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HIGHER EDUCATION EFFECTS ON THE REGIONAL UNEMPLOYMENT RATE IN POLAND

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Purpose: The main aim of this paper is to provide an empirical assessment of the impact of higher education on regional unemployment rate in Poland.
Design/methodology/approach: Using the fixed effects (FE) estimator, we estimated effects on the unemployment rate by the number of students and university graduates for the panel of annual data for 16 Poland's voivodships over the 2004-2024 period. The model controls for the impact of regional output growth, investment, production structure, wages, and consumer prices.
Findings: It is found that higher levels of human capital are associated with lower unemployment rates in the largest regions, which is broadly consistent with the Nelson–Phelps hypothesis and agglomeration effects. By contrast, in the smaller (peripheral) regions an increase in the number of students (graduates) leads to higher unemployment, while favourable dynamic effects are also observed. Our findings indicate the presence of structural mismatches and a limited capacity of peripheral regions to absorb highly educated labour.
Research limitations/implications: There are a few potential limitations of this study. First, our educational variables do not account for differences in the quality or in the field-of-study composition of higher education. Second, it is difficult to control for the effects of actual mobility of university graduates. Third, the analysis does not address intraregional differences in the higher education effects on unemployment.
Practical implications: For the largest voivodships, strengthening of the relationships between universities, innovations and labour market should be prioritized. For the peripheral regions, policymakers should create a more friendly environment to support local R&D activities.
Social implications: As differentiated higher education effects on unemployment may provide incentives for migration of university graduates to the largest urban agglomerations, a well-designed education policy has a potential to block these processes and provide support for a balanced regional development.
Originality/value: The article contributes to the literature by jointly accounting for unemployment effects of higher education both in levels and first differences across agglomeration and peripheral regions. For Poland, the study provides new evidence on the region-specific higher education effects on the unemployment rate.
Keywords: higher education, unemployment, PVAR model, Poland.
Category of the paper: Research paper.

