Social Inequalities and the Evolution of Social Sustainability in Romania (2008–2024)

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Abstract. This article investigates the relationship between social inequalities and social sustainability in Romania during the period 2008–2024, with reference to the objectives established under the Romanian National Sustainable Development Strategy 2030 (SNDDR 2030) and the United Nations Sustainable Development Goals framework. The study adopts a quantitative research design based on secondary data obtained from the National Institute of Statistics and examines eight socio-economic indicators reflecting income distribution, poverty, social exclusion, material deprivation, social protection expenditures, economic performance, and labour productivity. Pearson correlation analysis, complemented by OLS diagnostic procedures, is employed to assess statistical associations among the selected variables and evaluate the robustness of the empirical results. The findings indicate substantial improvements across several dimensions of social sustainability, particularly regarding reductions in poverty and severe material deprivation. Social protection expenditures display the strongest associations with improvements in poverty- and exclusion-related outcomes, whereas labour productivity growth exhibits weak and statistically non-significant relationships with the social indicators included in the analysis. These results suggest that improvements in economic performance do not automatically translate into stronger social sustainability outcomes. When evaluated against the targets established by SNDDR 2030, Romania has made considerable progress in reducing poverty and social exclusion; however, the current pace of improvement remains insufficient to fully achieve several national commitments by 2030. In addition, the productivity slowdown observed toward the end of the study period may pose challenges for future employment growth and socio-economic convergence.

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Overall, the results highlight the importance of effective redistributive policies, broader social protection coverage, and sustained investment in the social dimension of sustainable development in order to strengthen long-term social sustainability in Romania.

Keywords: social inequality; social sustainability; AROPE; social protection; SDG monitoring; SNDDR 2030; Romania.

1. Introduction

Over the past decades, Romania has experienced a profound transformation characterised by economic challenges, political and social imbalances, and gradual progress across multiple dimensions of its socio-economic structure. In this context, the country has increasingly incorporated sustainability considerations into its development agenda, primarily through the adoption and adaptation of best practices promoted at the level of the European Union.

Romania has made gradual progress in integrating the principles of sustainable development into its socio-economic framework, particularly through policies aligned with European Union objectives and investments in environmental and structural reforms. Nevertheless, significant challenges persist, especially regarding employment opportunities, educational attainment, and the high proportion of the population at risk of poverty or social exclusion, which continue to limit the achievement of inclusive and socially sustainable development (Sârbu 2015). In this context, economic inequality represents a major obstacle to sustainable development, as widening disparities can undermine environmental initiatives, equitable economic growth, and social cohesion. As highlighted by Dumitrescu-Popa (2024), addressing income inequality in Romania through improved access to education and resources, as well as investments in sustainable infrastructure and the adoption of circular economy practices, can support the transition towards a more inclusive and sustainable development model.

The analytical framework of this article draws on Romania's National Sustainable Development Strategy 2030 (SNDDR 2030), which aligns national development objectives with the United Nations 2030 Agenda for Sustainable Development (United Nations, 2015) and its 17 Sustainable Development Goals (SDGs), establishing quantified national targets for the social, economic, and environmental dimensions of sustainability. The indicators analysed in this article are directly linked to the social pillar of the SNDDR 2030 and to several of its priority SDGs, in particular SDG 1 (No Poverty), SDG 3 (Good Health and Wellbeing), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities). Under the SNDDR 2030, Romania has committed to

specific national targets that include reducing the relative poverty rate to below 11%, bringing the employment rate to at least 70% of the working-age population, and narrowing the income gap as measured by the S80/S20 ratio. The present article provides empirical evidence on Romania's progress towards and distance from these commitments over the period 2008–2024, contributing to the monitoring of national sustainability performance within the broader framework of the 2030 Agenda.

From a broader perspective, social sustainability is closely linked to the satisfaction of basic human needs and to individuals' capacity to participate actively in society. Persistent social inequalities, including poverty and social exclusion, restrict access to opportunities, resources, and essential services, thereby hindering the achievement of sustainable development. Consequently, reducing inequality represents a fundamental condition for promoting inclusive and sustainable societies. Social sustainability also requires the integration of social and environmental dimensions, ensuring that economic development contributes both to human wellbeing and to environmental protection. In this regard, policies aimed at reducing inequalities, improving living conditions, and strengthening community resilience play a crucial role in advancing sustainable development (Winston 2022).

The COVID-19 pandemic significantly intensified social inequalities by increasing poverty and unemployment, while simultaneously constraining public resources for health, education, and social protection (Jackson and Victor 2021). Although the crisis produced a temporary reduction in daily global CO_2 emissions, approximately 17% below 2019 levels during the spring 2020 lockdowns, these effects were quickly reversed as economic activity resumed (Le Quéré et al. 2020). Overall, the pandemic highlighted the need for integrated policy responses capable of simultaneously addressing social inequalities, supporting economic recovery, and promoting environmental sustainability (Antoniades et al. 2021).

A further major recent factor affecting social inequalities and sustainable development is the war in Ukraine, which has generated significant economic, social, and political repercussions across Europe. As highlighted by Żuk (2023), the conflict has influenced multiple dimensions of social life, including energy policy, environmental governance, economic stability, and the broader political climate, while also shifting geopolitical power relations and creating pressures that may weaken social standards and welfare protections in several European countries.

