



Long-term trends in sustainable development across the G7: a multidimensional perspective

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Abstract

This research investigates the sustainable development trajectories of the G7 countries, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. The analysis focuses on the three fundamental pillars of sustainability: the social, economic, and environmental dimensions, over the period 2000–2022. The construction of an interdisciplinary framework, based on few indicators such as poverty rates and education levels in the field, GDP per capita and unemployment rates in the economic sphere and CO₂ emissions and natural resource use in the environmental sector enables the research to make a comparative and temporal analysis of the sustainability performance of these advanced economies. Outcomes record uneven performance, with high economic standards, sustained social inequality, and persistent environmental problems. Studies also point to internal divergence in achieving sustainability goals, including signs of policy effectiveness and long-term commitment variation among G7 nations in balancing social inclusion, environmental protection, and eco-nomic development. These results fit the broader literature on sustainable development between developed countries and raise significant questions regarding the G7 model's capacity to launch global sustainability changes. Another crucial aspect is the role of renewable energy and energy efficiency in promoting sustainability. These findings offer practical insights for policymakers by highlighting the importance of integrated and differentiated approaches to sustainability, particularly in managing long-term trade-offs across economic growth, social equity, and environmental resilience.

Keywords Sustainable development · G7 countries · Emerging economies · Sustainability performance · Social · Economic · Environmental dimensions

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1 Introduction

Sustainable development has been an increasingly prevalent theme in international discourse since the release of the seminal 1987 United Nations report *Our Common Future*. That report defined sustainable development as the capacity to meet current needs without compromising the ability of future generations to meet their own (Villalobos and Carrasco 2025). This first set of definitions established a foundation for a shared vision of a more equitable and sustainable future and has since supported continued international efforts. The transition from the eight Millennium Development Goals (MDGs) to the more ambitious 17 Sustainable Development Goals (SDGs) was a key shift, emphasizing the interconnected nature of economic, social, and environmental challenges, and embedding the international community's aspiration for system change (Ciacci et al. 2024; Henderson and Loreau 2023; Alaimo et al. 2021; Dubash et al. 2021).

In the current global context, marked by climate emergencies, energy crises, and the aftershocks of the COVID-19 pandemic, the need to assess sustainability from a long-term, multidimensional perspective has become even more urgent. These converging challenges have brought new attention to how advanced economies can lead the global transition toward integrated and resilient development models.

Within this global environment, it has become an urgent task not only for policymakers and international organizations but also for the academic community, responsible for providing both conceptual and operational orientation (Lian and Changhao, 2024), to make sense of the multifaceted dimensions of sustainable development and to provide actionable frameworks for its attainment. The ecological footprint, as a rough estimate of the extent of human demand on nature versus the re-generative potential of the planet, is a useful metric to determine the sustainability of development trajectories (Radmehr 2022). Similarly, a country's energy mix, the breakdown of energy sources on which it relies constitutes a fundamental metric for both climate exposure and decarbonization potential (Dai et al. 2022).

The remaining key determinants of environmental sustainability are material productivity and resource intensity, which are increasingly recognized as being key levers in high-income economies such as the G7 economies. In these contexts, improvements in resource efficiency are likely to be linked with more advanced levels of technological maturity as well as with lower levels of environmental pressure (Celik et al. 2024). The G7 countries, which include Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States, play a pivotal role in shaping both the global economy and environmental governance (Albitar et al. 2024; Parra Saiani et al. 2024; Radmehr et al. 2022). These older economies, characterized by mature urbanization, high levels of industrialization, and competent political authority, represent critical laboratories for experimenting with how sustainability may be operationalized at scale (World Bank 2023; Khalid et al. 2022; Stern 2021).

Empirical studies have traditionally tested the impact of economic activities on the environment based on economic growth and per capita income variables. Although the variables provide a simple economic indicator, they do not capture structural change in the economy and the direction of technological change (Arnaut and Dada 2022; Balsalobre-Lorente et al. 2022; Taskin et al. 2022; Chu 2021). Hidalgo and Hausmann (2011) clarify that production requires not only labour and capital but also capabilities. Hidalgo and Hausmann originally developed the idea of economic complexity (2009).

Although numerous composite indicators have been developed to measure sustainability performance at the global and national levels (Yigitcanlar and Dizdaroglu 2015), the scholarly literature reveals a critical methodological gap. Relatively limited research has carried out unified comparative assessments drawing on all three dimensions of sustainability economic, social, and environment within a single coherent analytical framework, much less from a temporal perspective. A great deal of the literature is biased either toward environmental or economic indicators, with too little regard for synergistic interlinkages with social ones, which limits the potential for capturing the dynamic of sustainability in practice.

