THE IMPACT OF HUMAN CAPITAL ON THE COMPETITIVENESS OF COUNTRIES IN THE CENTRAL AND EASTERN EUROPEAN REGION (CEE)

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Abstract

In Central and Eastern European (CEE) countries, competitiveness is a pivotal factor given its impact on economic growth, the capacity to attract foreign investment, and integration into global markets. Human capital, defined as the aggregate of an individual's education, health, and skills, is a critical factor in determining competitiveness. It exerts a substantial influence on productivity, the innovative capacity of economies, and their capacity to achieve sustainable economic growth. The primary objective of the present study was to examine the relationship between human capital and the competitiveness of economies in Central and Eastern European countries. To this end, the V4 countries were compared with other countries in the region, the growth dynamics of selected indicators were analyzed, convergence trends were examined, and a regression analysis was performed on the relationship between these indicators in individual countries. To achieve this objective, a variety of scientific methods were employed. The Mann-Whitney U test was employed to compare the V4 countries with other countries in the region, while the dynamics of HDI and WCI development were assessed using the average growth coefficient. The sigma convergence method was employed to identify convergence trends, and the relationship between the HDI and WCI levels in individual countries was examined using the simple linear regression method, supplemented by the Durbin-Watson test. The findings indicated that the V4 countries are comparable to other countries in Central and Eastern Europe with regard to competitiveness and human capital. The σ-convergence results did not demonstrate a discernible convergence or divergence trend between countries. The application of regression analysis revealed a statistically significant impact of human capital on competitiveness in the Czech Republic and Estonia. In contrast, the majority of countries exhibited a weak or insignificant relationship between human capital and competitiveness, indicating the necessity of considering additional factors that influence competitiveness.

Key words:
Central Eastern Europe, Competitiveness, Human capital, Human Development Index, World Competitiveness Index

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INTRODUCTION

The European Union and other European countries are currently facing complex challenges in maintaining and strengthening their competitiveness. The impact of climate change, the emergence and dynamic development of artificial intelligence, and ongoing geopolitical tensions on the quality of life and economic stability and resilience of individual countries are significant. To ensure long-term success in this shifting landscape, it is imperative that Europe maintains its position as a catalyst for sustainable growth, innovation, and technological advancement, underpinned by the optimal utilization of human capital.

In response to these challenges, the countries of Central and Eastern Europe (CEE) have a special role to play, having undergone significant dynamic development over the past two decades. Initially, they established themselves primarily as a manufacturing base for the European Union and attracted a significant amount of foreign direct investment from Western Europe. Consequently, they have been progressively converging towards the EU's mean income level, concurrently embarking on a broadening of their economic portfolio, with a strategic emphasis on the advancement of the service sector and the promotion of activities characterized by elevated

added value. Ferrazzi et al (2024) have noted that several scientific and professional authorities have gradually begun to focus on the contribution of CEE countries and the competitiveness of the EU. They have also cited studies that provide further insights into the competitiveness and contribution of human capital in the Central and Eastern European region (Jazwinski, 2024; Ferrazzi et al 2025).

The Central and Eastern European (CEE) region is comprised of eleven countries: the Czech Republic, Slovakia, Poland, Hungary, Slovenia, Estonia, Latvia, Lithuania, Romania, Bulgaria, and Croatia. These countries constitute the sample for the present research. The primary objective of the present study was to examine the relationship between human capital, measured by HDI, and the competitiveness of economies, measured by WCI, from 2014 to 2023 in Central and Eastern European countries. To this effect, the V4 countries were compared with other countries in the region, the growth dynamics of selected indicators were analyzed, convergence trends were examined, and a regression analysis of the relationship between these indicators in individual countries was performed.

Despite the extensive literature devoted to human capital and economic growth, knowledge about the impact of human development on national competitiveness in Central and Eastern European (CEE) countries remains limited in the long term. A notable absence in the extant literature is empirical analyses based on panel data that would link the Human Development Index (HDI) and the World Competitiveness Index (WCI) within a unified analytical framework. In this context, longitudinal evidence comprises studies that systematically track the development of specific countries over time. This methodological approach enables the capture of the dynamics inherent in the relationship between human development and competitiveness, including potential lagged effects.

Despite the existence of numerous studies that have examined the relationship between human capital and the competitiveness of economies (see Bak et al., 2022; Gaona & Vásquez, 2021; Debrah, 2018, among others), the extent to which this relationship is manifested at the level of individual countries in the Central and Eastern European region, and whether the intensity of this relationship is uniform across all countries in the region, remains under-explored. Existing studies have focused on comparing old and new EU member states (Tijanic & Obadic, 2015) or have employed aggregated panel approaches (Cetinguc et al., 2023). However, these approaches may obscure specific national characteristics. However, there is a paucity of attention devoted to the integration of dynamic, convergence, and simple regression analysis at the individual country level, as well as the comparison of the V4 countries with other countries in the region. The present study aims to contribute to a deeper understanding of the role of human capital in shaping the competitiveness of Central and Eastern European economies. In addition, it seeks to identify differences in the strength of this relationship between individual countries in the region.

LITERATURE OVERVIEW

The concept of competitiveness has emerged as a prominent theme in the realm of professional literature. It has garnered significant attention from European Union representatives, as well as from the professional public and economic actors. This attention is attributed to the perception of competitiveness as a pivotal catalyst for economic growth, prosperity, and sustainable development. The professional public has long focused on examining the competitiveness of companies and national economies. However, the concept of regional competitiveness is a relatively new approach that is the subject of diverse interpretations and discussions. Some authors have even raised questions regarding the very applicability of the concept of competitiveness at the regional level. According to Krugman (1997), the employment of the term "competitiveness" within the context of regional economics can be problematic, as it may result in erroneous policy conclusions. The primary rationale for this phenomenon is the inherent complexity of defining regional competitiveness in a definitive manner, given the

multifaceted nature of regions as economic and social entities (Žitkusa, 2015). However, Staníčková (2019) asserts that only a systematic and thorough analysis grounded in multiple research approaches can yield a conceptually anchored definition and a reliable assessment of regional competitiveness. Conversely, several authors posit that regional competitiveness is a legitimate concept, provided it is understood as the capacity of a region to support economic activity and ensure the relative prosperity of its population (Begg, 1999; Huovari, Kangasharju & Alanen, 2000). Annoni & Dijkstra (2019) define regional competitiveness in this context as the ability of a region to provide businesses and residents with an attractive and sustainable environment for living and working, while reconciling the goals of economic success with social well-being and emphasizing both short-term and long-term sustainability. This approach also differentiates between the determinants of competitiveness (e.g., quality of human capital, innovation potential, accessibility, agglomeration effects) and its outputs (e.g., GDP per capita, income level, employment).

