European Journal of Sustainable Development (2025), **14**, 4, 817-830 ISSN: 2239-5938
Doi: 10.14207/ejsd.2025.v14n4p817

Public Expenditure on Education and Economic Growth: An Empirical Analysis of Causality in Serbia

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ABSTRACT:
The primary objective of this study is to investigate the existence of a causal relationship between public expenditure on education and economic growth in Serbia over the period 2007 to 2022. Public education spending is measured using three indicators: total public expenditure on education as a percentage of GDP, public expenditure on secondary education as a percentage of GDP, and public expenditure on higher education as a percentage of GDP. Economic performance is represented by the real GDP *per capita* growth rate. To test the hypotheses and achieve the research objective, a causality test based on Granger's methodology is employed. The results indicate a statistically significant unidirectional causal effect running from public expenditure on education to economic growth. Within the applied empirical framework, this suggests that trends in education-related public spending can be used to forecast real GDP *per capita* growth. These findings emphasize the importance of investment in education as a strategic factor in promoting sustainable economic development, warranting greater attention in the formulation of public policy.

Keywords: public expenditure, educational sector, rate of economic growth, Granger's approach to causality, Serbia

1. Introduction

The improvement of education as a key determinant of human capital accumulation (Lucas, 1988; Barro, 1990), implies continuous investment in the development of the educational system. In this regard, ample evidence confirms the thesis that investing in educational sector has a positive effect on average productivity and the rate of economic growth (Benos & Zotou, 2014; Cannon, 2010; Benhabib & Spiegel, 1994). One of the primary mechanisms for financing education is government funding. Over time, there has been a notable global trend of increased public financial support for educational institutions. In the USA, for example, the amount of public expenditure per pupil and student has grown faster than GDP since 1870s, a pattern observed in other developed countries as well (Carpentier, 2006).

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The present paper addresses the relationship between public expenditure on education and economic growth, which constitutes the main focus of the analysis. The importance of studying this relationship stems from the fact that education is considered one of the key drivers of long-term economic development. In this context, public investment in the education sector can significantly contribute to the improvement of the economy (Kelly, 1997). Properly directed public funds for education can not only help reduce poverty and stimulate long-term growth, but also serve as one of the mechanisms for mitigating the negative effects of a recession. Specifically, during a recession, increased public funding for education may function as an automatic stabilizer by preventing layoffs in the education sector and supporting household incomes, thereby helping to sustain aggregate demand amid economic downturns (Allegretto et al., 2022). Jackson et al. (2021) show that per-pupil budget cuts during the Great Recession in the United States led to lower test scores and reduced college enrollment, particularly in poorer states.

For economies that are especially vulnerable to cyclical shocks, education spending may serve a dual function – mitigating the immediate effects of a recession and laying the foundation for sustainable economic recovery. However, the effectiveness of this approach depends on factors such as the quality of public spending, the labor market's capacity to absorb educated workers, and the overall quality of educational institutions (Hanushek & Woessmann, 2012). Therefore, incorporating education expenditures into broader counter-cyclical fiscal strategies may increase economic resilience and accelerate post-recession recovery.

Within the body of theoretical research, the connection between public spending on education and economic growth is most commonly examined using endogenous growth models. These models suggest that public spending on education directly affects human capital accumulation, which in turn influences long-term economic growth (Glomm & Ravikumar, 1998; Kaganovich & Zilcha, 1999; Blankenau & Simpson, 2004). Unlike the relatively few theoretical studies, numerous empirical investigations have been conducted to explore the nature of this relationship. However, empirical findings are inconclusive, as there is still no definitive agreement on whether increased public spending on education stimulates economic growth or, alternatively, whether economic expansion leads to greater public expenditure on education. The lack of consensus serves as a key motivation for conducting this research. Additionally, given that the specific effects of public spending on education and its impact on the GDP growth rate in Serbia remain insufficiently explored, it is essential to provide concrete evidence that can inform national economic policy formulation.

The aim of this paper is to empirically examine the existence and direction of the causal relationship between public expenditure on education and economic growth in Serbia. Secondary data and econometric methods, including causality techniques, are employed in this paper to investigate the relationship.