Additionally, there is a lack of longitudinal studies that examine how sustainability performance changes over time, especially in high-income nations. However, recent research such as Xin et al. (2023), Cui et al. (2022) and Zhang et al. (2021) have observed the unemployment rate to have a positively correlated relationship with CO₂. These findings show that they tend to move in a positively linear fashion, highlighting the complexities of employment dynamics vis-a-vis environmental connections (Azimi et al. 2024).

This paper aims to bridge a gap in literature by providing a comprehensive longitudinal assessment of sustainable development in G7 economies over the period 2000–2022. To this end, it employs a multifaceted model that draws on critical indicators across the three dimensions of sustainability: GDP per capita and employment rate (economic); poverty ratio and education (social); and CO₂ emissions alongside natural resource depletion (environmental). Through this integrated approach, the study evaluates the extent to which G7 countries have achieved a balance between economic growth, social equity, and environmental stewardship over time.

By conducting this temporal integrative analysis of the sustainability performance of the G7 nations, the research seeks to offer new insights into how major advanced economies are addressing the challenges of sustainable development.

By providing a longitudinal and non-compensatory assessment, this work offers an innovative contribution to the empirical literature on sustainability measurement. It enables a more nuanced understanding of national sustainability trajectories within highly developed economies, highlighting both convergences and persistent disparities among G7 members.

The remainder of this paper is organized as follows: Sect. 2 reviews the literature. Section 3 outlines the methodology and data sources. Section 4 presents and discusses the empirical findings. Section 5 concludes with key implications, limitations, and suggestions for future research.

This study contributes to both theory and practice by applying a robust, non-compensatory composite index to trace sustainability trajectories over time and by offering evidence-based insights that can support decision-making in complex governance environments.

2 Literature review

The literature used today reflects the growing effort towards quantifying sustainability in terms of time, particularly focusing on mature economies' attempts to address concerns regarding maintaining long-term balance on the three dimensions of sustainable development.

Sustainable development, following the Brundtland Report (1987), is defined as development that meets present needs without compromising the ability of future generations

to meet theirs. This definition underpins the three-pillar approach adopted in this study, encompassing economic growth, social inclusion, and environmental stewardship.

Sustainability is envisioned as the sophisticated reconciliation between economic growth, social equity, and protection of the natural world has grown more at the forefront of intellectual interest and policy making, most significantly in high-income contexts such as the G7 (Lian and Li 2024; Celik et al. 2024). Much of this work has dealt with exploring the relationship between economic growth and environmental impacts, usually framed in terms of the Environmental Kuznets Curve (EKC) hypothesis. Empirical tests of the EKC hypothesis for G7 nations have produced different, sometimes inconclusive, outcomes (Celik et al. 2024; Liu et al. 2022). For instance, Liu et al. (2022) re-investigated the CO₂ emissions versus income relationship with a new elbow regression approach, which offered better interpretations of the EKC. In the same vein, Celik et al. (2024) employed the EKC to examine the environmental effects of material productivity indicators across G7 countries during 1970–2019, confirming the validity of the curve for the United States and Germany alone. Complementarily, Khalfaoui et al. (2023) employed wavelet coherence analysis to further de-tangle dynamic interlinkages between carbon emissions and growth trajectories.

The elbow regression model, as proposed by Liu et al. (2022), identifies the inflection point in the income–emissions curve, allowing for more accurate testing of the EKC hypothesis in advanced economies. In addition, Radmehr et al. (2022) document a two-way causal link between renewable energy consumption and both income level and ecological footprint, highlighting mutual interdependence between energy transition and socioeconomic progress.

At the same time, the transition to renewable energy and pursuit of energy efficiency is central axes in the sustainability paradigm. Radmehr et al. (2022) unraveled a two-way link between renewable energy consumption, income levels, and ecological footprints for 1990–2018 for G7 economies. Azimi and Rahman (2024) provide empirical proof of the Environmental Phillips Curve in the G7 countries, and there is evidence that rising unemployment rates are associated with falling CO₂ emissions. Economic growth, economic policy uncertainty, and population size all have a positive long-term effect on emission levels, with the consumption of renewable energy and technological innovation resulting in long-term emissions decline. Dai et al. (2022) emphasized the key role of energy structure in determining climate vulnerability profiles, whereas Liu (2023) found a positive correlation between energy efficiency and indicators such as economic growth, energy prices, and the increasing share of renewables in G7 countries during 1990–2020.

