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HUMAN CAPITAL, ECONOMIC GROWTH AND EMPLOYMENT: EMPIRICAL EVIDENCE FROM CENTRAL AND EASTERN EUROPE

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Abstract

The purpose of this article is to examine the impact of human capital systems (science, healthcare, and education) on economic growth and employment in the new Member States of the European Union from Central and Eastern Europe - Bulgaria, Romania, Czech Republic, Poland, Hungary, Slovakia, Slovenia, Croatia, Lithuania, Latvia, and Estonia. The empirical analysis uses regression by the method of least squares and annual data from Eurostat for the period 2013 – 2023. The results of the analysis show that the increase in expenditure on research and development increases the employment rate and the rate of real economic growth in the NMS-11. The increase in the share of the population with tertiary education increases the employment rate but does not affect the economic growth in the NMS-11. The increase in healthcare expenditure slows down the rate of economic growth but does not affect the employment rate in the new EU Member States from CEE.

Keywords: *economic growth; employment; human capital; science; healthcare; education; new Member States of the European Union from Central and Eastern Europe*

JEL Codes: *E24, F43, I23*

Introduction

The impact of human capital formation activities (science, healthcare, and education) on economic growth and employment is a serious problem in economic theory and practice, which concentrates the attention of business, the scientific community, politicians, the

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media, non-governmental organizations, and the whole society. There are many theoretical and empirical studies on this topic, whose results and recommendations vary depending on the methodology, time, and territorial scope.

Collectively, healthcare, tertiary education, and research and development emerge as essential components shaping the employment landscape. Investments in these domains strengthen individual employability, enhance workforce productivity, and drive innovation, leading to broader economic benefits. Policymakers are encouraged to adopt a holistic approach that intertwines these elements to foster robust employment growth and meet the evolving demands of a globalized labour market.

The purpose of this study is to analyse the impact of science, healthcare, and education on the rate of growth of real GDP and the employment rate in the NMS-11. The aim of the study is achieved through the accomplishment of the following tasks:

• Systematization of literary sources on the researched problem (point one);

• Empirical assessment of the impact of science, healthcare, and education on growth and employment in the NMS-11 (point two);

• Formulation of recommended policies for increasing economic growth and employment in the NMS with an emphasis on science, education, and healthcare (conclusion).

The methodology of the study includes regression analysis by the method of least squares and annual data from Eurostat for the NMS-11 in the period 2013 – 2023.

Literature Review

The relationship between healthcare, tertiary education, research and development (R&D), and their collective impact on economic growth and employment in New Member States (NMS-11) can be broadly characterized by a complex interdependence, where each of these sectors not only contributes individually to economic enhancement but also synergizes to bolster overall productivity and workforce participation.

Impact of human capital-forming activities on economic growth

Human capital-forming activities, particularly in healthcare, tertiary education, and research and development (R&D), significantly contribute to economic growth. An extensive body of literature supports the premise that investments in these sectors can profoundly enhance a nation's economic performance.

Healthcare is increasingly recognized as a vital component of human capital that significantly contributes to economic growth. Health expenditure is correlated with improved health outcomes, which enhance workforce productivity and longevity, thereby

fostering economic expansion. Wang (2015) emphasizes that higher health expenditure correlates positively with economic performance across OECD countries, illustrating that improved health outcomes boost productivity and overall economic output. This relationship is further supported by Bedir (2016), who discusses how investments in health can enhance human capital in developing countries, catalysing economic growth through improved health status and productivity. Furthermore, Khan et al. (2015) demonstrate in their analysis of SAARC countries that enhanced healthcare spending is associated with positive economic growth, reinforcing the notion of health investments as integral to human capital development.

Additionally, research by Piabuo and Tieguhong (2017) underscores the theoretical underpinnings of Barro's human capital models, which posit that health expenditure is fundamental for economic development. This is echoed in the findings by Alwago (2023), who highlights the connection between health expenditure, life expectancy, and economic growth in Kenya, asserting that the development of human capital is essential for sustained economic expansion. Wu et al. (2021) further contribute by employing a quantile-on-quantile analysis, revealing that the relationship between healthcare expenditure and economic growth varies across different economic contexts.