Huovari, Kangasharju, & Alanen (2000) similarly highlight the necessity of comprehending this concept in a more expansive manner, extending beyond the mere measurement of outcomes. They underscore that it encompasses the prerequisites for development and the capacity of the regional system to function efficaciously. Palinchak et al. (2021) posit that a region's high competitiveness is the result of effective organization and optimization of economic processes, the existence of adequate infrastructure, a functional institutional environment, and the effective activity of market actors. According to Wokoun (2016), the determination of regional competitiveness is not solely determined by production indicators. The structure of production, production capacities, innovation characteristics, the quality of the workforce, and the settlement structure are also factors that contribute to regional competitiveness. Huggins et al. (2014) posit that companies and their market position are pivotal factors in regional competitiveness, as companies are the primary drivers of knowledge creation, innovation, and new jobs. The degree of regional competitiveness is, to a considerable extent, contingent on the existence of conditions that facilitate the ability of companies to compete in both domestic and international markets. Wokoun (2016) further posits that a region is competitive if it is attractive to investors, entrepreneurs, and the transfer of know-how. In their 2019 study, Borovitskaya et al. characterized regional competitiveness as the ability of a region to succeed in competition with other regions. The factors that contribute to this success include population growth, innovation activity, and intellectual potential development. The study also identified factors that increase investment attractiveness, reduce socio-economic disparities, and improve the quality of life of the population. Kouskoura et al. (2024) identified ten primary domains of regional competitiveness through an exhaustive review of the extant literature. These domains include the economy, labor market, poverty and social inclusion, healthcare, educational infrastructure, environmental conditions, transport infrastructure, science and technology, high-tech industries, and innovation.

In Central and Eastern European (CEE) countries, competitiveness is a pivotal factor because it influences economic growth, the ability to attract foreign investment, and integration into global markets. The countries of Central and Eastern Europe (CEE) have shared historical experience of post-communist transformation and are now members of the European Union. The competitiveness of these countries is influenced by various historical, economic, and social factors. As previously stated, the Central and Eastern European countries that are members of the European Union (EU) include the following: Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia, as well as the Baltic countries of Estonia, Lithuania, and Latvia. Collectively, these nations have a population exceeding 100 million. The CEE countries do not constitute a region in the administrative sense; however, in the professional literature and research works of many authors (Gorzelak & Smętkowski, 2010; Pellényi, 2020; Holobiuc, 2021; Török, 2025; Rácz et al., 2025), they are often understood as a macro-region used for analytical and comparative purposes, as they share similar historical, economic, and institutional characteristics.

In recent years, the European Union has placed a premium on enhancing its competitiveness in order to address its deteriorating position in the global economy and the growing challenges posed by technological and geopolitical rivalry. Europe is particularly confronted with a lag in productivity growth and in the capacity to support innovative businesses when compared to the United States and China. This is evident in lower innovation dynamics, weaker development of digital technologies, and constrained access to venture capital (European Commission, 2025a; Letta, 2024). These factors have the potential to compromise the EU's capacity to sustain its position as a leader in technology and ensure sustained economic growth. On a global scale, the European Union (EU) is facing challenges to its competitiveness due to geopolitical tensions, fragmentation of global trade, and mounting risks in supply chains. In response to these challenges, the concept of economic security is gaining prominence, emphasizing the need to diversify sources, reducing strategic dependencies, and strengthening the resilience of the European economy (European Commission, 2023). High energy prices in the EU continue to present a substantial challenge, exerting a negative influence on the cost competitiveness of industry, particularly in energy-intensive sectors (European Commission, 2025b; Heussaff, 2024). In addition to external pressures, the EU is confronted with a number of internal structural challenges. The ongoing fragmentation of the single market, the presence of divergent regulatory frameworks, and the imposition of substantial administrative burdens have been shown to increase the costs of conducting business and to impede the cross-border expansion of companies (Borowiecki & Giovannelli, 2025; Letta, 2024). Weaker capital markets and insufficient access to financing for innovative projects further limit the creation and growth of technology-oriented businesses (European Commission, 2025a). A significant challenge confronting the region is the impending demographic shift, characterized by an aging population and a paucity of skilled labor. These factors have the potential to curtail the economic growth prospects of Member States. International institutions have identified the necessity for increased investment in education, skills development, and lifelong learning as a means of promoting productivity and facilitating the adaptation of the workforce to the digital and green transitions (Arnold et al., 2025; European Commission, 2025a). In essence, the EU's competitiveness is contingent upon its capacity to concurrently address global pressures and eliminate internal structural impediments. The European Union's long-term competitiveness is predicated on several key pillars, including the strengthening of innovation capacity, the deepening of the single market, the development of capital markets, and the investment in human capital. Considering the aforementioned challenges, human capital emerges as a pivotal factor in determining the competitiveness of the European Union and its Member States. The quality of the workforce, the level of education, skills, and the ability to adapt to technological change have a significant impact on productivity, innovation performance, and the ability of economies to generate higher added value. A multitude of studies have indicated that investment in education, the cultivation of digital competencies, and the promotion of lifelong learning are indispensable prerequisites for a fruitful transition to a knowledge- and innovation-oriented economy (European Commission, 2025a; Arnold et al., 2025).

Concurrently, evidence suggests that disparities in human capital levels among European Union member states play a pivotal role in the observed disparities in competitiveness. A body of research has demonstrated that countries and regions with a higher concentration of skilled labor, high-quality educational infrastructure, and a developed research and innovation ecosystem achieve better results in terms of productivity, innovation, and overall economic performance (Mulliqi et al., 2018; Žárská & Masárová, 2025). Human capital functions not only as an input factor in production but also as a strategic resource that enables the effective use of new technologies, including artificial intelligence, and strengthens the long-term resilience of the economy (Acemoglu & Autor, 2011; Goldin, 2016).

Despite the extensive literature focused on measuring international competitiveness, only limited attention has been paid to the potential determinants of this competitiveness, especially human capital, particularly in the context of Central and Eastern European economies. In this context, Mulliqi et al. (2018) empirically examine the impact of several human capital indicators

on international competitiveness and formulate key research questions focused on the extent to which the improvement in the competitiveness of Central and Eastern European economies can be explained by the growth of their human capital stocks and whether the differences in performance between countries result from differences in the quality and quantity of this capital.