The social sustainability dimension, while comparatively less concentrated, is manifested through studies on human capital, financial buffer, and inclusive growth. Lian and Li (2024) associated human footprints, human capital formation, and financial inclusion with sustainability success, acknowledging that these play a mediating effect on sustainability success. Luo and Li (2023) investigated the use of fiscal decentralization and human development indicators in shaping green innovation, affirming the underlying long-term contribution of education and human capital. Xiao and Tabish (2025) further carried this train of thought by investigating green finance procedures, demonstrating how educational advancement, openness in trade, and management of natural resources affect G7 nations' practice of sustainable investment. Contemporary literature emphasizes that sustainability is a multidimensional concept encompassing not only environmental and economic aspects but also, critically, the social dimension (Balsabore, 2025). Environmental degradation remains central to the

Sustainable Development Goals (SDGs), which also target poverty eradication, inequality reduction, and environmental protection (Heidarian 2025). Export-led growth is linked to domestic job creation and poverty reduction (Taha et al. 2023). Green growth policies, aimed at transitioning industrial structures towards more sustainable models, offer potential for new business opportunities and employment (Ghosh, 2024). Furthermore, governance quality plays a crucial role in advancing green growth and environmental protection. Key governance indicators, such as transparency, citizen participation, freedom of expression, and media freedom, are essential in ensuring public awareness and institutional responsiveness (Syed et al. 2025).

Environmental governance and regulation are another consistent theme in studies. Borozan et al. (2023) tested the impact of high environmental and business regulations on foreign direct investment flows, both between G7 economies and BRICS economies. Dahmani (2024) also explored the impacts of environmental tax systems and R&D-driven environmental technologies in driving ecological sustainability and the strategic policy architecture role in achieving sustainability goals.

Moreover, comparison with developing economies offers a context. Muguto and Muzindutsi (2022) contrasted volatility in BRICS stock returns and the G7 market based on opposing structural differences of financial systems. Nasim et al. (2024) examined determinants of banking efficiency in developed (G7) economies and developing (E7) economies and found mixed effects of institutions and regulatory systems.

Collectively, this literature highlights the multi-faceted nature of sustainability analysis in G7 economies, with dominant concern devoted to economic-environmental dynamics, renewable transitions, and policy responses. However, a comprehensively integrated, temporally harmonized approach that simultaneously records the evolution of economic growth, social justice, and environmental integrity is relatively under researched.

3 Materials and methodology

The data used in this research, for the G7 countries' sustainability performance from 2000 to 2022, came from the SDG Transformation Centre database and is available on Kaggle.com. The same database was used to produce the Sustainable Development Report 2023 by Sachs et al. (2023).

The economic dimension is measured using GDP per capita and the unemployment rate. The social dimension includes the relative poverty rate and educational attainment, proxied by secondary school completion. The environmental dimension comprises per capita CO₂ emissions and natural resource use, which reflects the ratio of domestic material consumption to GDP. All indicators are drawn from the SDG Transformation Centre database.

Measuring sustainable development requires an approach capable of integrating economic, social, and environmental dimensions into a single composite indicator. The Adjusted Mazziotta and Pareto Index (AMPI), which represents a variant of the original Mazziotta and Pareto Index (MPI) (De Muro et al. 2011; Mazziotta and Pareto 2012, 2016; Mazziotta and Pareto 2022), emerges as a robust non-compensatory approach for this purpose. It is adopted by the Italian National Institute of Statistics (I. Stat) for the analysis of complex phenomena over time (Müller-Fraczek 2023; Penco et al. 2020), but also across spatial dimensions (Mazziotta and Pareto 2018; Tarantola et al. 2000).

Its sequential construction process incorporates a penalty term, which contributes to its robustness, flexibility, and reproducibility. Consistently, the AMPI method offers a stable and reliable framework for constructing synthetic indicators in multidimensional assessment environments.

