

European integration and quality of life: a comparative analysis of former soviet republics and CEE EU member states through the Lens of SDGs

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ABSTRACT

This study examines multidimensional quality-of-life trajectories in CEE EU Member States and non-EU former Soviet republics, beyond economic growth alone. This work use a multidimensional approach based on the principles of the Sustainable Development Goals to evaluate the progress in the quality of life of 12 countries that were part of the Soviet Union but not members of the European Union along with 11 countries of Central and Eastern Europe that entered the European Union (Poland, Hungary, the Czech Republic, Slovakia, Romania, Bulgaria, Slovenia, Croatia, the Baltic states Estonia, Latvia, and Lithuania). In particular, the analysis focuses on the “Fair Distribution” group of SDGs, specifically, poverty reduction (SDG 1), food security (SDG 2), health and well-being (SDG 3), education (SDG 4), gender equality (SDG 5), reduction of inequalities (SDG 10), effective institutions (SDG 16), and global partnerships (SDG 17). These SDG Scores are immediately connected to the living conditions, subjective well-being, and individual opportunities. Indicators reflect the ability of societies to “protect capabilities for flourishing”. Utilizing a comparative statistical analysis approach during the years 2000 to 2022, we examine the differences in the trajectory of multidimensional quality of life among current CEE EU Member States and non-EU Former Soviet Republics. The results demonstrate a phenomenon of partial convergence among these two categories of countries during the years 2000 to 2022. The analysis on component level reveals that the biggest decreases in gap between the two categories were related to reduced inequalities and poverty, education, food security, and health. The findings suggest that European integration is associated with higher multidimensional well-being of citizens, although the magnitude and scope of these benefits vary across domains and countries.

1. Introduction

The post-Soviet and Central and Eastern European (CEE) regions constitute a unique empirical ground for examining the multidimensional implications of integration and development (Libman and Vinokurov, 2012). While the transition from centrally planned economies to market-oriented systems has been widely studied in terms of economic performance and institutional transformation (Libman and Obydenkova, 2013; Ivaldi et al., 2019; Santagata et al., 2019), fewer

contributions have explored how these structural shifts have affected the quality of life and social sustainability of citizens (Hovakimyan et al., 2021; Jakovljevic et al., 2021). The process of European integration, culminating in the accession of eleven CEE countries¹ to the European Union (EU), has not only implied economic convergence but also the diffusion of governance norms, social protection models, and distributive mechanisms that are central to the achievement of the Sustainable Development Goals (SDGs) (Allen et al., 2018; Mangaraj and Aparajita, 2020).

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¹ As there is no universal definition of CEE countries, it is important to clarify the classification adopted in this study. We follow the definition provided by Eurostat and INSEE, which includes the 11 Central and Eastern European countries that are currently members of the European Union. For analytical purposes, the countries were classified into two mutually exclusive groups based on their current institutional affiliation rather than their historical origin: (i) CEE EU Member States and (ii) non-EU former Soviet republics. Consequently, although Estonia, Latvia, and Lithuania are historically former Soviet republics, they are included in the CEE EU Member States group throughout the analysis.

Starting from the concept of sustainability, traditionally conceptualized as a tripartite framework encompassing environmental, economic, and social dimensions (O'Connor, 2006; Alaimo and Maggino, 2020; Ciacci et al., 2025), this study isolates the social pillar aiming to investigate whether European integration has translated into tangible improvements in quality of life and equality of opportunity for citizens, beyond GDP (Gross Domestic Product) growth. Our work aligns with the categorisation of the SDGs developed by Costanza et al. (2016), which includes the so-called “Fair Distribution” SDGs relating to poverty reduction (SDG 1), food security (SDG 2), health and well-being (SDG 3), education (SDG 4), gender equality (SDG 5), inequality reduction (SDG 10), strong institutions (SDG 16), and global partnerships (SDG 17). The authors assert that these SDG Scores are directly linked to daily living conditions, subjective well-being, and individual opportunities. This allows us to identify the ability of societies to “protect capabilities for flourishing” (Costanza et al., 2016).

European integration can be interpreted as a multidimensional process extending well beyond economic convergence. While accession to the European Union has undoubtedly fostered market integration and macroeconomic stability, it has also promoted the diffusion of institutional standards, social protection mechanisms, democratic governance, and equal opportunity policies. These changes are likely to affect the quality of life of citizens not only in terms of rising income levels, but also through better education, health, social inclusion, efficiency of institutions, and distribution of resources. In this light, the quality of life is to be interpreted as an end result of the process of social sustainability, whereby institutional convergence emerges as one of the important enabling factors. This, in turn, means that when assessing the impact of European integration, multi-dimensional criteria should be used rather than conventional economic measures like GDP.

Existing research has demonstrated that the EU convergence processes have strengthened the quality of governance and trust in institutions in EU member countries (Jurlin and Čučković, 2010; Pérez-Moreno et al., 2020). Factors affecting the levels of corruption and unemployment have been analyzed respectively by Kálmán et al. (2025) and Antohi et al. (2025). Nevertheless, gaps remain in terms of gender equality, income distribution and access and quality of services (Pikturnaitė et al., 2025) indicating the uneven spread of benefits for social welfare (Shanta and Adedokun, 2025). Moreover, the gap between EU member countries and non-EU post-Soviet countries provides a chance to examine whether the integration dynamics function as a trigger for social advancement or simply mirror pre-existing advantages in institutions.

However, the two groups should not be regarded as strictly comparable counterfactuals. They differ in their historical trajectories, economic structures, geographical conditions, institutional settings, and initial levels of development. The comparison adopted here is therefore intended to identify differences in multidimensional well-being trajectories between two historically and institutionally distinct groups rather than to estimate the causal effect of EU membership.

Such differences in structural terms are taken into account explicitly when analyzing the observed AMPI results.

The collapse of the Soviet state has led to a fragmented welfare system, weak civic mobilization, and high vulnerability to inequality (Cook and Iarskaia-Smirnova, 2023; Levitt et al., 2023). The following nation-building processes have generated different paths of social policy development, which include EU-compatible welfare regimes in the Baltic countries, and residual or informal protection regimes in Central Asia (Aidukaite, 2009; Toots and Bachmann, 2010; Avlijaš et al., 2021). These legacies continue to shape the distribution of opportunities, gender roles, and access to health and education, dimensions directly captured by SDGs 1–5 and 10.

This contribution, which aligns with recent cross-regional analyses of sustainability and development patterns in Asia, Africa, and Latin America (Gereffi, 2018; Plečko and Bradač Hojnik, 2024), extending their comparative lens to the European periphery, aims thus to address

the following research question (RQ): “How do multidimensional quality-of-life trajectories differ between current CEE EU Member States and non-EU former Soviet republics over 2000–2022, and to what extent do these trajectories exhibit convergence?”

To address abovementioned RQ, the present paper proposes a comparative framework, constructed through the Adjusted Mazziotta–Pareto Index (AMPI). This non-compensatory methodology ensures that high performance in one area (e.g., education), cannot offset weaknesses in others (e.g., inequality or governance), thus preserving conceptual consistency with the indivisible nature of sustainable development (Mazziotta and Pareto, 2022; Fili et al., 2025).

The paper is organized as follows. In Section 2, we present the theoretical background underlying this study. In particular, the dimensions of sustainable development are analyzed based on previous literature (Section 2.1), and the comparative scenario describing the divergent trajectories of EU and non-EU post-Soviet countries in relation to the social pillar of the SDGs is outlined. Section 3 provides a detailed description of the methodology and the data that was utilized for the analysis. The results of the analysis are presented and discussed in Section 4. Finally, Section 5 provides conclusions, insights into this work, limitations, and future research directions.

2. Theoretical framework

This section first presents an analysis of the main dimensions of sustainable development, which are generally articulated into economic, social, and environmental domains, and their articulation in the SDGs (subsection 2.1). Secondly, in 2.2 we outline the conceptual background guiding the analysis, emphasizing how European integration and institutional convergence influence the social pillar of sustainability through the lens of the “Fair Distribution” cluster of SDGs.

2.1. The classification of SDGs in literature

The academic community tends to divide the SDGs into three key sustainability categories (i.e. economic, social and environmental dimensions), but there are often some variations in the SDGs that fall into one category or another. For instance, Paoli and Addeo (2019) estimated the performance of the Sustainable Development Goals (SDGs) in EU member countries. They categorized the SDGs into three dimensions: social (1, 3, 4, 5, 11 and 16), economic (8, 9, 10 and 17), and environmental (2, 7, 12, 13 and 15).

In their study of the new possibilities linked to the use of artificial intelligence in achieving the SDGs, Alonso et al. (2021) classify the SDGs into the main dimensions of sustainability and into subgroups. The social development (11, 16 and 17) and equality (4, 5, 10) goals fall into the social dimension, the resources (6, 7, 12) and natural environment (13, 14, 15) goals fall into the environmental one, and the life (1,2,3) and economic and technological development (8, 9) goals fall into the economic one. Boufounou et al. (2023) once again analyzes how companies' performance on environmental, social, and governance indicators influences customer choice. The following breakdown is provided: social (1, 2, 3, 4, 5, 11, 16), economic (8, 9, 10, 12) and environmental (6, 13, 14, 15) dimensions. The authors have decided to exclude SDG 17 from these three categories.