The paper consists of five sections. After the introductory section, the second section offers a review of the relevant literature and defines research hypotheses. The third section outlines the methodology applied in the analysis, followed by the fourth section, which presents and interprets the obtained results. Finally, the last section summarizes the conclusions drawn from this study.

2. Literature Review

For many years, scholars worldwide have been interested in the connection between economic growth rates and public funding for education. Although endogenous growth theory predicts a positive impact of public spending on education on economic growth, empirical evidence is inconsistent, starting from the fact that there is no clear positive linear relationship between public spending on education and economic growth (Blankenau & Simpson, 2004). Using an endogenous economic growth model as the analytical framework, Mekdad et al. (2014) investigated how public spending on education is connected to economic growth in Algeria during the period from 1974 to 2012. Econometric methods, including Granger causality analysis, were applied. Granger causality analysis indicates that expenditures on education cause GDP growth, with the note that the effects of education on growth may become visible only after a longer period. A similar analysis was carried out in Vietnam, focusing on the interaction between government education funding and economic development over the 2006–2019 period (Le & Trang, 2021). By applying a VAR approach combined with Granger causality testing, the authors identified a bidirectional causal relationship between these two variables.

The relationship between public spending on education and economic growth was identified in a study involving eight EU countries over the period 1995–2015 (Dudzevičiūtė et al., 2018). Granger causality analysis showed that in certain EU countries, public expenditures can be a driver of economic growth, while in other cases, economic growth influences the level of public expenditures. A research conducted on ASEAN countries during the period 1995–2018 found that investments in education can have long-term positive effects on economic growth, as well as on the improvement of the population's educational structure (Tran, 2023). In the case of Georgia, Shainidze et al. (2024) concluded that increased public expenditure on education has a positive effect on household income growth. A study conducted by Ifa and Guetat (2018), using the ARDL model and focusing on Tunisia and Morocco over the period 1980–2015, found that the impact of public education spending on economic growth differs depending on the time horizon. In the short run, Morocco exhibits a positive correlation between public spending on education and GDP *per capita*, whereas in Tunisia, the relationship is negative. However, in the long term, education expenditure positively affects the economic growth of both countries, with the effect being more pronounced in Morocco.

Using data from a sample of 30 developing nations during the 1970s and 1980s, Bose et al. (2007) concluded that capital investments in the education sector were both positively and significantly associated with economic growth. In contrast, their findings suggest that total current education expenditures do not exert a statistically significant influence on economic performance. An investigation into how public education funding affects economic growth in Nigeria during the period 1985–2019, employing ARDL co-integration, an error correction model, and Granger causality techniques, revealed that current public expenditures allocated to education contribute positively to economic growth (Iheanacho & Nwaogwugwu, 2021). The research focusing on France during the period 1970 to 2012, employing Johansen's co-integration method, identifies a long-run equilibrium association among economic growth, capital, labor, and public spending on

education (Ozatac et al., 2018). Findings from this analysis highlight the important role that investment in education has in promoting economic growth in France.

An in-depth examination of both the organizational framework and funding approaches to higher education in Croatia, combined with the application of Granger causality analysis, demonstrated the presence of a statistically significant causal relationship between public financial support for higher education and GDP growth (Nikšić Radić & Paleka, 2020). These findings confirm the education-led growth hypothesis, underlining that enhanced public investment in the educational sector may foster national economic advancement. The same hypothesis was confirmed in the case of Sierra Leone, highlighting that priority should be given to public expenditures on higher education due to their crucial importance for economic growth (Jackson, 2021).

In the case of OECD countries, an analysis of the relationship between changes in different categories of government expenditures and GDP confirmed that investments in infrastructure and education contribute to economic growth (Gemmell et al., 2016). Complementing these findings, Jungo (2024) investigated the effects of public spending on education within a broader framework that also included financial inclusion and military expenditures, using data from OECD member states. The study confirmed that educational expenditures exert a statistically significant positive influence on economic growth, particularly in countries with higher institutional quality. These results underscore the importance of considering institutional context when evaluating the growth effects of education-related public investment. An empirical investigation conducted at the provincial level in China, covering the years 2007 to 2013, demonstrated that aggregate government investment in education exerted a significantly positive influence on economic growth, with the magnitude and nature of the effects differing across educational levels (Qi, 2016). Furthermore, a separate study utilizing panel data from 31 Chinese provinces spanning the period 2005 to 2021 provides evidence that state spending on education contributes positively to fostering innovation within enterprises (Tan et al., 2023).