Mathematically, the index construction process is as follows: the raw data matrix $X = \{x_{ijt}\}$, where x_{ijt} represents the value of the j -th indicator for the i -th unit at time t , is re-scaled to a normalized matrix $R = \{r_{ijt}\}$ through a constrained re-scaling equation so that all indicators are represented within a given range [70, 130]. The normalization is anchored to fixed benchmark values, referred to as goalposts, which are derived from the reference year 2000 (i.e., the initial year of data collection). The formula used is:

$$r_{ijt} = \frac{x_{ijt} - \text{Min}_{xj}}{\text{Max}_{xj} - \text{Min}_{xj}} * 60 + 70,$$

where Min_{xj} and Max_{xj} are the “goalposts” for the indicator j . The goalposts are determined using the formula:

$$\text{Ref}_{ijt} \pm \Delta, \text{ with } \Delta = \frac{\text{Sup}_{xj} - \text{Inf}_{xj}}{2}$$

where Ref_{xj} denotes the reference value of the j -th indicator for unit i at time t , and Inf_{xj} and Sup_{xj} represent, respectively, the minimum and maximum values of indicator j across all units and time periods.

Under this setup, each basic indicator is rescaled so that the reference unit in the reference year assumes a value of 100, while all other values are expressed relative to this benchmark.

The final step concerns the aggregation of the normalized indicators into the composite AMPI index, calculated as:

$$\text{AMPI}_i = \mu_{ri} \pm \sigma_{ri} c_{vi}$$

where $c_{vi} = \frac{\mu_{ri}}{\sigma_{ri}}$ is the coefficient of variation for the unit i .

The penalty term is subtracted from the mean when variability increases, reflecting a worsening internal imbalance. This formulation ensures that higher internal disparity reduces the overall score, maintaining the non-compensatory nature of the index.

Here, the AMPI score for each unit i is composed of two elements: the arithmetic means of the normalized indicators μ_{ri} , and a penalty term $\sigma_{ri} c_{vi}$, where σ_{ri} is the standard deviation and c_{vi} is the coefficient of variation. This penalty component captures the “horizontal variability” of indicators within each unit and penalizes those with greater internal imbalance, thereby rewarding more consistent profiles at the same mean level. Higher AMPI scores indicate stronger, more balanced sustainability performance across dimensions.

The AMPI was chosen not only because it can aggregate over one dimension into a unidimensional index, but also because it is non-compensatory. This feature makes it best suited for the measurement of sustainability, where a weak performance in one dimension (e.g., the environment) should not be offset by a strong performance in another (e.g., the economy). The internal penalty of imbalance in the AMPI allows for a more precise record

of multidimensional well-being (Ivaldi et al. 2020), and national statistical institutes such as ISTAT further confirming its methodological rigor (Bruzzi et al. 2022) enhances it.

For multidimensional deprivation (MD), when the composite indicators are downward-oriented, i.e., larger values reflect worsening conditions, the correction is applied. That is, the standardized indicators are offset upwards by a positive penalty so that the index accurately reflects negative changes in the underlying phenomenon (Traversa et al. 2024; Ciacci and Traversa 2021; Penco et al. 2020).

4 Results

Figure 1 displays the Adjusted Mazziotta and Pareto Index (AMPI) time series for all G7 countries from 2000 to 2022. This composite index integrates the economic, social, and environmental dimensions into a single normalized score, where higher values indicate more balanced and sustainable performance across all pillars. Since 2010, a general upward trend is observable, suggesting a gradual convergence of G7 countries toward higher levels of integrated sustainability. Nevertheless, significant differences persist. Germany and France maintain the most stable and virtuous trajectories, likely supported by robust welfare systems, sustained investment in green infrastructure, and consistent public policy frameworks. In contrast, the United States and Canada reveal greater volatility, especially during periods of systemic stress such as the 2008–2012 financial crisis and the COVID-19 pandemic (2020–2021). These fluctuations highlight the role of institutional resilience and long-term policy continuity in ensuring steady progress toward sustainability goals.

Figure 2 focuses on the environmental sustainability dimension, which incorporates CO₂ emissions and natural resource use. Among the three pillars, this is the dimension that shows the greatest divergence across G7 countries. The United Kingdom and France demonstrate consistent improvements over time, likely attributable to proactive decarbonization strategies, significant investments in renewable energy, and the adoption of stringent EU environmental regulations. In contrast, the United States and Japan display more volatile

