Discover Sustainability

Perspective

The Index of Sustainable Economic Welfare (ISEW) as a proxy for sustainable GDP: revisited and recapitulated

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Abstract
The purpose of this "perspective" type paper is to revisit and recapitulate an existing alternative approach to measuring economic and sustainable GDP (using the ISEW as a proxy) at both national and regional levels. Motivated by the recognized inadequacies of Gross Domestic Product (GDP) in capturing true economic welfare, this study highlights the need for comprehensive indicators that reflect genuine prosperity. While GDP has long served as the primary macroeconomic measure of development, it fails to account for genuine progress, prompting the exploration of alternative measures. In recent decades, sustainable development has become a focal point for global, national, and regional economies, highlighted by the United Nations' 17 Sustainable Development Goals. The inability of GDP to capture sustainable welfare has led to the proposal of various alternative indicators in the literature. This study revisits and recapitulates the Index of Sustainable Economic Welfare, first introduced by Daly and Cobb (For the common good: redirecting the economy toward community, the environment, and a sustainable future, Beacon Press, Boston, 1989), which adjusts GDP to better reflect sustainable development. The current "perspective" reviews the application of ISEW across different countries revealing significant insights into the limitations of GDP and the benefits of more holistic measures. Additionally, the study emphasizes the importance of capturing sustainable economic prosperity at the local level and advocates for the inclusion of cultural aspects as the fourth pillar of sustainable development.

Keywords Culture · Economic welfare · GDP · Regional ISEW · Sustainability · Well-being indicators

1 Introduction

The necessity for a comprehensive and accurate system of national accounts that can truly measure a country's economic and sustainable development has become increasingly urgent. Traditional reliance on Gross Domestic Product (GDP) has proven insufficient for policymakers who need to address the multifaceted challenges of modern economies. The Great Depression of 1929 and the aftermath of the second world war highlighted the limitations of existing economic measures and stressed the importance of government intervention and macroeconomic stability. In the 1930s, macroeconomics emerged as a distinct field, and in 1934, Simon Kuznets introduced the first official national income statistics, laying the groundwork for GDP. While GDP has since become the dominant metric for economic performance, its shortcomings are now evident. GDP fails to account for critical factors such as environmental degradation, income inequality, and

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non-market activities like domestic and voluntary work. These omissions are particularly problematic as they obscure the true state of economic welfare and sustainability.

Our motivation stems from these recognized inadequacies of GDP. As the global community strives towards the United Nations' 17 Sustainable Development Goals, there is a pressing need for indicators that can encompass economic, social, and environmental dimensions of development. The inability of GDP to do so, necessitates the adoption of more comprehensive measures of income and welfare. The Index of Sustainable Economic Welfare (ISEW), introduced by Daly and Cobb in 1989 [1], offers a good alternative. The ISEW adjusts GDP by considering environmental costs, income distribution, and the value of non-market labor, providing a more holistic view of economic welfare. The current paper revisits and recapitulates the ISEW, emphasizing its potential to guide policy decisions more effectively than GDP.

Thus, we aim to address the policy-level problem of developing sustainable economic frameworks that reflect true welfare. By highlighting the empirical applications of ISEW across various countries and regions, we demonstrate how this measure can reveal the genuine economic prosperity that GDP overlooks. Moreover, we stress the importance of incorporating cultural dimensions into sustainability assessments, advocating for the recognition of culture as the fourth pillar of sustainable development.

This study is crucial for policymakers who seek to implement strategies that foster sustainable growth. It highlights the necessity of moving beyond GDP to adopt measures like ISEW, which can better inform policies aimed at achieving balanced and inclusive economic development. By adopting these comprehensive indicators, governments can better address the complex realities of their economies, ensuring that progress leads to net improvements in quality of life of citizens. Overall, the paper is motivated by the need to support the adoption of the ISEW and other related measures as superior alternatives to GDP for measuring genuine growth and welfare. By revisiting and recapitulating the ISEW, we aim to shed light on its methodology, empirical applications, and potential improvements, thereby contributing to the broader discourse on sustainable development and economic welfare. In other words, the motivation of our paper is to unveil the deficiencies of GDP as a measure of economic well-being and to promote the use of more holistic and sustainable indicators like ISEW.

The structure of the rest of this paper goes as follows: After the introduction, follows part 2 with the theoretical background. Part 3 hosts the methodological framework, part 4 offers results and discussion and part 5 concludes the paper.