In this study, we adopted the framework developed by Costanza et al. (2016) to identify the SDGs most closely linked to people's well-being. This framework includes SDGs 1, 2, 3, 4, 5, 10, 16 and 17 in the social dimension. The authors define these indicators as those intrinsically linked to the fair distribution of resources and therefore truly capable of raising citizens' perceived well-being. The other two dimensions, namely the environment (6, 13, 14 and 15) and the economy (7, 8, 9, 11 and 12), concern natural and economic capital, respectively. Table 1 reports the classification of the 17 SDGs according to the framework proposed by Costanza et al. (2016). The empirical analysis focuses on the SDG Scores belonging to the Fair Distribution dimension (SDGs 1, 2, 3, 4, 5, 10, 16

Table 1

Classification of the 17 Sustainable Development Goals into the three sustainability dimensions according to Costanza et al. (2016).

Dimension	SDGs	Key themes
Social	1, 2, 3, 4, 5, 10, 16, 17	Poverty, hunger, health, education, gender equality, reduction of inequalities, strong institutions, partnerships
Environmental	6, 13, 14, 15	Clean water and sanitation, climate action, life below water, life on land
Economic	7, 8, 9, 11, 12	Clean energy, economic growth, innovation, sustainable cities, responsible consumption and production

Source: own elaboration based on Costanza et al. (2016).

and 17).

Building on this classification, the following subsection discusses how European integration may influence these dimensions through institutional convergence and social sustainability.

2.2. European integration through the lens of the social dimension

The idea of sustainable development has been developed during the past decades as a comprehensive approach that combines economic, social, and environmental aspects, with a growing focus on the social pillar as a factor of balanced and inclusive development (Hariram et al., 2023; Cai et al., 2025). In this comprehensive approach, the social aspect, which is usually described using a set of indicators such as poverty reduction, health, education, gender equality, and institutional quality, is the basis of human well-being and resilience (Pham-Truffert et al., 2020; Alaimo et al., 2022).

The European integration process, since the early 1990s, has been viewed as a transformative force that has impacted the quality of governance, institutionalization, and social norms in the CEE countries (Grabbe, 2003; Vučković et al., 2021).

The EU membership process of post-socialist countries has led to

changes within the welfare system, educational policy, and gender policy, which have produced positive effects in the social field (Silova, 2009).

However, empirical research shows that convergence has been uneven between fields and between countries (Polese, 2023; Hoppe and Libman, 2024). Researchers show that while CEE-EU countries have made progress in governance, education, and healthcare, significant disparities exist, particularly with respect to income distribution, gender disparities, and trust in institutions (Orenstein, 2008; Dorjnyambu, 2025).

In contrast, the non-EU post-Soviet republics display slower progress in social sustainability due to weaker governance mechanisms and fragmented welfare systems inherited from the Soviet period (Di Quirico, 2011; Odosashvili and Martin, 2025). In Fig. 1 the CEE and post-Soviet countries are shown.

The dissolution of the USSR (Union of Soviet Socialist Republics) created a dual trajectory in the region's development (Brown, 2015; Zemliansky and St. Amant, 2013). The Baltic and Central European countries, benefiting from Europeanization processes (Svetlicinii et al., 2025), rapidly integrated market reforms with institutional modernization, whereas many post-Soviet republics followed divergent models emphasizing stability over inclusion (Strong, 1995; O'loughlin et al., 2014).

This gap is expressed in terms of well-being, health outcomes, education, and gender equity (Jakovljevic et al., 2021). The literature is increasingly suggesting the importance of institutional quality and the effectiveness of governance as the crucial mediators between economic development and well-being (Österle, 2010; Levitt et al., 2023).

The latest studies confirm the relevance of economic and institutional variables for social well-being. The contribution of macroeconomic stability and urbanization for social well-being is stressed by Geng and Hassan (2025), while the influence of perceptions of corruption in EU member countries on a wider range of institutional and socioeconomic variables has been demonstrated by Kálmán et al. (2025). All these studies underline the necessity to take into account economic

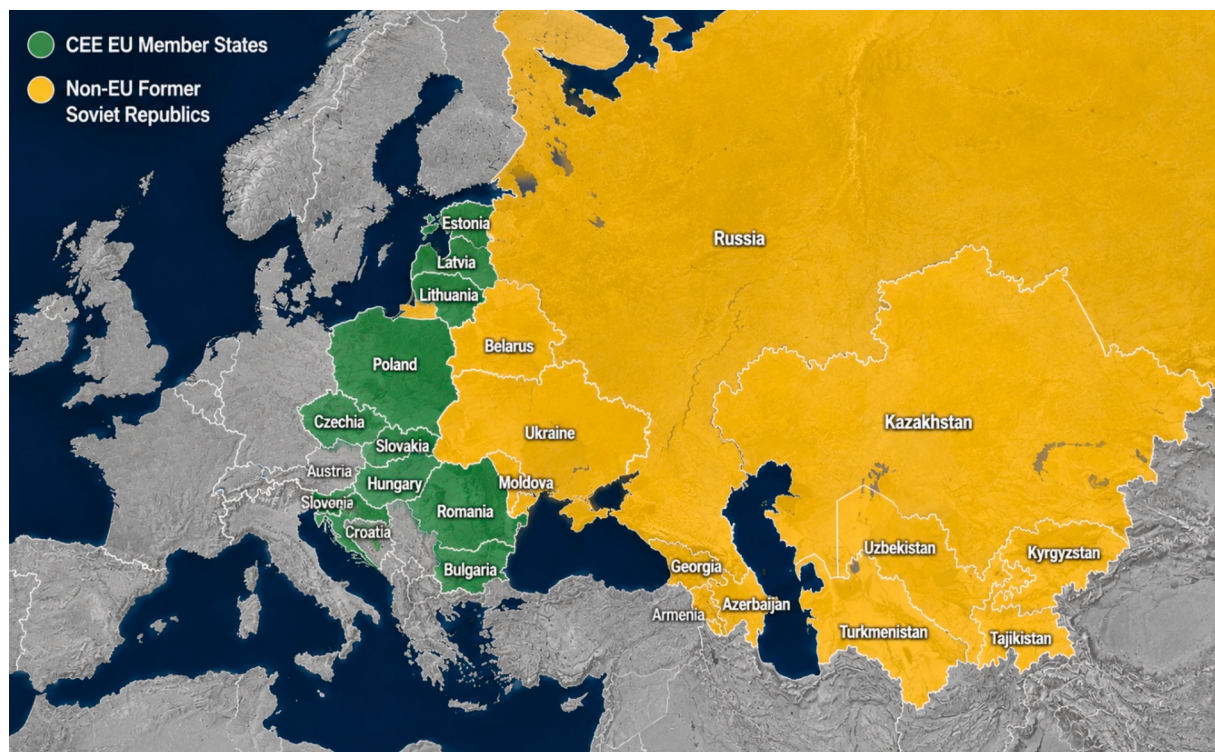


Fig. 1. Geographic distribution of the countries included in the study.

Source: Authors' elaboration based on Natural Earth boundaries.

and institutional variables to explain differences in multidimensional well-being between countries.

The comparative research underscores the role of EU membership as an external determinant which helped these countries to create effective governance and the rule of law which are necessary preconditions for achieving SDGs (Allen et al., 2018; Al-Thani and Koç, 2024). In turn, post-Soviet countries which were unable to join EU have experienced more fragile institutional development which is usually accompanied by corruption, weak administrative capacity, and distrust of people.

The relationship between integration and quality of life has also been investigated using the approach of multidimensional well-being studies. Fili et al. (2025) have shown that the results of environmental sustainability in the same regional context are strongly connected to the quality of governance and economic convergence, implying the same for the social dimension. Research using the human development and social progress approaches (Barrington-Leigh and Escande, 2018; Landi et al., 2018) have verified that multi-dimensional approaches enable a more comprehensive view of social progress because they include mutually dependent aspects of human development. In addition, cross-regional studies in Asia, Africa, and Latin America have supported the idea that institutional consistency and social inclusiveness are universal drivers of sustainable development paths (Lewis, 2013; Anokye et al., 2025). The literature underlines that social sustainability in post-transition societies is not only dependent on economic growth but also on strong institutions, distributive mechanisms, and inclusive governance. European integration has brought about some progress in terms of these factors for the CEE members, but the ongoing disparities in income levels and institution building suggest that there is need for an even approach that will help balance development and equity. Through analyzing the evolution of both EU and non-EU post-Soviet republics in terms of the “Fair Distribution” SDGs, this research adds to the existing literature and sheds light on the impact of integration processes on quality of life.

2.3. Novelty of the paper compared to similar studies

Macro analysis in recent times has used the concept of multi-criteria approaches in the assessment of dynamic sustainability performances of various regions. For example, in one case, Shmelev (2011) uses an approach of uncertainty randomization in the evaluation of dynamic sustainability of the economy of Russia from 1985 to 2008. In another case, Shmelev (2025) evaluates the sustainable developments of 14 major economies of the world (including OECD economies, China, and Brazil) in 1960–2015 by using linear aggregation approach with policy weights. This paper goes further than previous works in three different ways.