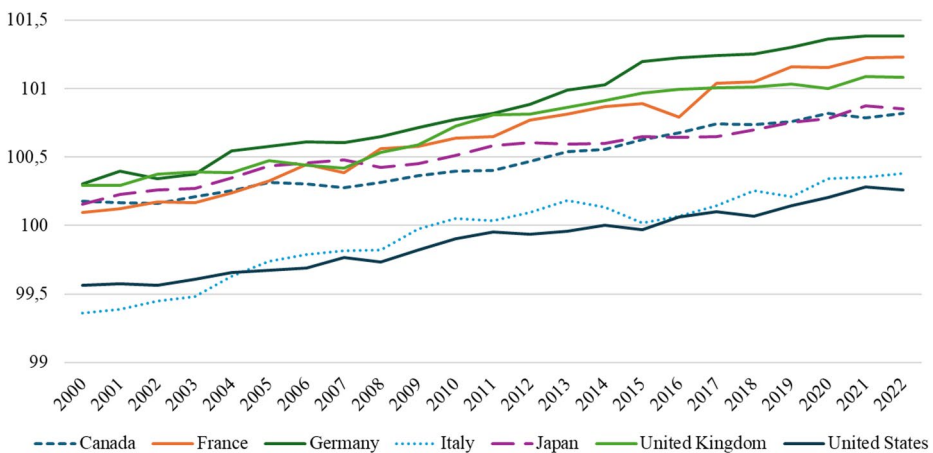


Fig. 1 Trends in G7 countries’ overall sustainability index from 2000 to 2022, combining economic, social and environmental dimensions.

Source Author’s elaboration

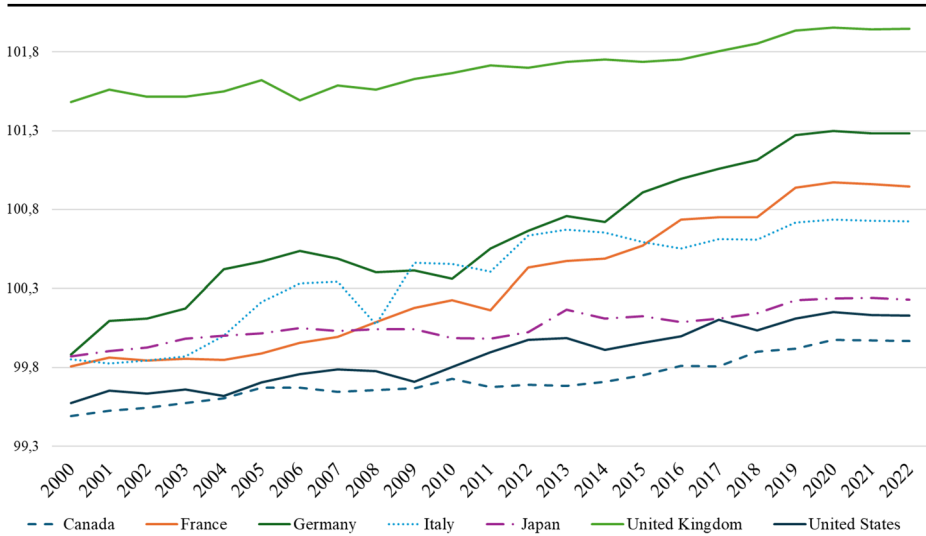


Fig. 2 Trends in the environmental sustainability index for G7 countries (2000–2022).

Source Author's elaboration

trajectories. Although recent improvements are evident, they remain insufficient to fully compensate for historically high levels of environmental degradation. Particularly noteworthy is the stagnation or reversal of progress in Italy and Canada after 2015, suggesting structural challenges in improving energy efficiency and reducing reliance on non-renewable resources. These disparities underline the urgent need for differentiated yet coordinated climate strategies tailored to the specific institutional and industrial contexts of each country.

Figure 3 presents the trends in the economic dimension, captured through GDP per capita and the unemployment rate. Among the three pillars of sustainability, the economic component appears to be the most homogeneous across the G7, with all countries showing a general upward trend over the period, albeit marked by clear interruptions corresponding to major global shocks. The 2008 financial crisis and the COVID-19 pandemic in 2020 produce visible dips across most national trajectories. The United States and Germany emerge as the most resilient, maintaining above-average scores and demonstrating strong recoveries driven by robust industrial capacity and technological innovation. In contrast, Italy consistently lags behind the group average, reflecting persistent structural weaknesses such as low productivity growth and chronically high unemployment. This underperformance highlights the limitations of economic expansion when not accompanied by inclusive social policies and structural reforms aimed at improving long-term sustainability.

