustered sample, allowing valid statistical inference at the population level.

TABLE 4
Wage regression analysis

Dependent variable: natural logarithm of gross monthly earnings	Coef.	Std. err.	t	Sig.
Gender	-0.193	0.022	-8.86	0.000
Age	0.003	0.001	2.94	0.003
High_ed_dummy	0.333	0.028	12.05	0.000
OE	-0.120	0.021	-5.66	0.000
Manufacturing	0.017	0.032	0.54	0.590
Construction	0.077	0.038	2.02	0.044
Retail	0.015	0.035	0.42	0.677
Transportation	0.095	0.058	1.62	0.104
Accommodation	0.111	0.040	2.73	0.006
Information	0.204	0.103	1.98	0.048
Finance	0.117	0.092	1.27	0.205
Education	-0.116	0.034	-3.35	0.001
Part_time	-0.515	0.074	-6.99	0.000
Small_firm	-0.037	0.021	-1.75	0.081
Const	9.263	0.062	15.53	0.000
Athrho	-0.613	0.084	-7.28	0.000
lnsigma	-1.053	0.039	-27.05	0.000
Rho	-0.546	0.059		
Sigma	0.349	0.014		
Lambda	-0.191	0.026		

Number of obs = 2896; Population size = 1.633.642; F(15, 2881) = 24.14; Prob > F = 0.000

Note: ***$p < 0.01$, **$p < 0.05$, *$p > 0.1$

The estimated parameters of the selection component of Heckman's model indicate the presence of selection bias in the sample of employed individuals. The parameter ρ, which measures the correlation between the errors of the selection and outcome equations, is negative and statistically significant, indicating a correlation between unobserved factors affecting both the probability of employment and the level of earnings. The statistically significant lambda parameter confirms the existence of selection bias and justifies the use of Heckman's selection model. The estimated value of the parameter σ reflects the dispersion of unobserved factors in the earnings equation, while the athrho parameter represents the transformed form of the correlation parameter ρ used in the estimation process.

The table above shows that certain personal characteristics are statistically significant in determining earnings, including gender, age, and higher education level. In addition, certain job-related characteristics are statistically significant for earnings, such as sector, type of job, and company size. As found in previous studies, the wages of women and younger workers are lower than those of their male and older counterparts, as indicated by the negative coefficients for gender and age. Since overeducation is central to the study and the results suggest that a high level of education has a positive effect on wages, the negative coefficient for overeducation reduces this effect and shows that overeducated workers earn less than equally educated individuals, which supports H3. However, experience can mitigate this, as greater age is associated with higher earnings. Part-time work is associated with significantly lower incomes. Compared to other sectors, wages are significantly higher in construction, accommodation and food, and the information sector, and lower in education.

CONCLUDING REMARKS

Growing belief in the benefits of education has led to a sharp increase in investment in education and a significant improvement in the educational structure of the population in recent decades, both globally and in the Republic of Croatia. As with investments in physical capital, many studies have sought to determine whether the return on investment in education justifies the expenditure. Since the mid-20th century, the return on investment in education has been estimated and shows that additional years of schooling increase wages or lifetime earnings in the labour market.

This paper examined the issue of overeducation in the Croatian labour market, focusing on its prevalence, causes, and impact on employee salaries. Overeducation is becoming in-

creasingly pronounced in Croatia, as in many other countries, because the educational level of the population is rising rapidly, while the structure of available jobs is not developing at the same pace. Based on data from the PIAAC survey from 2022 and 2023, and using a subjective method of measuring overeducation, it was found that 30.3% of respondents believe their workplace does not fully utilise the knowledge and skills they acquired through education. Analysis of the determinants of overeducation using the Heckman model revealed that gender, education level, field of education, sector, and company size play important roles. Women, especially those with higher education, are more likely to be overeducated. It was also found that employees in the public sector are less likely to be overeducated than those in the private sector. Regarding the impact of overeducation on wages, the results of the regression analysis confirm the hypothesis that overeducation affects wages. Overeducated employees earn statistically significantly less than their colleagues with similar educational qualifications who perform jobs corresponding to their level of education. This result is consistent with previous international research, which confirms that educational surplus can be partially utilised but does not bring the full economic benefit if it is not matched to the needs of the job. Findings show that overeducation in Croatia cannot be explained by a single mechanism but reflects the combined effects which goes in favour of assignment theory and career mobility dynamics.

Among the main limitations of the research, several aspects should be noted. Firstly, the use of a subjective method to measure overeducation introduces the risk of bias in respondents' perceptions, as individuals may apply different criteria when assessing the level of education required for their own job. Furthermore, the analysis was limited to those in employment, excluding the potentially large number of people who are out of the labour market due to overeducation. Finally, due to the nature of the available data, it was not possible to analyse in detail the dynamics of overeducation over time, such as how the position of overeducated workers changes throughout their careers.

Based on these results, several guidelines for future research can be proposed. Firstly, longitudinal monitoring of respondents' careers is recommended to determine the duration of overeducation and its impact on career development and lifetime earnings. It would also be useful to extend the analysis to the unemployed and workers in atypical employment (e.g. freelancers), which would provide a more complete picture of the consequences of overeducation. Furthermore, subjective and objective measurement methods should be combined and compared to minimise distortions and obtain more

robust indicators. Given the significant problem of emigration in Croatia, further research could examine how overeducation affects perceptions of opportunities and prospects in the home country.

The results presented here have important implications for policymakers. These include providing young people with better information when choosing their educational programmes, promoting enrolment in shortage occupations, and developing a system to predict future labour market needs. The lifelong learning system also requires further development to enable existing skills to be adapted to changes in the economy. The private sector could strengthen cooperation with educational institutions and develop internal career development strategies that allow optimal utilisation of employees' knowledge.

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Preobrazovanost i plaće u Hrvatskoj: nalazi iz PIAAC-a

Marija BEČIĆ
Sveučilište u Dubrovniku, Ekonomski fakultet,
Dubrovnik, Hrvatska

Cilj je rada utvrditi razinu, odrednice i utjecaj prekomjernog obrazovanja na plaće radnika u Hrvatskoj. Analiza je provedena na uzorku ispitanika iz Hrvatske, koristeći se podacima iz istraživanja PIAAC-a, koje provodi OECD za 2022. i 2023. godinu. Prekomjerno obrazovanje mjerilo se subjektivnom metodom, uspoređujući razinu formalnog obrazovanja ispitanika s razinom obrazovanja koju sami smatraju potrebnom za obavljanje svoga posla. Analiza pokazuje da 30,3 % ispitanika smatra kako njihove obrazovne kvalifikacije nisu dovoljno iskorištene na njihovu radnom mjestu. Za

analizu odrednica prekomjernog obrazovanja iskorišten je Heckmanov selekcijski model, kako bi se uzela u obzir moguća pristranost uzorka zbog uključivanja samo zaposlenih ispitanika. Utvrđeno je da su područje obrazovanja, iskustvo te vlasništvo poduzeća statistički značajne odrednice prekomjerna obrazovanja. Utjecaj prekomjernog obrazovanja na plaće procijenjen je regresijskim modelom te je utvrđeno da prekomjerno obrazovani radnici imaju niže plaće u usporedbi s jednako obrazovanim radnicima na odgovarajućim pozicijama.

Ključne riječi: preobrazovanost, plaće, Heckmanov selekcijski model, Hrvatska