2 Theoretical background

2.1 Sustainable development

Sustainable development has transitioned from a broad focus on the natural environment to a comprehensive and dynamic idea that includes environmental, economic, social, and cultural aspects. According to the 1987 "Our Common Future" report by the UN World Commission on Environment and Development, sustainable development is defined as "development that satisfies current needs without hindering future generations from fulfilling their own needs" [2].

This report highlighted the interdependent relationship between environment and development, suggesting that a crisis can only be avoided through sustainable development and the cooperation of social, economic, and political actors. Sustainable development now refers to a process where resource exploitation, investment direction, technological development, and institutional change are aligned to meet current and future human needs and aspirations. In subsequent years, numerous conferences further explored this concept.

In 1992, the United Nations Conference on Environment and Development, commonly known as the Earth Summit, took place in Rio de Janeiro, Brazil. This was the first gathering of global leaders to jointly tackle the 14 interconnected issues of environmental degradation and socioeconomic underdevelopment. During the summit, participants endorsed the Rio Declaration and adopted Agenda 21, a detailed action plan designed to communicate the urgent necessity for sustainable development to the world in the twenty-first century. Agenda 21, now regarded as a historical document, served as a framework for international community efforts across all areas of sustainable development. It highlighted the political dimensions of the obstacles that hinder the balance between human and natural systems and ultimately impede the development and well-being of future generations [3].

In 1997, the Kyoto Protocol was established, outlining essential measures for a long-term approach to addressing climate change driven by the rise in human-caused greenhouse gas emissions. This agreement required signatory nations to commit to reducing their greenhouse gas emissions during the first commitment period (2008–2012) by specific

Fig. 1 The three pillars of sustainability

Fig. 2 The 17 sustainable development goals

targets based on 1990 (or 1995 for some gases) emission levels. Notably, in December 2012, an eight-year extension of the Kyoto Protocol was agreed upon in Doha, Qatar, extending its validity to combat climate change until 2020.

In 2002, the World Summit on Sustainable Development (WSSD) in Johannesburg gathered tens of thousands of participants, including heads of state and government, national representatives, and leaders from non-governmental organizations (NGOs), businesses, and other key groups. The summit aimed to direct global attention towards urgent actions needed to tackle significant challenges, such as enhancing people's quality of life and conserving natural resources in a world with a growing population and rising demands for food, water, shelter, sanitation, energy, health services, and economic security.

The 2005 UN World Summit recognized three pillars of sustainable development: economic, environmental, and social (Fig. 1). The study by Caglar et al. [4] highlights the importance of targeted R&D investments in renewable energy, aligning with the current paper's emphasis on comprehensive and inclusive economic strategies for true prosperity.

2.2 The Sustainable Development Goals (SDGs) for 2030

In September 2015, the UN General Assembly in New York adopted 17 Sustainable Development Goals (SDGs) for 2030, aiming to improve the lives of millions of people [5–7]. These goals unite all countries around the three pillars of sustainable development, aiming for a more equitable, balanced, peaceful, and healthy world (Fig. 2). The SDGs emphasize the connection between environmental sustainability and socio-economic development and advocate for decoupling resource use and environmental degradation from economic growth to enhance prosperity and regional equity. Regarding empirical evidence on the role of green investments and innovation in achieving ecological sustainability and meeting Sustainable Development Goals (SDGs), specifically SDG 7 (affordable and clean energy) and SDG 13 (climate action), that is provided by Caglar et al. [8–13]. Also, other empirical findings that economic growth and trade openness harm environmental sustainability further support the call for alternative indicators like the ISEW, which integrate environmental and social dimensions into economic assessments [14].

Finally, on December 2015, in Paris, the Paris Agreement was adopted, which is considered a milestone, after world leaders set new ambitious targets against climate change. With this agreement, an action plan to limit global warming

was established, with the main goal of keeping the increase in the global average temperature well below 2 degrees Celsius, preferably 1.5, compared to pre-industrial levels.