Piabuo and Tieguhong (2017) find that health expenditure is fundamental to economic advancement, as it enhances labour productivity by reducing morbidity and mortality rates, which in turn permits greater workforce participation. Studies focusing on the NMS-11 indicate that improving healthcare systems fosters a healthier populace, which is essential for the economic vigour of these economies (Bloom et al., 2001).

Furthermore, Hasyim et al. (2020) emphasize the importance of a coordinated approach to public expenditure in education and health to maximize economic growth potential. Their findings suggest that enhanced health outcomes contribute to better educational attainment, creating a virtuous cycle that further supports economic development. This underscores that while healthcare alone is a significant contributor to growth, its synergistic effect with educational investments is equally critical.

The role of education, particularly tertiary education, is similarly vital for economic growth. The impact of tertiary education on economic growth has been extensively documented, emphasizing its role in enhancing human capital. Dangal's (2022) analysis demonstrates that higher education increases labour market productivity and innovation capabilities, which are indispensable for economic expansion. This aligns with the broader human capital theory, as outlined by scholars like Becker, where education is deemed an investment that enhances productivity and contributes directly to economic outputs (Öztürk, 2008). In their meta-regression analysis, Benos and Zotou (2014) consolidate evidence from various studies indicating that education has a significant positive impact on

economic growth, suggesting that the return on investment in education is widely confirmed across economic contexts.

Moreover, research by Hussaini (2020) emphasizes that increased government expenditure on higher education directly fosters economic growth by enhancing the qualifications and productivity of the labour force. Glewwe et al.(2014), examining Sub-Saharan Africa specifically, reaffirm the critical role of education in economic growth, emphasizing its necessity in creating a skilled workforce that can adapt to economic demands.

The endogenous growth model indicates that educational attainment directly correlates with increased levels of technological innovation, which plays a pivotal role in fostering economic growth (Mariana, 2015). Additionally, Dhrifi et al. (2020) note that improvements in educational outcomes are fundamental for the competitiveness of emerging economies in the NMS-11, as they enhance human capital necessary for sustaining growth.

Research and development also play a pivotal role in enhancing human capital and, subsequently, economic growth. The innovation generated from R&D activities contributes to productivity improvements and can lead to new technologies and processes that advance economic performance. Ramesh (2021) discusses how healthcare management strategies, which integrate R&D findings, can align health improvements with economic growth. Similar studies emphasize that technological advancements resulting from R&D expenditures increase productivity levels, thereby driving economic expansion.

R&D activities are vital for fuelling economic growth through innovation and technological advancements. Research shows that countries that invest in R&D tend to have higher productivity growth, as new technologies stimulate economic activity by enhancing efficiency across various sectors (Beztelesna et al., 2022). This is particularly relevant in the context of NMS-11, where fostering R&D can lead to the commercialization of new solutions and products that can drive economic growth.

Voyvoda and Yeldan (2015) suggest that public policy frameworks that prioritize R&D spending can lead to significant long-term economic benefits, as these investments lay the groundwork for robust and sustainable economic growth. Furthermore, the role of government intervention in promoting R&D activities is pivotal, as public funding can leverage private sector investments and lead to innovative outcomes that impact economic performance positively (Rehman et al., 2020).

In summary, healthcare, tertiary education, and research and development pose significant effects on economic growth through the lens of human capital formation. The empirical and theoretical literature underscores the multifaceted nature of how health investments, educational advancement, and R&D efforts are interlinked with improved

economic performance, validating the necessity of these sectors in policy and economic planning.

Impact of human capital-forming activities on employment

The impact of human capital-forming activities such as healthcare, tertiary education, and research and development (R&D) on employment is a critical area of investigation in the context of economic development. There are various studies that highlight how investments in these domains contribute to improving employability rates, enhancing workforce skills, and facilitating job creation in the NMS-11 countries.