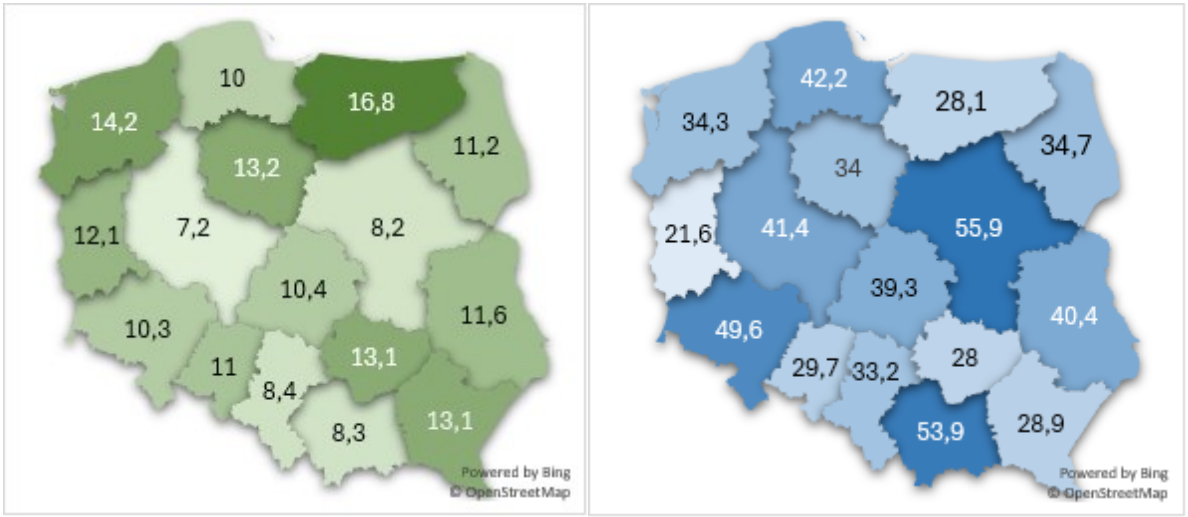
1. Introduction

There are numerous mechanisms of higher education influencing regional unemployment. First of all, it is due to regional output growth, with both demand for labour and supply of labour being influenced by higher education effects. As returns on education are related to agglomeration economy factors (Bolter, Robey, 2020), it creates additional channel of higher education affecting unemployment, with mobility of university graduates shaping regional labour markets to large extent (D'Ingiullo, Quaglione, 2025; Faggian, McCann, 2009). In such a context, factor endowments such as natural resources and local amenities do play a role (Südekum, 2003). Another important mechanism is related to the job search process (Mincer, 2001). Later models of the job matching process account for agglomeration effects, with enough room for the link between higher education and unemployment (Epifani, Gancia, 2003; Zierahn, 2011; Vom Berge, 2013). Besides benefits of sharing and matching, agglomeration economies provide with incentives for educated labour and a skilled labour pool (Bolter, Robey, 2020). Human capital accumulation may be connected to local characteristics such as population density (Combes, Gobillon, 2015). Other explanations for regional differences in the unemployment rate include such factors, as slow wage adjustment, high cost of migration, permanent differences in institutional characteristics etc (Rios, 2017).

Empirical evidence in favour of the inverse relationship between education and regional unemployment is found for European regions (Hermannsson, Scandurra, Graciano, 2021; Huňady, Pisár, 2016; Rios, 2017; Zeilstra, Elhorst, 2014). A better-educated population is associated with a lower regional unemployment rate in Germany (Schubert, Kroll, 2014) and Romania (Herman 2012), as well as in several other Eastern European countries (Jurajda, Terrell, 2007). However, despite strong theoretical arguments, a positive link between the number of university graduates and regional unemployment is found for Turkey (Algül, 2024). For Spain, it is established that peripheral regions suffer from exodus of university graduates and higher unemployment of those who remain at origin (González-Leonardo, 2023), with high seasonal volatility and extreme vulnerability to external crises of the tourist-oriented economy being among the explanations (Rodríguez, Martínez-Roget, Loureiro, 2025).

The unemployment rates in Poland are quite different across regions (Fig. 1a), ranging from 7.2-8.4% in Greater Poland, Masovian, Lesser Poland and Silesian voivodeships to almost twice as much in Subcarpathian, Swietokrzyskie and Kuyavian–Pomeranian voivodeships and as high as 16.8% in the Warmian-Masurian voivodeship. Such outcomes are in line with international evidence that the magnitude of unemployment disparities among regions within countries are not less that disparities among countries (Elhorst, 2003). The same significant regional disparities are observed in the number of students (Fig. 1b). Again, the largest number of students is a distinct feature of Masovian and Lesser Poland voivodeships, while Subcarpathian, Swietokrzyskie and Warmian-Masurian voivodeships being placed at the

bottom of the ranking. It suggests that there is an inverse relationship between the higher education enrolment and regional unemployment, being in support of earlier studies that link variations in skill levels to the pattern of regional unemployment in Poland (Newell, 2006).



a) the unemployment rate (%) b) the number of students per 1000 persons

Note: average values for the 2004-2024 period are presented.

Figure 1. Higher education and unemployment in Poland, 2004-2024.

Source: the GUS Local Data Bank (https://bdl.stat.gov.pl/bdl/start).

This study is aimed at studying higher education effects on the regional unemployment rate in Poland, with a control for regional growth rate, investments in the physical capital, consumer prices, wages and structural features. On the example of Poland, the article addresses a research gap in the literature regarding the potential differences in higher education effects across agglomeration and peripherical regions in the Central and Eastern European countries. It is important for the better design of the region-specific higher education policies aimed at better use of highly educated labour force and thus narrowing regional income disparities. In the remainder of this paper, Section 2 provides with a brief survey of the literature dealing with the higher education effects on regional unemployment. Section 3 presents data and statistical model, with the estimation results discussed in Section 4. Finally, Section 5 concludes.

2. Relevant literature

Earlier models of regional labour market were focused on migration decisions, wage-setting mechanisms and interplay between demand for labour and its supply (Elhorst, 2003). Education effects were not accounted explicitly. For example, Blanchard and Katz (1992) explain higher regional unemployment with a decrease in the labour supply and an increase in both labour

demand and wages. However, modern variants of the Blanchard-Katz model account for education attainment and demographic composition of population (Rios, 2014).