Human capital is currently regarded as a primary source of economic and organizational wealth, with knowledge and skills applied in practice generating added value becoming a pivotal factor (Gamal, 2008). A plethora of definitions for human capital exists, with various scholars emphasizing education, skills, qualifications, work experience, health, motivation, and investment in individual development (Baron & Armstrong, 2007; Bontis & Fitz-Enz, 2002; Roos et al., 2006). A distinguishing attribute of human capital is its inextricable link to the individual, which significantly impacts economic growth. The quality of human capital is particularly salient, as it influences economic prosperity (Purnomo et al., 2019). The authors also emphasize its accumulative and long-term nature, which contributes to its status as a primary source of sustainable development. In their seminal work, Acemoglu and Autor (2011) propose a definition of human capital as the aggregate of knowledge, information, ideas, expertise, and health possessed by individuals, positing its pivotal role in influencing labor productivity. Building upon this foundation, Goldin (2016) further elaborates on the concept, underscoring its interconnection with investment in education and training, a pivotal factor in the cultivation of human capital. The broader concept also encompasses practical knowledge, acquired skills, and organizational experience, including know-how and organizational memory (Hajšová, 2014; Radenovic & Krstić, 2017). The heterogeneity of approaches to defining human capital is indicative of its intricate nature. This intricacy complicates the accurate measurement of human capital, yet it also facilitates a more profound comprehension of its multidimensional character. Empirical research has confirmed that the value of knowledge, skills, and abilities concentrated in people often exceeds the value of physical capital. These further underscores the strategic importance of human capital for social and economic development (Pravdiuk et al., 2019).

In professional literature, human capital is measured using several types of indicators that capture its quantitative and qualitative dimensions. The most common of these are education-based indicators, utilized in the works of Barro and Lee (2013), the OECD (2023), and the UNDP (2023). These indicators primarily employ the mean years of schooling, expected years of schooling, the proportion of the population with tertiary education, the completion rate of secondary and tertiary education, and the results of international tests (PISA, TIMSS, PIRLS).

Another group consists of studies focusing on skills and competencies (skills-based indicators), which monitor the level of digital skills, problem-solving skills, cognitive abilities (test scores), and participation in lifelong learning (Grundke, 2018; De Grip, 2024; OECD, 2019; PIAAC). A significant focus is placed on health-based indicators, which acknowledge health as a pivotal component of productivity and workforce quality (WHO, 2018; World Bank, 2020). Furthermore, the approximation of human capital is frequently facilitated by the utilization of labor market indicators, including employment by educational attainment, the wages of highly skilled workers, labor productivity, and the proportion of employment opportunities in high-tech sectors. Additionally, innovation indicators, such as the number of researchers, patents, and R&D expenditure, are often employed to approximate human capital.

In recent years, composite indicators have also been widely used, combining several sub-indicators into a single summary index and combining the dimensions of education, health, and income. The most frequently utilized indicators are the Human Development Index (HDI), the Human Capital Index (HCI), the European Human Capital Index (EHCI), and the Education Index. These indices are systematically compiled by international institutions and employed to compare the extent of human capital among nations.

The human capital concept is approximated by the Human Development Index (HDI), a metric that captures key dimensions of education and health. The HDI is a widely used metric in

empirical literature. The HDI is a comprehensive indicator used to assess the level of social and economic development of countries and regions. It captures three basic dimensions of human development: health, education, and income. The index was first introduced by the United Nations Development Programme (UNDP) in the early 1990s and was first published in the Human Development Report in 1990. Human development is conceptualized as a process of expanding individuals' opportunities and enhancing their well-being, which extends beyond narrowly defined economic indicators (Stankovičová & Mojsejová, 2020). In the context of human development, it is imperative to consider not only income levels, but also the development of human capabilities through enhanced health, knowledge, and skills, as well as opportunities to apply individual abilities in working, social, cultural, and political life. In order to comprehensively assess a country's development potential, these areas should be in balance with each other (Majerová, 2012).

The HDI serves as a composite indicator of socio-economic development, evaluating the average results achieved by countries across three dimensions: long and healthy life (health index – HI), access to knowledge (education index – EI), and adequate standard of living (income index – II). The United Nations Development Program (UNDP) employs uniform weights for all three dimensions in its construction, with the resulting Human Development Index (HDI) value determined as the geometric mean of the aforementioned sub-indices (Stankovičová & Mojsejová, 2020).

GOAL AND METHODOLOGY

The primary objective of the study was to examine the relationship between human capital and the competitiveness of economies in Central and Eastern European countries. To this end, the V4 countries were compared with other countries in the region. In addition, the growth dynamics of selected indicators were analyzed, convergence trends were examined, and a regression analysis was performed on the relationship between these indicators in individual countries. The HDI was employed to denote the level of human capital, while the WCI was utilized to indicate the level of competitiveness. The period under analysis was from 2014 to 2023. Due to the unavailability of the HDI, which was last published for 2023, it was not possible to include more recent data. The necessary data were drawn from the United Nations Development Program and the International Institute for Management Development.

Initially, a statistical significance analysis was conducted to ascertain whether there was a substantial discrepancy in the HDI or WCI levels between the V4 countries and other Central and Eastern European nations. To this end, the Mann-Whitney U test was employed, a non-parametric test that, according to Nachar (2008), is among the most robust and capable of yielding statistically significant results. To this end, the Mann-Whitney U test was employed, a non-parametric test that, according to Nachar (2008), is among the most robust and capable of yielding statistically significant results. The analysis was based on the following relationships:

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \qquad (1)$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \qquad (2)$$

where:
n1, n2 – sizes of two groups

R1, R2 – sum of the order of values of the first and second groups.

The subsequent section of the analysis examined whether the growth dynamics of human capital in Central and Eastern European countries during the period under review exceeded the

growth dynamics of their competitiveness. To this end, the average growth coefficient was calculated using the geometric mean.

$$x_G = \sqrt[n]{x_1.x_2.\ldots.x_n} \qquad (3)$$

Subsequent to the analysis of growth dynamics employing the average growth coefficient, the focal point was shifted toward the identification of convergence trends. To this end, the sigma convergence method was employed.

$$(1/ T)* \log (Y_{i,T} / Y_{i,0}) = \alpha + ß * \log Y_{i,0} + U_i \qquad (4)$$

Conversely, a decline in the variance, denoted by σ, within a specified set of countries during the designated period of analysis indicates a convergence of variances among nations (Mazurek, 2013).

In the subsequent phase of the analysis, a simple linear regression analysis was applied separately for each country in order to examine the relationship between the HDI and WCI levels. This methodological approach enabled the assessment of the extent to which changes in HDI can explain the variability in competitiveness levels as expressed by WCI. In order to perform the regression analysis, it was necessary to determine the input data required for substitution into the linear regression function.

$$y_i = b_0 + b_1 x_i + \varepsilon \qquad (5)$$

The Durbin–Watson test was employed to ascertain the reliability of the regression coefficient estimates. The objective of this test is to detect autocorrelation in the residuals and identify potential intertemporal dependencies in the data. As Kenton (2025) asserts, the Durbin–Watson test quantifies the extent of autocorrelation present in the residuals of a regression model. The existence of autocorrelation has the potential to introduce significant distortions into statistical results, thereby leading to incorrect interpretation of trends, a phenomenon that is particularly problematic in the context of time series analysis. The calculations were based on the following relationship:

$$d = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} \qquad (6)$$

where:

T - number of observations

e_t - residual (difference between actual and predicted value) for a point in time.

