

The Socio-Economic Costs of Underfunding Education. A Multi-Country Case Study Approach

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Abstract. *Underfunding education represents a major challenge in terms of both social and economic consequences that negatively impacts workforce's competitiveness, economic growth, and social cohesion. Although numerous studies have underlined the advantages of increasing investment in education, the full extent of the negative effects caused by insufficient funding remains quite underdeveloped mainly in former soviet countries now benefiting from EU-27 membership. Thus, this study aims to fill this gap by assessing whether educational investment provides sufficient real outcomes in terms of smooth workforce integration into the labour market from seven European countries: Bulgaria, Czechia, Greece, Romania, Denmark, Norway, and Sweden. Towards this objective, a two-steps approach is performed: the analysis of secondary data in terms of stationarity, cointegration, and causality tests, as well as a comparative analysis, to evaluate the relationship between education underfunding, unemployment rate, and other relevant variables. The central question of our study investigates the extent to which underfunding of education contributes to socio-economic inequalities and long-term stagnation. The most striking finding emphasizes a stark contrast between Nordic countries' stable unemployment rates and Eastern Europe's higher volatility linked to funding levels, with countries allocating a higher share of GDP to education also benefitting from a more competitive economy, a more skilled workforce, and reduced social inequalities. Hence, this paper makes a significant contribution to the body of knowledge by extending prior work on former Soviet EU states in terms of the analysis of the complex relationship between digitalization, education, and sustainable economic growth. Future research directions could include expanding the analysis to a global level, using a longer timeframe, and developing future projections to identify potential economic gaps and effective intervention mechanism for optimizing education's impact on the economy.*

Keywords: education underfunding, public education, economic growth, human capital development, multi-country case study.

Introduction

Underfunding in education has emerged as one of the most widely discussed issues after the pandemic, primarily because education is invariably hailed as the strongest engine of economic

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growth, social cohesion, and technological innovation by both the human capital and endogenous growth theories (Jones, 2002; Jepsen & Montgomery, 2012; Yuan & Zhang, 2024). Over the last few years, scholars have noted the importance of funding education in human capital development, income equity, and sustainable economic growth (Welch, 1970; Carillo, 2024; Diakodimitriou et al., 2025). Yet, many European countries still face budget constraints that preclude them from providing quality education to all individuals (Neagu, 2012; Ion, 2013).

On one hand, numerous studies have explored the relationship between education investment and socio-economic outcomes and extensive research has established that countries with higher investment in education tend to perform better economically, have a higher employment rates, and achieve greater social stability. Previous empirical studies suggest that a higher funding for education leads to increased literacy rates, GDP per capita, and labour productivity. Similarly, prior studies have identified the worthwhile long-term outcomes of educational investment-increases in innovation capability, reduction in social disparities, and improvement in health status (Eurostat, 2021; OECD, 2022a). However, the ongoing disparities in funding structures among different European regions lead to varying strides of socio-economic progress (OECD, 2021).

In spite of recent substantial advances in research, a considerable number of gaps lie in regard to the socio-economic impact of chronic underfunding of education across a multitude of other European states. Despite the main focus of many studies on emphasizing the negative contributions of low educational expenditures on student performance, there are few recent studies investigating a multi-country comparative analysis across countries from the Eastern and Northern Europe. Thus, this research aims to fill a gap in this field by employing a comparative systematized analysis on a number of European states to assess the wider socio-economic effects of underfunding in education. Accordingly, this study seeks to answer to the following research question:

RQ1: What are the main socio-economic regional disparities of underfunding education across various European countries?

The answer to this research question sets out to give greater insight into the far-reaching effects of underfunding education on individuals and national economies alike. Additionally, the research hypothesis states that the direct effect on underfunding of education negatively affects the economic growth and social well-being of the analysed countries (H1).

The importance of this study will thus serve to inform policymakers and other stakeholders on the pressing need for increased education investment, even though governments still struggle to recover from the pandemic multi-fold crisis and face budgetary difficulties, primarily because continued education investments act as a mechanism for building economic resilience and social progress.

In this paper, a comparative cross-country case study approach is applied through a combination of systematically collected qualitative and quantitative data on various European nations. Thus, this comparative analysis will facilitate recognition of patterns, best practice, and areas in need of policy improvement made in education. The next section of the paper gives the review of the relevant literature on education funding and socio-economic outcomes.

