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SUSTAINABILITY TRADE-OFFS UNDER ECONOMIC GROWTH IN THE LOGISTICS SECTOR: EVIDENCE FROM SELECTED CEECS

Anna MISZTAL[1*], Burcu ZENGIN[2]

[1] Faculty of Economics and Sociology, University of Lodz, Poland; anna.misztal@uni.lodz.pl, ORCID: 0000-0002-7455-5290
[2] Business, Ankara Haci Bayram Veli University, Emniyet Mahallesi, Muammer Bostancı Cad. No:4,06500 Beşevler, Ankara, Turkey; burcu.zengin@hbv.edu.tr, ORCID: 0000-0001-5275-6748
* Correspondence author

Purpose: This paper examines the relationship between economic growth and the sustainability of the logistics sector in selected Central and Eastern European countries. It investigates whether this relationship is non-linear, varies across countries, and depends on inflationary and labour-market conditions.
Design/methodology/approach: Using annual panel data for 2008-2024 from Eurostat Structural Business Statistics for Poland, Czechia, Slovakia, Hungary, and Romania. The study is based on a composite sustainability index covering economic, social, and environmental dimensions. The fixed model includes a quadratic form of GDP, interactions between countries and GDP, and interactions between GDP, HICP and unemployment. The robust standard errors method is used.
Findings: GDP is positively associated with logistics-sector sustainability, while the trade balance is negatively related. The GDP-sustainability link is non-linear, with diminishing marginal effects. The strength of the relationship varies across countries, with the most significant impact in Slovakia. No systematic moderating role of inflation or unemployment is found.
Research limitations/implications: The analysis is based on aggregated sector-level indicators and a composite index; therefore, firm-level mechanisms cannot be inferred from these data. Future research might incorporate micro-level data, institutional drivers, and dynamic modelling.
Practical implications: Sustainable policies in the logistics sector should not necessarily be supported by growth factors and should include specific support for low-emission technologies, which may vary from country to industry.
Social implications: The results indicate that economic growth alone is not a guarantee of development that is both socially and environmentally balanced, thus supporting the need to enforce measures to boost green investments and labour standards to enhance environmental quality and labour stability, respectively.
Originality/value: The paper offers sector-level evidence on growth-sustainability trade-offs in CEEC logistics using a composite sustainability index, with tests for non-linearity and cross-country heterogeneity, in a single fixed-effects approach.
Keywords: sustainable development; logistics sector; economic growth.
Category of the paper: Research paper.

1. Introduction

One of the main challenges for the logistics sector in Eastern European countries is achieving the Sustainable Development Goals (Fikus, Liszka, 2024). EU legal solutions and increasing competitiveness and social awareness require companies to reduce greenhouse gas emissions, generate profits, and meet social expectations (Mariani et al., 2022; Kwilinski et al., 2023; Govindan, 2025). Furthermore, the sector must operate under changing macroeconomic and geopolitical conditions, the development of automation and new technologies, and fluctuating energy prices (Barbieri, Capoani, 2025; Semrau, 2025).

In this study, the logistics sector is understood in line with the European Union's statistical classification of economic activities (NACE Rev.2, Section H), which covers transportation and storage services, including land, water and air transport, warehousing, and supporting activities for transportation. This definition ensures conceptual consistency and comparability across the analysed countries.

Logistics is essential for economic growth, job creation, and the support of other industries (Khan et al., 2022; Krykavskyy et al., 2023; Bartosiewicz et al., 2025). On the other hand, its development causes damage to the natural environment, mainly due to the sector's high emission intensity (Li et al., 2025). This raises the question of whether economic growth promotes sustainable logistics development or whether it entails heterogeneous effects and potential sustainability trade-offs.

Previous studies show that economic growth has a significant impact on logistics sustainability (Comporek et al., 2022; Misztal, 2022; Barut et al., 2023). Moreover, the effects of the trade, inflation, and the labour market in the logistics sector also play a role (Ozcelebi et al., 2021; Chrysanthopoulou et al., 2025). However, the results of these studies are not conclusive. Several studies suggest that economic growth is associated with greater implementation of SDG goals (Bartosiewicz et al., 2025; Gniadkowska-Szymańska et al., 2025). Some researchers present different opinions. McNeil and Barnes (2025) and Güler et al. (2025) note that pressures to increase production, consumption, and competitiveness can lead to greater negative environmental impacts. Sectors highly dependent on energy prices, transportation costs, and developments in other sectors are particularly vulnerable. The logistics sector remains underexplored in the academic literature in Central and Eastern European countries.

Furthermore, there is a lack of analyses that simultaneously consider the variation in outcomes across countries and their stability under changing macroeconomic conditions. The study contributes to the literature by providing a sector-specific panel analysis of sustainability trade-offs under economic growth in Central and Eastern Europe. The analyses take into account significant differences between countries and macroeconomic conditions.