FINDINGS

In the initial phase of the analysis, the focus is on comparing the level of human capital and competitiveness between the V4 countries and other countries belonging to the Central and Eastern European region. The objective of this study is to ascertain the presence of any systematic disparities in the indicators examined between these groups of countries with analogous historical development. To this end, the Mann–Whitney U test is employed, which first analyzes the level of human capital expressed by the HDI index and then the level of competitiveness expressed by the WCI index. The research question guiding this study was as follows: Do the V4 countries exhibit a distinct level of human capital, as measured by the HDI, when compared to other countries within the Central and Eastern European region?

H0: There is no statistically significant difference in HDI between the V4 countries and other countries in the Central and Eastern European region.

H1: There is a statistically significant difference in HDI between the V4 countries and other countries in the Central and Eastern European region.

Table 1: Mann-Whitney U test: HDI

Group 1	Group 2	U value	Critical value u (p <0,05)	Z-score	p- value	Statistical significance
V4 Countries	The remaining states falling within the region of Central and Eastern Europe	55	31	-0.03413	0.48803	no

Source: UNDP, own calculations

The objective was to ascertain whether there is a statistically significant disparity in HDI between the V4 countries and other countries in the Central and Eastern European region. The period under analysis spanned from 2014 to 2023. The empirical distribution function of the test statistic U was determined to be 55, whereas the critical value at a significance level of $\alpha = 0.05$ was 31. Given that the calculated U value exceeds the critical value, the null hypothesis (H0) was accepted. This hypothesis posits that there is no statistically significant difference in HDI between the V4 countries and other countries in the Central and Eastern European region. This finding was corroborated by the low Z-score of 0.03413, which signifies a negligible disparity between the compared groups of countries, as well as the relatively high p-value of $0.48803 > 0.05$. The findings indicate that disparities in the aggregate level of human capital within the Central and Eastern European region are less pronounced than would be anticipated based on discrepancies in economic performance or the extent of integration into European structures.

Following an examination of the level of human capital expressed by the HDI index between the two groups of countries, a comparison of their competitiveness as expressed by the WCI index is subsequently undertaken. The research question guiding this study was as follows: Do the V4 countries exhibit a distinct level of competitiveness, as measured by the WCI, when compared to other countries within the Central and Eastern European region?

H0: There is no statistically significant difference in WCI between the V4 countries and other countries in the Central and Eastern European region.

H1: There is a statistically significant difference in WCI between the V4 countries and other countries in the Central and Eastern European region.

Table 2: Mann-Whitney U test: WCI

Group 1	Group 2	U value	Critical value u (p <0,05)	Z-score	p- value	Statistical significance
V4 Countries	The remaining states falling within the region of Central and Eastern Europe	49	31	-0.44364	0.32997	no

Source: IMD, own calculations

As in the previous case, the Mann-Whitney U test was used to determine whether there was a statistically significant difference in WCI values between the V4 countries and other countries in the Central and Eastern European region. The analysis was conducted on data from 2014 to 2023, with a significance level of $\alpha = 0.05$. The test statistic U was found to be 49, whereas the critical value at $p < 0.05$ is 31. Given the statistical insignificance of the WCI disparity between the V4 countries and those in Southeast and Eastern Europe, as evidenced by $U = 49 > 31$, it can be concluded that the observed differences in WCI are not statistically significant. This finding was corroborated by the low z-score of -0.44364, which falls within the insignificance interval, and by the relatively high p-value of 0.32997. The findings of this study support hypothesis H0, which posits that there is no statistically significant difference in WCI between the V4 countries and the other countries in Central and Eastern Europe. This finding suggests that, in terms of the development of competitiveness and the factors that may influence it, the V4 countries do not differ significantly from other countries in the region under review. This may be the result of their similar historical and institutional development.

A statistical analysis reveals no significant disparities between the V4 countries and other Central and Eastern European countries with regard to human capital or overall competitiveness. This phenomenon can be attributed to the composition of the two groups of countries, which include nations with relatively high and low values for individual indicators. For instance, within the WCI framework, countries such as the Czech Republic and Estonia demonstrate higher values, while Croatia, Bulgaria, and Slovakia, for instance, exhibit lower values. In the HDI, Slovenia, the Czech Republic, and Estonia exhibit higher values, while Romania, Bulgaria, and Hungary demonstrate lower values.

As human capital is frequently regarded as a primary factor contributing to enhanced economic performance and competitiveness in individual countries, subsequent analyses will concentrate on ascertaining whether the growth of human capital in Central and Eastern European countries during the specified period surpassed the growth of competitiveness in those countries. The average growth coefficient was employed to facilitate a comparative analysis of the dynamics exhibited by both indicators, thereby enabling a systematic comparison of the rate of change in HDI and WCI.

Table 3: Average growth coefficient - WCI

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Geomean
Bulgaria	-	1.099	1.227	1.065	0.999	0.939	0.964	0.855	1.011	0.912	1.003
Czechia	-	1.139	1.075	1.037	1.007	0.924	0.970	0.947	1.124	1.101	1.033
Estonia	-	1.075	1.063	1.057	1.009	0.926	1.049	0.968	1.071	0.973	1.020
Croatia	-	1.148	1.153	1.096	0.979	0.918	0.864	0.982	1.329	0.959	1.039
Latvia	-	0.967	1.113	1.080	1.006	0.952	0.921	1.012	1.035	0.824	0.986
Lithuania	-	1.157	1.032	1.021	1.017	0.991	0.786	1.172	1.045	0.976	1.016
Hungary	-	1.086	1.099	1.028	1.024	0.963	1.158	0.838	1.068	0.908	1.015
Poland	-	1.113	1.037	1.034	1.023	0.943	0.941	0.824	0.967	1.133	0.998
Romania	-	1.081	1.090	1.040	1.003	0.932	0.918	0.984	0.973	1.040	1.005
Slovenia	-	1.227	1.143	1.091	1.037	0.973	0.962	0.922	1.043	0.952	1.035
Slovakia	-	1.073	1.152	0.982	0.928	0.958	0.861	1.060	1.019	1.006	1.001

Source: IMD, own calculations

The average WCI growth coefficient, expressed as a geometric mean, captures the WCI trend between 2014 and 2023. The findings indicate that in nine out of eleven countries, there was a slight increase in the WCI during the period under review, despite the fact that the WCI

alternately decreased and increased in most countries. The highest average growth coefficient was recorded in Croatia (1.039), where the WCI increased by 3.9% during the period under review. Conversely, the lowest coefficient, indicating a decline, was recorded in Latvia (0.986). A decline was also documented in Poland, albeit to a lesser extent (0.998). This decline is distinct from the one observed in Latvia. Consequently, it can be deduced that the disparities in WCI dynamics among the countries examined are not substantial, with the majority exhibiting only moderate growth or stagnation. This finding suggests that the WCI level in these countries is subject to only minor fluctuations, exhibiting average growth or decline over the 10-year period.