Finally, Fig. 4 illustrates the evolution of the social sustainability dimension, measured through indicators such as poverty rates and educational attainment. The overall trend shows moderate improvement across most G7 countries, though with significant variation. Germany and the United Kingdom exhibit the most substantial progress since 2010, likely supported by active labor market policies, sustained investment in education, and redistributive social mechanisms. France presents a more gradual but steady trajectory of improvement. In contrast, Italy and the United States have experienced a relative decline in recent years, possibly driven by rising inequality, underinvestment in social infrastructure, and growing polarization in access to essential services such as education and healthcare. Japan,

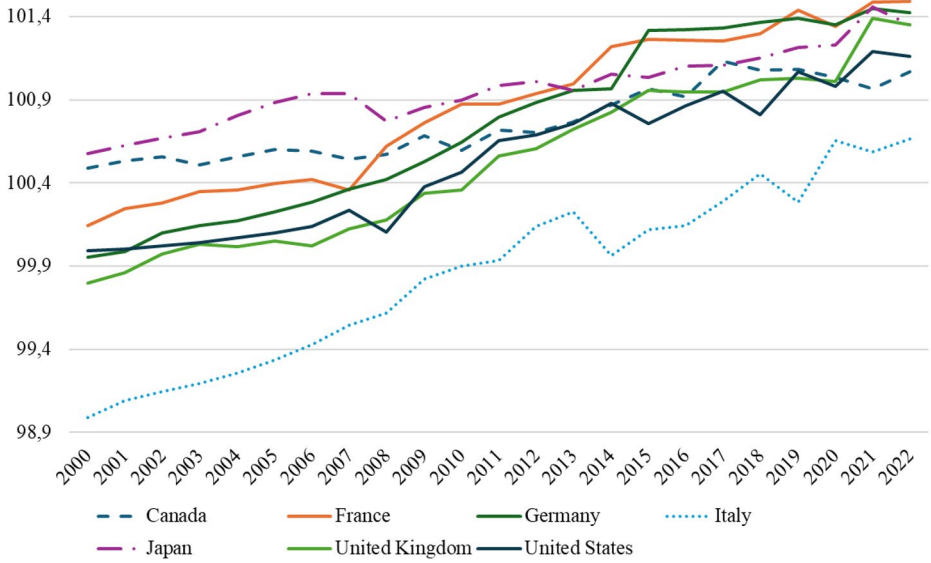


Fig. 3 Trends in the economic sustainability index for G7 countries (2000–2022).
 Source Author’s elaboration

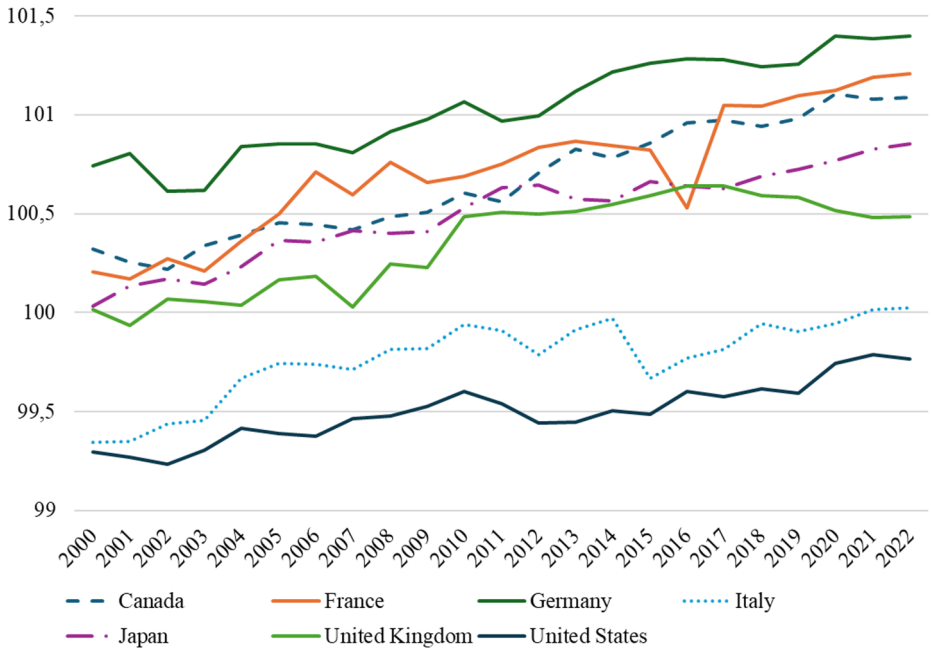


Fig. 4 Trends in the social sustainability index for G7 countries (2000–2022).
 Source Author’s elaboration

despite maintaining a medium–high level of performance, shows a marked deceleration after 2015, which may reflect increasing demographic pressure and challenges related to intergenerational inclusion. These patterns suggest that the social dimension is more vulnerable to structural imbalances and requires long-term, targeted policy interventions to ensure inclusive and equitable development.