This paper empirically analyses the relationship between economic growth and sustainable development in the logistics sector across selected Central and Eastern European countries. In particular, an analysis gives a new perspective and empirical evidence on sector-level sustainability trade-offs under economic growth. The study extends previous research, which mainly focused on simultaneously addressing non-linear effects, cross-country heterogeneity, and the conditional role of macroeconomic factors within a unified panel framework.

The study focuses on Poland, the Czechia, Slovakia, Hungary, and Romania. These countries have a common experience of systemic transformation and integration with the European Union. Moreover, they differ in logistics sector development and economic growth. These conditions enable the analysis of cross-country heterogeneity within a relatively similar institutional framework.

The study period, from 2008 to 2024, was characterised by disturbances such as the economic crisis, the COVID-19 pandemic, and the Ukraine War.

The study is based on Eurostat Structural Business Statistics and employs panel regression models with country- and year-fixed effects. This approach ensures control for unobserved heterogeneity and common time shocks. Interaction terms are then introduced to assess cross-country differences and the conditional nature of the estimated effects.

The paper is structured as follows: introduction, theoretical background, methodology, research results, discussion, and conclusions.

2. Theoretical background

2.1. Economic growth and sustainable development in the logistics sector

Economic growth leads to higher demand for transportation, warehousing, and distribution services (Andreoli et al., 2010; Comporek et al., 2022; da Silva et al., 2023; Bartosiewicz et al., 2025). Due to the increased demand for logistics services, the sector's financial results are improving and contributing to a greater share in GDP growth (Mahmood et al., 2025).

However, the impact of economic growth on the sustainable development of the logistics sector is not straightforward to interpret. GDP growth favours investments and the implementation of eco-innovations, which can generate additional profits and reduce the environmental footprint (Demirel et al., 2025; Ogbuabor et al., 2026). On the other hand, increasing the scale of logistics activity is associated with greater transport congestion, greater energy intensity, greenhouse gas emissions, and rising cost pressures (Tundys, Wiśniewski, 2026).

It is essential to note that the impact of macroeconomic conditions on the sustainable development of the logistics sector varies across time horizons (Gniadkowska-Szymańska et al., 2025; Baydar, Mete, 2026). If economies of scale result from pollution havens, environmental damage may increase in the short term (Bagchi, Sahu, 2025). In the long run, technological and organisational effects may improve the sector's environmental and economic performance (Guo et al., 2025). The direction of these processes is determined by the level of economic development, the sector's structure, and legal regulations. The impact of economic growth on the logistics sector can be understood through its effects on scale, structure, and technology (Delfin-Ortega, 2025; Yunxia, Yuqing, 2025). These mechanisms determine the nature of tensions between the Sustainable Development Goals.

From a broader theoretical perspective, the growth–sustainability nexus can be framed within the Environmental Kuznets Curve (EKC). In early stages of development, economic expansion increases environmental pressure, whereas at higher income levels structural change and technological progress may mitigate it. In the logistics sector, this implies a potentially non-linear relationship, with diminishing marginal sustainability effects as economies develop.

In this study, sustainable development of the logistics sector is understood as development in three dimensions: economic, environmental, and social (Khan et al., 2025; Kholaif, Tang, 2025). This approach assumes the need to combine logistics profitability with reducing negative environmental impacts and supporting the labour market (Comporek et al, 2022; Boşcoianu et al., 2025). This understanding of sustainable development implies the possibility of trade-offs between individual goals (Fertő, Harangozó, 2025; Holden et al., 2025), justifying the need for an empirical analysis of the relationship between economic growth and logistics sector development.

2.2. Sustainability Trade-offs in the Logistics Sector

In this study, a sustainability trade-off refers to tensions in which higher economic activity supports sustainability outcomes. However, the marginal gains weaken as the scale of activity increases, and may coincide with adverse effects on external balance indicators. As a result, trade-offs are analysed using the non-linear effects of GDP and the sign of the trade balance coefficient in the fixed-effects mode. In this interpretation, the trade balance is treated as a proxy for scale-related pressures associated with cross-border freight intensity, rather than a direct measure of sustainability.

Sustainable development of the logistics sector entails trade-offs among economic, environmental, and social objectives (Misztal, 2022; Vimal et al., 2025). The logistics firm would need to guarantee quality and on-time delivery while remaining profitable. With that happening, achieving environmental and/or social objectives can effectively threaten economic objectives (Murawski, 2025; Barbieri, Capoani, 2025).

Sustainability trade-offs in logistics primarily concern investment decisions (Akbar et al., 2025; Hoang et al., 2025). Implementing capital-intensive environmental projects is difficult, primarily due to rising prices (Sharma et al., 2025). In the social dimension, higher economic returns do not automatically improve working conditions (Gilardi, Lazazzara, 2025).

The scope and intensity of trade-offs depend on macroeconomic conditions and the level of sectoral development (Gniadkowska-Szymańska et al., 2025; Bartosiewicz et al., 2025b). In some cases, tensions between sustainability objectives can be mitigated. In others, conflicts persist between the pillars of sustainable development (Kareem et al., 2025). Therefore, identifying trade-offs requires empirical analysis that accounts for cross-country differences and temporal changes.