Table 4: Average growth coefficient - HDI

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Geomean
Bulgaria	-	1.006	1.004	1.002	1.004	1.004	0.989	0.989	1.022	1.012	1.003
Czechia	-	1.002	1.002	1.002	0.997	1.002	0.994	1.003	1.011	1.004	1.002
Estonia	-	1.003	1.002	1.004	1.003	1.004	1.000	0.998	1.003	1.003	1.002
Croatia	-	1.005	1.005	1.007	1.006	1.006	0.994	1.010	1.011	1.003	1.005
Latvia	-	1.006	1.006	1.007	1.006	1.006	0.999	0.991	1.011	1.009	1.004
Lithuania	-	1.003	1.007	1.011	1.005	1.006	0.993	0.999	1.001	1.008	1.004
Hungary	-	0.999	1.005	1.002	1.005	1.005	0.995	0.994	1.018	1.003	1.003
Poland	-	1.007	1.006	0.998	1.002	1.003	0.992	1.005	1.020	1.004	1.004
Romania	-	1.004	1.000	1.006	1.006	1.006	0.993	0.996	1.013	1.006	1.003
Slovenia	-	1.002	1.006	1.004	1.004	1.001	0.995	1.007	1.002	1.005	1.003
Slovakia	-	1.002	1.003	1.001	1.003	1.003	0.995	0.991	1.016	1.008	1.003

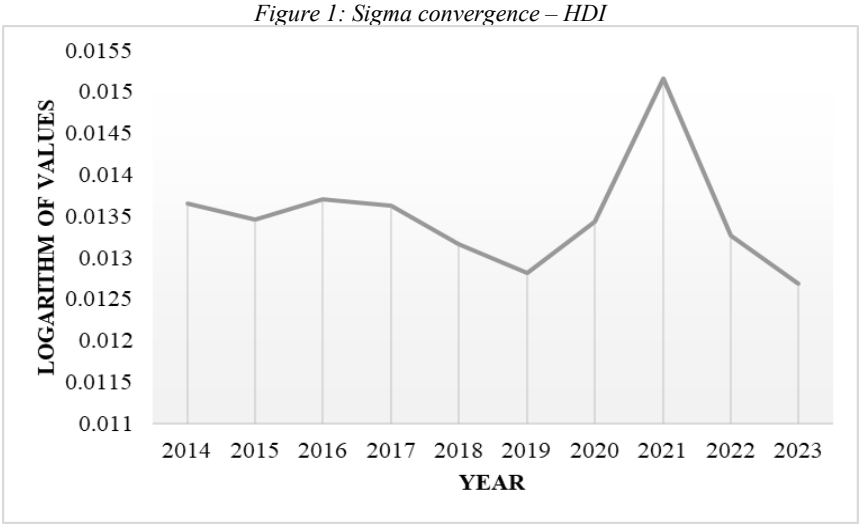
Source: UNDP, own calculations

The average growth rate of the Human Development Index, expressed as a geometric mean for the period 2014 to 2023, demonstrates a slight yet persistent increase in all countries under observation. The growth rate values range between 1.002 and 1.005, indicating that during the period under review, the HDI increased by 0.2% to 0.5%. The largest increase was observed in Croatia, while the smallest was recorded in the Czech Republic and Estonia. Notably, these countries are among the leaders in the Central and Eastern European region.

A comparative analysis of the average growth rate from 2014 to 2023 reveals that the growth dynamics of human capital surpassed those of competitiveness in four of the eleven countries under observation: Bulgaria by 0.1%, Latvia by 1.8%, Poland by 0.6%, and Slovakia by 0.2%. In the remaining seven countries, competitiveness growth exhibited an increase that exceeded human capital growth. The following countries have shown the following percentages: the Czech Republic (3.1%), Estonia (1.7%), Croatia (3.4%), Lithuania (1.3%), Hungary (1.2%), Romania (0.2%), and Slovenia (3.2%).

Subsequent to the evaluation of growth dynamics employing the average growth coefficient, the focus then transitions to the analysis of convergence trends. While the average growth coefficient provides insight into the direction and intensity of growth, σ-convergence offers a more nuanced perspective by incorporating variability between countries. This variability indicates whether countries within a region are converging towards a shared level of the indicators examined or, conversely, whether the observed differences between them are increasing.

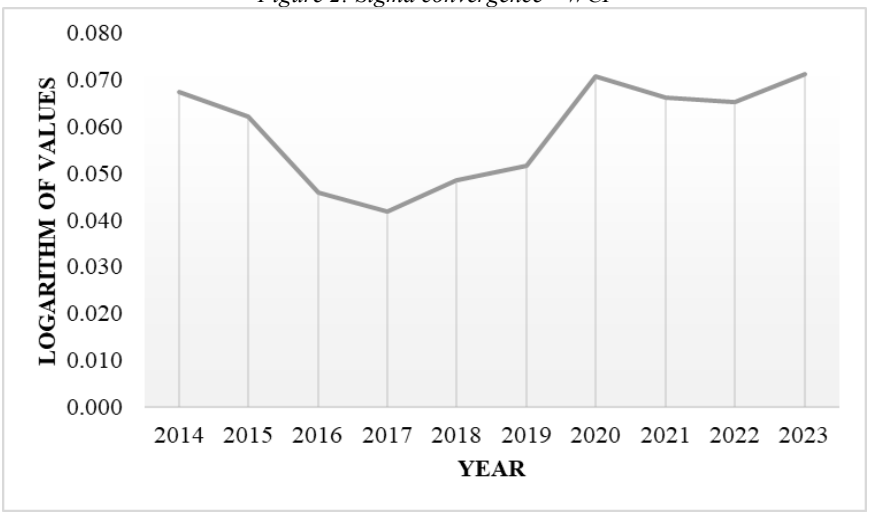
Figure 1: Sigma convergence – HDI



Source: UNDP, own elaboration

The development of the standard deviation of HDI values among Central and Eastern European countries in the period 2014 to 2023 points to a relatively stable level of differences in human capital within the region. During the observed period, the standard deviation values fluctuated within a narrow range from 0.0127 to 0.0152. A decline in standard deviation, indicative of a gradual convergence in HDI, is evident from the inception of the observed period. However, this trend was not sustained. In the 2020-2021 period, there was an increase in the standard deviation. This increase may be related to the impact of the Coronavirus disease 2019 (Covid-19) pandemic on individual countries, particularly in the areas of health and education, which are key components of the Human Development Index (HDI). In the 2022-2023 period, the standard deviation exhibited a decline, suggesting a tendency towards convergence at the conclusion of the period under consideration. These findings in the area of human capital development are thus consistent with previous findings that there are no statistically significant differences in HDI levels between the V4 countries and other countries in the Central and Eastern European region.