The concept of social sustainability provides an important conceptual framework for examining the relationship between social infrastructure, social

capital, and principles of social justice and equity. It emphasises the importance of participatory governance processes that enable collaboration among diverse stakeholders and support the development of informed local responses to social and environmental challenges. In this context, social sustainability promotes a strategic and preventive approach to social problems, addressing their underlying causes rather than merely reacting to their consequences, thereby contributing to the strengthening of social capital and the development of more resilient communities (Cuthill 2010). However, compared with the economic and environmental dimensions of sustainable development, the social dimension has received relatively limited attention in the academic literature, resulting in a less developed understanding of how social processes influence long-term sustainability (Cuthill 2003). Examining the relationship between social inequalities and social sustainability therefore becomes essential for understanding how societies can promote inclusive and sustainable development.

Against this background, the present article aims to explore the relationship between social inequalities and social sustainability in Romania, adopting a temporal perspective that highlights the evolution of key socio-economic indicators and their implications for sustainable development over the period 2008–2024. The article also evaluates Romania's progress against the targets of the SNDDR 2030 and the SDG monitoring framework, contributing to the empirical assessment of national sustainability commitments.

2. Literature review

2.1.The inequality–environment nexus: competing and complementary perspectives

The relationship between social inequality and environmental sustainability has generated a rich body of literature, with frequently divergent positions. A foundational point of convergence is that the two phenomena are deeply interconnected: vulnerable groups bear a disproportionate share of environmental degradation, while environmental crises simultaneously deepen existing social disparities (Martin et al. 2020). This dynamic challenge earlier approaches that treated economic growth, social equity, and environmental protection as separable policy domains. Yet precisely how these dimensions should be integrated and which should take precedence remains a point of tension in the literature.

One influential strand argues that social sustainability must be understood as a precondition for, rather than merely a complement to, environmental sustainability. Ballet, Bazin, and Mahieu (2020) contend that without robust social cohesion, equity, and effective social protection,

environmental policies lack the institutional and community foundations necessary for long-term effectiveness. From this perspective, poverty and social exclusion do not simply coexist with environmental degradation, they actively undermine it, because fragmented societies are less capable of collective environmental governance. Littig and Griessler (2005) reinforce this argument by criticising the conventional "three equal pillars" model of sustainable development, arguing that treating the social, economic, and environmental dimensions symmetrically obscures the foundational role of social conditions.

A different emphasis emerges from the environmental justice literature. Seyfang and Paavola (2008) focus not on social sustainability as a precondition, but on the distributional consequences of environmental policy itself, showing that climate and sustainability transitions can generate regressive outcomes if not accompanied by targeted redistributive measures. This shifts the analytical lens: the inequality–environment relationship is not only about whether unequal societies can sustain environmental commitments, but also about whether environmental policies reproduce or mitigate social inequality. Martin et al. (2020) take this argument further, contending that transformative rather than incremental approaches are required, integrating environmental policy with principles of social justice at the design stage rather than as compensatory add-ons.

2.2. Social cohesion, vulnerability, and the limits of growth

A second cluster of literature examines how social inequality mediates the relationship between economic development and sustainability outcomes. Berger-Schmitt (2000) establishes social cohesion, defined by solidarity, social integration, and equality of access, as a key intermediate variable: high inequality weakens cohesion, which in turn erodes the social trust and institutional capacity required for sustainable governance. This argument is implicitly echoed by Lehtonen (2004), who identifies social capital and institutional quality as the mechanisms through which social conditions shape long-term sustainability trajectories.

However, the literature diverges significantly on the role of economic growth. Adams (2004) argues that growth can contribute substantially to poverty reduction, provided its benefits are broadly distributed. This conditionally optimistic view contrasts with the more structuralist position of Dobrescu and Durach (2019), who find that in the Romanian case, GDP-driven growth has consistently failed to translate into social wellbeing, owing to structural imbalances and weak policy coordination. The implication is that the relationship between growth and inequality reduction is not automatic but

institutionally mediated, a conclusion that also emerges from Puiu (2024), who documents persistent gaps in inequality reduction in Romania despite macroeconomic progress.

This tension has direct implications for social protection design. Ikegami et al. (2016) argue that short-term financial transfers alone are insufficient for reducing chronic poverty; what is required are integrated policies that build assets and promote long-term economic mobility. Davies et al. (2013) extend this logic to resilience, demonstrating that social vulnerability is shaped not primarily by income shocks but by structural inequalities and institutional weaknesses, a finding that points towards the limits of narrowly economic approaches to sustainability.

2.3. *The under theorised social dimension and its institutional barriers*

A cross-cutting concern in the literature is that the social dimension of sustainable development remains comparatively under theorised. Littig and Griessler (2005) note that social sustainability has frequently functioned as a catchword, a politically convenient umbrella concept without clear analytical content, while Cuthill (2003) observes that social processes receive less scholarly attention than economic or environmental ones, resulting in weaker frameworks for policy design. Koning (2001) identifies social capital, inequality, and social inclusion as the key conceptual tools for operationalising social sustainability, but notes that their integration into formal sustainability assessments remains partial.