In this study, trade-offs are analysed at the logistics sector level. Empirically, these trade-offs are examined by combining sustainability index results with estimated effects on the trade balance, reflecting scale-related pressures associated with growth.

3. Research objectives, hypothesis, and research questions

Previous studies present that the relationship between economic growth and the sustainable development of the logistics sector may vary across economies (Comporek et al., 2022; Semrau, 2025). Economic growth can support investments, but it may also intensify sustainability trade-offs related to the scale of logistics activity (Vimal et al., 2025). The literature emphasises the importance of country-specific characteristics and selected macroeconomic conditions in shaping these relationships (Krykavskyy et al., 2023; Bartosiewicz, 2025).

The research goal is to examine the relationship between economic growth and SD in selected CEECs. The analysis focuses on identifying the direction and strength of this relationship, as well as its heterogeneity across countries.

Based on these considerations, the following central research hypothesis (H) is formulated: "Economic growth is associated with changes in the level of sustainability of the logistics sector, while the magnitude of this relationship differs across countries".

To address the primary hypothesis, the study is guided by the following research questions:

- Is economic growth associated with changes in the level of sustainability of the logistics sector?
- Does the strength of this relationship differ across the analysed Central and Eastern European countries?
- Do selected macroeconomic conditions, in particular inflation and labour market conditions, influence the relationship between economic growth and sustainability in the logistics sector?

These research objectives, hypotheses, and questions provide the basis for selecting the data and the empirical strategy applied in the subsequent sections of the paper.

4. Data and methodology

4.1. Data and Variables

The empirical analysis utilises annual panel data from 2008 to 2024 for Poland, the Czechia, Slovakia, Hungary, and Romania. All analytical indicators come from Eurostat's Structural Business Statistics. It ensures cross-country comparability and consistency over time.

The dependent variable is a composite indicator for the sustainable development of the logistics sector. The indicator considers three aspects of sustainability: economic, environmental, and social. The indicator is developed using sector-specific indicators.

Economic growth is the primary explanatory variable, which is measured by GDP. To control for the macroeconomic approach used in sustainability research and for sector performance, a series of macroeconomic control variables is considered. These include the trade balance deficit or surplus, HICP and the unemployment rate.

Selected variables are expressed in logarithmic form to reduce scale effects and facilitate interpretation of the estimated coefficients.

4.2. Construction of the Sustainability Index

The sustainability of the logistics sector is measured by a composite index which integrates economic, social, and environmental aspects. Let denote the country's sustainability index (SD_{it}) in the year. The index is calculated as the arithmetic mean of normalised analytical indicators according to the following expression:

$$SD_{it} = \frac{1}{K}\sum_{j=1}^{K}\left[\delta_j \cdot \frac{x_{ijt}}{\max\limits_{i}(x_{ijt})} + (1-\delta_j)\cdot\frac{\min\limits_{i}(x_{ijt})}{x_{ijt}}\right] \quad (1)$$

where:

x_{ijt} represents the value of analytical indicator j for country i in year t,

K is the total number of indicators included in the index,

$\delta_j \in \{0,1\}$ is a binary parameter identifying the direction of the indicator. For stimulants ($\delta_j = 1$), higher values indicate better sustainability performance, while for destimulants ($\delta_j = 0$), lower values correspond to more favourable outcomes. The minimum and maximum values are determined across countries for each year to ensure cross-country comparability.

The set of analytical indicators mirrors the multifaceted nature of sustainability in the logistics field. The economic dimension of sustainability measures the size, productivity, profit, and investment of the logistics companies. The social dimension of sustainability reflects the labour market, wages, labour force productivity, and labour-related cost structures. The environmental dimension of sustainability measures indicators relates to the pressure logistics exerts on the environment; the lower the pressure, the more sustainable the practice of logistics.

All indicators are given equal weight in the aggregation process, ensuring transparency and avoiding subjective assumptions about their relative importance. The index is sector-specific and serves to compare the level of logistics sustainability over time and across countries.

The index captures relative sustainability performance across countries and over time and is intended for comparative rather than absolute evaluation.

4.3. Empirical Strategy

The analysis is based on the panel data models that allow for controlling unobserved heterogeneity across countries and common time effects. All specifications are estimated using fixed effects for countries and years.

The baseline specification examines the average relationship between economic growth and the sustainability of the logistics sector across the analysed countries. The model is specified as follows:

$$SD_{it} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 TB_{it} + \beta_3 \ln(W_{it}) + \beta_4 U_{it} + \beta_5 HICP_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where:

SD_{it} denotes the sustainability index of the logistics sector in country $i$and year t,

$\ln(GDP_{it})$ represents economic growth,

TB_{it} is the trade balance,

$\ln(W_{it})$ denotes wages,

U_{it} is the unemployment rate,

$HICP_{it}$ captures inflation. Country fixed effects $\mu_i$control for time-invariant country-specific characteristics, while year fixed effects $\lambda_t$capture common shocks.