5 Discussion

Although the general trends are clear, the proximity of the AMPI values across countries, especially in recent years, suggests limited statistical dispersion. Future research could benefit from calculating confidence intervals or applying statistical discrimination metrics to better assess cross-national differences.

To measure the transforming relationship between economic growth, social welfare, and environmental sustainability in G7 countries, a wide correlation between four composite indicators—overall, economic, social, and environmental—and GDP was conducted employing Spearman's rank correlation coefficient. As it is a non-parametric test that optimally identifies monotonic relationships without assuming normality and therefore suitable for multi-dimensional development indicators, it has been employed. The results display consistently high and statistically significant positive correlations between GDP and the overall index, with coefficients greater than 0.95 and often very close to 0.99 for all G7 countries in 2000–2022. This implies that economic growth has been followed by more general improvements in quality of life, although the force of this connection may partly be an artefact of the employment of overlapping variables in the construction of indices. The economic index data show a nearly perfect correlation with GDP trends, decelerating slightly in pandemic years, showing temporary shocks from global crises. The strong correlation between GDP and the economic aspect can partly be attributed to partially structural overlaps in the variables included in both. While this is good for internal consistency, it also demands caution in interpretation. The green index features extremely high correlation coefficients, with minimal recent divergence pointing to emerging stresses in balancing growth and environmental resilience. The people index, if similarly, highly correlated with GDP, is more sensitive to external shocks and exhibits a marginally worsening coherence since 2015, suggesting social well-being lags economic recovery. Longitudinal design also facilitates pattern detection and structural change for resilience, providing critical knowledge upon which to ground joined-up policy interventions. It thus helps to reconceptualize development in terms other than the purely economic and map a multidimensional definition of progress in the developed world.

It should be noted that the economic index includes GDP per capita as a component, potentially introducing endogeneity in the correlation analysis. Although this bias is acknowledged, the high correlations may also reflect structural overlaps. A more robust approach would involve correlating the three dimensions (economic, social, environmental) directly, or applying stationarity checks and first-differencing to mitigate spurious correlations in time series.

A second component of the study involving the initial aggregate analysis of the relationship between GDP and composite economic, social, and environmental welfare indicators included a dis-aggregated analysis at the national level for G7 members. Spearman correla-

tion coefficient was used once more as it is applicable in identifying monotonic relationships without assuming a normal distribution. The reasoning behind this approach stemmed from the need to uncover country-specific patterns hidden in aggregate data so that structural and policy-related differentials across countries could be identified more clearly. Spearman correlations for all the G7 members (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) provided data on how much GDP relates to improvement in the general well-being index (OVER) as well as the economic (EC), social (SOC), and environmental (ENV) areas.

Results revealed that there existed consistently high and high and meaningful positive correlation ($p < 0.01$, two-tailed) between GDP and OVER index in all countries, with a range from 0.95 to 0.99. This reveals an extremely tight relationship between economic growth and multifaceted developments in quality of life. Sectoral decompositions also confirmed that the economic index (EC) most closely correlated with GDP in all countries ($r > 0.96$ – 0.98), suggesting almost perfect correlation between macroeconomic performance and sectoral indicators such as employment and income. The environmental index (ENV) also had high correlations with GDP ($r = 0.90$ – 0.97), but slightly lower than for EC, especially in Japan and the UK. This means that while economic growth generally benefits environmental progress, these kinds of relationships are not as strongly linked and may be affected by other national environmental policies or outside ecological pressures.

There was even more heterogeneity in GDP relative to the social index (SOC). Canada, Germany, and the United States had high correlations ($r = 0.90$ – 0.96), whereas Italy and the UK had lower but still significant correlations ($r \approx 0.80$ – 0.82), indicating a less direct relationship between economic growth and social well-being in those cultures. These imbalances underscore the importance of policies that are country-specific to guarantee that economic growth is converted into social development that is inclusive and equitable.

Generally, the country-level results reinforce the robustness of the initial aggregate results yet also reveal large national differences with implications for sustainable development policy. States such as Canada, Germany, and the US appear to have achieved a superior balance between economic expansion and improvement in the quality of life, whereas the weaker social links in states such as Italy and the UK suggest potential for gaps in economic performance to be converted into greater societal welfare. These tendencies highlight the significance of policy measures aimed at the social dimension of sustainability alongside economic and environmental priorities.