Literature review

The interest for research on the impact of digitalization in the education sector of Romania is grounded in many studies, with Varly et al. (2014) indicating significant economic losses associated with insufficient investment in education and estimating the lost productivity and tax revenues due to inadequate schooling especially among the Roma population. Additionally, their

study suggests that one additional year of schooling could generally enhance access to employment, pay, and health. Likewise, OECD (2022b) states that education quality should be improved to boost human capital, productivity, and economic sustainability.

This research paper builds upon these findings by exploring the role of digital education in developing human capital and economic growth in Romania. Numerous studies have addressed the economics of education, and many of them summarize the findings of Bradley and Green (2020), yet hardly any relate digitalization to learning outcomes and productivity in eastern European contexts, a gap that this research aims to fill. Thus, a set of recommendations can be offered in addressing this gap in order to assist the policymakers when optimizing their investments in education in an increasingly digitalized economic landscape.

Besides economic implications, this research draws additional inspiration from a pre-existing literature on the social benefits of education. According to OECD (2022b), high-quality education develops lifestyles that build the foundation for better health, enhanced civic engagement, and a higher level of resilience to threats such as climate change and pandemics. However, the influence of digital tools on social outcomes has not been comprehensively addressed in this body of literature, especially in low-digital-literacy countries and in the context of infrastructure gaps. The current research aims to elaborate on these findings by analyzing Romania's digital education strategies, thereby offering insights into how digitalization may strengthen the role of education in societal well-being.

Moreover, the literature studies selected for this research provide information concerning the economic valuation of education. For instance, Benos and Zotou (2014) meta-analyzed education growth in economic terms for increased evidence supporting the long-term advantage of investments in education, while Brunello et al. (2011) measured the causal interplay between educational outcomes and health results, traditional contributions to lowering healthcare costs. These studies thus provide a foundation for understanding education's contribution to economic and social progress and frame the theoretical underpinnings for an impact analysis of digital education on national economy and individuals' well-being.

Furthermore, the literature reviewed in this study is designed to be comprehensive in analyzing both economic and social aspects of education. While Burja and Burja (2013), as well as Égert et al. (2022) and De La Maisonnette et al. (2022) use macroeconomic modelling to evaluate education's impact on Romania's economic sustainability and link education policies to productivity, respectively, the combination of arguments here presents a massive potential basis for studying the interactions between education, digitalisation, and economic growth. Such studies are indicative of real experiences and theories of Romania's education system. They differ from many general discussions about education policy in that they restrict themselves to trends with quantifiable impacts on macroeconomic modelling and certain region-specific challenges. This study sets off with the ambition of pulling together all these findings, thus providing its contribution towards the discourse on the digitalisation of education, while providing prescriptions to policy for upgrading human capital development through technological advancement.

Methodology

Taking into consideration the main aim of this study, a multi-country case study approach was adopted to assess the socio-economic costs determined by underfunding education. For this purpose, seven countries were chosen for the comparative analysis: Bulgaria, Czechia, Greece, Romania, Denmark, Norway, and Sweden. The main criterion for the multi-country analysis was the national investment in education (percentage of GDP) from top three performing countries in

terms of both digitalisation and investment of education (Denmark, Sweden, Norway), and from four of the countries suffering from the most from education underfunding (Bulgaria, Greece, Romania, Czechia). In subsidiary, the choice of these particular countries is explained both by their contrasting historical funding trends and labour market structures that underline the comparative purpose of our research.

This research methodology employed quantitative analysis through econometric modelling to present a detailed comparative analysis of the effects of insufficient investment in education. In the first stage, we employ several complementary econometric models, such as OLS for initial relationships, FMOLS for cointegration robustness, and Phillips-Ouliaris for long-term dynamics. Data were collected for the period of 2013-2022 from both international and national databases, such as: World Data for global indicators concerning public spending in education, Eurostat for specific national indicators of European countries (unemployment rate, social inequalities, GDP), and National Institute of Statistics from Romania. Data management was performed in Microsoft Excel 2019, where descriptive data were generated for all variables. Additionally, other softwares were used for tables and figures generation (EViews 12), statistical analysis and econometric modelling (IBM SPSS Statistics).

Notwithstanding, our study has several limitations. One major limitation concerns the lack of data availability for a longer period of time for all the countries included in our comparative analysis. Another concerning issue could refer to sample size limitation (seven countries), whereas this particular choice is justified by the historical funding trends and labour market structures of those European countries. However, both limitations are reflected in their potential impact on statistical power of our econometric models.

