

## EMPLOYMENT CHANGES IN THE CONTEXT OF CHANGES IN EDUCATION CASE STUDY FROM LUXEMBOURG

<sup>a</sup>EVA GRMANOVÁ, <sup>b</sup>EVA IVANOVÁ

<sup>a</sup>Alexander Dubcek University of Trencin, Študentská 3, 911 50 Trencin, Slovakia

<sup>b</sup>Alexander Dubcek University of Trencin, Študentská 3, 911 50 Trencin, Slovakia

email: <sup>a</sup>eva.grmanova@tuni.sk, <sup>b</sup>eva.ivanova@tuni.sk

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**Abstract:** Labour shortage, the increasing share of employed foreigners and digitalisation are changing the factors affecting employment. The relationship between employment and education is changing. Luxembourg has a special position among EU countries, as has the largest share of employed foreigners in the EU. It has the best performing economy. The aim of the study is to specify the dependence between employment and education in Luxembourg using an econometric approach. In the specification and quantification of the model, statistical and econometric verification was performed. Employment is statistically significantly affected by the participation rate in education and training persons. The conclusions of the empirical analysis confirm the link between employment and adult education in Luxembourg.

**Keywords:** employment; adult education; tertiary educational attainment, econometric modelling.

### 1 Introduction

The current trend in the labour market is that the size of the workforce is changing. This change is the result of long-term unfavourable demographic trends. As a result, European Union (EU) countries are placing much more emphasis on employee retention and the employment of foreigners.

Luxembourg has a special position in the employment of foreigners. The country has the largest share of employed foreigners in the EU (54.2% of the employed) (Eurostat, 2024, 1) and the largest economic performance in terms of GDP. "Luxembourg is consistently ranked 1st in the world on the basis of GDP per capita" (Ministry of Foreign and European Affairs of the Slovak Republic, 2024). Across all indicators, Luxembourg's economy has continuously maintained or improved its position (Ministry of Foreign and European Affairs of the Slovak Republic, 2024). Luxembourg achieves excellent results in the use of Smart technologies in enterprises. It ranks third (in 2023) in the use of AL technologies in enterprises (Eurostat, 2024, 3). The country has the fourth-highest share of people who have participated in education in the last four weeks (after Sweden, Finland and Denmark). Based on its economic performance, Luxembourg can be seen as a model for other EU countries. We are also interested in the country because of the large proportion of working immigrants and high public support for immigration. Analysis of its approaches may be beneficial for other EU countries.

Existing studies highlight the fact that in the current era of staff shortage (Groiss & Sondermann, 2024; Deschênes, 2023) and rapid digital change, there is a need to address both the retention of existing staff (Gelencsér *et al.*, 2024; Haar & Kelly, 2024) and to make efforts to attract new staff. Staff shortage increase pressure on employers to increase employee retention efforts. Employee retention is a complex issue. It can be addressed in a number of ways. An important attribute is lifelong learning. It is directly linked to the labour market and the workforce. The importance of enhancing employment and education is set out in both national policies and transnational goals. Requirements for their improvement are also part of the concept of sustainable growth – Agenda 2030 (Esha, 2020).

Although there has been an increase in studies on the need for and impact of education on the labour market and on employment, it can be concluded that there has not been a full in-depth examination of the relationship between education and employment based on empirical studies. We consider the lack of

findings on the relationship between employment and adult learning to be a research gap at present.

With our case study focusing on Luxembourg, we want to identify the relationship in the most economically powerful country with a large share of foreigners. Based on the sources studied and the values of the indicators in Luxembourg, we assume that there is a direct relationship between employment and the highest level of education attained and adult education. If we confirm this relationship, we would like to draw attention to the need for the same approach to education in other EU countries.

We will two scientific hypotheses: H1 and H2.

H1: There is a relationship between employment and the share of persons with tertiary educational attainment in Luxembourg.

H2: There is a relationship between employment the participation rate in education and training (previous 4 weeks) persons (adult education) in Luxembourg.

The aim of the study is to specify the dependence between employment and education in Luxembourg using an econometric approach.