As implied by the Okun Law, the unemployment rate should be reduced by regional output growth, being influenced by education as the most important component of human capital. In such a context, it is important to distinguish between the factor-accumulation channel (applied use of new technologies) and the productivity channel (investments into productivity factors). The former approach implies that it is the stock of educated persons that matters (Nelson, Phelps, 1966), while the latter lays stress on the fact that only changes in the number of students (or university graduates) contribute to economic growth (Lucas, 1988). Modern critics of the human capital theory attract attention to the social context of learning and its external outcomes, such as peer group effects, learning through emulation of experts and co-workers, increasing generality of knowledge and technological know-how, inter-generational effects or even consumption of culture (Auerbach, Green, 2025). For transition economies, regional differences in the unemployment rate can be explained by inherited skill endowments, which condition the ability of regions to attract highly skilled labour as well as foreign direct investment (Jurajda, Terrell, 2007).

In the context of job search, Mincer (2001) relates a major benefit of education to the lower risk of unemployment. In addition to higher wages, better educated workers benefit from greater upward mobility in the workplace and greater employment stability. Technically, the unemployment rate is presented as follows:

$$U = p(S) \cdot p(U/S) \cdot \frac{d_U}{1 - d_O}, \tag{1}$$

where $p(S)$ is the probability of becoming unemployed after separation from the previous job, $p(U/S)$ is the probability of conditional unemployment when separated, d_U and d_O are fractions of time spent in unemployment and out of the labour force for the unemployed persons and by all workers, respectively. Education reduces probability of both separation and conditional unemployment, thus leading to a decrease in the probability of experiencing unemployment, as expressed by the term $p(S) \cdot p(U/S)$. More educated workers are likely to experience lower turnover due to greater learning ability and better job training. For better educated persons, a shorter period of finding a new job is resulting from smaller costs of both on the job and off the job search, greater efficiency in search for a new workplace, and greater intensity of search.

Agglomeration economies also play a significant role in explaining regional disparities. By combining building blocks of new economic geography and wage curve models, Südekum (2003) highlights importance of local preferences and scale economies in explaining how agglomeration effects contribute to regional disparities in unemployment and wages. It is demonstrated that large regions with economies of scale should have low unemployment rates and high wages, whereas the opposite outcomes are attributed to small regions. In the larger regions, wage premium results from the more intense use of technology, scale

economies and efficiency wages, as it is necessary to pay more in order to deter shirking in the low unemployment environment. In the presence of iceberg costs for interregional transportation of intermediate inputs, the degree of agglomeration is larger in regions with (i) stronger returns to scale and (ii) weaker preferences for staying in local community.

Based on empirical verification of several theoretical studies, Sbergami (2002) found for several European countries that agglomeration effects can be strengthened by migration of skilled workers into industrial regions with strong R&D activities. However, it could be a point of concern. Epifani and Gancia (2003) provided with theoretical arguments that inflows of immigrants into the larger regions reduces the unemployment rate in the short run, but it is reversed in the long run. Vom Berge (2012) proposed a model with search frictions for low-skilled immobile workers that predicts a higher unemployment rate in agglomerations due to a downward pressure on nominal wages. Kondo (2014) elaborated a model with negative externalities on the matching efficiency that lead to a higher unemployment in agglomerations with high employment density, even despite a positive relationship between nominal wages and agglomeration. If account for efficiency wages in agglomerations, it is possible to explain a lower unemployment in the periphery region (Zierahn, 2011).

3. Data and statistical model

For the purpose of our study, the panel data sample of annual time series for 16 voivodships over the 2004-2023 period has been used, as obtained from the General Statistical Office of Poland (online resource). Unemployment is measured by the regional unemployment rate, U_{it} (%), where subindex i stands for a region (voivodeship). Educational variable is proxied with the number of students and university graduates per 1000 of population, $STUD_{it}$ and $GRAD_{it}$ respectively. Among other variables used in the study, Y_{it} is the regional product per capita (in zlotys), INV_{it} are investments in physical capital (% of regional product), STR_{it} is the share of industrial production in the regional domestic product, W_{it} is the nominal wage (in zlotys), CPI_{it} is the consumer price level (index, 2002=100).