Investment in healthcare is associated with improved employability and job sustainability. Mahajan et al. (2022) discuss how employability skills are crucial in enhancing individual contributions to the labour force, suggesting that better health outcomes can facilitate higher employment levels. The argument rests on the premise that healthier individuals exhibit greater productivity, a vital criterion for employers seeking to enhance workforce efficiency. Furthermore, Gao et al. (2010) highlight that advanced technology relies on a workforce equipped with education, training, and health, indicating that investments in healthcare align with economic needs and improve employment opportunities.

Additionally, the mental health component of healthcare provision can significantly influence employability. Findings from Habicht suggest that psychosocial health impacts perceived employability, indicating that investments in mental health resources could enhance opportunities for individuals re-entering the job market (Habicht, 2023). A focus on both physical and mental health ensures that individuals are not only employed but also equipped and motivated to succeed in their roles.

Healthcare plays a critical role in employment rates, as it directly affects an individual's ability to participate in the labour force. Gao et al. (2010) emphasize that a healthy workforce enhances productivity, which is crucial for businesses requiring skilled labour to adapt to the demands of advanced technology. The connection between health and employment is particularly significant in the NMS-11, where transitioning economies rely on a productive workforce to support economic growth and stability.

Moreover, the psychological aspects of health are equally important. Mahajan et al. (2022) highlight that mental health improvements lead to enhanced employability, as individuals who feel well physically and mentally are more likely to seek and succeed in employment opportunities. The implications for employment policies are profound, as investing in healthcare not only supports individual well-being but also cultivates a more

reliable and capable workforce. This is particularly relevant for the NMS-11, where economic transitions can lead to increased job uncertainties, requiring a stable workforce.

Tertiary education plays a pivotal role in enhancing employability through skill acquisition and competency development. Leshoro's analysis (2014) shows a positive correlation between educational attainment and employment elasticity, indicating that areas with higher levels of education tend to experience greater employment growth. Education provides individuals with technical skills and the soft skills necessary for career advancement.

Clarke (2017) argues for a redefinition of employability, encompassing various forms of capital—human, social, and individual attributes—which enhances the employability landscape. This holistic approach positions education as more than mere skill acquisition; it incorporates broader individual attributes contributing to career success. Such an integrated view allows graduates to navigate the labour market effectively, matching their skills with employer expectations.

The relevance of higher education extends beyond initial job placement; it significantly influences career longevity and advancement. Nimmi et al. (2021) assert that developing employability perceptions is closely tied to lifelong learning opportunities stemming from educational experiences. This lifelong learning approach complements formal education, enabling individuals to adapt to changing employment conditions and maintain relevance in their fields.

Tertiary education is a pivotal human capital investment that significantly influences employability rates. Studies indicate a clear relationship between educational attainment and labour market outcomes. Jackson and Bridgstock (2020) contend that curricular, co-curricular, and extracurricular learning activities within higher education significantly enhance graduate employability. This is vital in the context of NMS-11, where disparities in educational access and quality can lead to variation in employment rates across the region.

Furthermore, Forrier et al. (2015) explore the dynamic nature of perceived employability, which is influenced by educational attributes and the ability to transition between jobs. In understanding employability beyond mere qualifications, this perspective reflects the changing nature of work environments in the NMS-11, where adaptability and continuous learning are increasingly important.

Aliu and Aigbavboa (2020) stress that university-industry collaborations enhance graduate employability, making graduates more appealing to employers by aligning educational outcomes with industry needs. Such collaborations are essential in the NMS-11, where economic structures are evolving, necessitating a workforce adept in relevant skills and knowledge areas.

R&D activities are intrinsically linked to innovation, which drives job creation and transformation across industries. Link and Scott (2013) assert that public subsidies for R&D facilitate employment growth, particularly in entrepreneurial settings where innovation leads to new job opportunities. This notion underscores how government policies can foster an environment conducive to employment through the support of innovative initiatives.