Some empirical studies suggest that the relationship between public education expenditures and economic growth is either negative or statistically insignificant. Yakubu and Gunu (2022), employing the ARDL methodology, analyzed the case of Ghana over the period 1970–2017 and found that public spending on education did not exert a statistically significant effect on economic growth in either the short or long term. Similarly, a study conducted in the case of North Macedonia for the period 1991–2020, using the ARDL model, identified a negative effect of public expenditure on GDP *per capita* in both the short and long run, although the long-term effect did not reach statistical significance (Shapkova Kocevska, 2023). Another study, based on a sample of 11 Eastern European EU member states and applying the ARDL methodology, revealed that the long-term association between public education spending and economic growth varies across countries – being absent in five and present in six (Coman Nuţă et al., 2022). The short-term effects were also mixed: in four countries, public education expenditures had a positive influence on economic growth, whereas in two, the impact was negative.

The prior research results indicate a lack of consensus in the empirical literature about the cause-and-effect connection between public spending on education and economic growth. Generally, these studies differ in sample structure, nature of data, and econometric methodology, which could be some factors that determine the research

outcomes to a certain extent. In the relevant literature, it is increasingly emphasized that factors such as the efficiency of public spending, quality of institutions, education policy, and structural differences among countries can significantly influence the direction and intensity of this relationship (Hanushek & Woessmann, 2012). Rajkumar and Swaroop (2008) show that the impact of public spending on development is strongly conditioned by the quality of institutions, with greater effects observed in countries that have better governance quality, i.e., higher levels of accountability and transparency in public administration. Furthermore, Hanushek and Woessmann (2007) emphasize that the mere amount of investment is not sufficient; education systems must be efficient in improving human capital for spending to yield economic benefits.

Serbia, with its specific institutional and socioeconomic challenges, such as insufficient efficiency of public spending and governance issues (World Bank, 2023), represents an example of a country for which it is justified to question the extent to which public expenditures on education can contribute to economic growth. In this context, comparing Serbia with countries that exhibit different outcomes can provide additional insight into the nature and limitations of the impact of education policies on economic growth.

Given the diverse findings in previous empirical studies, this paper proceeds to test the following research hypotheses:

- H1: Public expenditure on education has a causal effect on economic growth, *ceteris paribus*.
- H2: Economic growth has a causal effect on public expenditure on education, *ceteris paribus*.
- H3: A bidirectional causal link exists between public expenditure on education and economic growth, *ceteris paribus*.
- H4: No causal link exists between public expenditure on education and economic growth, *ceteris paribus*.

3. Data and Methodology

Empirical literature investigating the causal relationship between public expenditure on education and economic growth relies on a set of standard indicators. One of these is the total public expenditure on the education sector as a percentage of GDP. Public spending on education includes funding for educational institutions (both public and private), the costs of educational administration, as well as various types of transfers and subsidies directed toward private entities, including students, households, and other private stakeholders (World Bank, 2025). A key question that arises in this context is which level of education – primary, secondary, or higher – has the most significant impact on economic growth. One of the observations found in the literature is that investment in secondary education generates a more significant stimulus for economic growth compared to investment in general primary education (IIASA, 2008). Therefore, one of the general objectives is to ensure that most of the population has completed at least secondary education. In industrially developed countries, the higher education of young individuals is considered an important factor contributing to the enhancement of economic growth

(IIASA, 2008). Considering the above, two additional indicators are taken into consideration. These refer to public expenditure on secondary education as a percentage of GDP and public expenditure on higher education as a percentage of GDP. Including these indicators allows for a more detailed analysis of how different levels of education contribute to economic performance. In addition, real GDP *per capita* growth is used as an indicator of economic progress.

This study investigates the existence of a causal link between public expenditure on education and economic growth, using annual time series data for Serbia over the period 2007–2022. The data were sourced from the UNESCO database (UNESCO, 2025) and the World Bank database (World Bank, 2025). Data analysis is conducted using the econometric software EViews 10 version. For easier tracking of the further course of the research, abbreviations and a brief description of the observed variables are provided in Table 1.