As shown in Table 1, significant disparities across regions characterize not only the unemployment rate and number of students (graduates), but other variables as well. All Pesaran's tests indicate the strong presence of cross-sectional dependency in the panel set, while several unit root tests, Cross-sectional Augmented Dickey-Fuller (CADF), Cross-sectional Im-Pesaran-Shin (CIPS) and Cross-sectional Levin-Liu-Chu (CLLC), indicate that all panels are stationary in levels (results are available on request).

Table 1.
Descriptive statistics

Statistics	$STUD_{it}$	$GRAD_{it}$	U_{it}	INV_{it}	STR_{it}	ΔY_{it}	ΔW_{it}	ΔCPI_{it}
Mean	37.21	9.28	11.26	14.51	67.72	3.73	2.83	3.34
Std. Dev.	12.53	2.76	5.17	2.20	12.89	3.22	2.28	3.60
Max	68.04	16.68	29.20	23.22	103.58	13.84	7.33	16.10
Min	11.86	2.79	2.80	10.06	29.59	–4.25	–5.02	–1.70

Note. Here and hereafter Δ is the operator of first differences.

Source: Author's own work.

In order to account for both the Nelson-Phelps effect and investment effect of higher education, as assumed in the endogenous growth models, Krueger and Lindahl (2001) proposed to use the education variable simultaneously in levels and first difference. Assuming that higher education effects on unemployment mirror those ones regarding regional output, our baseline model presents as follows:

$$U_{it} = a_0 + a_1 EDU_{it}^k + a_2 \Delta EDU_{it}^k + a_3 \Delta Y_{it-1} + a_4 STR_{it} + \eta_i + \tau_t + \varepsilon_{it}, \quad (2)$$

where EDU_{it}^k is the educational variable ($k = 1,2$), η_i and τ_t are controls for regional and time effects, and ε_{it} is the stochastic factor.

Regardless of underlying motivation, it is expected that higher number of students (graduates) contributes to a decrease in the unemployment rate ($a_1, a_2 < 0$). Based on international evidence, for example Sbergami (2002), a higher share of industry in local output is likely to be favourable for a low unemployment either ($a_4 < 0$). A control for the lagged regional output growth is aimed at capturing unemployment effects in the fashion of the Okun's Law ($a_3 < 0$). In the extended model, investments in physical capital are aimed at capturing demand for labour effect, with a decrease in the unemployment rate to follow. The impact of higher wages is rather ambiguous. As higher wages are supposed to increase the supply of labour (Rios, 2014) and decrease unemployment, their contribution to the cost of production should work in the opposite direction. Consumer price inflation used to reduce purchasing power of workers and thus should increase unemployment via a decrease in both the supply of labour and demand for the labour force, resulting from income losses and stagnation of demand for goods and services in regional markets.

Eq. (2) is estimated for the full sample of 16 voivodships and for two sub-samples including (i) six largest voivodships, with dynamic urban centers such as Warsaw, Cracow, Gdansk, Katowice, Poznan, Wroclaw, and (ii) 10 other voivodships which are characterized on average by lower population density and lower level of regional output per capita. Such a split of the full sample is aimed at capturing potential differences in the higher education effects on unemployment between large regions with agglomeration economies and smaller regions lacking that kind of advantages.

4. Results

Estimation results for the full sample of 16 voivodships are presented in Tables 2 and 3. The fixed effects (FE) estimator is used in all cases, as suggested by the Hausmann test. A growth in the number of students helps to decrease unemployment rate, but this educational variable in levels is of the opposite effect (Table 2). Both outcomes are robust across different specifications of the regression model. Results stay intact if we use the number of graduates as the educational variable (Table 3). The stability of the signs and statistical significance of these parameters across alternative sets of control variables strengthens the credibility of the results obtained. In the analysis, we did not control for the border effect, as it implies the use of a dummy variable for borders in gravity model or accounting for the ratio of internal trade (production minus exports) to international trade, income level in the neighbouring countries or migration flows. In addition, it should be admitted that the available regional data sample is not long enough to allow for more comprehensive estimation strategies. Obviously, it is the challenge for future studies.