Figure 2: Sigma convergence – WCI



Source: IMD, own calculations

The standard deviation values of WCI ranged from 0.042 to 0.071, indicating that there are more significant differences between countries in terms of competitiveness than in terms of human capital. From the inception of the period under review, a slight decline in standard deviation can be observed, as evidenced by the HDI. Subsequently, between 2018 and 2020, there was an increase and subsequent stagnation in the following period. In consideration of the aforementioned developments, it is not feasible to identify a discernible convergence or divergence trend. Consequently, the disparities in competitiveness between nations remained relatively stable during the period under

examination. In this case, the findings are consistent with previous results, which indicate that there are no statistically significant differences in the WCI index between the V4 countries and other Central and Eastern European countries.

In the subsequent section, regression analysis is applied separately for each country to examine the relationship between the level of human capital and the level of competitiveness. Subsequently, the Durbin-Watson test was employed to assess the autocorrelation of the residuals, thereby substantiating the reliability of the estimates of the regression coefficients for each nation.

Table 5: Regression analysis — Bulgaria

Country	β (coefficient HDI)	Intercept	R^2	Adjusted r^2	t-stat β	p-value β	Durbin-Watson
Bulgaria	95.78	–23.46	0.0106	–0.113	0.293	0.777	0.505

Source: UNDP, IMD, own calculations

The application of regression analysis to data concerning Bulgaria indicates that HDI growth exerts a positive effect on WCI, albeit one that is statistically insignificant. This conclusion is supported by a high p-value (0.777). The value of the coefficient of determination, R^2, is 0.011, indicating that HDI accounts for a mere 1% of the variability in competitiveness. The Durbin-Watson test value (0.505) indicates positive autocorrelation of residuals, suggesting that intertemporal dependencies are not captured in the model. Therefore, the results should be interpreted with caution. The findings indicate that human capital growth in Bulgaria does not exert a substantial influence on enhancing competitiveness.

Table 6: Regression analysis – Czech Republic

Country	β (coefficient HDI)	Intercept	R^2	Adjusted r^2	t-stat β	p- value β	Durbin-Watson
Czechia	780.92	-631.5	0.478	0.413	2.706	0.027	1.05

Source: UNDP, IMD, own calculations

The application of regression analysis within the Czech Republic demonstrates that HDI growth exhibits a statistically significant positive impact (β = 780.93) on WCI, a finding that is substantiated by a p-value of 0.027 < 0.05. The coefficient of determination of 0.478 indicates that nearly 48% of the total variability in competitiveness is attributable to changes in human capital. However, given the relatively low value of R^2, it must be acknowledged that, in addition to human capital, other factors not examined in this study must also influence competitiveness in the Czech Republic. The Durbin-Watson test yielded a value of 1.05, indicating a slight positive autocorrelation of residuals. While this value is lower, it does not preclude the interpretation of the results. Consequently, it can be posited that, in contrast to Bulgaria, an increase in HDI directly contributes to the enhancement of competitiveness in the Czech Republic.

Table 7: Regression analysis – Estonia

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Estonia	504.72	-378.15	0.541	0.483	3.07	0.015	1.5

Source: UNDP, IMD, own calculations

The findings of the regression analysis in Estonia demonstrate a positive and significant relationship between the growth of human capital, as measured by HDI, and the development of competitiveness, as expressed by WCI. This indicates that an increase in human capital is associated with an enhancement in competitiveness. The value of the coefficient of determination, $R^2 = 0.541$, indicates that HDI accounts for more than 54% of the total variability, which is higher than in the Czech Republic. The Durbin-Watson test yielded a value of 1.5, indicating a slight positive autocorrelation of residuals. This value does not significantly call into question the validity of the regression analysis.

Table 8: Regression analysis – Croatia

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Croatia	255.1	-171.58	0.284	0.195	1.783	0.112	1.07

Source: UNDP, IMD, own calculations

Regarding Croatia, regression analysis reveals a positive correlation between human capital growth and competitiveness development. This correlation is substantiated by the positive estimate of the regression coefficient, β. However, it cannot be considered statistically significant, as the p-value of 0.112 is greater than $\alpha = 0.05$. The value of the coefficient of determination, $R^2 = 0.284$, indicates that approximately 28% of the variability in WCI is explained by changes in HDI. This finding suggests that the model's explanatory power is limited and indicates the necessity of considering additional factors that influence the development of WCI. The Durbin-Watson test yielded a value of 1.07 in this case, indicating a slight positive autocorrelation of the residuals. Consequently, the results of the regression analysis must be interpreted with a degree of caution. Therefore, although there is a suggestion of a positive relationship between the indicators examined in Croatia, it cannot be regarded as sufficiently robust and consistent.

Table 9: Regression analysis – Latvia

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Latvia	-21.096	83.37	0.002	-0.123	-0.119	0.908	0.99

Source: UNDP, IMD, own calculations

In the case of Latvia, the regression coefficient β, which has a value of 21.10, indicates only a very weak negative relationship between human capital, measured by HDI, and competitiveness development, measured by WCI. This relationship cannot be considered statistically significant based on the p-value of 0.908. The remarkably low value of $R^2 = 0.002$ suggests that changes in HDI account for a mere 0.2% of the variability in WCI, indicating that human capital exerted minimal influence on the shift in Latvia's competitiveness level during the observed period The insignificance of the results was corroborated by the Durbin-Watson test, which yielded a value of 0.99, thereby indicating positive autocorrelation of residuals. This finding suggests that the enhancement of Latvia's competitiveness is likely to be influenced by factors other than the mere increase in human capital.

Table 10: Regression analysis – Lithuania

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Lithuania	197.88	83.37	0.119	0.008	1.038	0.33	1.67

Source: UNDP, IMD, own calculations

In Lithuania, a positive relationship was observed between human capital growth, measured by the HDI, and competitiveness development, expressed by the WCI. However, given that the p-value of 0.33 exceeds the critical value of $\alpha = 0.05$, the result cannot be considered statistically significant. The coefficient of determination indicates that less than 12% of the variability in the WCI is attributable to changes in the HDI, suggesting that the model exhibits a relatively low degree of explanatory power. However, the Durbin-Watson test yielded a value of 1.67, suggesting a slight positive autocorrelation of the residuals. This outcome can be regarded as satisfactory. However, in the case of Lithuania, it can be posited that the growth of human capital is reflected only weakly and inconsistently in an increase in competitiveness. Therefore, other factors not captured in this analysis must have a more significant impact on its formation.

