

An empirical analysis of the link between labour productivity and salary in EU-CEE countries

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Abstract

This paper investigates the relationship between labour productivity and average wages per employee in 10 Central and Eastern European (CEE) European Union member states over the period 2009–2023. Using panel data from Eurostat and a log–log econometric specification, the study estimates the elasticity of wages with respect to labour productivity to assess whether wage dynamics align with productivity growth. The empirical results indicate a strong and statistically significant relationship between labour productivity and wages in all analysed countries. However, in seven out of ten economies, wage growth exceeds productivity growth, suggesting a persistent decoupling that may undermine macroeconomic competitiveness and long-term sustainability. Only Hungary, Poland, and Slovenia display a more balanced wage–productivity relationship during the analysed period. The findings highlight structural vulnerabilities specific to post-transition economies and emphasize the importance of productivity-enhancing investments, technological upgrading, and human capital development. The study contributes to the literature on competitiveness in CEE countries by providing empirical evidence on the risks associated with prolonged wage–productivity misalignment and its implications for economic growth and economic policy design.

Keywords: competitiveness, employee, transition, economic growth

1. Introduction

Over the past three decades, Central and Eastern European (CEE) countries have faced significant socio-economic challenges associated with the transition from centrally planned economies to democratic societies and market-based economic systems (Brada, 1993; Kuzio, 2001; Kolodko, 2020; Winiecki, 2008). Although CEE countries differ in their social, economic, and political contexts (Watson, 2000; Warson, 2013; Müller, 2020), they share a common feature, namely the transition towards a new model of economic growth (Fuchs-Schündeln and Schündeln, 2020; Borychowski et al., 2020; Orłowski, 2019).

The transition process varied considerably across countries in terms of duration and growth performance, reflecting differences in macroeconomic structures and institutional frameworks within the region (Arčabić, 2016; Wallace and Latcheva, 2006). Following the collapse of communism, CEE countries were supported in their transition to market economies by major international financial institutions, particularly the International Monetary Fund (IMF) and the World Bank (WB). The reform packages promoted by these institutions emphasized fiscal adjustment, privatization of state-owned enterprises, trade and price liberalization, improved public expenditure management, protection of private property rights, and the expansion of economic freedom (Lütz and Kranke, 2014; Reinsberg et al., 2021; Chmielewska and Sławiński, 2021; Eisemon, 2014; Andrieş et al., 2020).

A key element of the restructuring process was the privatization of non-competitive state-owned enterprises, which aimed to reallocate resources toward more productive investment opportunities with higher economic multiplier effects, thereby enhancing productivity at the macroeconomic level (Radić et al., 2021; Mickiewicz, 2009). After nearly five decades of centrally planned economic systems, the primary objective of CEE countries was to narrow the gap in economic growth and development relative to Western European economies (Petrariu et al., 2013; Radicic, 2023). However, persistent risks, structural imbalances, and socio-economic vulnerabilities resulted in uneven and relatively slow recovery trajectories (Hölscher et al., 2011). During the transition period, average growth rates in CEE countries remained below those observed in other emerging market economies (Staehr, 2018).

In contrast, over the past fifteen years—often referred to as the post-transition period—CEE economies have recorded average growth rates exceeding those of emerging economies, with particularly strong performance observed in the Baltic states: Estonia, Latvia, and Lithuania (Ocolişasu et al., 2022; Štreimikienė and Kačerauskas, 2020). Through market liberalization and EU accession, these countries not only pursued economic performance objectives but also benefited from favorable global economic conditions conducive to sustainable growth (Blavasciunaite et al., 2020; Alexiou et al., 2020; Uzelac et al., 2020).

Policymakers increasingly recognized that sustained productivity growth—driven by investment with multiplier effects and innovation across economic sectors—was essential for long-term development. Achieving this objective requires the development of a robust private sector supported by a healthy business environment (Rashed and Shah, 2021), the modernization of market-regulating institutions (Nureev et al., 2020), the strengthening of the rule of law (Scheppele et al., 2020), and the elimination of inefficient regulations that hinder market functioning.