Results and discussions

In this section the author presents the main findings of his/her research. It is important to use critical thinking in order to analyze realistically the results obtained, and how the research hypotheses have been validated or not. Also, it is important to compare results of present research with results obtained in similar research, by using the literature in the domain.

First of all, to assess whether educational investment provides sufficient real outcomes in terms of smooth students' integration into the labor market, we measured the unemployment rate from 2013 to 2022 for the seven European countries (Bulgaria, Czechia, Greece, Romania, Denmark, Norway, and Sweden).

As shown in Figure 1, the unemployment rate has followed a downward trend for almost all European countries between 2013 and 2019, yet Norway has been the only state that has recorded an increase of 1.26 points until 2016, when its unemployment rate entered a more stable and constant path. Paradoxically, even if the most significant decrease from 27.68% in 2013 to 12.42% in 2022 belongs to Greece, which suggests that numerous beneficial macroeconomic measures have been successfully implemented to reduce the highest unemployment rate from EU-27, Greece still holds the record for the highest unemployment rate across Europe in 2022 (12.42%). The second most significant decrease has been recorded by Bulgaria (8.67 points), which also had difficult struggles in 2013 when 12.94% of their individuals were unemployed, but in 2022 the unemployment rate has dropped to 4.26%. Due to the transition to a more digitalised economy, both Greece and Bulgaria have adapted their national strategy in terms of prioritizing digitalisation, which helped the labour market to offer job diversification through digital technologies implementation and digital infrastructure expansion into key public areas, thus generating new job opportunities for gen Z.

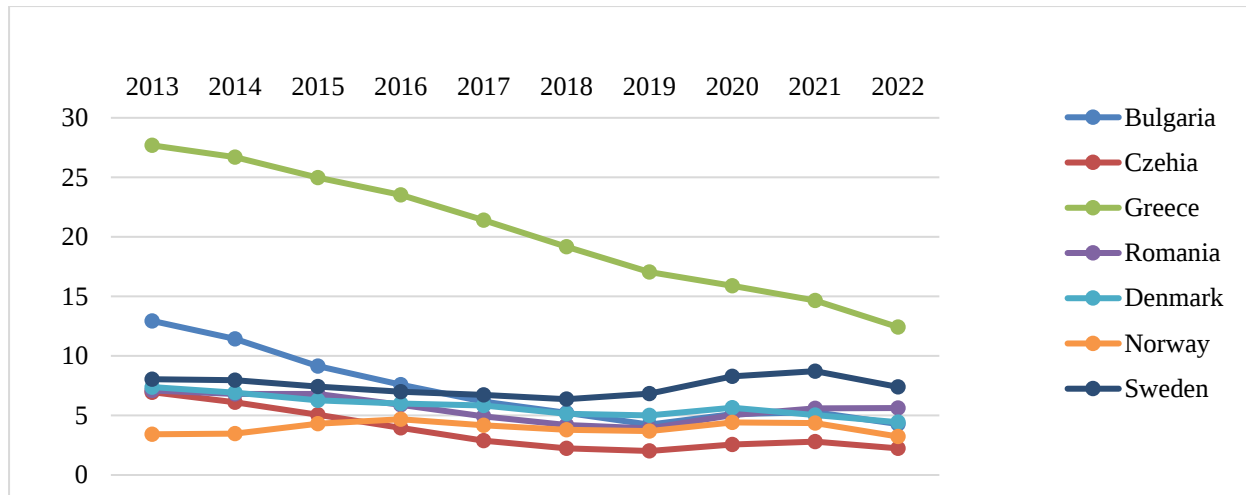


Figure 1. Unemployment rate between 2013-2022, %

Source Authors' own computation from Eurostat database.