Moreover, the interplay between high-skilled immigration and employment in STEM occupations exemplifies the crucial role of R&D in workforce development. Jaimovich and Siu (2017) illustrate that high-skilled migrants, often engaged in R&D roles, contribute disproportionately to job creation and technological advancement in their host countries. Therefore, fostering a skilled workforce through education and R&D not only meets immediate labour demands but also contributes to long-term economic health.

The dynamic between human capital and employment, particularly through R&D pathways, represents a significant growth opportunity. Mushtaq et al. (2022) emphasize the importance of promoting human capital development in harnessing globalization benefits for employment. By investing in R&D and associated human capital, economies can effectively position themselves to exploit global opportunities while enhancing domestic job growth.

Investments in R&D are instrumental in creating employment opportunities, particularly in sectors reliant on innovation. R&D facilitates new business development and the growth of existing businesses through technological advancements. Link and Scott (2013) assert that public R&D subsidies significantly promote employment growth, particularly in entrepreneurial firms. This assertion is particularly applicable in the NMS-11, where fostering innovation is a key strategy for enhancing economic resilience and creating jobs.

In addition, the global competition landscape underscores the importance of R&D in sustaining employment. As economies in the NMS-11 strive to adapt to global market changes, the innovative capacities fostered through R&D investments contribute to job creation and retention in critical industries. The transition to knowledge-based economies requires a workforce well-equipped with the latest skills, directly linking R&D investments to strategic employment outcomes.

Integrating insights from healthcare, education, and R&D can amplify employment benefits significantly. Studies emphasize that improving health outcomes enables individuals to pursue higher education and engage in lifelong learning, which in turn positions them favourably in the labour market. Moreover, fostering a culture of R&D and linking educational curricula to technological advancements can enhance employability prospects for graduates (Nimmi et al., 2021).

In summary, the impact of healthcare, tertiary education, and R&D on employment in the NMS-11 is multifaceted and profound. Investments in healthcare ensure a healthier, more productive workforce; tertiary education enhances the qualifications and employability of individuals, while R&D drives innovation and job creation. To foster a robust employment landscape, policymakers in the NMS-11 should prioritize human capital investments that align with industry needs and economic goals, facilitating sustainable growth and workforce stability

Empirical Analysis

Influence of science, healthcare, and education on economic growth in the NMS-11

Methodology

The effects of science, healthcare, and education on economic growth in the NMS-11 are studied through regression by the method of least squares (OLS), which includes the following variables:

GDPGRij – rate of change of real GDP of country i in year j compared to year j-1 (in percent);

GERDij – gross domestic expenditure on R&D of country i in year j (percentage of GDP);

HCEij – total healthcare expenditure in country i in year j (percentage of GDP);

TEPij – share of the population with tertiary education in country i in year j (percentage of the population aged between 15 and 64 years).

The dependent (target) variable is GDPGR. GERD, HCE, and TEP are independent (explanatory) variables that reflect the influence of science (R&D), healthcare, and education on economic growth in the NMS-11.

The Hausman tests indicate probabilities above 5 percent (0.82 and 0.18), which means that the pooled mean group (PMG) estimator should be preferred to the mean group (MG) or dynamic fixed effects (DFE) estimators. The optimum number of lags for each variable in the PMG ARDL is selected automatically by EViews based on the Akaike Information Criterion.

Data

The study uses annual data from Eurostat for real economic growth, R&D expenditure, healthcare expenditure, and the share of the population with tertiary education in the NMS-11 for the period 2013 – 2023.

Results

The results of the stationarity tests (see Table 1) show that GDPGR, GERD, HCE, and TEP are integrated of order zero, which allows for the direct application of OLS.