Labour productivity, therefore, represents a central pillar of economic growth and stability, with policy efforts increasingly focused on technological advancement, innovation, and human capital development (Trenovski et al., 2023). The competitiveness of a national economy directly influences living standards and overall prosperity; however, in contemporary economic conditions, competitiveness must also be sustainable, meaning that present needs are met without compromising future development (Steger and Bleischwitz, 2017). When a country experiences sustained economic growth, firms operate in a healthy business environment, real wage dynamics are aligned with labour productivity developments, and new jobs can be created. Together, these factors enhance economic competitiveness (Rusu and Roman, 2018).

2. Theoretical background

When analyzed theoretically, the concept of competitiveness often involves economists examining the relationship between the average growth of labour productivity and the average growth of wages. In the economic context of recent decades, dominated by economic crises and imbalances generated by both endogenous and exogenous factors, this phenomenon is attributed to overwhelming importance in the analysis of external balance.

Competitiveness is an extremely important indicator at both macroeconomic and microeconomic levels. Analyzed from this perspective (productivity-wage growth), competitiveness primarily arises at the microeconomic level, generating effects at the aggregate level (Ailenei and Mosora, 2011; Falciola et al, 2020).

At the microeconomic level, the production function represents the functional relationship between its outcomes (output) and the volume of resources utilized (input). An important indicator of the production function is marginal productivity, which represents the tendency of production variation with respect to factor variation. Specifically, for a production function of the form: $Q=Q(K,L)$ we have: $\eta_K=\frac{\partial Q}{\partial K}$, referred to as the marginal productivity of capital, and $\eta_L=\frac{\partial Q}{\partial L}$, referred to as the marginal productivity of labour.

In economic literature over the past few decades, the link between wages and labour productivity has been attributed an extremely important role regarding the growth and economic competitiveness of an economy, with the objective of building an equitable and sustainable society where the fruits of progress are shared by all its members (Van Biesebroeck, 2014).

Policymakers and economists consider that this correlation between wage gains and productivity, when not respected, can generate significant inflationary pressures on the economy (Mahlberg et al., 2013).

Other economists argue that wages are not a causal factor in determining inflation; wage increases are not predictors of inflation through the cost channel (Mehra, 1991).

Recent research on this subject has shown that in some countries wage dynamics are significantly below labour productivity dynamics, leading to a decrease in national income (Hurst and Kahn, 2023; Kaas and Kircher, 2015; Donovan et al., 2023). At the household level, the effects also reduce available personal income, thereby impacting aggregate demand.

Moreover, there are countries where wage dynamics surpass labour productivity dynamics (Slaveski, and Kozheski, 2024), a situation that can affect external competitiveness and significantly diminish the volume of investment. Therefore, this wage-productivity link holds a central place in theoretical economic research, but especially in applied research, as policymakers strive to find optimal solutions favorable to inclusion and the labour market.

At the macroeconomic level, we analyze the connection between wage dynamics and productivity dynamics, with the ultimate goal being long-term sustainable economic growth. Wages represent the main source of available personal income, directly influencing the standard of living and quality of life (Roberto and Pedro, 2007).

Fluctuations in wage earnings directly influence the level of employment in a national (or sectorial) economy. If there are no economically just correlations between these two variables (with labour productivity being the dependent variable), it may indicate the

existence of imbalances in the real economy, reflected either in genuine inflationary or deflationary pressures, or in a distorted wage price affecting labour supply and demand (Kumar et al. 2012).

At the microeconomic level, the relationship between marginal productivity, workforce dynamics, and wage earnings is crucial, analyzed within the framework of marginal value theory and production theory. The aforementioned connection is the basic rule on which wage setting relies, meaning that the dynamics of the minimum wage should be lower than those of labour productivity (Valentina, 2006). From a decision-making perspective, it is believed that such a situation can lead to long-term production growth and an optimal level of employment (Meager and Speckesser, 2011). Additionally, countries affected by recession, with sustained economic growth and, consequently, higher labour productivity growth than wage growth, have managed to absorb negative shocks much more effectively (Morikawa, 2023).

Labour productivity is one of the most important pillars underlying long-term economic growth and a significant indicator of competitiveness. An increase in labour productivity leads to an optimal level of employment in the sector only if aggregate demand is adequate (Van Biesebroeck, 2014).