To examine potential non-linearities and diminishing returns in the relationship between economic growth and sustainability, an extended specification that includes a quadratic term for economic growth is estimated. It allows for identifying potential sustainability trade-offs associated with the scale effect of economic activity.

$$SD_{it} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 (\ln(GDP_{it}))^2 + X'_{it}\delta + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

A positive value of β_1 combined with a negative value of β_2 would indicate diminishing marginal effects of economic growth on sustainability, consistent with the existence of sustainability trade-offs.

To examine whether the effect of economic growth differs across countries, interaction terms between economic growth and country-specific dummy variables are introduced. Poland serves as the reference country. The model is specified as:

$$SD_{it} = \alpha + \beta_1 \ln(GDP_{it}) + \sum_{c \neq PL} \gamma_c \left[\ln(GDP_{it}) \times D_{ic}\right] + \mathrm{X}'_{it}\delta + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

where:

D_{ic} is a dummy variable equal to one for country $c$and zero otherwise,

X_{it} is the vector of control variables included in the baseline model. The implied country-specific effect of economic growth is obtained as the sum of the baseline coefficient and the corresponding interaction term.

To assess whether macroeconomic conditions modify the relationship between economic growth and sustainability, interaction terms between economic growth and selected macroeconomic variables are included. The conditional specification is given by:

$$SD_{it} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 Z_{it} + \beta_3 [\ln(GDP_{it}) \times Z_{it}] + \mathrm{X}'_{it}\delta + \mu_i + \lambda_t + \varepsilon_{it} \quad (5)$$

where Z_{it} represents either inflation (HICP) or the unemployment rate (U).

All of these estimations are run using fixed-effect estimators with robust standard errors to correct for heteroscedasticity. As robustness tests, different standard error estimators, such as country-clustered and Driscoll & Kraay standard errors, are employed to ensure that the baseline findings remain consistent.

Note that, because the cross-sectional dimension of the panel is relatively small (five countries), the empirical approach emphasises fixed-effects models over dynamic panel models. The goal of the empirical work is to uncover structural and cross-sectional heterogeneities in the relationship between growth and sustainability, rather than dynamic patterns of adjustment.

4.4. Potential endogeneity and identification considerations

A primary methodological concern in exploring the growth-sustainability link is endogeneity, driven by the spectre of reverse causality and omitted variables correlated with economic growth and sectoral sustainability. To empirically address such problems, the methodological design assumes country- and year-fixed effects to control for omitted-variable bias in testing cross-sectional fixed effects alongside standard shocks. Furthermore, it controls for relevant macroeconomic aggregates such as trade balance, inflation, unemployment rates, and wages. It is important to note that the results are interpretive and conditional. Nevertheless, it is vital to note that the sample is small (N = 5), for which dynamic group mediation or the instrumental variable technique would not be statistically justified.

In this case, the methodological approach is premised on the use of fixed effects and robustness tests with clustered robust standard errors, as well as Driscoll-Kraay standard errors.

5. Research results

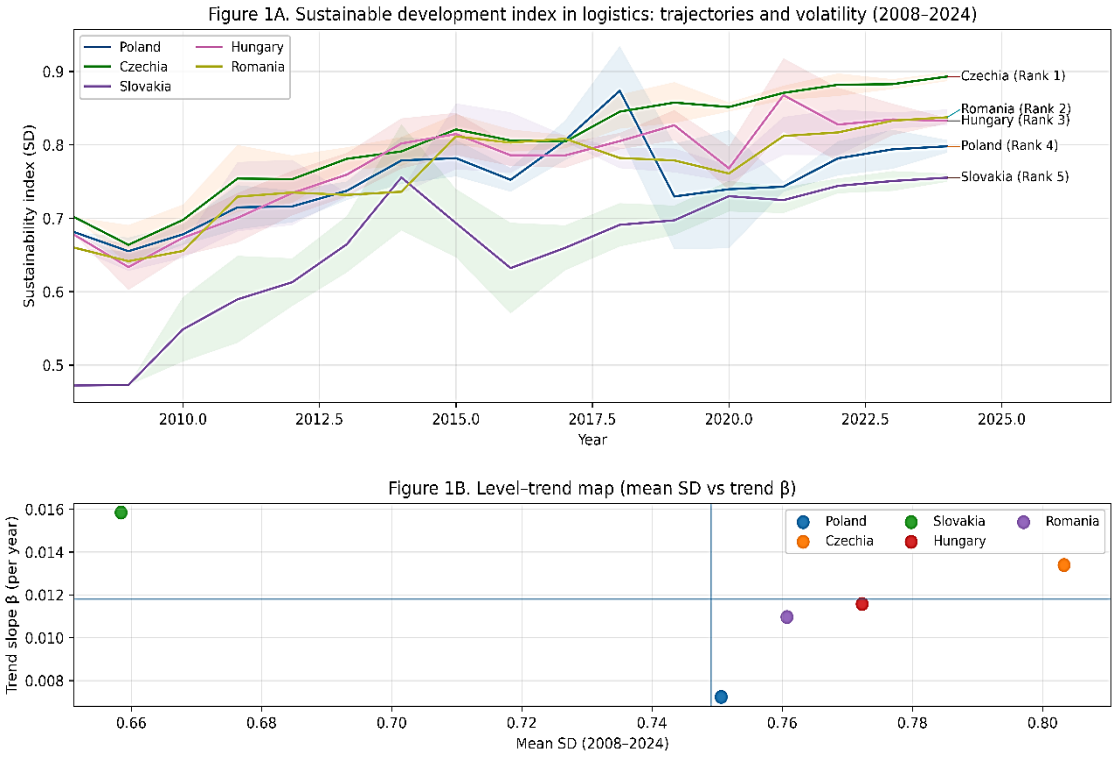
Table 1 presents both descriptive statistics and long-term trends of the Sustainable Development Index in the analysed countries. The results indicate considerable cross-country differences in the levels and variability of SD, along with heterogeneous growth paths over time. In particular, countries with lower initial SD levels often exhibit stronger upward trends, which motivates further panel analysis of the role of economic growth and macroeconomic conditions.