In contrast, nor Greece, neither Bulgaria have yet achieved their digital maturity, while Scandinavian states have been leaders in terms of both digitalisation of education and digital economy (Denmark, Norway, and Sweden), and have maintained a constant unemployment rate over the period of analysis, which could be attributed to their maturity level of digitalisation. For instance, Norway has the lowest decrease of the unemployment rate (0.19 points) between 2013 and 2022 when managed to achieve one of the lowest unemployment rates of only 3.23%, and is followed by Sweden with a decline of 0.66 points for the same period. Still, Sweden's unemployment rate of 7.39% in 2022 is quite higher than those of the other Nordic countries, even than Romania's unemployment rate of 5.61% in 2022. Less digitalised than all the other countries in our comparative analysis, Romania has managed to obtain a contraction of 1.42 points of the unemployment rate for the same time span. The third most significant decline has been obtained by Czechia (4.72%), which also has the lowest unemployment rate in 2022 of just 2.22%. Another striking observation to emerge from the data comparison was the rapid choc absorption of the associated pandemic crises, with all countries recording lower levels of unemployment rate in 2022 than in 2021.

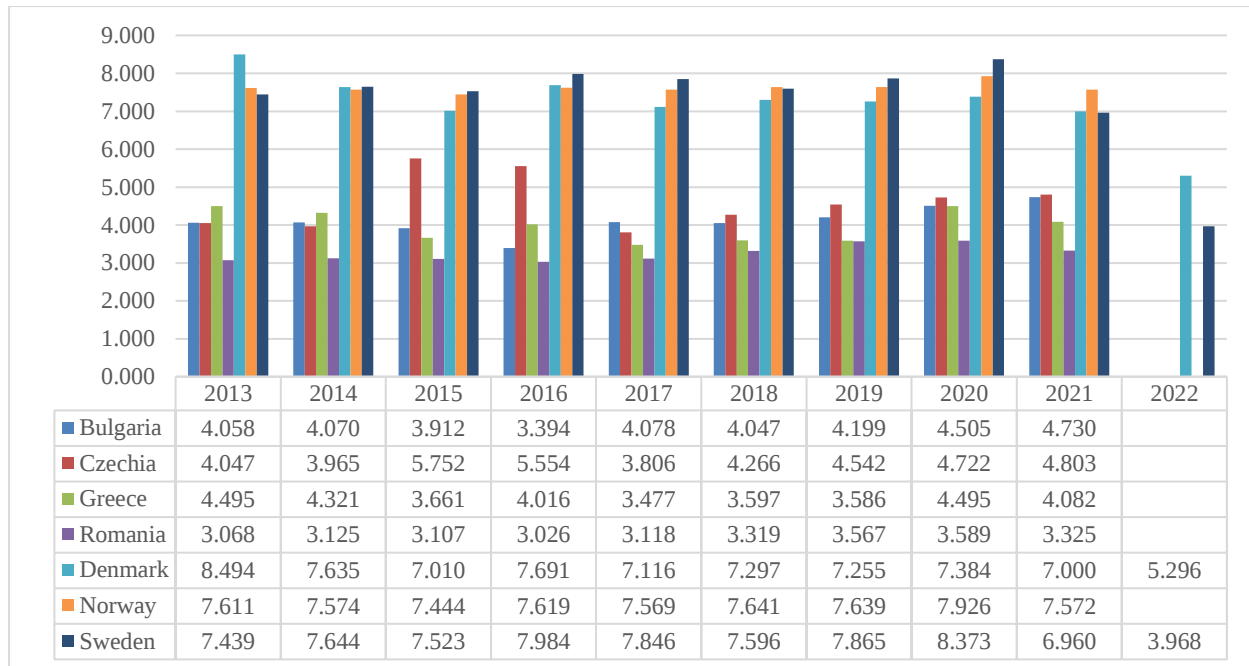


Figure 2. Public investment in education between 2013 and 2022, % of GDP

Source: Authors' own computation from Eurostat database.

It can be seen from the data in Figure 2 that all countries have reported a constant evolution of their percentages of GDP allocated to education sector, while data availability for 2022 lacks for five of the countries in our analysis (Bulgaria, Czechia, Greece, Romania, and Norway). This figure is revealing in several ways. On one hand, Nordic countries like Norway, Sweden, and Denmark provide significant yearly percentages of GDP to education field (>7% of GDP until 2021), allowing the implementation of sustainable educational policies that include teachers financial incentives and subventions, as well as numerous youth development programs. In contrast, Eastern European countries spend less than 4.8% of their GDP on education, with Romania situating constantly on the last position among European countries (3.3% of GDP in 2021). Hence, these discrepancies among different European nations and regions contribute to the gap enlargement between expected educational outcomes and students' real competencies, but also to the asymmetry of regional professional opportunities for youngsters.