The relationship between labour productivity and economic growth varies significantly and is not constant over time. Some research suggests weak or even nonexistent relationships between labour productivity and economic growth during an economic crisis. However, empirical evidence supports the idea that an increase in labour productivity during a crisis is a key driver of economic recovery following macroeconomic imbalances (Auzina-Emsina, 2014).

The existence of wage differentials in relation to productivity is explained in neoclassical economic theory. In a perfectly competitive market, factors of production (labour and capital) involved in the production process are rewarded according to their productivity. An important role in determining profits and wages is attributed to the marginal productivity of capital and labour (Romer, 1990).

The relationship between marginal productivity and the number of employees can be illustrated by a function of marginal productivity relative to the units of labour factor utilized. Initially, an increase in the number of employees could lead to a significant increase in marginal productivity. This is because new employees bring additional skills and competencies and can contribute to production growth significantly (Awaysheh et al., 2023).

However, as the number of employees increases, the positive effect of adding each employee may gradually diminish. This phenomenon is known as the law of diminishing marginal returns.

Thus, at some point, marginal productivity may begin to decline, meaning that adding another employee may result in a smaller or insignificant increase in production. This can be caused by either the inadequacy of the capital factor of production, inefficient coordination among employees, or a decrease in the quality of the labour factor.

Wage developments are an important factor influencing domestic purchasing power and quality of life, but they also implicitly influence economic growth (Kosanović et al., 2017; Stander et al., 2019).

Additionally, marginal productivity and the number of employees can be influenced by several factors, such as employee qualifications, available technology, education levels,

and effective human resource management. These factors can affect how marginal productivity changes with fluctuations in the labour factor structure (Chahrour et al., 2023).

The presence of the labour factor in the production function has both a quantitative and qualitative dimension. Labour productivity is reflected not only by the absolute number of labour units but also by their quality and education (Machin and Reenen, 1998, Hanushek et al., 2017).

Another indirect factor influencing labour productivity is education, an important characteristic underlying labour differentiation. Therefore, in recent decades, this endogenous factor has been of special interest to specialists and decision-makers (Jin et al., 2019).

Although the transition process has been uneven, observers believe that most Central and Eastern European Countries (CEECs) have managed over the past 25 years to close the economic gap with developed EU countries in terms of income levels. This has been driven by increases in foreign investment and labour productivity (Becker et al., 2018).

In recent years, CEE countries have become increasingly visible in international markets, especially in Europe (Bierut et al., 2017).

This trend has been driven by the expansion of multinational companies' activities in Central and Eastern European countries, where they have been attracted by relatively low labour costs and easy access to European markets (Blăjuț, 2015; Radlo and Sass, 2012; Schuh, 2012). As a result, most Central and Eastern European countries have become increasingly integrated into global trade. Consequently, over the past 25 years, the share of these countries' exports in total world exports has doubled (Bierut et al., 2017).

3. The model and data

In this scientific approach, we will analyse the competitiveness of the countries in the CEE region, focusing on the dependency between nominal labour productivity and average salary. The countries included in this scientific study are the EU member states located in the CEE region, namely: Bulgaria, Czechia, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia. The variables used are average labour productivity and average full-time adjusted per employee. In this regard, we have a dataset spanning from 2009 to 2023. For model accuracy and comparability, the data were collected from EUROSTAT.

In the econometric model below, average full time adjusted salary per employee variable is an endogenous variable depending on nominal labour productivity – the exogenous variable.

In the following, we will look for an econometric model of the form:

$$\text{Sal} = c \cdot \text{Lab_prod}^{a1} + u \quad (1)$$

where we note:

Average full-time adjusted salary per employee – Sal

Nominal Labour productivity – Lab_prod

c, a1 – constants from the regression equation

u – the error term.

The essential advantage of a power-type econometric model is that, under the conditions of an almost constant elasticity, it allows its determination. Thus, for the proposed

model, the elasticity is: $\varepsilon = \frac{\frac{\partial Sal}{\partial Lab_prod}}{\frac{Sal}{Lab_prod}} = \frac{c \cdot a1 \cdot Lab_prod^{a1-1}}{\frac{c \cdot Lab_prod^{a1}}{Lab_prod}} = a1$. This means that with a 1%

change in Nominal Labour productivity, the Average full time adjusted salary per employee will increase with a1%.