First, geographically and institutionally, rather than considering the case of the development of just one country (Shmelev, 2011), or the mixed case of global economic leaders (Shmelev, 2025), the present research focuses precisely on CEE member states and the non-EU post-Soviet republics. This makes it possible for authors to examine the influence of one institutional procedure: EU integration. Secondly, from a methodological perspective, it should be noted that, instead of applying a tripartite (economic, social, environmental) approach, we isolate the social dimension (“Fair Distribution” SDGs). Also, we use the Adjusted Mazziotta-Pareto Index (AMPI), non-compensatory index, combined with Canonical Discriminant Analysis (CDA) for the 2000–2022 period.

In addition, in relation to the policy factors that drive the identified performance differences among the countries, the latest body of literature emphasizes that the sustainability performance of nations is highly dependent upon institutional and socio-economic determinants. In this regard, Hezardastan and Shmelev (2025) showed how particular policy tools (such as taxation policies) and socio-economic measures (for instance, education level) serve as important drivers for sustainable waste management and circular economy systems within countries with different institutional regimes, such as the UK and Finland. Relying on this assumption, we believe that the institutional framework of the EU

integration – the mechanism that promotes the spread of governance values, education standards, and social safety nets – may represent one of several institutional factors associated with the different multidimensional quality-of-life trajectories observed between the two groups of countries.

3. Methodology

3.1. Analytical framework

The study compares multidimensional quality-of-life trajectories between the two country groups beyond economic growth alone.

As illustrated in Fig. 2, the research was developed through eight sequential phases. First, the study selected the countries and the SDGs belonging to the “Fair Distribution” cluster. Second, country-level SDG Scores for the selected Goals were obtained from the Sustainable Development Report 2023 database. The variables employed in this paper are the SDG Scores of countries which appear in the Sustainable Development Report (SDR) 2023. They are composite indicators calculated using the officially approved method of the SDR, based on several harmonized international indicators. This paper makes use of the published SDG Scores as the input variable for AMPI without reproducing them from the underlying elementary indicators.

Thirdly, the Adjusted Mazziotta-Pareto Index (AMPI) was estimated for each country in the period 2000–2022. Finally, Canonical Discriminant Analysis (CDA) is used to evaluate statistical differences between EU member countries and former Soviet republics.

To better capture this multi-dimensional view, we chose to use the Adjusted Mazziotta-Pareto Index (AMPI) as a composite measure of well-being. The analysis is conducted on eight SDGs that belong to the so-called “Fair Distribution” group: SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 10 (Reduced Inequalities), SDG 16 (Peace, Justice and Strong Institutions), and SDG 17 (Partnerships for the Goals). These SDGs include the most crucial factors that influence human development and are directly linked to the living standards of citizens. The AMPI was estimated annually for 23 countries (12 non-EU former Soviet republics and 11 CEE countries that joined the EU) over the period 2000–2022 using the SDG Scores reported in the Sustainable Development Report 2023 database. These SDG Scores are composite measures calculated according to the official SDR methodology from multiple internationally harmonized indicators. Therefore, the variables that have been considered for the AMPI include published SDG Scores and not the elementary indicators used to calculate the scores. Hence, in the current analysis, the published SDG Scores are used as the input variables and not their elementary indicators. When it comes to incorporating SDG Scores that are pre-aggregated into a second composite measure, there are certain precautions that need to be taken from a methodological point of view. This is since SDG Scores themselves aggregate multiple elementary indicators. This approach may entail implicit weighting effects, as the number and relative contribution of elementary indicators underlying each SDG Score are not necessarily identical across Goals. Moreover, some elementary indicators or closely related dimensions may contribute to more than one SDG Score, potentially introducing partial redundancy or correlation among the dimensions subsequently aggregated by the AMPI. In the present study, however, the eight published SDG Scores are treated as distinct goal-level dimensions rather than as elementary indicators. The AMPI should therefore be interpreted as a synthetic measure of balanced performance across these eight SDG dimensions, rather than as a direct aggregation of the underlying elementary indicators. Table 2 summarizes the eight SDG Scores used as input variables for the construction of the AMPI composite index.

Each SDG Score was subsequently normalized according to the AMPI normalization procedure and then aggregated using the non-compensatory AMPI procedure to obtain the composite index. The

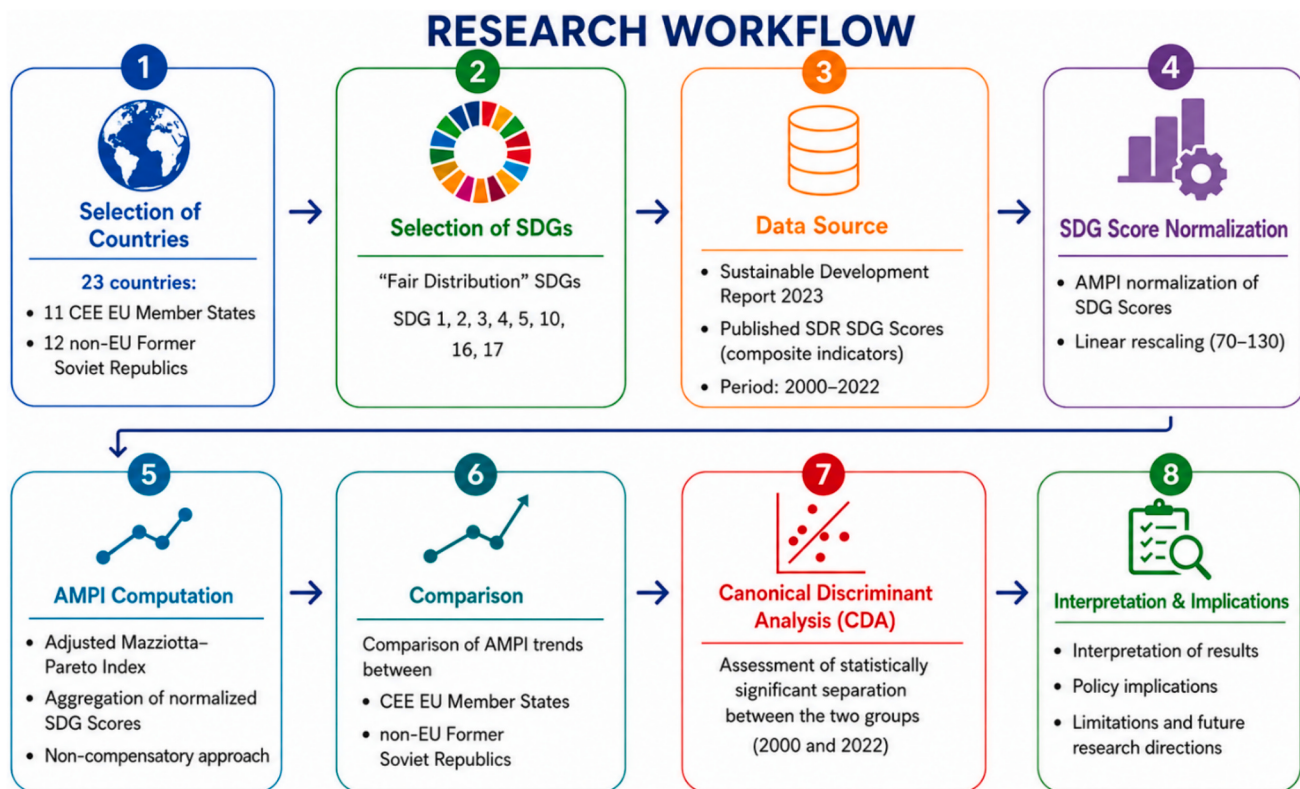


Fig. 2. Analytical framework of the study.

Source: own elaboration.

Table 2

Published Sustainable Development Goal (SDG) Scores used as input variables for the construction of the Adjusted Mazziotta–Pareto Index (AMPI) (Unit score 0–100).

SDG Score	Sustainable Development Goal
SDG 1 Score	No Poverty
SDG 2 Score	Zero Hunger
SDG 3 Score	Good Health and Well-being
SDG 4 Score	Quality Education
SDG 5 Score	Gender Equality
SDG 10 Score	Reduced Inequalities
SDG 16 Score	Peace, Justice and Strong Institutions
SDG 17 Score	Partnerships for the Goals

Data source: Sustainable Development Report 2023 (Sachs et al., 2023).

AMPI is computed according to the procedure originally proposed by Mazziotta and Pareto (2016) and subsequently refined by Mazziotta and Pareto (2022). Each indicator is first standardized according to its polarity and then aggregated using a non-compensatory approach, which penalizes unbalanced performances among the component dimensions. Following the standard AMPI methodology, the normalized values are subsequently rescaled through the linear transformation $\times 60 + 70$, which maps all SDG Scores onto the conventional interval [70,130]. This transformation is a methodological convention adopted to improve the interpretability and comparability of the indicators without altering their relative distances or the ranking of the statistical units (Mazziotta and Pareto, 2018).

The normalization step of the AMPI methodology is formally defined as follows: $X = \{x_{ijt}\}$ is the “raw” matrix where x_{ijt} is the value of j -th indicator I unit I in time t , and the constrained re-scaling equation allows to show how all SDG Scores are to be represented within an established range [70, 130]. The normalization process uses predetermined benchmark or goalpost values, which relates to the reference year 2000

(i.e. the year data were first collected).