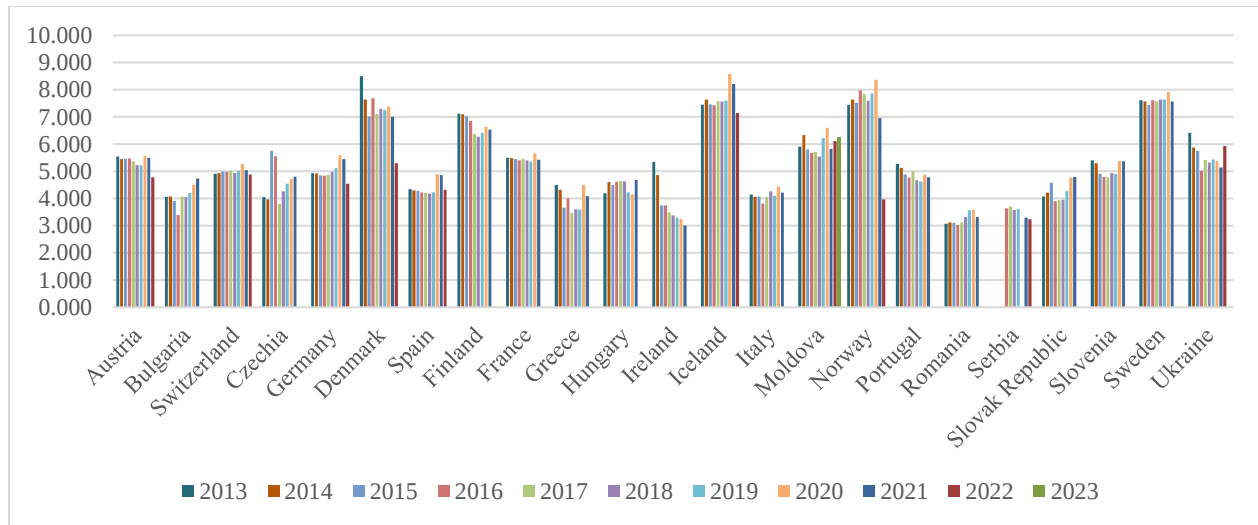


Figure 3. Public investment in education between 2013 and 2022 across EU-27, % of GDP

Source: Authors' own computation from Eurostat database.

For a better understanding of the impact of public investment in education in terms of percentage of GDP, we extended our comparative analysis over EU-27 for the same period of time. From the data in Figure 3, it is apparent that there are many significant differences among European nations in terms of education funding, while the pandemic had also influenced crucially governmental budgetary strategies. In contrast with Nordic countries' stable evolution of the education public investment, other countries like Italy, Serbia, Spain, Romania, and Greece have recorded an important decline of the percentage of GDP allocated to education mostly after 2019, when funds were redirected towards other sectors of activity. For instance, in 2021 Romania has the third lowest investment in education with 3.32% of GDP, after Ireland's allocation of only 3% of GDP and Serbia's education underfunding of just 3.23% of GDP. Thus, these countries strategies have led to education underfunding and could also translate into labour force disruptions.

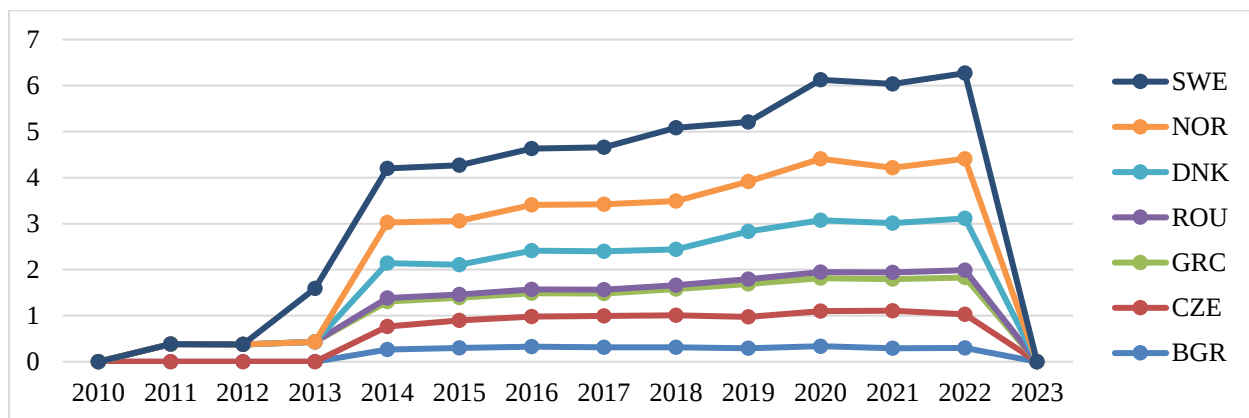


Figure 4. Educational attainment, doctoral or equivalent, of individuals +25 between 2013 and 2022 for the sample countries, %

Source: Authors' own computation from Eurostat database.