Table 1: Summary of Variables Included in the Analysis

Variable	Description
$TPEOE_t$	Total Public Expenditure On Education (% GDP)
$PEOSE_t$	Public Expenditure On Secondary Education (% GDP)
PEOHEt	Public Expenditure On Higher Education (% GDP)
GDPt	Gross Domestic Product (growth rate *per capita*)
Note: t = period from 2007 to 2022	

To examine the causal relationship between public spending on education and economic growth, this study applies the Granger causality test, originally developed by Granger (1969). It is a statistical concept of causality based on prediction. Specifically, given two variables, Xt and Yt, X is said to cause Y if the future values of Y can be forecasted with greater accuracy by incorporating past values of X, assuming all other factors remain constant. The standard version of the Granger causality test is applicable to time series that are stationary.

The Augmented Dickey-Fuller (ADF) unit root test is commonly used to test the stationarity of time series (Dickey & Fuller, 1981). More precisely, when testing stationarity, an autoregressive equation is estimated in the following form:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=1}^{k} \beta_i X_{t-i} + u_t \qquad (1)$$

where X_t is the considered variable (TPEOEt, PEOSEt, PEOHEt, GDPt), t is time, u_t is the stochastic error term, a_0, a_1, a_2, β_i are the set of estimated parameters. Following equation (1), the test is conducted to examine the null hypothesis that the time series contains a unit root, represented as H_0: $\alpha_2 = 0$. This is compared with the alternative

hypothesis that the time series does not exhibit a unit root, H_1: $\alpha_2 < 0$. The alternative hypothesis that the time series is stationary is accepted when the test statistic is sufficiently small or substantially negative. The procedure relies on the critical values provided by MacKinnon (1996), with evaluations conducted at the 1%, 5%, and 10% significance levels.

Since macroeconomic time series often exhibit non-stationarity, the analysis can, in such cases, be conducted using one of the modified Granger causality test techniques. In this study, the modified Granger causality approach proposed by Toda and Yamamoto (1995) is applied to analyze the direction of the causal relationship between public funding allocated to the educational sector and *per capita* economic growth. In contrast to the conventional Granger approach, the method proposed by Toda and Yamamoto applies an augmented VAR model that incorporates extra lags, determined by the highest integration level among the analyzed series.

Once the stationarity properties of the time series have been assessed and their integration order identified, the next step involves constructing a VAR model in order to determine the appropriate lag length. Following this, an augmented VAR system in levels is specified – typically of the order $n + g_{max}$ – where, for the case of two variables, the general form is presented as follows:

$$Y_t = a_0 + \sum_{l=1}^{n} a_{1l} Y_{t-l} + \sum_{l=n+1}^{n+g_{max}} a_{2l} Y_{t-l} + \sum_{l=1}^{n} b_{1l} X_{t-l} + \sum_{l=n+1}^{n+g_{max}} b_{2l} X_{t-l} + e_{Y_t} \quad (2a)$$

$$X_t = c_0 + \sum_{l=1}^{n} c_{1l} X_{t-l} + \sum_{l=n+1}^{n+g_{max}} c_{2l} X_{t-l} + \sum_{l=1}^{l} d_{1l} Y_{t-l} + \sum_{l=n+1}^{n+g_{max}} d_{2l} Y_{t-l} + e_{X_t} \quad (2b)$$

where Y_t and X_t denote the variables; a, b, c and d denote the coefficients; e_{Yt} and e_{Xt} denote the stochastic error terms; n denotes optimal lag length, g_{max} denotes the highest order of integration of the variables.