This theoretical gap has practical consequences. Leal Filho et al. (2022) find that institutional barriers, resource constraints, and weak organisational capacity are the primary obstacles to implementing social sustainability, suggesting that the problem is not only one of political will but also of analytical and institutional infrastructure. In the Romanian context, Frone (2020) documents how European-funded investments have reduced certain forms of social exclusion while leaving deeper territorial and structural vulnerabilities intact, particularly in rural areas. Popa (2023) adds a spatial dimension, identifying a growing polarisation between rural and urban areas driven by compounding inequalities of opportunity, a dynamic that standard aggregate indicators fail to capture.

Recent assessments of Romania's progress within the SDG monitoring framework reinforce these findings. Puiu (2024) and Munteanu (2023) both document considerable gaps in achieving SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), and SDG 1 (No Poverty) at the national level, noting that despite improvements in macroeconomic aggregates,

Romania's performance on social sustainability indicators remained among the weakest in the EU-27 in the post-2015 period. The National Institute of Statistics (NIS) Progress Report on the National Sustainable Development Strategy for the 2030 Horizon (NIS, 2023) similarly identifies persistent deficits in income distribution, material deprivation, and social protection coverage relative to national targets set under the SNDDR 2030. Frone (2020) further argues that the synergies between development objectives and sustainability policies remain insufficiently activated in Romania, limiting the country's capacity to close the gap between formal commitments under the 2030 Agenda and measurable social outcomes.

2.4. *Synthesis: convergences, tensions, and implications*

Across these perspectives, two broad conclusions emerge. First, there is strong convergence around the view that economic growth is necessary but insufficient: without redistributive policies, effective social protection, and institutional capacity, growth does not automatically reduce inequality or advance social sustainability (Adams 2004; Dobrescu and Durach 2019; Ikegami et al. 2016). Second, the literature diverges on causal priority: some authors treat social sustainability as a precondition for environmental outcomes (Ballet et al. 2020; Littig and Griessler 2005), while others treat environmental policy design as a driver of social inequality (Seyfang and Paavola 2008; Martin et al. 2020). These are not necessarily incompatible positions, but they imply different policy sequencing: the first prioritises social investment before environmental transition, the second argues for integrating equity into environmental policy from the outset.

A further unresolved tension concerns the scale of intervention. Davies et al. (2013) and Leal Filho et al. (2022) both point to institutional and structural barriers as the primary constraints, implying that incremental reform is insufficient. Berger-Schmitt (2000) and Lehtonen (2004), by contrast, emphasise gradual social capital accumulation and institutional learning.

For Romania, whose trajectory combines formal EU sustainability commitments with persistent structural inequalities, both dimensions appear relevant, suggesting that the country's social sustainability challenges cannot be addressed through either social investment or institutional reform alone, but require their deliberate combination. Romania's commitments under the SNDDR 2030 and the UN 2030 Agenda represent the formal policy framework within which these tensions must be resolved, making empirical monitoring of social indicators both analytically necessary and practically relevant.

3. Methodology

This study employs a quantitative research approach to analyse the relationship between social inequalities and social sustainability in Romania during the period 2008–2024. The analysis is based on secondary statistical data from the National Institute of Statistics, including sustainable development indicators associated with the National Sustainable Development Strategy 2030 (SNDDR 2030) and the national SDG monitoring framework. The selected indicators reflect the social, economic, and sustainability dimensions relevant to the study of social inequalities, and correspond directly to the targets established under the SNDDR 2030 and to the international SDG monitoring indicators published by Eurostat (2025). The main indicators included in the analysis are: the Gini coefficient (%), the S80/S20 income quintile ratio, the at-risk-of-poverty-or-social-exclusion (AROPE) rate (%), the severe material deprivation rate (%), the relative poverty rate (%), social protection expenditures (million EUR), real GDP per capita (EUR), and labour productivity growth (%).

To examine the relationships between these variables, Pearson correlation analysis was employed using standard statistical software. The Pearson correlation coefficient (r) measures the direction and intensity of linear relationships between variables, while statistical significance was assessed through p-values at a 5% significance threshold. Results were also represented through a correlation matrix heatmap to facilitate the visualisation of interdependencies among indicators. The correlation analysis should be interpreted as descriptive because several variables exhibit long-term trends and stationarity was not formally tested.

Additionally, the study includes graphical diagnostic analyses to evaluate the robustness of statistical relationships and the validity of regression assumptions. A simple OLS regression model was estimated with the AROPE rate as the dependent variable and social protection expenditures as the explanatory variable ($R^2 = 0.730$, $p < 0.001$). The diagnostic plots examine: (1) residuals vs fitted values, to assess linearity and the absence of systematic patterns; (2) a Normal Q-Q plot, to evaluate the normality of residuals; (3) a scale-location (spread-level) plot, to test homoscedasticity; and (4) Cook's distance combined with leverage, to identify potentially influential observations.