The main point we want to stress is that the participation rate in education and training (previous 4 weeks) persons in Luxembourg could not be so high if the employers in Luxembourg did not provide educational activities to working foreigners, whose share is more than 50%. Thus, in Luxembourg both the government and employers show a positive approach towards adult education. This is different from the approach of many countries in the EU (see e.g. the approach in Great Britain in Liu-Farrer *et al.*, 2023). At the same time, it is important that employees are willing to participate in education. This is based on theoretical concept of regional opportunity structures (Bernard *et al.*, 2023). The availability of opportunities on a regional scale explains differences in inequalities. In a country with a high economic performance, with a positive approach of the government and business towards adult education, the share of people participating in education and influencing the labour market situation is high too. If this assumption is confirmed, in countries where there is a shortage of employees, it will be appropriate to consider introducing support programmes for adult education in order to retain employees.

The findings of our study can contribute to the understanding of the relationship between employment and education. The added value lies especially in identifying the relationship between employment and adult education in the most advanced country, whose approach can serve as an example for other countries. The results of our study may be relevant to government policy makers, employers and researchers, seeking to address the issue of employee retention or adult education. They can provide important education-related approaches.

The study consists of five main sections. The Introduction, stating the purpose of the study, is followed by the Literature review. This section provides an overview of recent findings on the relationship between employment and education published in scholarly studies while highlighting the factors causing disparities across countries. The following section describes the data and research methods. This is followed by the Results and Discussion. The last section is Conclusion.

### 2 Literature review

Existing studies point out that knowledge and skills from school are very important but need to be continuously adapted to the changing environment (Mirke *et al.*, 2019). Consequently, knowledge and skills acquired at school are not sufficient for the entire working life of people (Lindqvist *et al.*, 2023). Employers

in most professions require employees to learn technology and digital skills. In addition, soft skills and employee continuous personal development are vital. The primary goal of continuing education is to improve the knowledge and skills of employees, and thereby enhance organizational performance, employee productivity, and competitive strength (Hajdari *et al.*, 2023).

Lifelong learning has positive impact on development not only at the micro level but also on the prosperity of a country – especially on economic well-being, productivity, social development, or employment. "Participation in adult learning (in general) stimulates the economic well-being of a country, as countries with higher levels of skills and competences are more likely to be more competitive" (European Commission, 2018, p. 19). "The continuing vocational training is seen as an investment, which is expected to yield productivity gains which lead to returns on investment" (Cedefop, 2015, p. 166). Education is important for forming smart people in building Smart Regions. Using technology is not possible without smart people (Chye *et al.*, 2022).

Many studies have found that adult learning increases employability, participation, or prospects in the labour market. Training has positive effect on both the number and length of employment episodes. Adult education affects greatly *older workers'* employability in terms of improving their adaptability in the labour market (Kalenda & Kočvarová, 2022; Nilsson, 2016; Picchio & van Ours, 2013; Yeatts *et al.*, 2000). Adult education depends on the economic capability of nations. Economic downturns may induce the adoption of austerity measures, meaning that less people can engage in adult education. Nevertheless, public policies may tend to increase spending on adult education and thus to regulate the labour market (European Centre for Development of Vocational Training, 2015).

Promoting adult learning is part of government policies and objectives in the EU. "The importance of adult learning is reflected in EU-level targets, namely that by 2025, at least 47% of adults aged 25-64 should have participated in learning during the last 12 months (European Education Area) and that by 2030, at least 60% of all adults should be participating in training every year" (Eurostat, 2023, 4). There are huge differences across nations regarding the impact that educational attainment and lifelong learning have on employment. The effects of adult education on employability and employment vary considerably across countries (Midtsundstad, 2019; Bélanger *et al.*, 2015; Nordlund *et al.*, 2012; Heckman *et al.*, 1999; Gritz, 1993). Differences arise from different national characteristics.

Continuous adult learning plays a major role in SMEs because by developing the skills of business owners, managers and employees, businesses remain viable and prosperous (Saah, 2022). It is, however, necessary to have enough educators (Beszédes & Farkas, 2023). It needs to be underscored that education appears to be effective especially when it is led by people who have both experience from practice and academic knowledge (Janowski *et al.*, 2023). Continuous learning is part of building Smart Regions. Only people who have mastered the latest skills are able to innovate and improve sustainable development and quality of life and make efficient use of resources (Ručinská & Fečko, 2018).