The year 2000 was also adopted as the common starting point for the longitudinal comparison. However, the CEE countries considered in the analysis joined the European Union at different times, with most entering in 2004, Bulgaria and Romania in 2007, and Croatia in 2013. Consequently, the 2000–2022 trajectories encompass different pre- and post-accession periods across countries. The analysis is therefore not intended to identify a causal effect of EU accession or to isolate pre-accession from post-accession effects. Rather, it provides a comparative assessment of the evolution of multidimensional well-being over a common observation period, contrasting the trajectories of current CEE EU Member States with those of non-EU former Soviet republics.

The AMPI is calculated as follows:

$$r_{ijt} = \frac{x_{ijt} - \text{Min}_{xj}}{\text{Max}_{xj} - \text{Min}_{xj}} \times 60 + 70 \quad (1)$$

Where Min_{xj} and Max_{xj} are the “goalposts” for the indicator j namely the minimum and maximum values of indicator j observed across all countries and years considered. Since all SDG Scores are of positive polarity, high normalized scores indicate good social development results. The goalposts are defined using the following formula:

$$\text{Ref}_{xj} \pm \Delta_j \text{ with } \Delta_j = \frac{\text{Sup}_{xj} - \text{Inf}_{xj}}{2} \quad (2)$$

In Eq. (2), Ref_{ijt} denotes the reference value for indicator j , calculated as its mean across all countries in the baseline year (2000), while Inf_{xj} and Sup_{xj} denote the lower and upper limits used to define the normalization range. These quantities provide a common reference framework for the normalization of each SDG Score over the 2000–2022 period. The normalized SDG Scores are subsequently aggregated through the non-compensatory AMPI formulation.

Depending on the polarity of the phenomenon under investigation,

the Adjusted Mazziotta–Pareto Index can be computed either as AMPI₋ for positive phenomena, or AMPI₊ for negative phenomena (Mazziotta and Pareto, 2016, 2018). Since all SDG Scores included in this study were oriented so that higher values correspond to more favourable social development outcomes, the AMPI₋ formulation was adopted. Accordingly, the penalty term is subtracted from the arithmetic mean, reducing the composite score of countries characterized by greater imbalance among the component indicators while preserving the non-compensatory nature of the index.

$$\text{AMPI}_{-i} = \mu_{ri} - \sigma_{ri} \text{CV}_i \quad (3)$$

Where $\text{CV}_i = \frac{\sigma_{ri}}{\mu_{ri}}$ is the coefficient of variation for the unit i . The penalty term is subtracted from the arithmetic mean to penalize greater imbalance among the normalized indicators while preserving the non-compensatory nature of the index.

Because the AMPI uses a non-compensatory aggregation approach, the negative impact of increased variance on the mean scores leads to greater variation in the degree of internal disparity within each index. Therefore, it is impossible for a poorly performing country to mask that deficiency by having a high score in another dimension. This characteristic of the AMPI makes it particularly valuable in evaluating a country's equal and balanced achievement of sustainability objectives.

To complement the AMPI results, a component-level downside sensitivity analysis was performed on the eight underlying SDG Scores. Since all published SDG Scores are expressed on the same 0–100 scale, for each country-year we calculated the squared shortfall of each below-average SDG Score relative to the country-specific mean of the eight dimensions and expressed it as a share of the total squared shortfall across below-average dimensions. This diagnostic does not represent an algebraic decomposition of the AMPI penalty term; rather, it identifies which relatively weak SDG dimensions contribute most to within-country downside imbalance.

The most important characteristics of the AMPI are its robustness, ability to be compared over time and space, and ability to capture the multi-dimensions of full well-being without the distortions that can be created through compensatory aggregation, such as arithmetic mean or principal component score analysis. Because of these qualities, the AMPI has been widely used in disparity analysis, sustainable development, and quality of life studies at the regional and international levels.

3.2. Discriminant analysis

To evaluate whether AMPI values provide a statistically measurable differentiation between the two country groups, we applied Linear Discriminant Analysis (LDA) using the AMPI values as input data and the country group (EU vs non-EU former Soviet republics) as the categorical variable. LDA determines one or more discriminant functions, which are linear combinations of predictors, that provide maximum separation of the groups by maximizing the ratio of between-group variance to within-group variance. The discriminant function helps in the classification of countries into pre-defined groups. The effectiveness of the model is evaluated through:

- the percentage of correctly classified observations.
- the Wilks' Lambda test for overall model significance.
- and the posterior probabilities of group membership.

Furthermore, the analysis includes a plot of the canonical discriminant function, wherein the values for the first canonical discriminant function are plotted, providing a clear picture of the relative locations of the two groups on a chart. As is common in applications of LDA to comparisons of territorial disputes, the method determines the discriminant functions such that there is maximum variability between the groups. Given that the discriminant model uses a single predictor (AMPI), normality was assessed separately within each group using the

Shapiro–Wilk test, while homogeneity of variance was evaluated using Levene's test. For 2000, the Shapiro–Wilk test did not indicate significant departures from normality for either CEE EU Member States ($W = 0.962$, $p = 0.793$) or non-EU former Soviet republics ($W = 0.976$, $p = 0.965$). Similarly, for 2022, normality was not rejected for either group ($W = 0.898$, $p = 0.177$ and $W = 0.893$, $p = 0.128$, respectively). Levene's test likewise did not reject homogeneity of variance in either 2000 ($F = 3.626$, $p = 0.071$) or 2022 ($F = 0.208$, $p = 0.653$). Thus, at the conventional 5% significance level, the diagnostic tests provide no evidence of substantial violations of the normality and variance-homogeneity assumptions underlying the discriminant analysis. Since neither normality nor variance homogeneity was rejected at the 5% significance level, there is no empirical evidence that the discriminant results are materially affected by violations of these assumptions. All the discriminant results were confirmed to be statistically significant based on four different multivariate tests: Wilks' Lambda, Pillai's Trace, Hotelling–Lawley, and Roy's Largest Root, where each test indicated statistical significance of the canonical model at $p < 0.01$.

However, there are some limitations of this research. First, potential selection and comparability issues arise from the composition of the two country groups. CEE EU Member States and non-EU former Soviet republics differ in their historical trajectories, economic structures, geographical conditions, institutional settings, and baseline development levels. Consequently, these two sets cannot be viewed as perfect counterfactuals to each other and cannot be compared based solely on the process of EU integration. Structural differences between them can play a role in the patterns observed as well. Another weakness of this approach is that the SDG scores are used as one of the inputs for the AMPI calculation. Since these SDG scores are aggregated indices themselves, there is a potential for inheriting implicit weights and connections within them. Future research could address this issue by reconstructing the analysis from the underlying elementary indicators and explicitly assessing their correlation and relative contribution to the final composite measure. A further methodological limitation concerns the repeated-country structure of the annual data. The AMPI trajectories from 2000 to 2022 are based on repeated observations for the same countries and therefore may exhibit temporal dependence. In the present study, these annual trajectories are used descriptively to assess the evolution of multidimensional well-being, while the discriminant analyses are conducted separately for 2000 and 2022 and therefore rely on cross-sectional country observations at each time point. Serial correlation was not explicitly modelled through a longitudinal panel specification. Consequently, the results should not be interpreted as causal longitudinal estimates. Future research could extend the analysis by applying panel-data or other longitudinal models that explicitly account for within-country dependence and heterogeneous temporal dynamics. The future study can adopt the mixed method approach in order to overcome the limitations of the current research.

4. Results and discussion

This section presents the results of the comparative analysis between Central and Eastern European (CEE) EU member states and former Soviet republics that remain outside the European Union. Quality of life indicator with multiple dimensions was developed using the Adjusted Mazziotta–Pareto Index (AMPI), which was calculated for the “Fair Distribution” cluster of the Sustainable Development Goals. It is necessary to highlight that the AMPI is a non-compensatory index, therefore, it punishes asymmetric development across dimensions.

4.1. Longitudinal trends in AMPI values

Table 3 reports the AMPI scores for 23 countries from 2000 to 2022. The index is standardized, allowing for direct temporal and cross-country comparisons.