Next, Figure 4 compares the educational attainment, doctoral or equivalent, of individuals over 25 years old from the seven countries in our study for the time span from 2013 to 2022. What

is interesting in this data is that all countries have registered an explosion of doctoral certificates between 2013 and 2014. For example, the most impressive increase has been recorded by Sweden from 1.6% of individuals over 25 years old possessing a PhD in 2013 to 4.2% in 2014, which represents an increase 2.6 times bigger than the reference year. In contrast, Eastern countries like Romania, Greece, and Bulgaria have scored lower rates of educational attainments than the other countries in our comparison, suggesting these countries face both financial struggles for the R&D and for the development of doctoral studies offer. The hierarchy of 2022 is again dominated by Scandinavian countries with Sweden having 6.2% of individuals over 25 years old possessing a doctoral certificate, followed by Norway with 4.3%, and by Denmark with 3.1%. The most surprising aspect of the data is in the Romanian achievement of the forth position with 2% of their adults over 25 years old having graduated doctoral studies, despite its lowest percentage of GDP allocated to education and research among all European countries. The bottom half of the hierarchy is occupied by Greece (1.9%), Czechia (1%), and Bulgaria (0.2%).

Table 1. Regression analysis using OLS method

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROMANIA	0.569892	0.204316	2.789268	0.1081
NORWAY	-0.111158	0.275151	-0.403991	0.7253
GREECE	-0.000373	0.000104	-3.599929	0.0692
DENMARK	-0.000403	0.000320	-1.258085	0.3353
BULGARIA	0.310749	0.302143	1.028482	0.4118
CZECHIA	-1.249855	0.580548	-2.152890	0.1642
SWEDEN	0.486176	0.269861	1.801579	0.2134
C	2023.422	2.233096	906.1064	0.0000
R-squared	0.999543	Mean dependent var		2017.500
Adjusted R-squared	0.997941	S.D. dependent var		3.027650
S.E. of regression	0.137372	Akaike info criterion		-1.141682
Sum squared resid	0.037742	Schwarz criterion		-0.899614
Log likelihood	13.70841	Hannan-Quinn criter.		-1.407230
F-statistic	624.2507	Durbin-Watson stat		3.260668
Prob(F-statistic)	0.001600			

Source: Authors' own research via EViews.

The results of the regression analysis using Only Least Squares (OLS) method to estimate the impact of the unemployment rate on the percentage of GDP to education for the period between 2013 and 2022 are summarised in Table 1. All variable coefficients show the impact over each state in terms of GDP allocation. In the case of Romania, the value of 0.569892 of the coefficient suggests that on average the unemployment rate increase (explicative variable) would tend to significantly escalate the education funding. Contrastingly, Greece presents an opposite relationship between investments in education and the unemployment rate, because of its macroeconomic policy oriented towards a more relaxed perspective over unemployment rate reduction and education funding (4% of GDP in 2022). Moreover, the value of F-statistic (624.2507) shows strong evidence that our model is significant and might explain the variation of the percentage of GDP allocated to education.

Table 2. Regression analysis using FMOLS method

Dependent Variable: PIB				
Method: Fully Modified Least Squares (FMOLS)				
Sample (adjusted): 2014 2022				
Included observations: 9 after adjustments				
Cointegrating equation deterministics: C				
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
BULGARIA	0.351523	0.142585	2.465359	0.2453
CZECHIA	-1.264261	0.314566	-4.019067	0.1552
DENMARK	-0.000424	0.000155	-2.735456	0.2231
GREECE	-0.000384	9.44E-05	-4.071825	0.1533
NORWAY	-0.079381	0.197268	-0.402403	0.7564
ROMANIA	0.552338	0.147075	3.755496	0.1657
SWEDEN	0.469048	0.216635	2.165152	0.2754
C	2023.634	1.777682	1138.356	0.0006
R-squared	0.999391	Mean dependent var		2018.000
Adjusted R-squared	0.995128	S.D. dependent var		2.738613
S.E. of regression	0.191153	Sum squared resid		0.036539
Long-run variance	0.003342			

Source: Authors' own research via EViews.