The results of the econometric evaluation of the OLS regression (see Table 2) indicate two statistically significant variables – GERD (at a critical significance level of 10%) and HCE (at a critical significance level of 5%). The sign and absolute value of the coefficient in front of GERD indicate that, all other things being equal, a 1% change in the share of R&D expenditure in GDP will lead to a 0.74% change in real economic growth in the same direction. The sign and absolute value of the coefficient in front of HCE suggest that, all other things being equal, a 1% change in the share of healthcare expenditure in GDP will lead to a 0.57% change in real economic growth in the opposite direction.

Table 1. Stationarity tests on the baseline values of GDPGR, GERD, HCE and TEP

Variable	*Probability*
GDPGR	0.0000
GERD	0.0177
HCE	0.0228
TEP	0.0052

Source: Own calculations

Table 2. Econometric estimation of the OLS regression

Variable	*Coefficient*	*Standard error*	*t-statistic*	*Probability*
GERD	0.741357	0.402885	1.84012	0.0687
HCE	-0.565315	0.220702	-2.56144	0.0119
TEP	0.005213	0.024467	0.21306	0.8317
C	5.744364	1.403158	4.09388	0.0001

Source: Own calculations

The adjusted coefficient of determination is 0.75, which means that the OLS regression explains 75% of the variation of real economic growth in the NMS-11 through changes in the shares of R&D and healthcare expenditures in GDP and the share of the population with tertiary education in the total population aged between 15 and 64 years. The probability of the F-statistic is 0.00, which allows accepting the alternative hypothesis

that the OLS model adequately reflects the relationship between GDPGR, GERD, HCE, and TEP.

The analysis reveals a statistically significant positive relationship between R&D expenditure and economic growth. A 1% increase in the share of R&D expenditure in GDP leads to a 0.74% increase in real economic growth, holding other factors constant. This underscores the critical role of innovation and technological advancement in driving economic growth in the NMS-11 countries.

Healthcare expenditure has a statistically significant negative impact on economic growth. A 1% increase in healthcare expenditure as a share of GDP is associated with a 0.57% decrease in real economic growth. This counterintuitive result may reflect inefficiencies in healthcare spending or the possibility that higher healthcare costs divert resources from more productive investments.

The share of the population with tertiary education does not show a statistically significant impact on economic growth in this analysis. This could indicate that the benefits of higher education take longer to materialize or that other factors, such as the quality of education or labour market alignment, play a more critical role.

The OLS regression model explains 75% of the variation in economic growth, indicating a strong fit. The F-statistic confirms the overall significance of the model.

Influence of science, healthcare, and education on employment in the NMS-11

Methodology

The effects of science, healthcare, and education on employment in the NMS-11 are studied through regression by the method of least squares (OLS), which includes the following variables:

EMPLij – employment rate in country i in year j (in percent);

GERDij – gross domestic expenditure on R&D of country i in year j (percentage of GDP);

HCEij – total healthcare expenditure in country i in year j (percentage of GDP);

TEPij – share of the population with tertiary education in country i in year j (percentage of the population aged between 15 and 64 years).

The dependent (target) variable is EMPL. GERD, HCE, and TEP are independent (explanatory) variables that reflect the influence of science (R&D), healthcare, and education on employment in the NMS-11.

Data

The study uses annual data from Eurostat for the employment rate, R&D expenditure, healthcare expenditure, and the share of the population with tertiary education in the NMS-11 for the period 2013 – 2023.

Results

Table 3. Stationarity tests on baseline values of EMPL, GERD, HCE and TEP

Variable	*Probability*
EMPL	0.0000
GERD	0.0177
HCE	0.0228
TEP	0.0052

Source: Own calculations

The results of the stationarity tests (see Table 3) show that GDPGR, GERD, HCE, and TEP are integrated of order zero, which allows for the direct application of OLS.

The results of the econometric evaluation of the OLS regression (see Table 4) indicate two statistically significant variables – GERD (at a critical significance level of 1%) and TEP (at a critical significance level of 1%). The sign and absolute value of the coefficient in front of GERD indicate that, all other things being equal, a 1% change in the share of R&D expenditure in GDP will lead to a 4.81% change in the employment rate in the same direction. The sign and absolute value of the coefficient in front of TEP suggest that, all other things being equal, a 1% change in the share of the population with tertiary education will lead to a 0.39% change in the employment rate in the same direction.