To obtain a linear regression, we logarithmize the relationship, obtaining:

$$\ln(Sal) = \ln(c) + a1 \cdot \ln(Lab_prod) + u, \text{ where } u \text{ is the new error term.}$$

After finishing the calculations, to recover the regression equation we will replace c with e^{Constant} (where "Constant" comes from the regression analysis).

Considering the Taylor series expansion of a function $f:(a,b) \rightarrow \mathbf{R}$, indefinitely differentiable with bounded derivatives around a point x_0 :

$$f(x) = f(x_0) + \frac{f'(x_0)}{1!}(x - x_0) + \dots + \frac{f^{(n)}(x_0)}{n!}(x - x_0)^n + \frac{f^{(n+1)}(\xi)}{(n+1)!}(x - x_0)^{n+1} \quad (2)$$

$\forall x \in (a,b), \xi \in (x_0, x)$ (or (x, x_0)) we obtain that the variation of the function by neglecting the terms from the second derivative onwards is:

$$\Delta f \approx f'(x_0) \Delta x \quad (3)$$

For the function: $Sal = f(Lab_prod) = c \cdot Lab_prod^{a1}$ we have that: $\Delta Sal \approx c \cdot a1 \cdot Lab_prod_0^{a1-1} \Delta Lab_prod$ where Lab_prod_0 is the initial value of Nominal Labour productivity.

4. Analysis of the relationship between nominal labour productivity and average full-time adjusted salary per employee

After a long period of a planned economy, the countries of Central and Eastern Europe entered another stage of development based on free-market principles. While the transition process was difficult and challenging (for some of them, it still is), in the early 2000s, these countries began to experience significant structural reforms and important economic recoveries.

Within EU member countries, differences in salaries are a major source of inequality. Salary disparities also exist within the CEEC, even when adjusted for purchasing power parity (Michael, 1996).

Some countries in Central and Eastern Europe have attracted a large volume of foreign investment to stimulate production and exports in the industrial sector and have adopted a situation of social welfare and increased government involvement to enforce industrial policy. Slovenia has successfully adopted an economic mix between competitive industries and non-corporatist social inclusion (Bohle and Greskovits, 2019).

By analyzing the panel data, we attempt to capture a more comprehensive picture regarding competitiveness, in the sense that low wages are based on low labour productivity rates and vice versa. Labour productivity also depends on many factors, including worker skills, entrepreneurial and managerial efficiency, the level of technology and innovation in the economy (Drahokoupil and Piasna, 2018).

From another perspective, income inequality beyond the optimal level will lead to low wages for low-skilled workers, a situation that can weaken the social bond between employees and employers (Misztal, 2020). All the former communist countries in the analysis have a long individual experience with different aspects of the transition process so

far and each of them offers different perspectives with implications not only at the macroeconomic level but also at the regional level (Becker, Torbjörn, et al., 2018).

Table no.1

Full descriptive statistics for Bulgaria, Czech Republic, Estonia, Latvia and Lithuania

Variable/Country	Bulgaria	Czech Republic	Estonia	Latvia	Lithuania
Constant					
Coefficient	-3.947	-3.195	-2.530	-3.577	-7.163
Std. Error	0.584	0.347	0.577	0.825	1.499
T-Test	-6.759	-9.207	-4.385	-4.336	-4.779
P-Value	31·10 ⁻⁶	17·10 ⁻⁷	11·10 ⁻⁴	12·10 ⁻⁴	57·10 ⁻⁵
Lower Bound	-5.761	-4.273	-4.322	-6.139	-11.819
Upper Bound	-2.133	-2.117	-0.738	-1.015	-2.507
ln(Lab_prod)					
Coefficient	1.334	1.217	1.158	1.269	1.611
Std. Error	0.061	0.033	0.055	0.081	0.146
T-Test	21.869	36.879	21.055	15.667	11.034
P-Value	20·10 ⁻¹¹	0	31·10 ⁻¹¹	72·10 ⁻¹⁰	27·10 ⁻⁸
Lower Bound	1.145	1.115	0.987	1.017	1.158
Upper Bound	1.523	1.319	1.329	1.521	2.064
R	0.989	0.996	0.988	0.979	0.958
R Square	0.977	0.992	0.976	0.958	0.917
Adjusted R Square	0.975	0.991	0.974	0.954	0.909
F-statistics	474.172	1345.870	438.701	248.060	121.831
Probability (F-stat)	0.345	0.589	0.435	0.414	0.301
Durbin-Watson Stat	1.206	1.686	0.839	0.728	0.786