4. Results

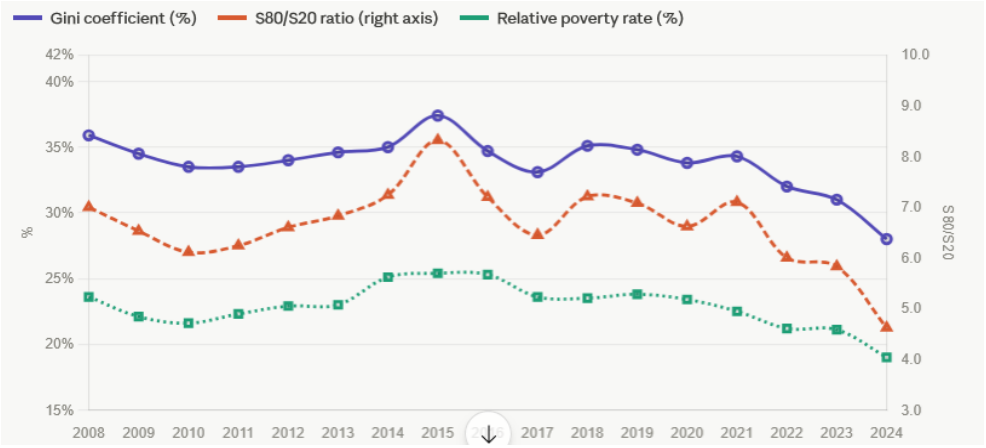
The results section presents the main statistical relationships between social inequality indicators and social sustainability variables in Romania during the period 2008–2024, based on descriptive analysis, Pearson correlation analysis, and graphical statistical representations.

4.1. Dynamics of social inequality and social sustainability indicators in Romania (2008–2024)

The first part of the results section presents descriptive analyses of social inequality and social sustainability indicators in parallel and separately, in order to provide an overview of their evolution over the period under study. According to the graphs presented in Figure 1, both the Gini coefficient and the S80/S20 income quintile ratio reached their highest values around 2015 (37.4% and 8.32, respectively), indicating an intensification of income disparities between social groups and a widening gap between rich and poor populations. One possible explanation for these elevated values is the long-term effects of the 2008 economic crisis, which continued to influence social inequalities and social vulnerability in Romania in subsequent years (Scutaru et al., 2015). Both indicators subsequently declined substantially over the following decade: by 2024, the Gini coefficient had fallen to 28.0% and the S80/S20 ratio to 4.62, the lowest values recorded over the entire 2008–2024 period, suggesting a meaningful improvement in income distribution and a gradual reduction of disparities between higher- and lower-income groups. The relative poverty rate followed a broadly similar trajectory, rising from 23.6% in 2008 to a peak of 25.4% in 2015 before declining to 19.0% by 2024.

These trends are directly relevant to the national targets established under the SNDDR 2030. SDG 10 (Reduced Inequalities) and its associated SNDDR targets call for a sustained reduction of the S80/S20 ratio and the relative poverty rate. The data confirm that Romania has made progress on both metrics over the 2008–2024 period, with the S80/S20 ratio declining from 7.0 to 4.62 and the relative poverty rate falling from 23.6% to 19.0%. However, the SNDDR 2030 progress report (NIS, 2023) notes that Romania's relative poverty rate remains significantly above the EU-27 average and that the pace of reduction is insufficient to meet the national 2030 targets. The temporary reversal observed after 2021, when the AROPE rate rose from 30.4% to 34.4% before declining to 27.9% in 2024, illustrates the fragility of these improvements and the sensitivity of social sustainability indicators to macroeconomic shocks.

Figure 1. Evolution of the main social inequality indicators in Romania, 2008–2024



Source: National Institute of Statistics

Figure 2 presents the evolution of social sustainability indicators in relation to social inequalities over the same reference period (2008–2024). The results indicate a substantial increase in social protection expenditures, from 20,069 million EUR in 2008 to 53,447 million EUR by 2024[1], representing a more than 2.6-fold nominal increase, alongside sustained growth in real GDP per capita, from 7,500 EUR in 2008 to 11,220 EUR in 2024. Concurrent with these increases, the AROPE rate declined from 44.2% in 2008 to 27.9% in 2024, and the severe material deprivation rate fell markedly from 32.9% to 11.0% over the same period. However, despite these economic improvements, the efficiency of social transfers, excluding pensions, in reducing poverty remained approximately three times lower in Romania compared with the European average (Preoteasa 2016), suggesting persistent structural weaknesses within the social protection system.

Moreover, although social protection represented the largest category of public expenditure across EU member states, Romania remained among the countries allocating the lowest share of GDP to social protection (Eurostat, 2025). According to Eurostat data, in 2023 Romania allocated only 12.8% of GDP to social protection, significantly below countries such as Finland (25.7%), France (23.4%), or Austria (21.4%), highlighting the limited capacity of social policies to reduce social vulnerabilities and inequalities.