Moreover, we constructed another regression model using Fully Modified Least Squares to predict the impact of independent variables (country-specific effects) over GDP for the time span from 2014 to 2022, although the results obtained raise questions concerning the statistical significance of our model, which might be explained by our small sample size (Table 2). The high values of the R-squared (0.999391) and Adjusted R-squared (0.995128) could indicate that almost all variations in GDP is explained by this model. However, such a high value of the R-squared could also indicate overfitting in a small sample. Moreover, the low values of sum squared residuals (0.036539) and long-run variance (0.003342) might confirm that the model is table because of its small estimation error. What is interesting in this data is that Romania, Bulgaria, and Sweden show positive relationships with GDP, while Czechia and Greece demonstrate negative ones.

Furthermore, we applied a Phillips-Ouliaris test to investigate the nature of the long-term equilibrium relationship between the percentage of GDP to education and the unemployment rate (Table 3). Additionally, the null hypothesis states that the series are not cointegrated, meaning that its rejection will indicate that the variables move together over time. The value of the Phillips-Ouliaris tau-statistic (-10.19820) with a p-value of 0.0116 indicate the rejection of the null hypothesis, suggesting that the variables are cointegrated and share a long-run relationship. Similarly, cointegration is supported by the high absolute t-statistic and very low p-value (0.0003), which also indicate strong evidence that the residuals from the regression are stationary. In addition, the value of the Durbin-Watson statistic (2.527679) suggests no significant autocorrelation in residuals and reinforces the validity of the test. However, the contradiction between the tau and z-statistics shows instability due to the small sample size. Overall, the test output indicates strong evidence of cointegration based on the significant tau-statistic (p=0.0116) and the stationarity of the residuals (p=0.003), but the z-statistic (p=0.9993) suggests caution towards reliability on this conclusion and possible issues with test power due to the small sample size (n=9).

Table 3. Regression analysis using Phillips-Ouliaris test

Cointegration Test - Phillips-Ouliaris			
Cointegrating equation deterministics: C			
Null hypothesis: Series are not cointegrated			
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)			
No d.f. adjustment for variances			
		Value	Prob.*
Phillips-Ouliaris tau-statistic	-10.19820	0.0116	
Phillips-Ouliaris z-statistic	-13.09916	0.9993	
*MacKinnon (1996) p-values.			
Intermediate Results:			
Rho - 1	-1.651380		
Bias corrected Rho - 1 (Rho* - 1)	-1.455462		
Rho* S.E.	0.142718		
Residual variance	0.002382		
Long-run residual variance	0.000759		
Long-run residual autocovariance	-0.000811		
Number of observations	9		
Number of stochastic trends**	8		
Phillips-Ouliaris Test Equation:			
Dependent Variable: D(RESID)			
Method: Least Squares			
Sample (adjusted): 2014 2022			
Included observations: 9 after adjustments			
Variable	Coefficient	Std. Error	t-Statistic
RESID(-1)	-1.651380	0.268130	-6.158874
R-squared	0.825523	Mean dependent var	0.004894
Adjusted R-squared	0.825523	S.D. dependent var	0.123920
S.E. of regression	0.051762	Akaike info criterion	-2.979882
Sum squared resid	0.021434	Schwarz criterion	-2.957968
Log likelihood	14.40947	Hannan-Quinn criter.	-3.027172
Durbin-Watson stat	2.527679		

Source: Authors' own research via EViews.

Discussion

The main goal of our study was to analyse the socio-economic costs resulting from underfunding education in a multi-country case study design. Based on human capital and education-for-growth theories, this research aimed to determine the long-term economic and social effects of educational underinvestments. The methodology involved a comparative analysis of levels of education funding with the effects of education funding levels on economic variables such as employment rates, income inequality, and social mobility across countries with varying degrees of educational expenditures.