In terms of the changing age structure of the workforce, it is worth noting that employment is associated with healthy ageing (Arroyo-Quiroz *et al.*, 2023). Educational expansion is associated with better employment options and healthy ageing. A college degree also improves employment prospects (Ali & Jalal, 2018). It is a common practice that employers give preference to college graduates when they select new employees. They do so because of their greater adaptability to jobs and their ability to be more productive. Employers' interest in university graduates has also been stimulated by the proliferation of digital technologies. Jobs are becoming more flexible and complex, and require workers with independent thinking and creativity, which are the distinctive qualities of mainly university graduates. Tertiary

educational attainment has benefits for both employers and employees. "An increase in education raises the wage earned. This is because higher education will help workers achieve certain better positions" (Wicaksono *et al.*, 2023, p. 6). Myslíková & Večerník (2019) give emphasis to higher wages in the service sector as many workers with tertiary educational attainment work there. Increases in educational attainment are reflected in performance increases across industries (Sinaga *et al.*, 2019). It remains also true that "education contributes to human capital accumulation, positively impacting productivity" (Wicaksono *et al.*, 2023, p. 6). Regarding national differences, the share of people with tertiary educational attainment has been increasing across the EU countries over the last decade (Profirou *et al.*, 2022). However, countries differ in its growth rate and the differences by gender

### 3 Research methods

To know and understand the specifics of the relationships between employment and other macroeconomic factors, it is suitable to use time series or panel data and an econometric approach. Time series and econometric approaches allow to understand relationships and reveal occurring events within an economic system (Lütkepohl & Krätzig, 2004). Methodologically, the econometric approach using time series emphasizes the need to investigate their cointegration in case they are non-stationary, and thus to detect the so-called spurious regressions. This fact is referred to by several authors (Adamec *et al.*, 2017; Výrost *et al.*, 2013; Blatná, 2018; Fromentin, 2013; Hatrák, 2007).

Within education, we consider it important to monitor the share of people with tertiary education and the share of people participating in lifelong learning. The indicator participation rate in education and training (previous 4 weeks) persons from 25 to 64 years (adult education) is used to characterize adult learning. In order to identify the impact of education, we will also use the indicator of the share of people with tertiary educational attainment. Employment is expressed with the indicator of the employment persons in the labour force from 15 to 64 years in % ( $v_{1t}$ ). Tertiary educational attainment is quantified using the share of persons with tertiary educational attainment from 15 to 64 years in % ( $v_{2t}$ ). Adult learning is quantified using the participation rate in education and training (previous 4 weeks) persons from 25 to 64 years in % ( $v_{3t}$ ).

The data are drawn from the Eurostat database (2023, 1; 2023, 2; 2023, 3). The period analysed is 1993 to 2020. The years of 2021 and 2022 were markedly affected by the epidemiological situation. For this reason, the 2021 and 2022 data were not used in the analysis.

The basic stages of the econometric approach include 1/ Model specification. In this stage, variables are selected, functional forms chosen, and the model built. 2/ Quantification of the econometric model. In this stage, parameter estimation is made. 3/ Verification of the econometric model. In the third stage, statistical and econometric verification are performed. 4/ Application of the econometric model, in which the results are applied and compared (Adamec *et al.*, 2017). The first step is to specify the relationship between dependent and independent variables. Time series are employed and the relationships between variables are quantified.

The shape of the model is:  $v_{1t} = f(v_{2t}, v_{3t}) + \epsilon_t$ , where  $\epsilon_t$  represents the random component - the residue component and  $\epsilon_t \sim N(0, \sigma_0^2)$  holds true.

The basic functional relationship is:

$$v_{1t} = \beta_0 + \beta_1 v_{2t} + \beta_2 v_{3t} + \epsilon_t, \quad t = 1, 2, \dots, T. \quad (1)$$

The dependent variable  $v_{1t}$  is employment persons in the labour force from 15 to 64 years in %.

Independent variables are:

1/  $v_{2t}$  - the share of persons with tertiary educational attainment from 15 to 64 years in %.

2/  $v_{3t}$  - the participation rate in education and training (previous 4 weeks) persons from 25 to 64 years in %.

OLS method is used to express an econometric model expressing a linear relationship between the dependent and independent variables.

#### Characteristics of the model specification procedure

An important part of the analysis is to check the stationarity of the time series. In the case of non-stationarity, the cointegration of time series is identified. In the case of non-stationarity of time series with independent variables that are not cointegrated with the time series of the dependent variable, it may be a spurious regression and model (1) will not be used (Lukáčik & Pekár, 2006). Transformation is used, stationarity and cointegration of time series with logarithmic variables examined and model (2) utilized.

$$\log v_{1t} = \beta_0 + \beta_1 \log v_{2t} + \beta_2 \log v_{3t} + \epsilon_t \quad t = 1, 2, \dots, T \quad (2)$$

Augmented Dickey-Fuller test will be used to check stationarity. Engle-Granger test (Lukáčik & Pekár, 2006) will be used to check cointegration. Model specification will be verified by RESET test - second and third powers. Statistical and econometric verifications for each model are performed. Gretl statistical software was used to make the analysis. In case of stationary or non-stationary cointegrated time series, statistical and econometric verification in the expressed model are carried out.