Table no.2

Full descriptive statistics for Hungary, Poland, Romania, Slovenia and Slovakia

Variable/Country	Hungary	Poland	Romania	Slovenia	Slovakia
Constant					
Coefficient	-1.190	-1.441	-4.176	-1.388	-5.778
Std. Error	0.761	0.490	0.753	0.837	1.034
T-Test	-1.564	-2.941	-5.546	-1.658	-5.588
P-Value	15·10 ⁻²	15·10 ⁻³	17·10 ⁻⁵	13·10 ⁻²	16·10 ⁻⁵
Lower Bound	-2.368	-2.795	-6.515	-2.758	-8.989
Upper Bound	-0.012	-0.087	-1.837	-0.018	-2.567

	ln(Lab_prod)				
Coefficient	1.024	1.057	1.334	1.076	1.455
Std. Error	0.075	0.048	0.076	0.079	0.099
T-Test	13.653	22.021	17.553	13.620	14.697
P-Value	31·10 ⁻⁹	84·10 ⁻¹¹	22·10 ⁻¹⁰	31·10 ⁻⁹	14·10 ⁻⁹
Lower Bound	0.908	0.924	1.098	0.947	1.148
Upper Bound	1.140	1.190	1.570	1.205	1.762
R	0.972	0.990	0.983	0.972	0.976
R Square	0.945	0.980	0.965	0.944	0.952
Adjusted R Square	0.940	0.978	0.962	0.939	0.948
F-statistics	188.726	486.696	306.606	187.076	216.781
Probability (F-stat)	0.742	0.668	0.306	0.745	0.646
Durbin-Watson Stat	0.904	1.551	0.874	0.819	0.804

Figures 1–10 illustrate the evolution of nominal labour productivity and the average full-time adjusted salary per employee in the analysed CEE countries over the period 2009 - 2023. The results indicate a positive and stable relationship between the two variables across all economies. However, in the majority of countries, wage dynamics outpace labour productivity growth, suggesting the presence of structural imbalances with potential implications for economic competitiveness. Only Hungary, Poland, and Slovenia exhibit a relatively more balanced wage–productivity relationship throughout the analysed period.

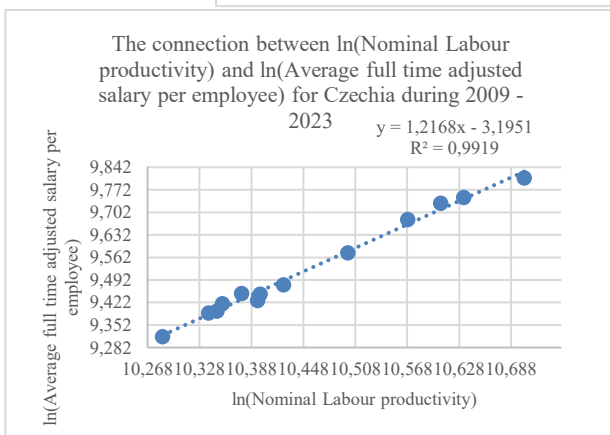
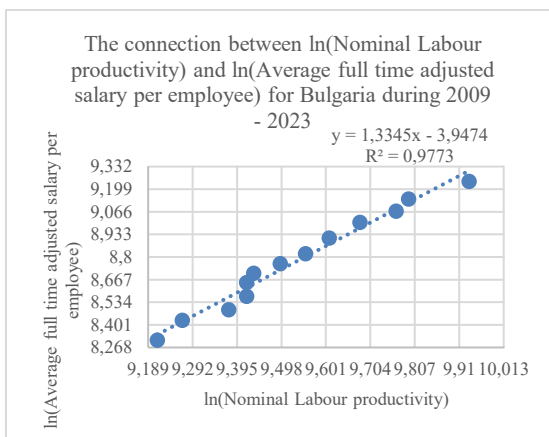