6 Conclusions

The comparative analysis of the sustainability performances of the G7 nations offers a multi-dimensional view of the shifting priorities and policy orientations of the world's major economies. The evidence suggests that while the G7 group reflects a shared interest in sustainable development, there are substantial national variations along social, economic, and environmental axes. These variations are not merely the product of divergent institutional arrangements and policy choices, but also the product of the impact of historical legacies, socioeconomic structures, and political will.

Thematic convergence on some fronts, such as macroeconomic stability and technological progress, is juxtaposed with deep divergence on others, i.e., environmental and social.

These findings argue for a more cohesive, longer-term-oriented public policy that is sensitive to the extremely interdependent interaction among the dimensions of sustainability. In that case, internal heterogeneity within the G7 can be appreciated not as a weakness but as a wellspring of strength. Differing national trajectories can be fertile soil for cross-learning and experimentation, with the construction of adaptive and context-specific policy.

Policy-wise, the findings imply the need for coordinated yet differentiated policies, with a priority on systemic integration along with multi-level governance. Greater policy coherence, underpinned by international benchmarking and standard measures, could hold the secret to speeding up sustainability transitions. Second, the witnessed variability in sustainability trajectories across G7 nations underscores the scope for more integrated and forward-looking public policies. Countries can benefit from having national sustainability frameworks that are both internationally coherent and nationally distinctive, thereby fostering greater resilience, legitimacy, and effectiveness. Policymakers are therefore recommended to adopt flexible governance models facilitating innovation and experimentation together with accountability and long-term commitment.

Based on these results, policymakers in G7 countries should consider adopting sustainability strategies that explicitly balance all three pillars: economic, social, and environmental, rather than focusing on economic performance alone. The strong correlation of GDP with sustainability indicators is a signal that economic growth may be channeled into sustainable development only if supplemented with certain investments into social welfare and environmental resilience. While CO₂ emissions are widely used as a proxy for environmental degradation, it is important to note that CO₂ is not a pollutant per se but a naturally occurring gas essential for life. The causal link between anthropogenic CO₂ emissions and global temperature rise remains a debated issue in the scientific community, and future sustainability assessments may benefit from incorporating multiple environmental pressure indicators.

Future studies could explore how regional or urban uses of AMPI reveal additional inequalities, or combine this index with qualitative assessments to better understand local sustainability dynamics. Comparative studies with G20 or EU countries could also extend the scope of temporal benchmarking.

Future studies may also explore structural social risks such as demographic decline, which affects labor force availability and social security sustainability, particularly in Japan and Italy. Similarly, increasing cultural heterogeneity due to unmanaged migration flows may introduce challenges to social cohesion and long-term sustainability in G7 countries.

The research is subject to limitations that should be noted. First, the application of composite indices, while facilitating cross-country comparisons, can obscure key intra-country variations and institutional complexities. Second, the choice of indicators, while guideline-prescribed, entails inevitably normative subjective judgment that may bear on interpretability. Third, since the study is founded on a cross-sectional design, it remains limited in following temporal dynamics and causal processes. Longitudinal designs must be the focus of future studies and encompass qualitative methods to enlighten us about institutional determinants of performance and contextualize observed trends. More intense inclusion of bottom-up approaches, including stakeholder interviews and participatory assessments, would also deepen the image of how sustainability is implemented at the local level and how citizens view it. Finally, while the AMPI provides a robust and justifiable structure, it also has some limitations of method. The construction draws upon normative decisions like indicator choice, normalization cut-off points, and penalization policy. While such decisions

are justified, they can impinge upon comparability across countries and must be justified. In addition, the fixed benchmark values taken from the base year may short-change the more recent change in absolute performance.

Concisely, the study adds to the knowledge of sustainability governance among high-income economies and provides a valuable analytical framework for guiding evidence-based policy transformation. Convergence should not be an objective, but a shared normative consensus on the construction of resilient, inclusive, and forward-looking strategies. A consciousness of the differentiated sustainability pathways within the G7 can allow for more integrated and foresight-capable policies that can deal with both global problems and national specificity. This report contributes to the necessity of making sustainability a cross-cutting theme of all major policy domains, including fiscal policy, innovation systems, labor markets, and education, rendering the transition to sustainability both fair and sustainable in the long run.

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