Table 1.
Descriptive statistics and trends in sustainable development (SD) in selected Central and Eastern European countries

Country	Mean SD	Std. dev.	Min	Max	Trend (β)	t-stat	R^2	Obs.
Czechia	0.803	0.070	0.664	0.893	0.0134	13.87	0.928	17
Hungary	0.772	0.067	0.633	0.868	0.0116	6.98	0.764	17
Poland	0.751	0.055	0.655	0.874	0.0072	3.50	0.449	17
Romania	0.761	0.063	0.641	0.837	0.0110	7.32	0.781	17
Slovakia	0.658	0.092	0.472	0.756	0.0158	6.69	0.749	17

Source: Eurostat (SBS, sbs_sc_ovw).

Figure 1 above shows the SD index for the period ranging from 2008 to 2024. From the trends across all countries, it is evident that SD is rising, though it experiences fluctuations. Czechia experiences a steadily rising trend, while Poland and Hungary record fluctuations. Romania shows a less steeply rising trend, while Slovakia shows the most significant improvements over time despite recording the lowest starting point.



Source: Eurostat Structural Business Statistics (sbs_sc_ovw); authors' calculations.

Figure 1. Evolution of the sustainable development index in the logistics sector (2008-2024).

Source: Eurostat (SBS, sbs_sc_ovw).

Table 2 presents the results of the fixed-effects regression on the SD index. The estimated model exhibits strong explanatory power (R^2= 0.925) and a statistically significant F-statistic. Economic growth, as measured by ln(GDP), is positively and statistically significantly associated with sustainable development, whereas the trade balance is negatively and significantly associated with the sustainability index. The inclusion of country and year fixed effects confirms that the estimated relationships are identified after controlling for unobserved country-specific characteristics and common time effects.

Table 2.

Baseline fixed-effects regression results for sustainable development (SD)

Panel A. Coefficient estimates			
Variable	***Coefficient***	***Robust SE***	***z-stat***
ln(GDP)	0.118	0.041	2.88
Trade balance	−0.000002	0.0000004	−4.48
ln(Wages)	−0.080	0.074	−1.09
Unemployment	0.008	0.007	1.16
HICP	−0.003	0.003	−1.12
Panel B. Model diagnostics and specification tests			
Country fixed effects/ Year fixed effects	Yes	F-statistic (model)	53.01
Observations	85	Prob > F	0.000
Number of countries	5	Durbin–Watson statistic	1.51
Within R^2	0.925		

Source: Eurostat (SBS, sbs_sc_ovw).

Including a quadratic term for economic growth reveals a statistically significant non-linear relationship between GDP and the sustainable development of the logistics sector (Table 3). While the linear GDP term is positive and significant, the negative and significant squared term indicates diminishing marginal effects of economic growth on sustainability. This suggests that economic growth supports sustainability improvements, although its marginal contribution weakens at higher levels of GDP.

Table 3.
Non-linear effects of economic growth on sustainable development (FE)

Panel A. Coefficient estimates			
Variable	**Coefficient**	**Robust SE**	**z-stat**
ln(GDP)	1.465	0.654	2.24
(ln(GDP))²	-0.058	0.023	-2.56
Trade balance	-0.000001	0.0000004	-2.41
ln(Wages)	-0.076	0.071	-1.07
Unemployment	0.009	0.007	1.29
HICP	-0.003	0.003	-1.01
Panel B. Model diagnostics			
Country/ year fixed effects:	YES	Prob	> F: 0.000
Observations	85	Within R²	0.931
Number of countries	5	Durbin–Watson statistic	1.54
F-statistic (model): 49.87			

Source: Eurostat (SBS, sbs_sc_ovw).