The research findings reveal that underfunding in education influences negatively socio-economic impacts. The countries with lower investment in education saw higher unemployment rates, greater income inequality, and lower GDP per capita growth. Along with the quantitative findings, qualitative analysis showed that the underfunding of education created mismatches in the labour market, reducing the innovation capacity and preventing social cohesion. It is worth noting that the case studies from (country names) demonstrated that even modest increases in educational funding translated into clear economic performance gains and social stability improvement.

Our results support existing literature highlighting the importance of education in facilitating economic development and reducing inequalities. Scholars (Brunello & De Paola, 2020; Hanushek & Woessmann, 2021; Thomas & Burnett, 2013) argue that underfunding will not allow for the accumulation of human capital and hence affect economic growth. Our study expands on these findings by offering cross-national evidence about the compounding effects of underfunding on labour markets and social structures, while addressing digitalisation's central role in enhancing education quality through increased investments would help lower ranking countries to reduce the digital gap.

Limitations of this study must also be acknowledged. First, data availability and consistency between different countries presented a challenge, which may have compromised aspects of the interpretation. Second, even as the multi-country approach offers comparative insight, it will not capture country-specific cultural, political, or other factors that might influence macroeconomic decisions about education funding. Also, this study emphasized macroeconomic indicators, which might overlook individual-level experiences and microeconomic impacts of underfunding. Lastly, another limitation is represented by the cultural and political specificity that might have a different impact on financial decisions concerning public education across analysed countries. Future research could use longitudinal data more conclusively to address long-term outcomes.

From what we found, some recommendations for the policy emerge. Greater and sustained investments in education need to be a top priority for governmental authorities from Romania, Bulgaria, Czechia, and Greece, especially in early childhood and vocational training programs which yield substantial economic returns. Policies designed to promote a more equitable distribution of educational resources will further help address access and outcome disparities. Future studies should probe experimental or quasi-experimental designs to explore the causal mechanisms linking education funding with socio-economic outcomes. More research should also examine how the private sector and innovative financing models can help plug shortfalls in public investment in education.

Overall, this study drives home the point that education ought to be viewed by any policymaker, now more than ever, as a crucial engine propelling an economy and social well-being into the distance. Education underfunding is not a mere backward expense on beating the future but a wise investment to enable tomorrow's wealth.

Conclusion

To sum up, the main goal of the current study was to determine the socio-economic consequences of education underfunding in terms of GDP growth through a comparative analysis of seven European countries. Returning to the question posed at the beginning of this study, it is now possible to state that the findings of our multi-country comparative analysis tend to suggest a significant impact of education underfunding over socio-economic growth and wellbeing. Thus, these results validate the hypothesis that underfunding education generates long-term socio-economic costs because the analysed data indicate that short-term savings from budget cuts in education are offset by important long-term losses, which include lower labour productivity and increased social expenditures. Specifically, Nordic countries (Denmark, Sweden, and Norway) that spend a higher percentage of GDP to education purposes benefit from a more skilled workforce, which lead to enhanced productivity and national economic competitiveness. Conversely, European states (Bulgaria, Romania, Greece, and Czechia) that allocate a smaller ratio of GDP to their education sector find themselves unable to compete with leading countries from the Northern

Europe due to a lower productivity created by individuals that have benefitted from a smaller governmental educational investment.

The main contribution of our study consists in emphasizing a stark contrast between Nordic countries' stable unemployment rates and Eastern Europe's higher volatility linked to insufficient education funding levels, as well as highlighting how the Nordic-Eastern divide offers lessons for EU policy cohesion. Moreover, the present study adds to the growing body of research that indicates a very strong relationship between the macroeconomic variables analysed. Hence, this research confirms previous findings and contributes additional evidence that suggests that education underfunding has negative social and economic effects in terms of both lower national productivity (GDP) and less skilled workforce. In this context, recommendations for policy makers include increasing the percentage of GDP spent on education, developing teacher training programs to equip the educators to facilitate their students learning in the AI era, and implementing inclusive study programs for vulnerable students in order to diminish the digital gap.

Notwithstanding, the generalisability of these results is subject to certain limitations. For instance, the current study is based on a small sample of countries (Denmark, Sweden, Norway, Romania, Czechia, Greece, Bulgaria), which future research could address by increasing the number of countries (+30) included in the analysis. Secondly, this study was limited by the absence of sufficient data for recent years (2022, 2023), but future lines of research could expand the time span by taking into consideration a greater period of time. Finally, future studies could improve the predictive power through the use of different estimation techniques that enhance the generalisability of the findings.

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