Table 11: Regression analysis – Hungary

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Maďarsko	270.36	-168.8	0.136	0.028	1.123	0.294	1.36

Source: UNDP, IMD, own calculations

The findings of the regression analysis for Hungary indicate a positive relationship between human capital growth and competitiveness development. This is substantiated by the estimated regression coefficient, β, which is positive (270.36). However, the p-value of $0.294 > \alpha = 0.05$ indicates that this relationship is not significant. Therefore, it cannot be concluded that the increase in HDI had a clear impact on the increase in WCI during the period under review. The insignificance of the results is also confirmed by the low coefficient of determination R^2, which shows that the model explains only 13.6% of the total variability. Consequently, factors beyond the level of human capital must exert an impact on the growth of competitiveness in Hungary.

Table 12: Regression analysis – Poland

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Poland	-336.43	363.93	0.198	0.098	-1.406	0.197	0.84

Source: UNDP, IMD, own calculations

In Poland, regression analysis revealed a negative correlation between human capital development and economic competitiveness. This finding defies conventional assumptions regarding the expected positive correlation between these indicators. However, in Poland, an increase in HDI was associated with a decline in WCI during the period under review. However, this relationship did not prove to be statistically significant, as evidenced by the p-value ($0.197 > \alpha = 0.05$). The model's explanatory power was found to be inadequate, as evidenced by the relatively low coefficient of determination ($R^2 = 0.198$). The Durbin–Watson test yielded a value of 0.84, indicating significant positive autocorrelation of residuals. This finding suggests that the reliability of estimates is reduced, likely due to the fact that simple linear regression is incapable of capturing the fluctuating development of the WCI.

Table 13: Regression analysis – Romania

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Romania	-60.3	108.23	0.011	-0.112	-0.301	0.771	0.56

Source: UNDP, IMD, own calculations

The regression analysis results in Romania demonstrated a modest negative correlation between HDI and WCI. However, this correlation did not attain statistical significance, as indicated by a p-value of 0.771, which exceeded the alpha level of 0.05. This finding was corroborated by the coefficient of determination R^2, which indicated that the model accounted for a mere 1.1% of the variability in WCI, suggesting a negligible explanatory capacity. The Durbin–Watson statistic in this case demonstrated a value of 0.56, indicating a robust positive autocorrelation of residuals. This finding indicates that the development of competitiveness in Romania is characterized by a substantial dynamic component that is not fully captured by the model. Consequently, this dynamic component leads to a reduction in the reliability of the estimated parameters.

Table 14: Regression analysis – Slovenia

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p- value β	Durbin-Watson
Slovenia	627.33	-512.25	0.348	0.266	2.066	0.073	0.67

Source: UNDP, IMD, own calculations

A regression analysis of Slovenia indicated a moderately strong positive relationship between the Human Development Index (HDI) and economic competitiveness. Pursuant to the regression coefficient value $\beta = 627.33$, it can be posited that human capital growth in this nation is concomitant with heightened competitiveness. However, the p-value for the regression coefficient 0.073 slightly exceeded the statistical significance level $\alpha = 0.05$. The coefficient of determination $R^2 = 0.348$ indicated that approximately 35% of the variability in WCI can be attributed to changes in HDI, which is a higher value compared to most of the countries examined. However, this does not guarantee that the model possesses sufficient explanatory power. This hypothesis was corroborated by the outcomes of the Durbin–Watson test (0.67), which indicated that the temporal dynamics underlying the development of competitiveness are not fully reflected in the model. Consequently, the interpretation of the results should be conducted with a high degree of caution.

Table 15: Regression analysis – Slovakia

Country	β (coefficient HDI)	Intercept	R^2	Adjusted R^2	t-stat β	p-value β	Durbin-Watson
Slovakia	-88.048	133.12	0.012	-0.112	-0.31	0.764	0.79

Source: UNDP, IMD, own calculations

In the Slovak context, as in the broader international sample, no statistically significant relationship between HDI and WCI was confirmed in the period 2014-2023. This finding is supported by the p-value for the regression coefficient (0.764) exceeding the alpha level of 0.05. The value of the coefficient of determination, $R^2 = 0.012$, indicates that the model accounts for a mere 1.2% of the variability in competitiveness, deeming it to possess negligible informative value. Consequently, human capital does not serve as the primary factor that determines the level of competitiveness in Slovakia. This hypothesis was supported by the Durbin–Watson test value of 0.74, which indicates positive autocorrelation of residuals. That is, the model does not effectively capture the relationship under investigation.

The findings of a simple regression analysis in eleven countries in Central and Eastern Europe predominantly suggest an insignificant impact of human capital on the competitiveness of economies, despite the anticipated contrary outcome. A statistically significant impact of HDI on WCI was recorded in the Czech Republic and Estonia; however, the explanatory power of the models was not particularly high in these countries either. However, the Durbin–Watson test indicated a slight positive autocorrelation of residuals in these countries, which does not preclude the interpretation of the results. These countries thus represent an exception within the region under review, where it has been demonstrated that human capital growth does indeed contribute to

increased competitiveness. The insignificance or ambiguity of the impact of human capital on the level of competitiveness in the remaining nine states can be explained by several factors. Of these, the most salient is the uneven development of the WCI, which exhibits frequent year-on-year fluctuations. A multitude of additional factors that have the capacity to exert a substantial influence on the development of competitiveness are incorporated into the WCI calculation. These factors may not have demonstrated positive development during the period under review. Such factors include, but are not limited to, investment in infrastructure, innovation activities, and structural reforms. In the period under review, developments may have been influenced by external shocks, including the impact of the Coronavirus Disease 2019 (Covid-19) pandemic. The effects of the pandemic were reflected in the sigma convergence achieved.