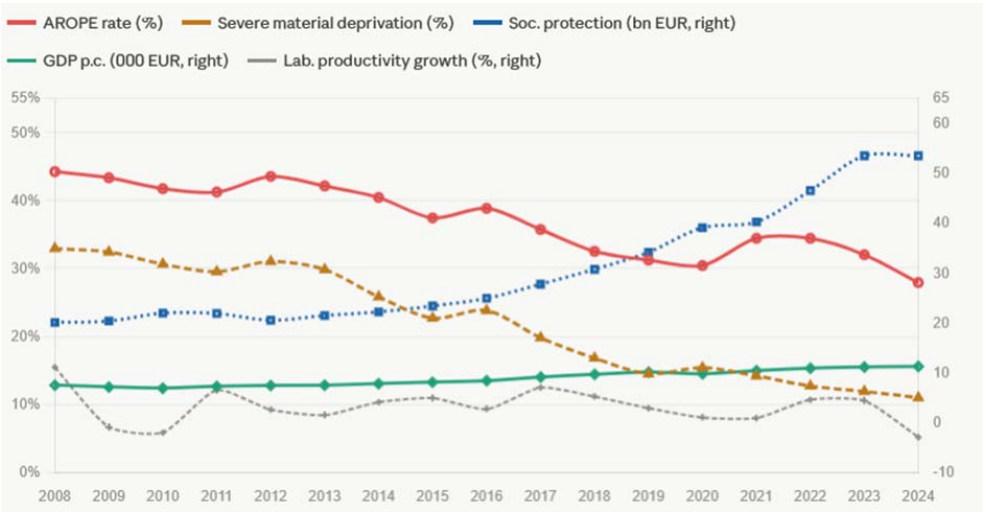
[1] The 2024 value for social protection expenditure reflects the most recent available data at the time of analysis (2023 provisional estimate).

The evolution of the AROPE rate and the severe material deprivation rate is directly tracked by the SNDDR 2030 and the national SDG monitoring framework. SDG 1 (No Poverty) and SDG 3 (Good Health and Wellbeing) both include targets associated with reducing poverty and material deprivation. Under the SNDDR 2030, Romania committed to lifting at least two million people out of poverty or social exclusion risk relative to the 2015 baseline. The data for 2024, with the AROPE rate at 27.9%, represent the most favourable reading over the entire series; nonetheless, Romania remains above the EU-27 average and the national trajectory has been interrupted twice, in 2012–2013 and in 2020–2022, by economic shocks that temporarily reversed progress. The severe material deprivation rate, which declined from 32.9% to 11.0% over the period, is a key indicator of SDG 1 and one of the headline metrics for SNDDR 2030 monitoring reported by INS. Its persistent decline, even over the course of the pandemic period, reflects the cumulative impact of rising social protection expenditures and broadly sustained economic growth.

Labour productivity growth exhibited considerable volatility throughout the analysed period. Having reached its peak of +11.1% in 2008, it contracted to −0.9% and −2.0% in 2009 and 2010 respectively as a direct consequence of the global economic crisis, before recovering to a post-crisis high of +7.0% in 2017. A notable deterioration is observed at the end of the series, with labour productivity recording a significant contraction of −2.9% in 2024, the largest decline registered outside the crisis years, raising concerns about structural competitiveness. Over the full period 2008–2024, the mean annual labour productivity growth rate was 3.2%.

SDG 8 (Decent Work and Economic Growth) includes labour productivity among its headline indicators. The SNDDR 2030 sets targets for sustained productivity gains as a prerequisite for convergence with EU living standards. The negative productivity growth recorded in 2024 (−2.9%) signals a potential structural challenge: if sustained, it could interrupt the income convergence dynamic that underpinned much of Romania's social progress between 2015 and 2023, with implications for SDG 8 monitoring and for the SNDDR 2030 employment targets.

Figure 2. Evolution of social sustainability and economic indicators in Romania, 2008–2024



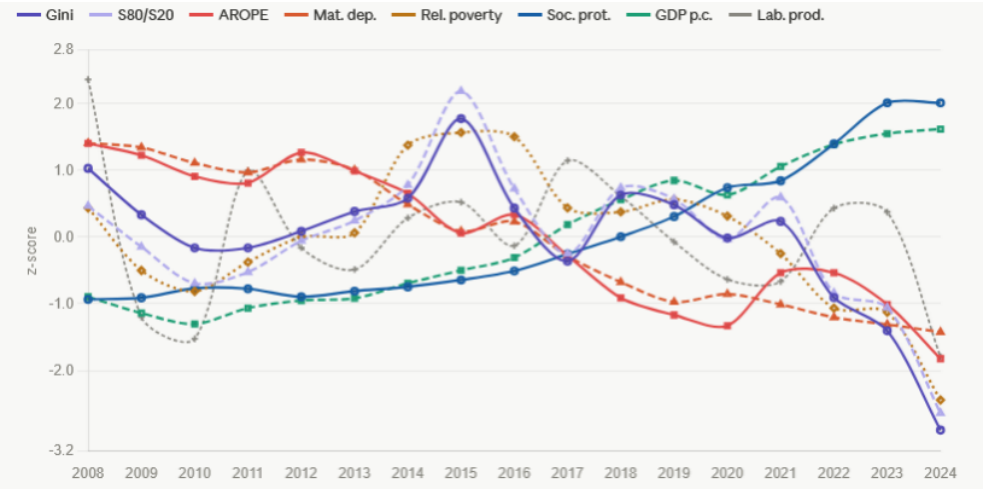
Source: National Institute of Statistics

In addition to the two figures discussed above, Figure 3 highlights the complex interdependence between economic performance, social protection mechanisms, and social inequality in shaping social sustainability in Romania. The graph presents the standardised evolution (z-scores) of all analysed indicators during 2008–2024, contributing to a more comparable perspective across variables measured in different units and facilitating the identification of common trends and divergences between social inequality and social sustainability dimensions.