To assess whether a causal relationship exists between the variables, the *Wald* test is used to evaluate the statistical relevance of the parameters in the VAR($n+g_{max}$) model. Based on the specification given in equation (2a), the null hypothesis stating that variable X does not Granger-cause variable Y (H_0: $b_{1l} = 0$ for $l=1...n$) is tested against the alternative (H_1: $b_{1l} \neq 0$). Likewise, using equation (2b), the reverse hypothesis – that Y does not Granger-cause X – is examined by testing H_0: $d_{1l} = 0$ against H_1: $d_{1l} \neq 0$, for the same lag structure. The *Wald* test is conducted on the first n coefficients from the estimated matrix, while the additional g_{max} lags included in the model are excluded from hypothesis testing, as their coefficients are treated as non-relevant. The resulting test statistic asymptotically follows a chi-squared (χ^2) distribution and remains valid even when the variables are integrated at different orders and cointegration is either present or absent, on the condition that the integration order does not surpass the predetermined number of lags in the model (MacKinnon, 1996). If the null hypothesis suggests that X_t does not cause Y_t, then the trend of Y_t cannot be predicted based on the past trend X_t. In other words, the corresponding coefficients for these variables (b_{1l}) are equal to zero.

4. Research Results

At the outset of the empirical analysis, all time series – with the exception of GDP, due to the presence of negative values – were transformed into their natural logarithmic form. In the initial stage, the analysis focused on testing the stationarity properties of the variables using the Augmented Dickey-Fuller (ADF) unit root test. The findings from this procedure can be found in Table 2 and cover two different model specifications: one that includes both an intercept and a deterministic trend, and another that contains only the intercept. The GDP series was found to be stationary in level form. In contrast, the other variables display non-stationarity at levels in both model variants. As shown in Table 2, the series logTPEOE, logPEOSE, and logPEOHE become stationary after first differencing, indicating that they are integrated of order one, i.e., I(1).

Table 2: Results of the Augmented Dickey-Fuller Test for Stationarity

Level form		
Series	**Intercept & Trend (lag)**	**Intercept Only (lag)**
logTPEOE	-1.743781 (1)	-2.587596 (1)
logPEOSE	-1.958073 (1)	-1.781318 (2)
logPEOHE	-3.237061 (2)	-0.752829 (1)
GDP	-7.168183** (0)	-5.841815*** (0)
First-differenced form		
Series	**Intercept & Trend (lag)**	**Intercept Only (lag)**
ΔlogTPEOE	-3.743064* (0)	-2.806016*** (0)
ΔlogPEOSE	-4.058275** (1)	-3.527310* (1)
ΔlogPEOHE	-4.437030* (0)	-4.586344* (0)

Source: Own calculation, 2025
Note: The lag length included in the model was selected based on the Schwarz Information Criterion.
Symbols (*), (**), *and (***) indicate statistical significance at the* 1%, 5%, *a*nd 10% *levels, respectively.*

Choosing a suitable number of time lags represents a vital step when building a VAR model. Including too many lags can decrease the test's efficiency and result in a reduction of degrees of freedom. Table 3 presents the criteria applied to identify the optimal lag length for the VAR model. Examination of the information criteria values clearly indicates that the optimal lag length for this particular model is 1.

Table 3: Optimal Lag Lengths According to Different Selection Criteria for the Four-Variable VAR Model

Lag	LR	FPE	AIC	SC	HQ
0	NA	3.37e-06	-1.250755	-1.068167	-1.267657
1	50.41020*	1.39e-07*	-4.566174*	-3.653235*	-4.650684*

Source: Own calculation, 2025
Notes: The selected lag order, according to the criterion, is indicated by an asterisk (*). The LR test statistic, which is a sequentially modified likelihood ratio test, is performed at a significance level of 5%. *FPE refers to the Final Prediction Error, while AIC stands for the Akaike Information Criterion. The abbreviation SC denotes the Schwarz Information Criterion, and HQ corresponds to the Hannan-Quinn Information Criterion.*

Another important characteristic of the VAR model is its stability. In the case of the chosen lag length (1), the model's stability was assessed. As illustrated in Figure 1, all unit roots lie inside the unit circle, which confirms that the estimated VAR model is dynamically stable. This outcome indicates that the model meets the criteria for stationarity.