Figure 1

Figure 2

Data source: Eurostat, own calculations

Data source: Eurostat, own calculations

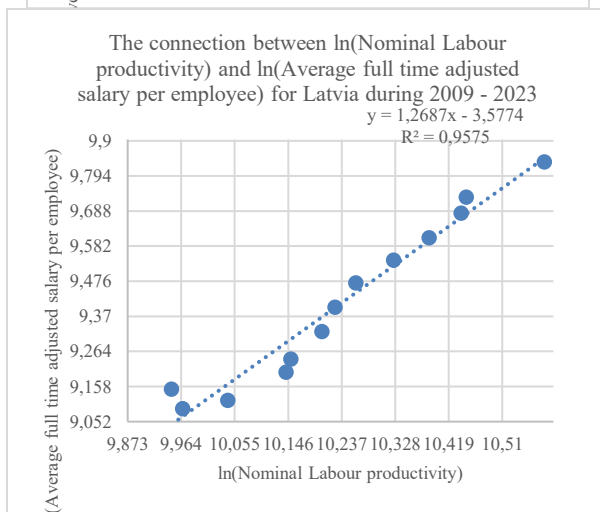
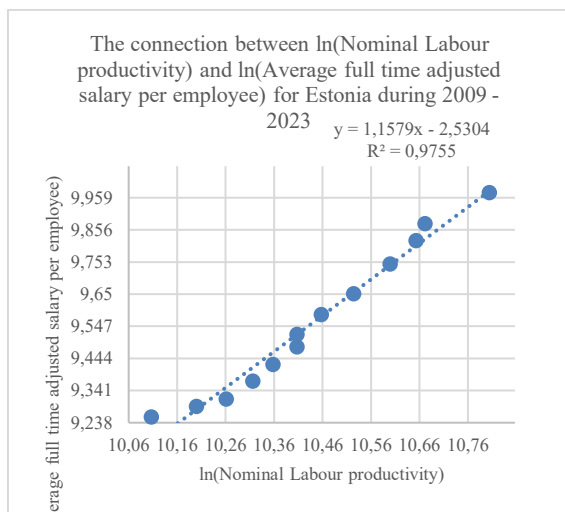


Figure 3

Figure 4

Data source: Eurostat, own calculations

Data source: Eurostat, own calculations

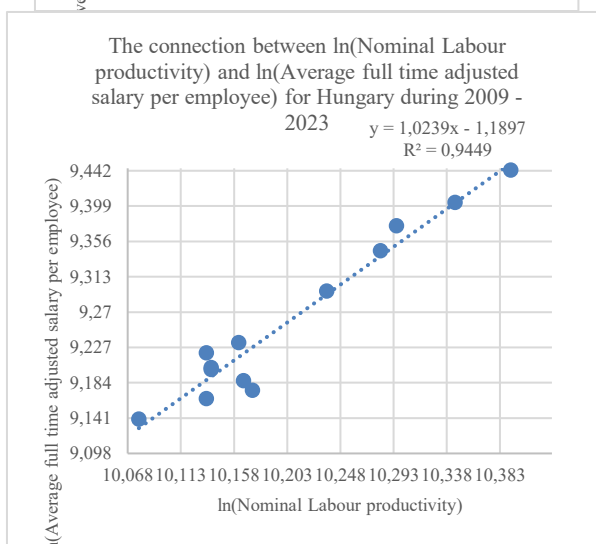
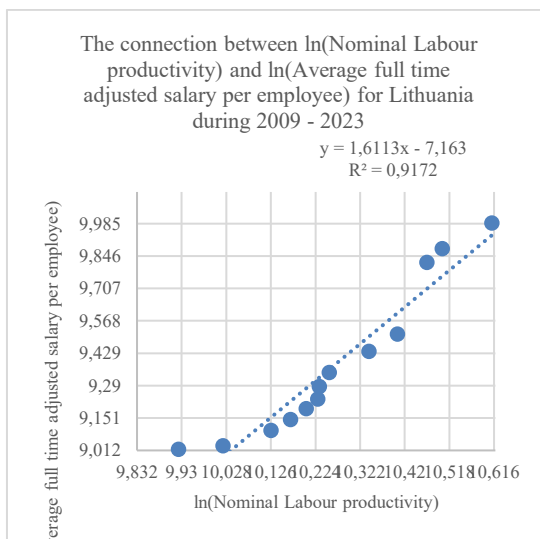