The standardised series clearly reflect the impact of the 2008 economic crisis, as indicators associated with economic growth (GDP per capita and labour productivity) registered very low z-scores in 2009–2010, followed by gradual recovery and renewed instability in subsequent years. During 2014–2015, social inequality indicators, including the Gini coefficient ($z = 1.77$), the S80/S20 ratio ($z = 2.18$), and the relative poverty rate ($z = 1.56$), reached their highest standardised values, confirming that the social sustainability of Romania remained fragile in the period following the financial crisis. Social protection expenditures and GDP per capita followed a sustained upward trajectory throughout the period, with their z-scores rising from approximately −0.9 in 2008 to +2.0 and +1.6 respectively by 2024. Conversely, the AROPE

rate and material deprivation rate showed the most pronounced downward standardised trends, reaching z-scores of −1.82 and −1.43 by 2024.

Figure 3. Standardised dynamics of social inequality and social sustainability indicators in Romania (2008–2024)



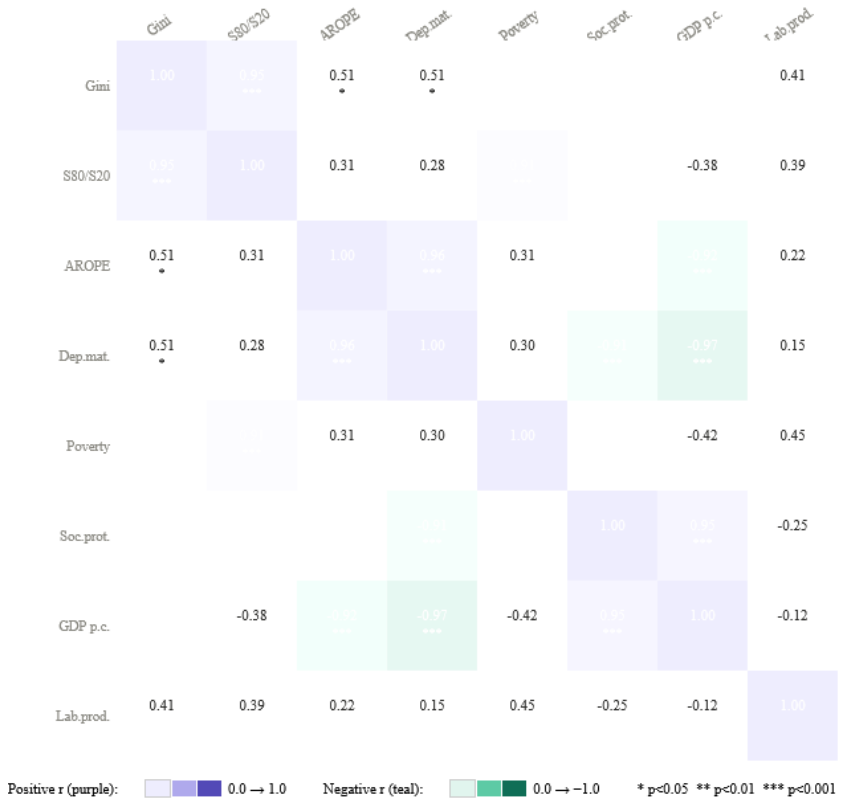
Source: Authors' calculations based on National Institute of Statistics data. Values expressed as z-scores (mean = 0, SD = 1).

An important exception is represented by the year 2020, when economic indicators declined sharply (GDP per capita fell from 10,080 EUR in 2019 to 9,760 EUR) while social protection expenditures increased considerably (from 34,130 to 39,059 million EUR), reflecting the need for stronger state intervention in response to the economic and social consequences of the COVID-19 pandemic. Notably, the AROPE rate temporarily rebounded from 30.4% in 2020 to 34.4% in 2021 before resuming its downward trend, reaching a series low of 27.9% by 2024.

4.2. Bridging social inequalities and social sustainability in Romania (2008–2024)

While the first section of the results separately analysed the evolution of indicators associated with the two main dimensions of the study, this section focuses on the statistical relationships between these variables through Pearson correlation analysis. Figure 4 presents the full correlation matrix for the eight indicators, highlighting several statistically significant associations and emphasising the interdependence between economic development, social protection mechanisms, and social vulnerabilities.

Figure 4. Pearson correlation matrix: social inequality and social sustainability indicators, Romania 2008–2024



Source: Authors' calculations. n = 17. * p < 0.05, ** p < 0.01, *** p < 0.001.

One of the strongest positive correlations identified over the 2008–2024 period is between the Gini coefficient and the S80/S20 income quintile ratio (r = 0.952, p < 0.001), confirming the direct and highly significant association between overall income dispersion and polarisation between the top and bottom quintiles. A similarly strong relationship is observed between the AROPE rate and the severe material deprivation rate (r = 0.960, p < 0.001), indicating that at-risk-of-poverty or social exclusion and material deprivation evolve in close synchrony across the period. The relative poverty rate is strongly associated with both the Gini coefficient (r = 0.859, p < 0.001) and

the S80/S20 ratio ($r = 0.910$, $p < 0.001$), confirming the coherence of the inequality indicators cluster.