Table 4 presents cross-country heterogeneity. The fixed-effects interaction model, with Poland as the reference country, shows that the impact of economic growth differs across countries, with the effect significantly stronger in Slovakia. At the same time, differences in Czechia, Hungary, and Romania are not statistically significant. Panel B shows that the implied effects of economic growth on sustainable development are positive across all countries, but statistically significant only for Slovakia. Panel C confirms good model fit and joint statistical significance.

Table 4.
Country-specific effects of economic growth on sustainable development (SD)

Panel A. Coefficients (differences in GDP effect vs Poland)			
Variable	***Coefficient***	***Robust SE***	***z-stat***
ln(GDP) [Poland baseline]	0.134	0.174	0.769
ln(GDP)×Czechia (diff vs PL)	0.051	0.065	0.783
ln(GDP)×Hungary (diff vs PL)	0.050	0.074	0.678
ln(GDP)×Romania (diff vs PL)	−0.054	0.081	−0.658
ln(GDP)×Slovakia (diff vs PL)	0.238	0.076	3.135
Trade balance	−0.000	0.000	−1.282
ln(Wages)	−0.072	0.110	−0.654
Unemployment	0.016	0.007	2.294
HICP	−0.005	0.003	−1.760

Cont. table 4.

Panel B. Implied GDP effect in each country (β_total)			
Country	**Implied GDP effect (β)**	**Robust SE**	**z-stat**
Poland	0.134	0.174	0.769
Czechia	0.185	0.163	1.134
Hungary	0.184	0.160	1.149
Romania	0.080	0.176	0.455
Slovakia	0.372	0.184	2.019
Panel C. Model diagnostics			
Country FE/ Year FE	Yes	Adj. R^2	0.918
Number of countries	5	F-statistic (joint significance)	91.242
Observations	85	Prob > F	0.000
R^2	0.946	Durbin–Watson statistic	1.823

Source: Eurostat (SBS, sbs_sc_ovw).

Figure 2 shows substantial cross-country heterogeneity in the GDP–SD relationship, with Slovakia exhibiting a significantly more potent effect than the other analysed countries.

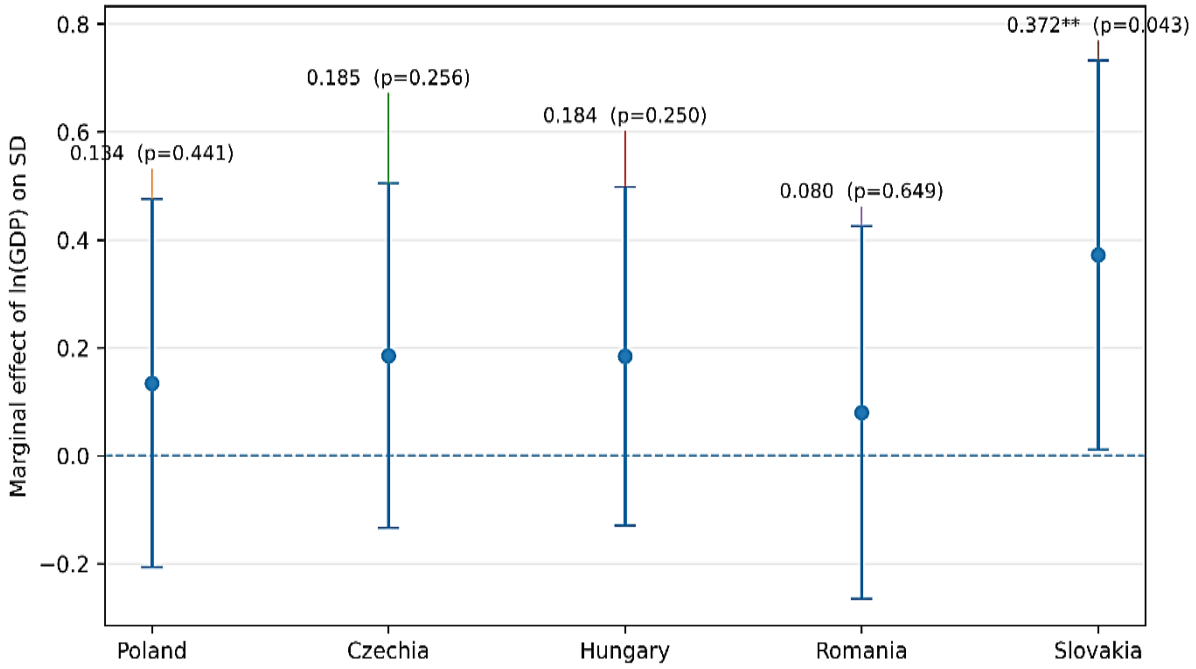


Figure 2. Country-specific marginal effects of economic growth on SD

Source: Eurostat (SBS, sbs_sc_ovw).