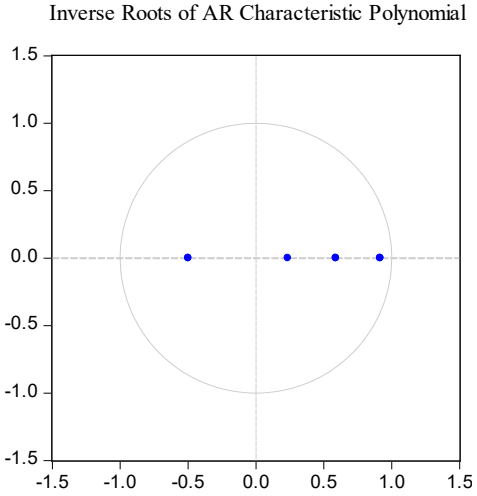

***Figure 1**: The Stationarity Test of VAR (1)*
Source: Own draft, 2025

Given that three of the four analyzed series exhibit stationarity only after first differencing, the maximum order of integration (g_{max}) is determined to be 1, and the selected lag length (n) is also set to 1. As a result, the estimated VAR model is specified in levels and includes four variables, with a total lag order of $n + g_{max} = 1 + 1 = 2$. Accordingly, the following system of equations is applied to examine the causal relationship between public funding allocated to the educational sector and economic growth:

$$\begin{bmatrix} GDP_t \\ logTPEOE_t \\ logPEOSE_t \\ logPEOHE_t \end{bmatrix} = \Phi_0 + \Phi_1 \begin{bmatrix} GDP_{t-1} \\ logTPEOE_{t-1} \\ logPEOSE_{t-1} \\ logPEOHE_{t-1} \end{bmatrix} + \Phi_2 \begin{bmatrix} GDP_{t-2} \\ logTPEOE_{t-2} \\ logPEOSE_{t-2} \\ logPEOHE_{t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_{GDP} \\ \varepsilon_{logTPEOE} \\ \varepsilon_{logPEOSE} \\ \varepsilon_{logPEOHE} \end{bmatrix} (3)$$

Subsequently, in order to investigate the causal relationships among the analyzed variables, constraints are applied to the model parameters, expressed through the following hypotheses:

I H0: $\phi_{12}^{(1)} = 0 \rightarrow$ logTPEOE does not have a Granger causal effect on GDP;
II H0: $\phi_{21}^{(1)} = 0 \rightarrow$ GDP does not have a Granger causal effect on logTPEOE;
III H0: $\phi_{13}^{(1)} = 0 \rightarrow$ logPEOSE does not have a Granger causal effect on GDP;
IV H0: $\phi_{31}^{(1)} = 0 \rightarrow$ GDP does not have a Granger causal effect on logPEOSE;
V H0: $\phi_{14}^{(1)} = 0 \rightarrow$ logPEOHE does not have a Granger causal effect on GDP;
VI H0: $\phi_{41}^{(1)} = 0 \rightarrow$ GDP does not have a Granger causal effect on logPEOHE

Causality is confirmed when the null hypothesis is rejected, based on the statistical relevance of the modified *Wald* (*MWald*) statistic at significance thresholds of 1%, 5%, or 10%. The findings from the VAR(2) model with four variables are displayed in Table 4.

Table 4: Results of Causality Testing Based on the Toda-Yamamoto Approach

Null Hypothesis	$n+g_{max}$	***Wald* Statistics**	***p*-values**
logTPEOE does not have a Granger causal effect on GDP	1+1=2	14.05235*	0.0000
GDP does not have a Granger causal effect on logTPEOE	1+1=2	0.697460	0.8543
logPEOSE does not have a Granger causal effect on GDP	1+1=2	6.549284**	0.0515
GDP does not have a Granger causal effect on logPEOSE	1+1=2	1.438131	0.9640
logPEOHE does not have a Granger causal effect on GDP	1+1=2	4.727121***	0.0856
GDP does not have a Granger causal effect on logPEOHE	1+1=2	2.045883	0.4536

Source: Own calculation, 2025
Asterisks (*), (**) *and* (***) *indicate statistical significance at the* 1%, 5%, *and* 10% *levels, respectively.*

The findings indicate that the null hypothesis – logTPEOE does not have a Granger causal effect on GDP – was rejected at the 1% significance level, suggesting a strong, statistically significant causality running from total public expenditure on education (TPEOE) to GDP. However, the reverse relationship was not confirmed. Similarly, a

unidirectional Granger-causal relationship was identified from public expenditure on secondary education (PEOSE) to GDP, significant at the 5% level, while no causality was observed in the opposite direction. In addition, the analysis confirms a unidirectional Granger-type causal relationship from public spending on higher education (PEOHE) to GDP, which is statistically significant at the 10% level. As in the previous cases, GDP does not exhibit a causal effect on PEOHE.