From the perspective of social sustainability, the analysis reveals strong negative correlations between social protection expenditures and the indicators of vulnerability. Social protection expenditures are significantly negatively correlated with the AROPE rate ($r = -0.854$, $p < 0.001$) and the severe material deprivation rate ($r = -0.905$, $p < 0.001$), and also with the Gini coefficient ($r = -0.744$, $p < 0.001$) and the relative poverty rate ($r = -0.614$, $p < 0.01$). Similarly, GDP per capita shows strong negative correlations with the AROPE rate ($r = -0.917$, $p < 0.001$) and with severe material deprivation ($r = -0.975$, $p < 0.001$), and is strongly positively associated with social protection expenditures ($r = 0.950$, $p < 0.001$), reflecting the joint upward trajectory of economic development and social spending over the period.

In contrast, labour productivity growth is not significantly correlated with any other indicator in the analysis (all $p > 0.05$), with the highest association observed with the Gini coefficient ($r = 0.411$, $p = ns$). This finding reflects the high year-to-year volatility of productivity growth, which decouples it from the smoother, trend-driven dynamics that characterise the remaining indicators. Together with the relatively weak associations identified between economic performance indicators and social inequality measures, these results indicate that improvements in social sustainability in Romania do not emerge automatically from economic expansion. Rather, they require well-designed redistributive mechanisms, effective social protection policies, and inclusive development strategies that ensure the benefits of economic progress are broadly shared across society.

These findings carry direct implications for the interpretation of Romania's progress under the SNDDR 2030 and the SDG framework. The strong negative association between social protection expenditures and AROPE ($r = -0.854$) and material deprivation ($r = -0.905$) provides empirical support for the SNDDR 2030's emphasis on social transfer adequacy as a central lever for reducing poverty. Conversely, the decoupling of labour productivity growth from social outcomes suggests that productivity gains alone, as tracked under SDG 8, are insufficient for advancing SDG 10 targets in the Romanian context without complementary redistributive mechanisms. The joint trajectory of GDP per capita and social protection expenditures ($r = 0.950$) further indicates that Romania's capacity to fund social programmes has expanded with economic development; however, the persistently low share of GDP allocated to social protection (12.8% in 2023) compared with EU peers underlines that the SNDDR 2030 target of strengthening social cohesion and

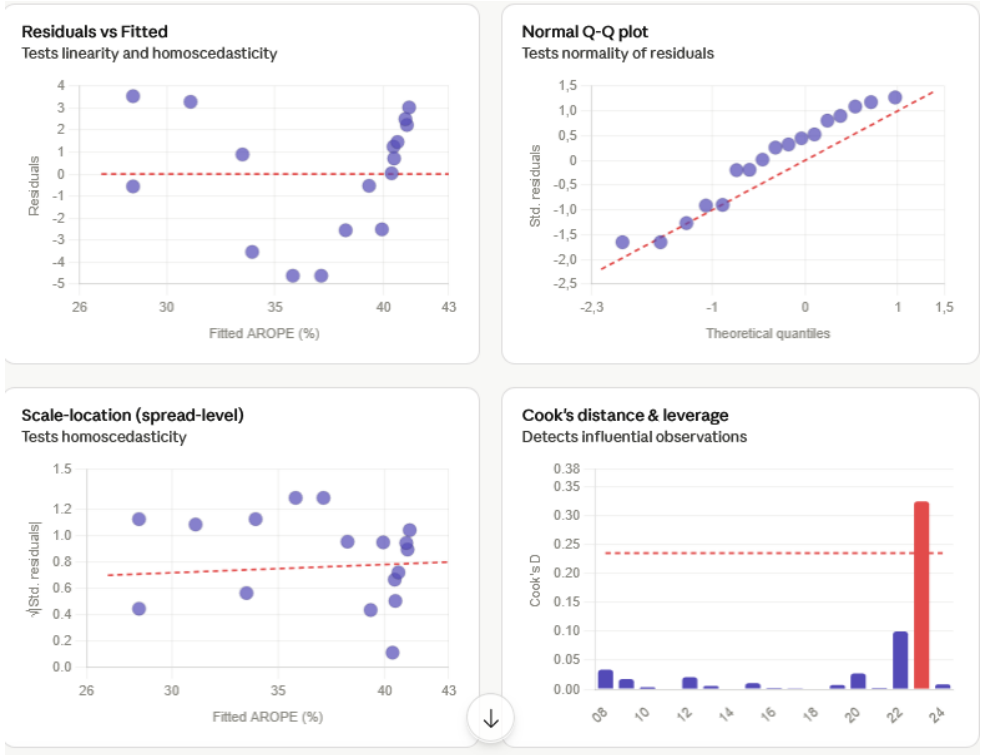
reducing inequality cannot be achieved through economic growth alone, but requires deliberate policy choices regarding the level and structure of social spending.

The findings confirm the strong interdependence between social inequalities and social sustainability in Romania over the period 2008–2024, highlighting that sustainable social development requires both economic progress and effective social and institutional support mechanisms.