Table 5 assesses whether the impact of economic growth on the sustainable development of the logistics sector is conditional on inflation and labour-market conditions. The fixed-effects interaction model shows that neither inflation nor unemployment significantly modifies the growth–sustainability relationship, while the trade balance remains negatively and statistically significant. Model diagnostics indicate a good overall fit and confirm that the estimated coefficients reflect average effects across the analysed countries.

Table 5.
Economic growth–sustainability trade-offs under inflationary and labour-market pressures

Panel A. Coefficient estimates			
Variable	***Coefficient***	***Robust SE***	***z-stat***
ln(GDP)	−0.058	0.179	−0.33
HICP	0.000	0.021	0.02
ln(GDP) × HICP	−0.000	0.002	−0.16
Unemployment	−0.056	0.073	−0.77
ln(GDP) × Unemployment	0.006	0.007	0.88
Trade balance	−0.000001	0.000001	−2.28
ln(Wages)	−0.110	0.075	−1.47
Panel B. Model specification and diagnostics			
Country/ Year fixed effects	Yes	F-statistic (joint significance)	52.68
Number of countries	5	Prob > F	0.000
Observations	85	Durbin–Watson statistic	1.52
Within R^2	0.926		

Source: Eurostat (SBS, sbs_sc_ovw).

Figure 3 shows that the marginal effect of economic growth on sustainable development is not statistically significant across inflation and unemployment regimes, indicating no systematic macroeconomic trade-offs.

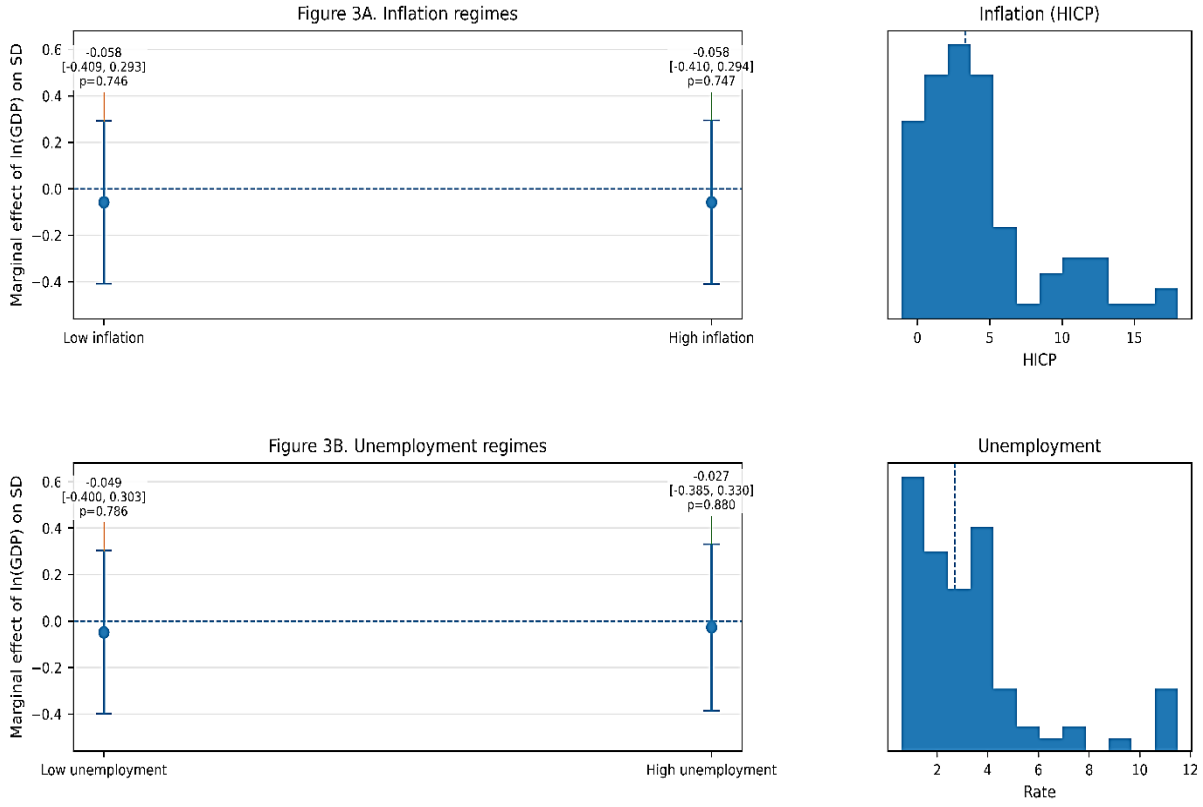


Figure 3. Effect of economic growth on SD under inflation and unemployment regimes.
Source: Eurostat (SBS, sbs_sc_ovw).

Overall, the results indicate a positive relationship between economic growth and the sustainable development of the logistics sector, with substantial cross-country heterogeneity and no evidence of systematic macroeconomic trade-offs.