At the beginning of the observation period, the AMPI values of the

Table 3
Adjusted Mazzziotta-Pareto Index (AMPI) for Quality of Life, 2000–2022.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Armenia	89.01	89.81	89.52	90.01	90.00	90.80	92.02	94.47	94.62	95.03	95.51	96.34	96.54	96.92	96.84	96.92	95.62	95.26	95.60	97.37	99.63	98.47	98.54
Azerbaijan	85.05	88.62	92.40	92.13	92.76	92.69	92.80	92.86	93.04	93.24	93.70	94.43	95.16	96.41	96.39	96.50	96.89	98.82	99.54	99.92	101.04	101.44	101.22
Belarus	100.77	101.01	100.91	100.46	104.08	104.16	104.06	104.06	105.19	104.73	104.39	104.62	105.33	105.11	105.63	106.24	106.73	106.90	106.97	107.44	107.53	107.29	106.99
Bulgaria	98.36	100.42	100.48	100.00	100.95	100.37	100.71	99.64	102.50	101.78	102.03	101.75	101.28	101.73	100.61	100.24	98.61	99.50	98.63	99.44	99.10	99.33	99.49
Croatia	98.52	99.28	99.80	99.22	100.16	100.55	100.67	100.46	101.23	101.65	101.87	101.95	102.30	102.89	102.91	102.61	103.11	102.91	104.50	105.02	107.05	107.56	107.53
Czechia	102.17	102.71	103.09	102.85	104.16	103.70	103.66	103.55	104.52	104.87	104.40	105.39	104.59	105.64	106.39	106.97	106.93	106.19	106.38	106.65	107.63	108.18	109.05
Estonia	99.52	99.49	99.37	99.69	100.81	101.28	100.66	101.92	102.20	103.00	102.99	102.68	103.26	102.97	103.80	106.00	105.27	106.71	106.40	107.50	108.11	107.80	109.38
Georgia	87.31	88.64	89.58	90.31	91.50	91.78	91.87	91.87	92.09	92.51	91.80	92.73	94.03	94.74	95.56	96.52	97.59	96.62	98.13	98.66	99.63	99.66	99.85
Hungary	101.06	101.89	101.54	101.50	102.73	102.26	102.98	102.09	103.51	103.27	102.45	102.74	101.71	101.79	100.09	100.47	100.22	101.41	100.93	101.38	100.20	100.27	100.24
Kazakhstan	91.44	92.47	93.18	93.47	93.31	90.77	94.40	95.11	95.71	96.78	97.68	99.18	98.78	99.21	100.09	100.47	100.22	101.41	100.93	101.38	100.20	100.27	100.24
Kyrgyz Republic	91.62	92.95	93.18	93.52	92.67	92.63	90.89	93.66	94.25	95.87	95.96	97.42	97.43	97.38	97.66	98.20	99.06	100.43	100.93	100.83	100.54	100.40	99.91
Latvia	97.54	97.70	98.20	98.29	98.58	97.72	99.13	98.45	99.05	100.09	100.02	100.25	102.03	102.12	101.74	102.92	102.63	102.32	102.60	103.48	104.42	104.31	104.87
Lithuania	98.17	98.53	98.90	99.03	99.57	99.55	100.06	100.06	99.89	100.34	101.19	101.73	101.92	101.73	101.52	100.82	101.99	101.28	101.92	102.21	103.68	103.81	104.70
Moldova	94.20	94.28	95.77	96.06	97.37	97.43	98.01	96.88	99.05	98.91	98.94	99.88	100.43	101.22	102.37	101.63	102.28	102.71	103.70	104.61	103.87	106.87	107.24
Poland	100.80	102.05	102.12	101.94	102.57	102.97	103.06	103.41	103.93	104.47	104.65	104.89	105.57	104.97	106.16	106.50	106.87	107.10	106.88	107.16	107.33	107.54	108.90
Romania	93.24	94.21	94.15	94.50	95.72	95.39	95.19	95.16	97.14	97.29	97.62	98.26	96.94	96.83	96.25	96.40	96.99	97.41	98.57	99.12	99.77	99.60	99.73
Russian Federation	90.94	91.68	92.12	91.46	91.70	91.62	91.77	92.06	93.45	93.21	93.50	94.97	93.86	94.39	95.56	96.47	97.83	98.87	99.08	99.46	100.49	100.43	99.97
Slovak Republic	101.70	102.54	102.66	102.25	102.97	102.37	103.47	103.42	104.49	104.01	103.55	104.53	104.26	103.92	105.37	105.41	104.96	104.94	105.42	105.76	106.67	106.87	106.89
Slovenia	105.18	105.48	106.58	105.48	106.66	106.90	106.56	106.49	106.75	107.05	107.97	109.65	109.56	108.62	109.89	110.01	110.22	109.81	109.33	109.81	110.28	110.27	110.40
Tajikistan	81.48	79.51	82.69	83.78	84.00	84.28	84.48	85.92	85.88	87.31	88.45	88.92	88.10	88.99	89.68	89.74	91.07	92.00	92.23	92.84	93.42	93.80	93.75
Turkmenistan	94.77	95.05	96.12	96.37	96.92	96.67	97.34	96.23	96.12	96.64	97.26	96.94	96.14	96.46	97.24	98.44	98.78	98.38	98.58	99.41	99.61	99.65	99.88
Ukraine	95.94	96.87	97.21	96.39	96.96	97.25	97.12	97.08	98.52	96.09	98.30	99.63	100.07	100.13	99.40	99.76	99.84	100.20	101.11	102.38	102.97	103.59	103.25
Uzbekistan	82.51	83.08	84.57	84.02	84.69	85.03	86.25	86.59	86.49	86.72	87.66	88.61	89.57	89.34	89.80	90.88	92.18	92.70	94.06	95.54	97.28	98.27	98.59

two groups of countries are clearly separated. The member states of the EU (such as Slovenia, the Czech Republic, Estonia, and Poland) are already close to or above 100, which means that they have a high level of multidimensional well-being. The former Soviet republics, on the other hand, generally start with lower AMPI values, although considerable heterogeneity is already evident within the group, with Belarus and Ukraine displaying comparatively higher levels of multidimensional well-being.

Since the EU enlargement in 2004, most CEE countries recorded overall improvements in AMPI, with particularly strong progress in the Baltic States and Central Europe. Among the non-EU post-Soviet countries, Belarus and Moldova continue to improve, while Kazakhstan also catches up. Tajikistan remains the weakest performer throughout most of the study period, while Uzbekistan, together with Kazakhstan, Belarus and Moldova, records substantial improvements over time. As seen from the country profiles in Fig. 3, the AMPI does not only measure progress, but balance in all different aspects of life. There is a widening gap in the beginning of the 2000s, which is then followed by a moderate level of convergence over time. This trend follows findings from other studies on the importance of institutions, education, and health.

To measure the convergence across the entire time span, the yearly difference between the average AMPI score of CEE EU Member States and that of non-EU former Soviet republics was calculated for each year from 2000 to 2022. The between-group difference fell from 9.24 AMPI points in 2000 to 5.14 points in 2022, resulting in a total decrease of around 44.4%. In the case of the entire series of years, the between-group difference demonstrated a considerable downward trend, with a predicted linear decrease of around 0.22 AMPI points annually. Correspondingly, the correlation between the year and the between-group gap was highly negative (Pearson's $r = -0.975$). While there is some year-to-year variation visible, especially toward the end of the time span, the overall 2000–2022 path suggests some convergence between the two groups, implying that the decrease in the difference did not only happen between the first and the last year of the period under consideration.

As a robustness check, the country rankings obtained through the AMPI were compared with those generated using the Dynamic DP2 distance method (Somarriba and Peña, 2009), employing the same eight SDG Scores. Rank-order concordance was measured annually for the 2000–2022-time frame via the Spearman's rho coefficient and Kendall's tau-b coefficient. To provide comparable analysis of changes in time, country-year observations were combined, and the dynamic DP2 was estimated within one reference frame for the entire time span of 2000–2022 (Ivaldi et al., 2026; Pavanini et al., 2026). Correlations were very strong and statistically significant at all points in time with Spearman's rho being between 0.949 and 0.997 and Kendall's tau-b being between 0.834 and 0.9. These results indicate a high degree of robustness of the country rankings to the choice of aggregation method."

4.2. Canonical discriminant analysis (CDA) on AMPI

To assess whether the differences in AMPI values translate into statistically significant separations between the two groups, a canonical discriminant analysis (CDA) was conducted for 2000 (Tables 4 and 5) and 2022 (Tables 6 and 7).

All multivariate tests, Wilks' Lambda, Pillai's Trace, Hotelling-Lawley Trace, and Roy's Largest Root, consistently confirm the statistical significance of the discriminant function ($p < 0.001$). All four multivariate test statistics (Wilks' Lambda, Pillai's Trace, Hotelling-Lawley Trace, and Roy's Largest Root) yielded the same inferential conclusion, consistently indicating a statistically significant separation between CEE EU Member States and non-EU Former Soviet Republics ($p < 0.001$). These results confirm that the discriminant function effectively distinguishes the two groups on the basis of the AMPI values. The discriminant function obtained from the AMPI data set for the year 2000 yielded a strong and highly significant separation between the EU and non-EU former Soviet republics groups. The canonical correlation ($r =$