4.3. Regression diagnostic analysis

In order to evaluate the robustness of the statistical relationships reported above and to validate the regression assumptions underlying the OLS model (AROPE ~ social protection expenditure, $R^2 = 0.730$, $p < 0.001$), four diagnostic plots were generated, as presented in Figure 5.

Figure 5. Regression diagnostic plots: OLS model AROPE (%) ~ social protection expenditure (million EUR), Romania 2008–2024



Source: Authors' calculations. n = 17, R^2=0.730, p<0.001.

The Residuals vs Fitted plot shows no systematic curvature or fan-shaped pattern, supporting the assumptions of linearity and approximate homoscedasticity. Residuals range from −4.62 to +3.54 percentage points, with no clear trend across the fitted value range (28–41%), indicating that the linear specification is broadly appropriate. The Normal Q-Q plot confirms that standardised residuals follow the theoretical normal distribution closely, with no substantial deviation at the tails, supporting the normality assumption. The Scale-Location plot shows a roughly flat trend in the square root of absolute standardised residuals across fitted values, further consistent with homoscedasticity.

Cook's distance analysis identifies 2023 as the observation with the highest influence ($D = 0.325$), primarily driven by its high leverage position at the extreme of the social protection expenditure range (53,447 million EUR). While this value is below the conventional Cook's $D > 0.5$ threshold for high influence, it approaches the sample-size-adjusted threshold of $4/n = 0.235$, suggesting that the 2023 observation warrants caution in interpretation. No other observation displays a Cook's D above 0.15 (see Cook, 1977). Overall, the diagnostic analysis supports the reliability of the OLS estimates for this sample, while acknowledging the limitations inherent in a small-sample time series context.

5. Conclusions

Over the period 2008–2024, Romania has experienced significant economic, social, and institutional transformations, shaped by the aftermath of the global financial crisis, the COVID-19 pandemic, and the geopolitical repercussions of the war in Ukraine. At the same time, the country has progressively integrated the principles of sustainable development into national public policies, particularly in the context of European integration and the implementation of the United Nations 2030 Agenda.

The present article examined the relationship between social inequalities and social sustainability in Romania by analysing the evolution of eight key socio-economic indicators between 2008 and 2024. The research was based on a quantitative approach using secondary statistical data provided by the National Institute of Statistics, together with Pearson correlation analysis and regression diagnostic methods.

The results underline that social sustainability is a multidimensional process influenced by both economic and institutional factors. Over the analysed period, several indicators showed meaningful improvement: the AROPE rate declined from 44.2% (2008) to 27.9% (2024), the severe material

deprivation rate fell from 32.9% to 11.0%, the Gini coefficient decreased from 35.9% to 28.0%, and the S80/S20 ratio dropped from 7.0 to 4.62. These gains are associated with a substantial increase in social protection expenditures, which rose from 20,069 million EUR in 2008 to 53,447 million EUR by 2024. However, the persistence of structural inequalities, Romania's comparatively low social protection spending as a share of GDP (12.8% in 2023 versus EU averages of 21–26%), and the significant labour productivity contraction of −2.9% recorded in 2024 demonstrate that economic growth does not automatically generate social cohesion or equitable development. The correlation analysis confirms that social protection expenditures are the indicator most strongly associated with reductions in AROPE ($r = -0.854$) and material deprivation ($r = -0.905$), reinforcing the redistributive role of social spending.

Evaluated against the targets of the National Sustainable Development Strategy 2030 (SNDDR 2030) and the UN Sustainable Development Goals, the data reveal a mixed picture. Romania has made substantial progress on SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities) indicators, with material deprivation and income concentration both declining significantly between 2008 and 2024. However, the pace of improvement remains insufficient to meet national targets under the SNDDR 2030 by the 2030 deadline. The relative poverty rate, at 19.0% in 2024, remains significantly above the national target and the EU-27 average. The labour productivity contraction of 2024 introduces risks for SDG 8 (Decent Work and Economic Growth) trajectories and for the convergence dynamic that underpins much of Romania's social sustainability progress. The SNDDR 2030's emphasis on the social pillar of sustainable development, specifically on strengthening social protection, reducing poverty, and building an inclusive labour market, is therefore both empirically supported by the findings of this article and practically urgent given the distance still remaining to the 2030 targets. The article contributes to the evidence base for SNDDR 2030 monitoring and provides a quantitative reference point for national and European SDG reporting on Romania's social sustainability trajectory.

The present study has several limitations. First, the analysis relies on nationally aggregated secondary data, which does not capture regional or rural/urban disparities identified by Popa (2023) as particularly significant in Romania. Second, while Pearson correlation analysis identifies statistically significant associations, it does not establish causal relationships and does not control for confounding factors. Third, the small sample size ($n = 17$) limits the power of formal statistical tests. Also, the correlation analysis should be

interpreted as descriptive because several variables exhibit long-term trends and stationarity was not formally tested.

Future research could extend this analysis through panel data or regression approaches with additional controls, integrate disaggregated regional-level data, and examine the mechanisms through which social protection expenditure translates into sustained reductions in social vulnerability within the SNDDR 2030 framework.

Use of GenAI tools

Generative AI and related assistive technologies (ChatGPT by OpenAI and Claude developed by Anthropic) were used to improve clarity, grammar, coherence, proofreading and overall readability of the text.

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