Table 2.
Number of students effects on the unemployment rate (all voivodships)

Variables	(1)	(2)	(3)	(4)	(5)
Const	5.701***	7.892***	7.724***	8.122***	6.388***
$STUD_{it}$	0.142***	0.130***	0.130***	0.123***	0.129***
$\Delta STUD_{it}$	–0.169**	–0.149**	–0.151**	–0.156**	–0.152**
ΔY_{it-1}	–0.025	–0.046	–0.047	—	—
STR_{it}	—	–0.021	–0.021	–0.021	–0.021
INV_{it}	—	—	0.010	0.022	0.015
ΔW_{it-1}	—	—	—	–0.157**	—
ΔCPI_{it-1}	—	—	—	—	0.404*
R^2	0.94	0.93	0.94	0.94	0.94

Note. Here and hereafter ***, **, and * mean statistical significance at the 1%, 5% and 10% levels.

Source: Author's own work.

Table 3.
Number of university graduates effects on the unemployment rate (all voivodships)

Variables	(1)	(2)	(3)	(4)	(5)
Const	5.701***	7.892***	7.724***	8.122***	6.388***
$GRAD_{it}$	0.142***	0.130***	0.130***	0.123***	0.129***
$\Delta GRAD_{it}$	–0.169**	–0.149**	–0.151**	–0.156**	–0.152**
ΔY_{it-1}	–0.025	–0.046	–0.047	—	—
STR_{it}	—	–0.021	–0.021	–0.021	–0.021
INV_{it}	—	—	0.010	0.022	0.015
ΔW_{it-1}	—	—	—	–0.157**	—
ΔCPI_{it-1}	—	—	—	—	0.404*
R^2	0.94	0.93	0.94	0.94	0.94

Source: Author's own work.

Regardless of the educational variable used, it is found that both regional output growth (ΔY_{it-1}) and investments in the physical capital (INV_{it}) do not affect the unemployment rate, while consumer prices are associated with higher unemployment. Among differences, wage growth contributes to a lower unemployment in the specification (4) with the number of students. Regions with a higher share of industry (STR_{it}) seems to have a lower unemployment, but only in the estimates with university graduates and control for investments.

As presented in Table 4, there is a positive effect of the number of students on unemployment for the largest voivodships, an outcome in line with the Nelson-Phelps hypothesis claiming that it is the level of human capital that matters most in adopting new technology. Consequently, the unemployment rate declines in the wake of stronger output growth. However, an inverse relationship between $STUD_{it}$ and U_{it} is not confirmed by the estimates with university graduates (Table 5). In both cases, dynamic changes in the educational variable do not have any impact on the unemployment rate. In the smaller regions, both the number of students and the number of graduates in levels are significantly associated with unemployment, whereas their changes exert a strongly negative effect. This implies that short-term increases in human capital reduce unemployment, while its accumulation leads to persistent structural mismatches. Accordingly, the stronger responsiveness of unemployment to both student and graduate numbers in smaller regions explains the asymmetry of educational effects in levels and first differences in the panel estimates for the full sample of regions, as reported in Tables 2 and 3. Only in the largest regions is an adverse relationship observed between consumer prices and unemployment, alongside a contrastingly favourable impact of industrialization and regional output growth.

Table 4.
Number of students effects on the unemployment rate

Variables	Largest voivodships			Other voivodships		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
Const	19.318***	18.971***	16.015***	3.420	3.582	3.045
$STUD_{it}$	–0.109**	–0.120**	–0.118**	0.274***	0.273***	0.275***
$\Delta STUD_{it}$	0.054	0.067	0.046	–0.299***	–0.306***	–0.299***
ΔY_{it-1}	–0.104	—	—	–0.048	—	—
STR_{it}	–0.048*	–0.046	–0.042	0.008	0.008	0.008
INV_{it}	–0.081	–0.059	–0.058	0.009	0.014	0.007
ΔW_{it-1}	—	0.001	—	—	–0.127	—
ΔCPI_{it-1}	—	—	0.888***	—	—	0.071
R^2	0.94	0.94	0.95	0.94	0.94	0.95

Source: Author's own work.