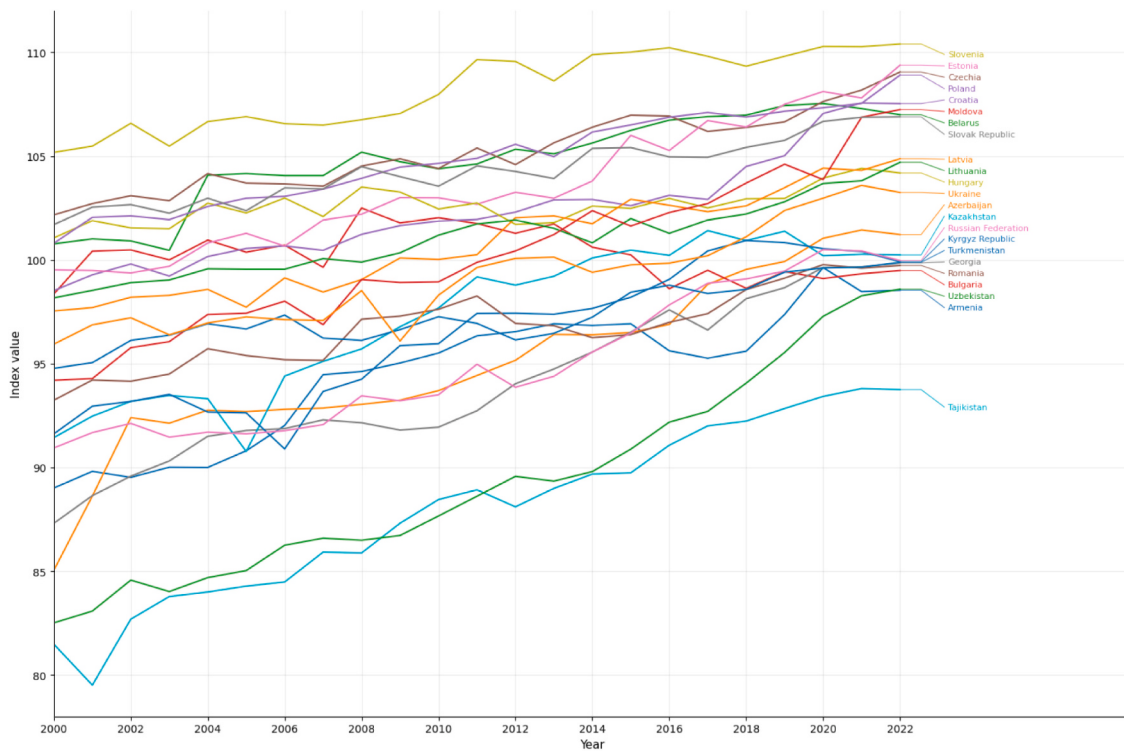


Fig. 3. Evolution of the Adjusted Mazziotta–Pareto Index (AMPI) for multidimensional quality of life in Central and Eastern European countries and non-EU former Soviet republics, 2000–2022.

Source: own elaboration.

Table 4
Canonical Discriminant Analysis Based on AMPI – Year 2000/1.

Eigenvalue	Percentage	Cumulative percentage	Canonical correlation	Likelihood ratio	Approx. of F	NumDF	DenDF	Prob>F
108,389,779	100,0000	100,0000	0,7,212,004	0,47,986,999	22,7619	1	21	0,0001*

Test	Value	F exact	NumDF	DenDF	Prob>F
Wilks' Lambda	0,47,987	22,7619	1	21	0,0001*
Pillai's Trace	0,52,013	22,7619	1	21	0,0001*
Hotelling–Lawley Trace	10,838,978	22,7619	1	21	0,0001*
Roy's Largest Root	10,838,978	22,7619	1	21	0,0001*

0.72; $r^2 \approx 0.52$) indicates a strong association between the discriminant function and group membership. Out of 23 observations (Table 5), three countries were misclassified (13.0%): Belarus (actual non-EU former Soviet republics → predicted EU), Romania (actual EU → predicted non-EU former Soviet republics), and Ukraine (actual non-EU former Soviet republics → predicted EU). All the three countries have AMPI scores in the range from 95 to 100, which means that they are located on the borderline between the two groups.

Overall, in 2000 the EU group exhibited a higher and more homogeneous quality-of-life profile, whereas the non-EU former Soviet republics group was more dispersed and internally heterogeneous. The entropy $R^2 = 0.51$ further indicates relatively strong classification performance in 2000. To examine whether this separation persisted over time, the same canonical discriminant analysis was subsequently performed using the 2022 data.

In Table 6 the canonical discriminant analysis is based on AMPI for 2022.

By 2022, the discriminant function remains statistically significant though weaker, with a canonical correlation of 0.59 and Wilks' Lambda of 0.66 ($p = 0.0033$). These findings indicate a weakening of the separation between the two groups and are consistent with a process of

partial convergence in AMPI values. However, the canonical model has retained its discriminatory power in distinguishing between the two country groups: CEE EU Member States and non-EU former Soviet republics; yet the overlapping of the two groups has increased, indicating similarity of well-being multidimensional profiles. The results of classification give additional information on this process (Table 7). In 23 observations, four countries were misclassified (17.4%): non-EU former Soviet republics countries Belarus and Moldova were classified as EU, while EU countries Bulgaria and Romania were classified as non-EU former Soviet republics. This two-way flow across the group boundary shows a process of selective convergence, where some post-Soviet countries (notably Belarus and Moldova) have reached the AMPI level similar to that of Central and Eastern European EU member states, while some EU member states (such as Bulgaria and Romania) have stayed below the average multidimensional performance of the Union. The predicted membership probabilities for these borderline countries, typically ranging between 0.6 and 0.8, confirm that they occupy an intermediate developmental position within the continuum between the two groups.

The fall in canonical correlation from 0.72 to 0.59 and the decrease in entropy R^2 from 0.51 to 0.28 lend additional support to this

Table 5
Canonical Discriminant Analysis Based on AMPI – Year 2000/2.

	Row	Effective	DistQuadr	Prob.	-Log (Prob)		Predicted	Prob (Predicted)	Others
Armenia	1	FORMER USSR (NON-EU)	0,092392	0,9301	0,072		FORMER USSR (NON-EU)	0,9301	
Azerbaijan	2	FORMER USSR (NON-EU)	1,339,094	0,9864	0,014		FORMER USSR (NON-EU)	0,9864	
Belarus	3	FORMER USSR (NON-EU)	4,981,303	0,0786	2544	*	EU	0,9214	
Bulgaria	4	EU	0,078407	0,8062	0,215		EU	0,8062	FORMER USSR (NON-EU) 0,19
Croatia	5	EU	0,060559	0,8165	0,203		EU	0,8165	FORMER USSR (NON-EU) 0,18
Czechia	6	EU	0,293,577	0,9553	0,046		EU	0,9553	
Estonia	7	EU	0,000944	0,8723	0,137		EU	0,8723	FORMER USSR (NON-EU) 0,13
Georgia	8	FORMER USSR (NON-EU)	0,449,719	0,9651	0,036		FORMER USSR (NON-EU)	0,9651	
Hungary	9	EU	0,091305	0,9299	0,073		EU	0,9299	
Kazakhstan	10	FORMER USSR (NON-EU)	0,047899	0,8245	0,193		FORMER USSR (NON-EU)	0,8245	EU 0,18
Kyrgyz Republic	11	FORMER USSR (NON-EU)	0,067190	0,8126	0,208		FORMER USSR (NON-EU)	0,8126	EU 0,19
Latvia	12	EU	0,208,781	0,7452	0,294		EU	0,7452	FORMER USSR (NON-EU) 0,25
Lithuania	13	EU	0,103,228	0,7930	0,232		EU	0,7930	FORMER USSR (NON-EU) 0,21
Moldova	14	FORMER USSR (NON-EU)	0,664,519	0,5889	0,529		FORMER USSR (NON-EU)	0,5889	EU 0,41
Poland	15	EU	0,060750	0,9223	0,081		EU	0,9223	
Romania	16	EU	1,917,442	0,3155	1154	*	FORMER USSR (NON-EU)	0,6845	
Russian Federation	17	FORMER USSR (NON-EU)	0,012567	0,8532	0,159		FORMER USSR (NON-EU)	0,8532	EU 0,15
Slovak Republic	18	EU	0,193,583	0,9458	0,056		EU	0,9458	
Slovenia	19	EU	1,414,465	0,9873	0,013		EU	0,9873	
Tajikistan	20	FORMER USSR (NON-EU)	3,716,211	0,9970	0,003		FORMER USSR (NON-EU)	0,9970	
Turkmenistan	21	FORMER USSR (NON-EU)	0,880,162	0,5286	0,637		FORMER USSR (NON-EU)	0,5286	EU 0,47
Ukraine	22	FORMER USSR (NON-EU)	1,415,991	0,4045	0,905	*	EU	0,5955	
Uzbekistan	23	FORMER USSR (NON-EU)	2,909,911	0,9954	0,005		FORMER USSR (NON-EU)	0,9954	
Origin	Count	Number of incorrectly classified		Percentage of incorrectly classified		R-squared entropy		–2 Log likelihood	
Training	23	3		13,0435		0,50,967		15,6128	

interpretation: indicating a weaker separation between the two groups in 2022 than in 2000. To sum up, by 2022, the two country groups are less distinctly differentiated than in 2000. The analysis of AMPI shows that a corridor of convergence has emerged, where some of the post-Soviet countries converged to the EU standards of multidimensional well-being, and some EU countries still remain behind the best ones. This pattern is more clearly illustrated by the canonical discriminant plot shown in Fig. 4.

The canonical discriminant plots synthesize the evolution of the multidimensional differentiation between the two groups of countries,

the CEE EU member states and the non-EU former Soviet republics, over the period considered. In 2000, the canonical plot clearly reveals two distinct and well-separated groups along the first discriminant function. These differences are based on the values of AMPI. The centroids, which represent the mean location of the groups, are quite far apart, ensuring that EU member states and post-Soviet republics were in two distinct regions of the multidimensional space of well-being.

The EU group is more compact and homogeneous, indicating a uniform pattern of balanced progress in the SDG dimensions, while the non-EU former Soviet republics group is more scattered, suggesting

Table 6

Canonical Discriminant Analysis Based on AMPI – Year 2022/1.