5. Discussion

Previous research on the relationship between economic growth and sustainable development in the logistics sector has yielded mixed conclusions (Comporek et al., 2022; Misztal, 2022). Some researchers suggest that economic growth has a positive impact on the economic, social and environmental pillars of the logistics sector (Bartosiewicz et al., 2025; Gniadkowska-Szymańska et al., 2025). Others underline that logistics development can hurt the natural environment (Li et al., 2025; Barut et al., 2023). The obtained results are consistent with this research trend, confirming that this relationship is not uniform and depends on national conditions and the specific research methodology employed (Misztal, 2022).

The research results confirm a substantial relationship between economic growth and the sustainable development of the logistics sector (Comporek et al., 2022). The answer to the first research question is therefore affirmative. Economic growth promotes improved sustainable development. This result suggests that as economic activity increases, so do the opportunities for companies to invest in the social and environmental spheres (Demirel et al., 2025; Guo et al., 2025). The non-linear pattern observed in the results suggests diminishing marginal sustainability gains from economic growth in the logistics sector. This pattern is consistent with the Environmental Kuznets Curve: early growth increases environmental pressure through scale effects, while at higher income levels structural and technological improvements mitigate it. The diminishing marginal effect in logistics reflects the shift from expansion-driven growth to efficiency and low-emission adjustments.

At the same time, the results indicate significant variation in the strength of this relationship between the analysed countries (Bartosiewicz et al., 2025). Therefore, the answer to the second research question is affirmative, although the strength of the effect differs considerably across countries. The strongest and statistically significant effect of economic growth was observed in Slovakia. In the remaining countries, this relationship was weaker or statistically ambiguous. This means that economic growth does not translate equally into sustainable development of the logistics sector in all economies (Krykavskyy et al., 2023). Structural factors play a key role, including the level of infrastructure development, the structure and level of development and innovation within the sector, and the general business environment (da Silva et al., 2023; Mahmood et al., 2025).

The conditional analysis did not confirm that inflation and unemployment significantly moderate the impact of economic growth on the sustainable development of the logistics sector. Therefore, the third research question was not empirically supported. This result suggests that short-term macroeconomic fluctuations have a limited impact on this relationship (Ozcelebi et al., 2021; Chrysanthopoulou et al., 2025). However, long-term processes in which the effects of investment are visible are significant (Gniadkowska-Szymańska et al., 2025).

The negative impact of the the trade balance on the sustainability of the logistics sector remains a significant element of the discussion (Barut et al., 2023). This may indicate that the increased intensity of freight flows is associated with additional environmental costs (Li et al., 2025). This result confirms the existence of real trade-offs between increased logistics activity and sustainable development goals (Fertő, Harangozó, 2025; Vimal et al., 2025).

The results confirm a relationship between economic growth and the sustainable development of the logistics sector, with cross-country differences in the magnitude of this relationship. No evidence is found for conditional effects related to inflation or labour-market conditions (Comporek et al., 2022; Bartosiewicz et al., 2025).

The study has certain limitations. The analysis is based on aggregated sector-level data. This approach limits the ability to identify the mechanisms operating within enterprises. Also, the method used to calculate the synthetic indicator may influence the resulting estimation models (Holden et al., 2025). The analysis is limited to selected Central and Eastern European countries, which constrains the generalisability of the results.

The study's results suggest several important practical implications. First, supporting the sustainable development of the logistics sector should not be based solely on stimulating economic growth. It is essential to implement appropriate legal regulations to support business processes in the sector (Murawski, 2025). Implementing facilitation measures and creating financial mechanisms to support logistics SD should be key here (Kholaif, Tang, 2025). Public policy at both national and EU levels should prioritise support for low-emission and energy-efficient technologies in the logistics sector (Barbieri, Capoani, 2025; Tundys, Wiśniewski, 2026).

Future research may extend the current study by adding microeconomic evidence, using dynamic and non-linear modelling approaches, and even extending to broader geographic and institutional contexts (Akbar et al., 2025; Bagchi, Sahu, 2025; Krykavskyy et al., 2023).

6. Conclusions

This paper examines the connection between economic growth and the sustainable development of the logistics sector in selected Central and Eastern European countries from 2008 to 2024. The synthetic sustainability index captures both average effects and cross-country variation.

The results suggest that sustainability trade-offs arise mainly from scale-related effects of economic activity. At the same time, the impact of economic growth on sustainable logistics development varies across countries, with the most substantial impact observed in Slovakia. However, conditional analysis did not confirm that inflation or unemployment levels significantly altered this relationship.

Economic growth is not the only factor essential for sustainable logistics development. The sustainable development of the logistics sector depends on the business models and strategies adopted, as well as national regulations governing business activities. The limitations of this study relate to the use of aggregated sectoral data and the assumptions underlying the index construction. The obtained results should be interpreted as conditional statistical associations within a fixed-effects identification framework, rather than definitive evidence of causal relationships.

Further research could focus on microeconomic analyses, a dynamic approach, and expanding the geographic scope of the analyses.

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