Table 4. Econometric estimation of the OLS regression

Variable	Coefficient	Standard error	t-statistic	Probability
GERD	4.811467	0.879101	5.47317	0.0000
HCE	-0.351733	0.481575	-0.73038	0.4668
TEP	0.385356	0.053388	7.21806	0.0000
C	54.26815	3.061712	17.7248	0.0000

Source: Own calculations

The adjusted coefficient of determination is 0.67, which means that the OLS regression explains 67% of the variation of the employment rate in the NMS-11 through changes in the shares of R&D and healthcare expenditures in GDP and the share of the population with tertiary education in the total population aged between 15 and 64 years. The probability of the F-statistic is 0.00, which allows accepting the alternative hypothesis that the OLS model adequately reflects the relationship between GDPGR, GERD, HCE, and TEP.

It can be concluded that R&D expenditure has a strong positive impact on employment. A 1% increase in the share of R&D expenditure in GDP leads to a 4.81% increase in the employment rate. This highlights the job-creating potential of innovation and research-driven industries.

The share of the population with tertiary education also has a statistically significant positive effect on employment. A 1% increase in the share of the population with tertiary education leads to a 0.39% increase in the employment rate. This suggests that a more educated workforce contributes to higher employment levels, likely due to improved skills and productivity. Healthcare expenditure does not show a statistically significant impact on employment in this analysis. This could imply that healthcare spending does not directly influence labour market dynamics in the NMS-11 countries. The OLS regression model explains 67% of the variation in employment, indicating a good fit. The F-statistic confirms the overall significance of the model.

Both economic growth and employment benefit significantly from increased R&D expenditure. Policymakers in the NMS-11 countries should prioritize investments in science, technology, and innovation to foster sustainable economic development and job creation. The negative relationship between healthcare expenditure and economic growth warrants further investigation. It may be necessary to improve the efficiency of healthcare spending or reallocate resources to more productive sectors. While tertiary education does not significantly impact economic growth in the short term, it positively affects employment. This suggests that education policies should focus on aligning skills with labour market needs to maximize economic benefits.

It is recommended that:

- R&D funding be raised in order to stimulate economic growth and employment;
- Healthcare spending be re-assessed to make sure it contributes positively to economic outcomes;
- The link between education and labour market demands be strengthened to enhance the economic impact of higher education.

Conclusion

The paper underscores the interlinked nature of healthcare, tertiary education, and R&D in shaping human capital and their collective impact on economic growth in the NMS-11 As economies evolve, it is imperative to adapt human capital development strategies continually to meet industry demands and support sustainable employment growth. Ensuring that policies align with the needs of both workers and employers will be crucial for fostering a resilient labour market.

The increase in the share of R&D expenditure in GDP and the share of the population with tertiary education increase employment in the NMS-11, while the impact of healthcare expenditure is statistically insignificant.

The effects of science, healthcare, and education on real economic growth in the NMS-11 are fundamentally different. While the increase in R&D expenditure accelerates economic growth, the increase in healthcare expenditure slows down the growth of real GDP, and the change in the share of the population with tertiary education does not affect the percentage change in the aggregate product in the NMS-11.

It can be concluded that, among the human capital-forming activities, science in the face of R&D has the strongest favourable effects on the employment rate and economic growth in the NMS-11. The economic effects of healthcare and education vary, which indicates the need for reforms in these sectors to utilize their full economic potential. Policymakers in the NMS-11 must thus prioritize these areas to sustain and accelerate economic growth effectively.

The empirical analysis highlights the importance of science (R&D) and education in driving economic growth and employment in the NMS-11 countries, while raising questions about the role of healthcare expenditure. Policymakers should leverage these insights to design targeted strategies for sustainable development.

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