Eigenvalue	Percentage	Cumulative percentage	Canonical correlation	Likelihood ratio	Approx. of F	NumDF	DenDF	Prob>F
0,52,455,229	100,0000	100,0000	0,58,657,457	0,65,593,027	11,0156	1	21	0,0033*

Test	Value	F exact	NumDF	DenDF	Prob>F
Wilks' Lambda	0,6,559,303	11,0156	1	21	0,0033*
Pillai's Trace	0,3,440,697	11,0156	1	21	0,0033*
Hotelling–Lawley Trace	0,5,245,523	11,0156	1	21	0,0033*
Roy's Largest Root	0,5,245,523	11,0156	1	21	0,0033*

heterogeneous and relatively low levels of quality of life. Such an observation is in line with the findings obtained from statistical data, which demonstrate high eigenvalue, equal to 1.08; canonical correlation, amounting to 0.72; and Wilks' Lambda, equal to 0.48 ($p < 0.001$). In turn, such statistics indicate that the two groups of countries are clearly separated from each other. The two clusters partly overlap: some post-Soviet non-EU countries such as Moldova and Belarus approach the EU centroid, while some EU countries like Bulgaria and Romania are close to the second cluster.

The above-described trend indicates the reduction of multidimensional gap in well-being measured through AMPI, leading to partial convergence rather than full homogeneity. This conclusion is confirmed by the following statistical indicators: canonical correlation coefficient decreases to 0.59; Wilks' Lambda increases to 0.66 ($p = 0.003$). The latter means that even though the discriminant function is capable of distinguishing the two groups significantly, the distinction is not as noticeable as 20 years ago. In light of the above, the canonical plots and misclassification analyses are as follows: Belarus, Romania, and Ukraine in 2000; Belarus, Bulgaria, Moldova, and Romania in 2022. The gradual merging of the group distributions indicates a two-fold process: while European integration may be associated with a measurable degree of convergence through the improvement of the multidimensional capabilities of the CEE countries, the observed dispersion within and between groups bears witness to the persisting differences in governance, equality, and institutional development. Moving from two sharply distinct clusters in 2000 to a partially overlapping configuration in 2022, this transition encapsulates the core finding of the study—a process of selective convergence in multidimensional quality of life across the European and post-Soviet space. The discriminant results also suggested a weakening of the AMPI-based distinction between EU and non-EU countries over time, due to both the diffusion of institutional and social improvements beyond EU borders and the persistence of internal asymmetries within the Union itself. The combined statistical evidence supports selective convergence rather than full harmonization in multidimensional quality of life.

4.3. Interpretation and implications

These results prove that the AMPI approach works well in reflecting both the positive dynamics and existing gaps in terms of multidimensional well-being development in the European and post-Soviet regions. The fact that the AMPI approach penalizes uneven developments across the SDG dimensions means that, in addition to the level of development, its quality is also measured. The results suggest that European integration has been associated with multidimensional progress beyond economic growth, in line with previous literature. (Mann, 2015; Holobiuc, 2021; Beyer et al., 2025). However, the process of convergence is still not complete and is asymmetric (Pina and Sicari, 2021).

- High and sustained performance is observed in Slovenia, Czechia, Poland, and Estonia, all of which record AMPI values above 107 in 2022. Latvia and Lithuania also show substantial improvement over

the period, although their 2022 AMPI values remain below this threshold. These countries represent the most successful cases of integration, where EU membership has been accompanied by stronger institutional capacity, education quality, and social protection, leading to sustained and balanced advances in well-being (see Konieczna-Salamatin and Sawicka, 2021; Kapustāns, 2022; Bučar and Udovič, 2023).

- Partial convergence characterizes Moldova and Belarus, which display steady improvement and an increasing alignment with the multidimensional standards of the EU, though their institutional and governance frameworks remain more fragile (see Akhmetzharov and Orazgaliyev, 2021; Korosteleva and Petrova, 2023).
- In the 2022 discriminant classification, Bulgaria and Romania are classified with the non-EU former Soviet republics group.
- Persistent lagging is most evident in Tajikistan, whereas Uzbekistan and the Kyrgyz Republic have shown substantial progress over time but still remain below the highest-performing CEE EU countries. Our results are in line with Sodiqova et al. (2025) pertaining Tajikistan, Babaev et al. (2024) for Uzbekistan and Binkaya (2023) regarding the Kyrgyz Republic.

The decrease in the discriminant ability from 2000 to 2022 indicates that the disparities in the quality of life based on AMPI have been narrowed to a great extent. Despite the increase in convergence over time, it is important to note that there still exist some important disparities in multidimensional well-being between the two groups, as is evident from the AMPI scores and discriminant analysis.

The analysis serves to underline that EU membership and institutional proximity to EU norms are conducive to balanced progress across SDGs, given the embedding nature of countries in the relevant frameworks of governance, regulation, and cohesion funding that favor multidimensional well-being. However, the persistence of internal disparities among EU members points to the need for strengthened territorial and social cohesion policies, targeted especially at peripheral and less developed regions (Nagy and Benedek, 2021). In this perspective, the AMPI proves to be a sensitive and policy-relevant tool for monitoring the multidimensional consequences of integration. To provide a more direct component-level interpretation of the AMPI trajectories, the evolution of the eight underlying SDG Scores was also examined separately for the two country groups between 2000 and 2022. The largest reductions in the mean between-group gaps were observed for SDG 10 (Reduced Inequalities), whose gap declined from 13.67 to 3.20 points, and SDG 1 (No Poverty), from 25.09 to 14.94 points. Substantial narrowing was also observed for SDG 4 (Quality Education), SDG 2 (Zero Hunger), and SDG 3 (Good Health and Well-being). By contrast, the gap in SDG 16 (Peace, Justice and Strong Institutions) remained broadly stable, while the difference in SDG 5 (Gender Equality) slightly widened. These component-level results indicate that the observed convergence in the composite AMPI is associated primarily with improvements in inequality reduction, poverty, education, food security and health, whereas institutional quality and gender equality remain areas in which convergence is weaker or absent. Accordingly, policy recommendations should focus not only on sustaining progress in the dimensions that have

Table 7
Canonical Discriminant Analysis Based on AMPI – Year 2022/2.

	Row	Effective	DistQuadr (observed)	Prob (observed)	-Log (Prob)		Predicted	Prob (predicted)	Others
Armenia	1	FORMER USSR (NON-EU)	0,367,649	0,8581	0,153		FORMER USSR (NON-EU)	0,8581	EU 0,14
Azerbaijan	2	FORMER USSR (NON-EU)	0,013808	0,6893	0,372		FORMER USSR (NON-EU)	0,6893	EU 0,31
Belarus	3	FORMER USSR (NON-EU)	2,799,229	0,2045	1587		* EU	0,7955	
Bulgaria	4	EU	3,005,117	0,1912	1654		* FORMER USSR (NON-EU)	0,8088	
Croatia	5	EU	0,188,471	0,8265	0,191		EU	0,8265	FORMER USSR (NON-EU) 0,17
Czechia	6	EU	0,714,752	0,8939	0,112		EU	0,8939	FORMER USSR (NON-EU) 0,11
Estonia	7	EU	0,871,900	0,9049	0,100		EU	0,9049	
Georgia	8	FORMER USSR (NON-EU)	0,063345	0,7872	0,239		FORMER USSR (NON-EU)	0,7872	EU 0,21
Hungary	9	EU	0,218,809	0,5773	0,549		EU	0,5773	FORMER USSR (NON-EU) 0,42
Kazakhstan	10	FORMER USSR (NON-EU)	0,021688	0,7620	0,272		FORMER USSR (NON-EU)	0,7620	EU 0,24
Kyrgyz Republic	11	FORMER USSR (NON-EU)	0,055509	0,7835	0,244		FORMER USSR (NON-EU)	0,7835	EU 0,22
Latvia	12	EU	0,080518	0,6380	0,449		EU	0,6380	FORMER USSR (NON-EU) 0,36
Lithuania	13	EU	0,108,391	0,6233	0,473		EU	0,6233	FORMER USSR (NON-EU) 0,38
Moldova	14	FORMER USSR (NON-EU)	3,028,084	0,1898	1662		* EU	0,8102	
Poland	15	EU	0,644,019	0,8881	0,119		EU	0,8881	FORMER USSR (NON-EU) 0,11
Romania	16	EU	2,789,352	0,2052	1584		* FORMER USSR (NON-EU)	0,7948	
Russian Federation	17	FORMER USSR (NON-EU)	0,048380	0,7798	0,249		FORMER USSR (NON-EU)	0,7798	EU 0,22
Slovak Republic	18	EU	0,068038	0,7894	0,237		EU	0,7894	FORMER USSR (NON-EU) 0,21
Slovenia	19	EU	1,458,655	0,9330	0,069		EU	0,9330	
Tajikistan	20	FORMER USSR (NON-EU)	3,604,630	0,9731	0,027		FORMER USSR (NON-EU)	0,9731	
Turkmenistan	21	FORMER USSR (NON-EU)	0,059214	0,7853	0,242		FORMER USSR (NON-EU)	0,7853	EU 0,21
Ukraine	22	FORMER USSR (NON-EU)	0,440,438	0,5101	0,673		FORMER USSR (NON-EU)	0,5101	EU 0,49
Uzbekistan	23	FORMER USSR (NON-EU)	0,350,005	0,8556	0,156		FORMER USSR (NON-EU)	0,8556	EU 0,14
Origin	Count	Incorrect classification number		Percentage of incorrectly classified		R-squared entropy		–2 Log likelihood	
Training	23	4		17,3913		0,28,317		22,8249	

contributed most to convergence, but also on addressing those dimensions in which substantial or persistent gaps remain. Overall, the results suggest that the observed convergence is multidimensional but uneven across the underlying SDG components. The AMPI framework makes these differences visible at the aggregate level, while the component-level analysis helps identify the dimensions in which convergence has been stronger and those in which persistent disparities remain.