DISCUSSION

A comparative analysis of Central and Eastern European countries reveals that they exhibit similar levels of competitiveness to those observed in the most developed EU countries. This finding aligns with the conclusions of Tijanic and Obadic (2015), who reported that the majority of new EU member states demonstrate lower levels of competitiveness in comparison to their predecessors. This phenomenon can be attributed to the observation that countries that acceded to the EU later allocate a greater proportion of their investment budgets to infrastructure and environmental initiatives as opposed to human capital development. Miron et al. (2022) emphasize the role of human capital as a strategic element of competitiveness in strengthening the process by which lagging countries catch up with advanced countries. However, a comparative analysis of the average growth rate of human capital and competitiveness in the countries under scrutiny revealed that in seven of the eleven countries (the Czech Republic, Estonia, Croatia, Lithuania, Hungary, Romania, and Slovenia), the increase in competitiveness exhibited greater dynamism than the increase in human capital. However, Sener & Delican (2019) have indicated that the promotion of competitiveness in less developed countries is more challenging than in the most developed countries and requires different mechanisms, which may be the reason for this situation. The convergence method did not reveal any clear convergence or divergence trends between countries. However, a tendency towards divergence was observed during the pandemic, which may reflect the sensitivity of HDI and WCI developments to external shocks, as well as the different approaches taken by countries to managing the impact of the pandemic. Preliminary regression analysis indicated that, across nine of the eleven Central and Eastern European countries examined, human capital exhibited no substantial influence on competitiveness. This finding contradicts Onyusheva's (2017) observation that factors influencing human capital are correlated with the level of economic competitiveness in the Republic of Kazakhstan. In the region under examination, a statistically significant impact of human capital on competitiveness was confirmed only in the Czech Republic and Estonia. However, given the relatively lower values of the coefficient of determination, it can be concluded that other factors must also have a major impact on competitiveness in these two countries. For instance, Ábel et al. (2025) underscore the significance of innovation and technological advancement in this context. The findings of the Durbin-Watson test indicated that simple linear models may not adequately capture the development of competitiveness. This is because competitiveness is typically attributed to the combined influence of multiple factors rather than to the effect of a single factor alone (Schwab and WEF, 2015). Furthermore, Hanushek & Woessmann (2012) emphasize that the impact of human capital may not be direct, but rather indirect, manifesting through innovation or productivity.

While we have succeeded in highlighting certain salient facts, it is imperative to acknowledge the limitations inherent in the examination of the relationship between human development and the competitiveness of nations. Firstly, it is imperative to acknowledge that competitiveness is a multidimensional concept, which precludes its full capture by a single indicator. The World Competitiveness Index (WCI) is a comprehensive metric of economic

performance and institutional environment, though it is subject to certain limitations. The index is based on a combination of hard statistical data and questionnaire survey results, which may affect its objectivity and international comparability to some extent. As Olczyk (2016) observes, the selection of variables, the weighting of components, and the integration of hard and subjective data can result in methodological ambiguity and challenges regarding the objectivity of the resulting competitiveness rankings. Secondly, the Human Development Index (HDI) is also an aggregate indicator that captures the fundamental dimensions of human development. However, it does not fully reflect the quality of education, the structure of the workforce's skills, or the specific competencies relevant to the digital and knowledge economy. Consequently, the HDI may underestimate certain aspects of human capital that are critical to competitiveness. Therefore, Herre & Arriagada (2023) recommend considering the use of other indices, such as the Inequality-Adjusted Human Development Index (IHDI), the Gender Development Index (GDI), or the Augmented Human Development Index (AHDI). Thirdly, a temporal discrepancy exists between alterations in human development and their subsequent impact on competitiveness. Consequently, short-term fluctuations in the HDI value may not directly correspond to changes in the WCI level, thereby complicating the interpretation of the results. It is important to note that the results may be influenced by factors not directly included in the model. These factors may include institutional quality, economic policy, economic structure, or external shocks (e.g., financial crises, pandemics, or geopolitical events). Therefore, it is imperative that the findings be interpreted with appropriate caution.

CONCLUSION

The objective of the present study was to examine the relationship between human capital and the competitiveness of economies in Central and Eastern European countries. To this end, a comparative analysis was conducted among the V4 countries and other countries in the region. The study further involved an analysis of the growth dynamics of selected indicators, an examination of convergence trends, and a regression analysis of the relationship between these indicators in individual countries. This objective was successfully achieved. The results of the Mann–Whitney U test demonstrated that there were no statistically significant differences in the level of human capital or competitiveness between the V4 countries and the other countries in the Central and Eastern European region. This finding suggests that all countries exhibit analogous indicator values. This phenomenon may be attributed to the historical developments that characterized the second half of the 20th century, during which all countries operated within centrally planned, socialist-oriented economies. An analysis of the dynamics of human capital and competitiveness development demonstrated that the HDI exhibited positive growth in all the countries examined; however, the increases between 2014 and 2023 were negligible. The development of the WCI exhibited less stability, with regular fluctuations occurring within individual years. In the case of Latvia and Poland, a decline was observed during the period under review. The σ-convergence results complemented the previous analysis by offering a perspective on the development of differences between countries. However, in neither scenario can a stable convergence or divergence trend be identified. The standard deviation for both the HDI and the WCI exhibited an alternating pattern between decline and increase. For instance, an inclination toward divergence was noted during the CoV-19 pandemic, a phenomenon that may be indicative of the sensitivity of these indicators to external shocks. The application of regression analysis revealed that, in nine out of 11 countries, human capital exhibited no significant impact on competitiveness. The correlation observed in these nations was either negligible or non-existent, particularly in the case of Poland, indicating that competitiveness might be contingent on disparate factors. The statistical significance of human capital on competitiveness was confirmed in the Czech Republic and Estonia. However, even within these countries, the model explained only about 50% of the total variability. Furthermore, the outcomes of the Durbin–Watson test indicated the presence of relatively significant autocorrelation of residuals in several instances, suggesting the dynamic nature of competitiveness development, which simple linear models are incapable of fully capturing.

Considering the findings, it can be posited that human capital, while widely regarded as a pivotal catalyst for sustained economic growth and an instrumental factor in enhancing competitiveness, does not invariably translate into tangible gains in competitiveness within the context of Central and Eastern European countries. The analysis indicates that, in the absence of other concomitant factors, the mere augmentation of human capital is insufficient to trigger a substantial escalation in competitiveness. These findings underscore the necessity for a more comprehensive approach to enhancing the competitiveness of economies in the region of Central and Eastern Europe.

The social contribution of this study lies primarily in public policy-making aimed at supporting competitiveness and long-term development in Central and Eastern European countries. The finding that the growth of human capital in the region alone is not sufficient to significantly increase competitiveness indicates the necessity for a more comprehensive and integrated approach to economic policy that extends beyond traditional investments in education and health. The social contribution of the work is twofold. Firstly, it provides empirical evidence that can be used by national and regional development strategy makers. This evidence can be used to allocate public resources in a more targeted manner and focus on areas with the highest multiplier effect. Consequently, the research endeavors can contribute to the reduction of regional inequalities, the promotion of social inclusion, and the enhancement of the quality of life of the population in the Central and Eastern European region. From a methodological perspective, the study underscores the efficacy of integrating non-parametric tests, growth dynamics analysis, convergence methods, and regression analysis in the examination of intricate macroeconomic relationships. This approach can function as a foundational starting point for subsequent research endeavors focused on other regions or for extending the model with additional variables. In sum, the work contributes to a more profound comprehension of the conditions under which human capital can support competitiveness. Furthermore, it establishes a foundation for future research aimed at identifying the factors that strengthen or weaken this relationship.

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