Indirectly, our findings may suggest support for agglomeration theories. Better adaptation of advanced technologies or more intense innovation activities by more educated local populations in the largest voivodships can be explained by such factors as higher mobility of university graduates (D'Ingiullo, Quaglione, 2025; Faggian, McCann, 2009), better pooling (Bolter, Robey, 2020) or job matching (Epifani, Gancia, 2003; Zierahn, 2011; Vom Berge, 2013). For the smaller voivodships, higher unemployment of educated persons can result from

the lack of abovementioned factors. As argued by Südekum (2003), preferences for local amenities can be important either. In such environment, it is important to eliminate obstacles for the long-term gains from higher education. Consequently, policymakers should create a more friendly environment to support R&D activities at the local higher education institutions. For this purpose, incentives for natural and applied fields of study are suggested. It could be helpful in creating such a local pool of educated persons that allows for technology-based regional growth as a prerequisite for low unemployment. Otherwise a present situation when the short-term gains from a higher growth rate in the number of students coincides with the long-term losses may persist.

Table 5.
Number of university graduates effects on the unemployment rate

Variables	Largest voivodships			Other voivodships		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
Const	12.602***	11.707***	8.009***	7.589***	7.914***	6.716***
$GRAD_{it}$	0.081	0.041	0.104	0.756***	0.752***	0.761***
$\Delta GRAD_{it}$	0.006	0.028	–0.005	–0.621***	–0.659***	–0.644***
ΔY_{it-1}	–0.143*	—	—	–0.020	—	—
STR_{it}	–0.040	–0.037	–0.032	–0.011	–0.011	–0.011
INV_{it}	–0.082	–0.051	–0.049	–0.005	0.002	–0.001
ΔW_{it-1}	—	0.031	—	—	–0.150	—
ΔCPI_{it-1}	—	—	0.947***	—	—	0.254
R^2	0.94	0.94	0.94	0.94	0.94	0.95

Source: Author's own work.

5. Conclusions

The empirical analysis confirms that the number of students (in levels) contributes to a reduction in the unemployment rate in the six largest regions of Poland, while the opposite effect is observed in the remaining regions. However, smaller (or peripheral) voivodships benefit from a dynamic educational effect (in first differences), which is a hint on likely educational mismatches. The robustness of the obtained results has been verified by the use of such controls as regional output, investments and wages. Our results imply that the productivity channel prevails in smaller voivodships, while the long-term benefits stemming from better use of new technologies are present in the largest voivodships, in full accordance with the Nelson-Phelps hypothesis. Much more favourable long-term effects of higher education for the largest voivodships can be explained by the combination of several agglomeration factors, such as higher mobility of university graduates, better pooling or job matching. In addition to the lack of abovementioned factors, higher unemployment of educated persons in the smaller voivodships can be explained by stronger preferences for local amenities. In such an environment, it is important to remove barriers to the long-term benefits of higher education

by fostering a more supportive framework for research and development activities within local higher education institutions. To this end, targeted incentives for natural and applied sciences are recommended. More generally, restoring an upward trend in university student enrolment across all regions of Poland, including the largest ones, is essential, while placing a much stronger emphasis on scientifically oriented fields and research activities in smaller voivodships.

There are a few potential limitations of this study. First, the educational variables employed, i.e. number of students and university graduates per 1000 of population, do not account for differences in the quality of education or in the field-of-study composition of higher education offerings at regional public and private higher education institutions. Second, it is difficult to control for the effects of actual mobility of university graduates due to the lack of data. Third, the analysis does not address intraregional differences in the higher education effects on unemployment. Future studies should take into account microeconomic data, fields of study effects and the impact of labour migration on regional economy developments, especially in the context of labour market functioning mechanisms. As mentioned above, a comprehensive study of border effects can be informative as well.

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