The sensitivity analysis of within-country imbalance provides complementary evidence. Over the full 2000–2022 period, the largest

below-average contributions to internal imbalance among CEE EU Member States were associated with SDG 17 (Partnerships for the Goals), accounting on average for 59.9% of the total squared shortfall, followed by SDG 2 (Zero Hunger; 17.9%) and SDG 5 (Gender Equality; 15.8%). Among non-EU former Soviet republics, the imbalance was more broadly distributed across dimensions: the largest contributions were associated with SDG 2 (24.4%), SDG 16 (Peace, Justice and Strong Institutions; 19.5%), SDG 5 (16.1%), and SDG 1 (No Poverty; 15.8%). These results show that the dimensions underlying the AMPI imbalance differ substantially between the two groups. In particular, institutional

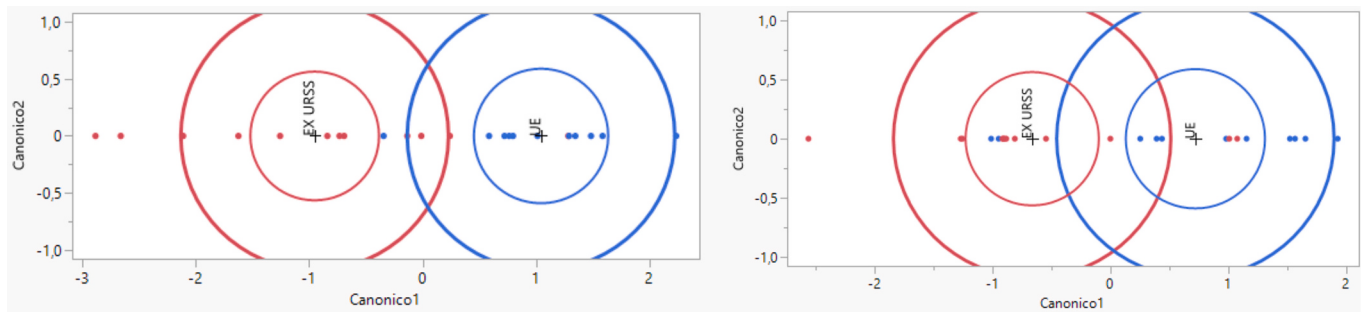


Fig. 4. Canonical Discriminant Plot Based on AMPI (2000 vs 2022). Comparison of group separation (EU vs Non-EU former Soviet republics) over time.
Source: Authors' elaboration based on canonical discriminant scores.

quality represents a considerably more important source of imbalance among non-EU former Soviet republics, whereas SDG 17 is the dominant weak dimension within the CEE EU group. Gender equality remains a relevant source of imbalance in both groups. These percentages should therefore be interpreted as shares of downside within-country imbalance rather than as an algebraic decomposition of the AMPI penalty term.

To interpret the differences in multidimensional quality of life between the two groups, it is important to consider the broader institutional context in which these trajectories developed. The comparatively better performance of several CEE EU Member States should not be interpreted as a simple consequence of economic growth or as a causal effect of EU membership; rather, integration into EU policy frameworks, including European Cohesion Policy, may represent one of several institutional factors associated with these trajectories. The access to European cohesion funds has been a direct cause of regional economic growth, increase in gross value added, and structural modernization (Shebanin et al., 2022). Moreover, these funds have provided substantial social externalities; as evidenced by Borz et al. (2022) and López-Bazo (2022), proper application and efficient promotion of EU-funded projects increases European identity among citizens and their support of the integration process. This macro-institutional anchor may have contributed to the modernization of public administration and the rule of law (SDG 16) and to the transition toward EU-compatible social protection systems.

On the other hand, the different approaches to development in non-EU post-Soviet republics mostly contribute to their underperformance. The transition era posed various sustainability challenges from different dimensions, as seen in the dynamic assessment of Russia's transition in terms of economic, environmental, and social shift (Shmelev, 2011). After the collapse of the USSR, such countries experienced fragmentation of their welfare systems, where political stability was prioritized over social inclusion. As emphasized by Shmelev (2025), in his broader assessment of world economies, sustainability performance highly relies on institutional governance, social coherence, and close integration of the three pillars of sustainability. In the absence of the coherent framework offered by the EU, post-Soviet nations have been unable to adopt the necessary policy instruments that function as essential drivers of multidimensional well-being. Furthermore, analysis of such varied macro trajectories necessitates robust analytical approaches, which Shmelev and Rodríguez-Labajos (2009) showed to be indispensable for grasping the true complexities of sustainable development, and where excellent economic performance cannot be used as a means of compensating for social weaknesses.

Additionally, macroeconomic policy interventions, including the adoption of the Euro or the retention of their own currencies, lead to diverse dynamics among nations belonging to the EU group. Comparative analysis conducted recently reveals that countries that adopted the Euro (like Slovenia, Slovakia, Lithuania, Latvia) enjoyed a stabilization strategy during economic crises recently experienced. As shown by

Panait and Radoi (2025), these countries had low volatility of interest rates, quick return to inflation, and stable FDI (Foreign Direct Investment) flows because of ECB (European Central Bank) tools that protected them from market fragmentation. Conversely, the reason why CEE countries that have not joined the Eurozone (such as Poland, Hungary, and Czechia) is mostly due to domestic political considerations. According to Dandashly and Verdun (2018), Euro skepticism by domestic elites, institutional veto players and tensions between the central bank and government have led to the delay in the process of Euro adoption. These countries, despite keeping their monetary sovereignty, have faced tougher periods of inflation and volatility of capital accounts. Indeed, Schadler et al. (2005) state that the process of the transition period and preparation to Euro adoption entails vulnerability for these countries as they experience rapid credit bubbles and pressure from capital inflows speculation. The combination of different macroeconomic environments (greater stability within the Eurozone versus the retention of national currencies in several non-euro-area EU Member States) may represent one possible factor contributing to the observed internal heterogeneity, particularly with respect to reducing inequalities (SDG 10).

Recent evidence also highlights substantial heterogeneity within the CEE group in specific dimensions of social development. For example, Pikturaite et al. (2025), examining access to higher education in the Baltic States and Poland through the Leaving No One Behind framework, found that progress in higher education attainment and accessibility remains uneven across countries, suggesting that convergence at the aggregate level may coexist with persistent disparities in specific dimensions of social inclusion.

5. Conclusions

This paper compares multidimensional quality-of-life trajectories in CEE EU Member States and non-EU former Soviet republics, adopting a broader perspective than economic prosperity alone. Using the multidimensional approach to the issue, based on the “Fair Distribution” SDGs, we conducted an empirical analysis of 11 EU members from Central and Eastern Europe (CEE) in comparison with 12 non-EU countries – former Soviet republics for the years 2000–2022, utilizing the Adjusted Mazziotta-Pareto Index (AMPI) and Canonical Discriminant Analysis (CDA).

Our findings show that CEE EU Member States generally display higher levels of multidimensional quality of life than non-EU former Soviet republics, while the distance between the two groups has narrowed over time. The mean AMPI gap declined from 9.24 points in 2000 to 5.14 points in 2022, corresponding to an overall reduction of approximately 44.4%, indicating partial rather than complete convergence. The component-level analysis shows that the largest reductions in between-group gaps occurred for SDG 10 (Reduced Inequalities) and SDG 1 (No Poverty), followed by SDG 4 (Quality Education), SDG 2 (Zero Hunger), and SDG 3 (Good Health and Well-being). By contrast,

convergence was weaker for SDG 16 (Peace, Justice and Strong Institutions), whose between-group gap remained broadly stable, and for SDG 5 (Gender Equality), for which the difference slightly widened. These findings therefore point to a multidimensional but uneven convergence process.

These findings contribute to the literature by showing that the effects of European integration should be evaluated through multidimensional measures of well-being rather than solely through economic performance. The adoption of the “Fair Distribution” SDGs and the AMPI provides a non-compensatory framework capable of capturing balanced social progress and highlighting dimensions that may remain hidden when conventional economic indicators are used alone. Policies-wise, the findings highlight the importance of building stronger institutions, minimizing inequalities and formulating inclusive social policies in order to pursue sustainable and equitable development in Europe.

It is also necessary to note that certain limitations are present. First of all, while taking into account only the social aspect of sustainable development, the economic and environmental components are left aside. Furthermore, even though internationally comparable secondary data have been used, such aspects of the quality of life as social cohesion, trust and governance culture can hardly be measured using harmonized indicators. Finally, while the comparative AMPI-LDA approach reveals convergent trends, it does not identify any cause-and-effect links between European integration and multidimensional well-being.

Possible directions for future research may include the examination of other dimensions of sustainable development, use of the mixed-methods research approach and application of longitudinal or causal analysis.

CRediT authorship contribution statement

Tiziano Pavanini: Writing – review & editing, Writing – original draft, Conceptualization. **Tommaso Fili:** Writing – review & editing, Writing – original draft. **Enrico Ivaldi:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Enrico Musso:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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