#### Statistical verification

If the regression coefficient  $\beta_1$  is not statistically significant or the model does not meet the econometric verification conditions, the variable  $v_{2t}$  is omitted. If the regression coefficient  $\beta_2$  is not statistically significant or the model does not meet the econometric verification conditions, the variable  $v_{3t}$  is omitted.

As part of the statistical verification, the statistical significance of the model parameters is verified through a t-test (Adamec *et al.*, 2017). F-test is employed to verify the statistical significance of the model (Lukáčik & Šlosiar, 2010).

#### Econometric verification

Econometric verification checks whether the requirements for the econometric model are met. The Chi-square goodness-of-fit test is used to analyse the normality of the residuals. The Breusch-Godfrey test is used to detect first-order autocorrelation or the LM test for first-order autocorrelation (Vogelvang, 2005, p. 119). RESET test is used to identify model specifications (Hatrák, 2007). The statistical significance of the parameters and the model as well as the normality of the residuals, autocorrelation and model specification is assessed at the significance level of 0.05. The adjusted coefficient of determination expresses what percentage of the total variability is explained by the model.

## 4 Results and Discussion

#### Model specification and quantification for Luxembourg

Luxembourg reported below-average employment rates throughout the period analysed. However, the share of people with tertiary education was consistently above average from 2004. Luxembourg ranks among countries with the fastest growing shares of tertiary-educated people. From 2009, Luxembourg also had a consistently above-average share of people aged 25-64 who participated in education and training in the previous four weeks. It can therefore be assumed that major policy changes in adult learning had been implemented (Graph 1).

Time series  $v_{1t}$   $v_{2t}$  were non-stationary and non-cointegrated. Time series  $v_{3t}$  was stationary (time series with a trend). Due to the non-cointegration of non-stationary time series with the original values, logarithm values were used.

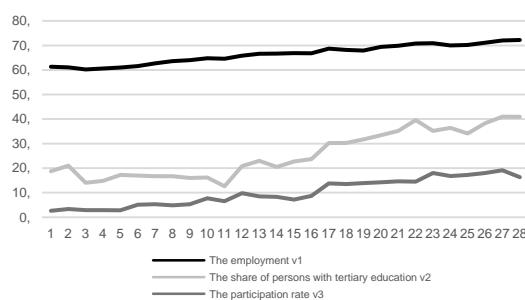
The resulting model for Luxembourg

$\log v_{1t}$ ,  $\log v_{3t}$  are non-stationary and but cointegrated (Graph 2).  $\log v_{2t}$  is not cointegrated with  $\log v_{1t}$ . Using the OLS method, the resulting model was obtained:

$$\log v_{1t} = 4.01166 + 0.08596 \log v_{3t} + \epsilon_t \quad t = 1, 2, \dots, 28 \quad (3)$$

Both model and regression coefficient  $\beta_2$  are statistically significant. There is a statistically significant relationship between  $\log v_{1t}$  and  $\log v_{3t}$ . Regression coefficient is a positive number (Tab. 1). There is a positive relationship between the two variables. The model has a normal distribution of residuals; there is no autocorrelation of residuals. The model is correctly specified (Tab. 1).

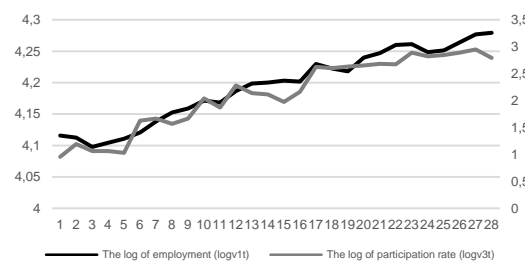
Graph 1: Indicators evolution in Luxembourg



Note: the numbers on the x-axis in represent 28 years since 1993. Data on tertiary educational attainment from 15 to 64 years in % was not published in 1998. It was estimated as the arithmetic average of the 1997 and 1999 values.