The analysis indicates that government spending on education, especially total education-related expenditures, plays an important role in forecasting economic growth. However, certain components of the education system, such as secondary and higher education, appear to exert a comparatively weaker influence. The results obtained in this research align with previous empirical evidence suggesting that public education funding may serve as a key indicator of economic development (Jackson, 2021; Nikšić Radić & Paleka, 2020; Qi, 2016).

5. Conclusion

This study set out to examine the causal relationship linking public education expenditure with the growth rate of real economic activity in Serbia. In this context, the relationship between selected indicators of public expenditure on education and real GDP *per capita* was examined. The results point to a statistically significant, unidirectional effect – interpreted in line with the Granger causality approach—originating from total public expenditure on education toward economic growth. Furthermore, a unidirectional causal relationship was identified, running from public expenditure on secondary education and from public expenditure on higher education to economic growth.

These findings suggest that indicators of public expenditure on education can serve as useful variables for forecasting the growth rate of real GDP *per capita*. Drawing on these findings, it is possible to confirm the first research hypothesis (H1) – which posits a causal relationship from public expenditure on education to economic growth, ceteris paribus. In contrast, the other three hypotheses – predicting a causal effect of economic growth on public expenditure on education (H2), the existence of a bidirectional causal relationship (H3), and the absence of any causal relationship between the observed variables (H4) – were not supported by the results.

Regarding the implications of this research for economic policy, the results indicate that, in Serbia, public expenditure on education constitutes a segment of government spending that should receive special attention from the perspective of economic growth. Investments in education have long-term effects that are reflected in the improvement of human capital, increased labor productivity, technological advancement, and long-term economic development. However, it should be noted that there is a certain time lag between investment in education and measurable economic effects. The benefits of investing in education often take several years to become visible, requiring patience and consistency in policy implementation. Although these findings are based on data from Serbia, they may have broader significance for other countries, especially those in transition or with similar institutional and economic characteristics. The identified causal relationship between public expenditure on education and economic growth points to the potential universality of the benefits of investing in the education

sector, which may be relevant for policymakers in other countries aiming for sustainable economic development through the strengthening of human capital.

While the findings confirm a unidirectional causal relationship from public education expenditure to economic growth, future research and policy design should consider long-term structural implications. Public investment in education contributes not only to short-term economic indicators but also to deeper transformations in the quality of human capital, institutional capacity, and the innovation potential of the economy. However, the successful implementation of education-driven growth strategies may face significant challenges, including inadequate funding, inefficiencies in public administration, and misalignment between education outcomes and labor market needs. Therefore, translating education's predictive potential into tangible growth requires targeted, well-coordinated, and sustained policy measures. These may include long-term budgetary commitments to the education sector, curriculum reforms aligned with future labor demands, and stronger mechanisms for monitoring policy outcomes. Such steps would help ensure that the identified causal link translates into practical and impactful strategies for national development.

Furthermore, it should be noted that the research has certain limitations. One limitation relates to the length of the time period for which data are available. Namely, the study covers a relatively short sixteen-year period, which, for methodological reasons, makes it impossible to include other relevant variables in the analysis and restricts the ability to capture long-term or delayed economic effects. This temporal limitation may affect the robustness and reliability of the findings. For transitional economies such as Serbia, where structural changes unfold gradually, the limited time span represents a notable methodological limitation that must be considered in the interpretation of the results. In light of these constraints, the present findings should be regarded as provisional and revisited through future empirical investigation. Additionally, future research could explore alternative approaches to examining the relationship between education and development by incorporating broader performance indicators beyond GDP *per capita*. Promising directions include assessing the impact of education on innovation capacity, poverty reduction, and labor market adaptability. Such a multidimensional perspective may contribute to a better understanding of the developmental role of education and strengthen both the policy relevance and theoretical contribution of future studies.

Acknowledgment: The Ministry of Science, Technological Development and Innovation of the Republic of Serbia provided financial support for this research, under Contract No. 451-03-137/2025-03/200099.

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