Figure 5

Figure 6

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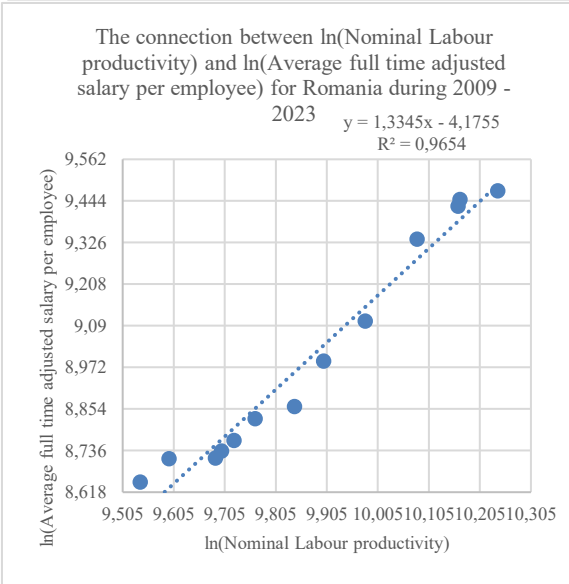
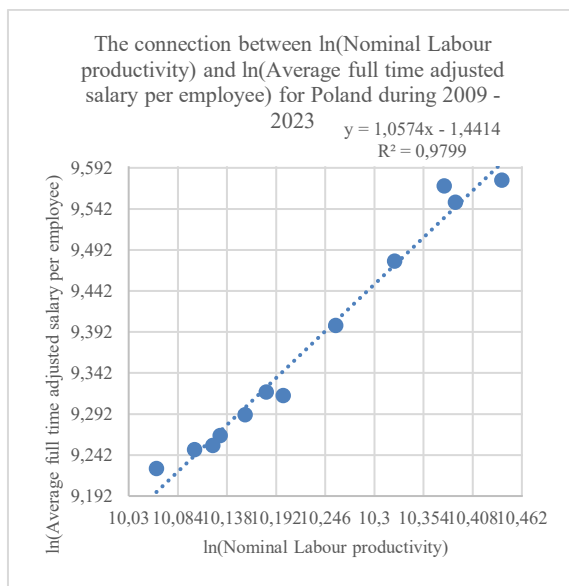


Figure 7

Figure 8

Data source: Eurostat, own calculations

Data source: Eurostat, own calculations

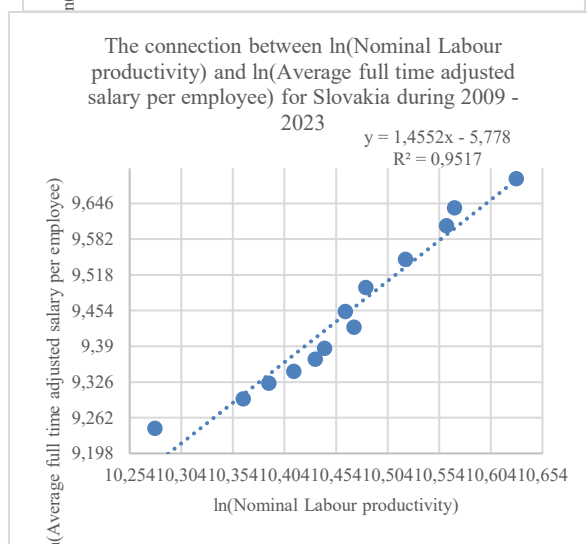
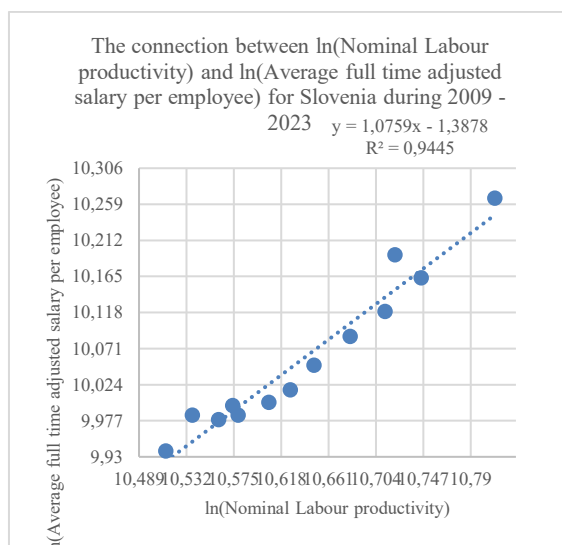