Source: Own elaboration according Eurostat (2023, 1; 2023, 2; 2023, 3).

Graph 2: Evolution of logarithm indicators in Luxembourg



Note: the numbers on the x-axis in represent 28 years since 1993.

Source: Own elaboration according Eurostat (2023, 1; 2023, 2).

The share of employment persons in the labour force from 15 to 64 years in Luxembourg is affected by the participation rate in education and training (previous 4 weeks) persons from 25 to 64 years.

One percent increase in the proportion of the participation rate in education and training (previous 4 weeks) persons from 25 to 64 years in % will increase the share of employment persons in the labour force from 15 to 64 years by 0.0860 percent on average. The dependence between employment and tertiary educational attainment from 15 to 64 years in % was not confirmed.

Tab. 1: Characteristics of the Luxembourg model

	Coefficient	T-ratio	P-value
constant	4.01166	438.9	7.62e-52***
$\log v_{3t}$	0.08596	20.89	8.99e-18***
p-value (F)		8.99e-18	
adjusted R-squared	0.94159		
Chi-square			0.777804
LM test for autocorrelation			0.21323
RESET test for specification			0.23751

Source: Own calculations based on Eurostat (2023, 1; 2023, 2; 2023, 3).

We can summarise that the impact of adult education on employment in Luxembourg was statistically significant. The Luxembourg model expresses a direct relationship between the logarithms of variables. Thus, it characterises the relationship between annual changes in both variables. More than 94% of the total variability is estimated by the Luxembourg model. For the Luxembourg model, the impact of the independent variable on the dependent variable is high compared to the impact of a random disturbance. The conclusions obtained indicate a significant impact of adult education on employment. Promoting adult education in Luxembourg also promotes employment.

Because Luxembourg has a large proportion of working immigrants, the connection between employment and adult education would not be achievable without an excellent immigrant education system. We consider Luxembourg's approach to adult education for immigrants as a model for other countries. A unique aspect of adult education in Luxembourg is its success in supporting immigrants' professional development. Luxembourg ranks first in the share of "employed foreign-born (immigrants) who increased their qualifications from their last job before migrating to their current job" (Eurostat, 2024, 2). Based on the above, we can view the system of adult education aimed at immigrants, as an example of good practice in immigrant integration.

As a result of our examination of the state of the art in addressing the issue in scientific studies, we found out that the authors mentioned in our critical analysis point out that employment and education are in mutual interaction (Arora, 2023; Le *et al.*, 2023; Choy & Le, 2023; Eurostat, 2023, 4; Kalenda & Kočvarová, 2022). As expected, in line with the sources mentioned above, we were able to specify the dependence between employment and adult education in Luxembourg. The impact of tertiary education on employment was not confirmed.

A limitation of our study is that we tested the relationships between employment and education for an exceptional country with a high-performing economy and a large share of foreigners; these relationships may therefore be specific to this country. However, the study is intended to point out that the in terms of its approach to adult education, Luxembourg can serve as a model for other countries.

The research findings, however, support Melnikova *et al.* (2019) assertion that adult learning is an important factor in tracking employment so there is a need for raising awareness of its significant role and for promoting adult education at the level of government policies.

## 5 Conclusions

The aim of the study was to specify the dependence between employment and education in Luxembourg. The research hypothesis that there is a relationship between employment and adult education in Luxembourg was confirmed. The results of the analysis based on an econometric approach involving, at non-stationarity, the verification of time series cointegration confirmed that employment was statistically significantly affected by adult education. The derived functional relationship for Luxembourg is expressed by the logarithms of variables. The change in employment in Luxembourg is influenced by the change in the share of people who have participated in education in the last four weeks. For the model in Luxembourg, the impact of the independent variable on the dependent variable is high compared to the impact of a random disturbance.

Based on fact that Luxembourg has achieved first place in the share of "employed foreign-born (immigrants) who increased their qualifications from their last job before migrating to their current job", we can view the system of adult education aimed at immigrants as an example of good practice in immigrant integration.

The study confirmed adult learning to be an important means for increasing employment in Luxembourg. Its promotion at national level is therefore of crucial importance.

The study extends knowledge in the field of labour market and education. In addition, the value of the research study lies in confirming the impact of adult education on employment. The research findings can provide government policy makers in countries with relevant data confirming the importance of national policies aimed at promoting adult education for employment.

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**Primary Paper Section: A**

**Secondary Paper Section: AH**