Figure 9

Figure 10

Data source: Eurostat, own calculations

Data source: Eurostat, own calculations

5. Discussions and conclusions

In the present scientific paper, we adopted a comprehensive approach to the relationship between labour productivity per employee and average adjusted salary per employee, aiming to highlight characteristic elements specific to post-communist countries that are now EU members.

The relationship between wages and productivity, more precisely, the relationship between wage dynamics and productivity dynamics, has become of particular economic relevance, especially in recent years, given the macroeconomic imbalances both at the regional and national levels.

Although the relationship between these two variables is complex and multifactorial, labour productivity is the most important explanatory factor for wage growth. All research

in the field highlights the importance of labour productivity in the evolution and justification of wages.

The validity of macroeconomic estimates of the link between wage dynamics and productivity is supported by econometric analyses and empirical evidence. In the other seven countries included in the analysis, the rate of wage growth exceeds that of labour productivity, with the exception of three countries (Hungary, Poland, and Slovenia). If this situation persists for a long period, it can erode competitiveness both at the macroeconomic and microeconomic levels.

As stated in the analysis, all ten countries under review share the common factor of transitioning to a market economy, which, for some of the analysed countries, is either incomplete or still ongoing.

One thing is certain: following integration into the European Union, all countries were required to adopt pre- and post-accession structural reforms, which visibly improved the macroeconomic climate. However, most countries (Czechia, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia, and Slovakia) have managed to narrow the competitiveness gap with developed countries, while Romania and Bulgaria have not been able to make much progress in closing the development gap through the reforms implemented.

Another common observation resulting from the analysis is that wages, during the analyzed period, are growing faster than labour productivity. We can assert that this is specific to these countries due to their similar economic structure, adopted economic models, and, of course, the challenges they still face.

While the study focuses on the complex relations between labour productivity and wage growth, several limitations constrain its comprehensive understanding. Firstly, the analysis presents the relationship between these variables, neglecting the nuanced influence of additional factors that may confound their association, such as technological advancements, socioeconomic disparities, and institutional frameworks. Secondly, the reliance on macroeconomic estimations and empirical data, while valuable, introduces potential methodological limitations, including data quality issues, model specification biases, and assumptions inherent to econometric analyses. These limitations underscore the need for future research to adopt a more holistic approach, accounting for a broader array of variables and encompassing a more diverse range of countries to offer a comprehensive understanding of the complex relationship between labour productivity and wage growth.

On the road to a market economy, these economies excessively stimulated consumption, and a large part of it was based on imports, domestic productive capacities being insufficient. Now, after 35 years of transition to a market economy, economic decision-makers need to focus on stimulating productivity, investing in modern technologies, qualifying and appropriately specializing human capital. Additionally, population ageing, insufficiently skilled labour, and migration are issues that need to be addressed to de-tension the labour market and increase labour productivity.

The existence of a persistent gap between wage dynamics and productivity not only threatens macroeconomic competitiveness but also affects the transmission mechanism of monetary policy in the real economy, as it can generate inflationary pressures through the cost channel.

From a policy perspective, the results suggest that wage-setting mechanisms in most CEE countries have become increasingly disconnected from productivity developments. While higher wages have supported domestic demand and social convergence, persistent wage growth exceeding productivity may erode cost competitiveness in the medium and

long run. Policymakers should therefore prioritize productivity-enhancing measures, such as investment in technological upgrading, innovation, and human capital formation, rather than relying predominantly on wage-led growth strategies.

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