2.3 Sustainable development and culture

Sustainable development is not one-dimensional. An important addition is the concept of cultural sustainability, which has emerged under the social pillar since the Brundtland Commission. Scholars argue that culture should be considered the fourth pillar of sustainable development. In 2001, Jon Hawkes' work "The Fourth Pillar of Sustainability" laid a foundation for this view [15], which was further supported by Soini and Birkeland in 2014 [16]. They identified seven aspects of cultural sustainability: heritage, vitality, economic viability, diversity, locality, ecological resilience, and eco-culture. In 2010, the UCLG (United Cities and Local Governments) association's "Culture is the Fourth Pillar of Sustainable Development" declaration urged local and regional authorities to develop stable cultural policies (Fig. 3). The UN's 2030 Agenda also includes culture and cultural policies as sub-goals of sustainable development, particularly in Goal 11, which aims to strengthen efforts to protect and preserve the world's cultural and natural heritage. Culture, as a social creation, reflects the unique characteristics and values of a place and influences development approaches. Recognizing cultural capital as a key element of local societies and integrating it into sustainable development models can provide a more comprehensive assessment of sustainability.

2.4 Economic development and the "Threshold Hypothesis"

Several authors [17–21] have argued that continuous economic development through increased consumption does not necessarily lead to corresponding increases in social and economic well-being. Instead, beyond a certain point, it can lead to a deterioration in quality of life.

Manfred Max-Neef [17] introduced the "threshold hypothesis," which suggests that economic growth improves quality of life up to a certain point. Beyond this threshold, further economic growth can actually diminish well-being. Given GDP's inadequacies and the growing interest in sustainable development, there has been significant debate about finding welfare measures that could serve as alternatives to GDP. Various classification schemes have been proposed in the literature to help policymakers select the appropriate sets of indicators.

2.5 Regional development and regional GDP

Determining the economic and sustainable development of a region is crucial for selecting appropriate economic and policy measures at the regional level. Each region, considered as a 'living organism,' exhibits a dynamic relationship between its social and economic characteristics. As separate local government entities, regions have specific jurisdictions and powers granted by the central administration. However, the uniqueness of each region's characteristics presents challenges.

At the European level, regulation no. 1059/2003 of the European Parliament established a common statistical nomenclature of territorial units, known as "NUTS," to facilitate the collection, development, and publication of harmonized regional statistics across the European Union.

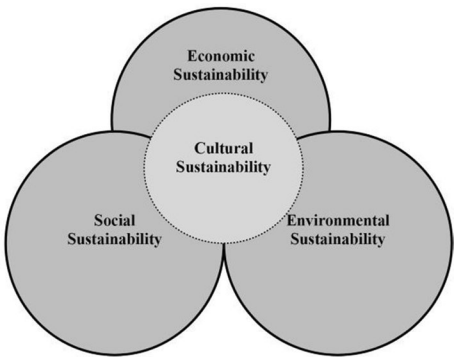

Fig. 3 Addition of the 4th pillar of sustainable development

Regional inequalities, which are differences in various spatial units or opportunities (e.g., business investments, employment, cultural activities, tourism), are a primary research focus in Regional Science. To capture these fundamental magnitudes and figures, appropriate measures and indicators are necessary.

The most significant problem is the limited availability of statistics at the regional level. Often, data is insufficient both qualitatively and quantitatively, leading to the adoption of logical assumptions to reduce national data to regional data. Analogous to national accounts, regional accounts provide information on key economic variables at the regional level.

2.6 The importance and usefulness of regional GDP

Regional GDP can be an effective tool for policy-making, especially in addressing regional structural and sectoral issues. The selection and implementation of regional policy yields better results when based on comprehensive information and data specific to a region. Additionally, regional accounts can be used to evaluate policy outcomes. For instance, the economic gap between Northern and Southern European Union countries has widened over the past 15 years, threatening European cohesion. This gap highlights the need for more targeted regional policies.

In recent years, the European Union has set specific goals for regional policies, using regional GDP as a key reference point. For example, the allocation of expenditure for structural and investment funds is based on regional accounts.

The European Union regional policy first emerged with the creation of the European Regional Development Fund in 1975, which aimed to support economic development in disadvantaged regions. In the 1980s, this policy expanded with the addition of the European Social Fund. A significant reform in 1988 focused the allocation of funds around specific objectives, introducing principles of additionality and partnership, leading to increased resources and improved management processes. The Maastricht Treaty in 1992 established the Cohesion Fund, emphasizing environmental and transport projects. The 2006 'Leipzig Charter on Sustainable European Cities' further reaffirmed the role of cities in achieving social cohesion and shifted the policy focus towards urban development with significant funding to support these initiatives.

3 Methodological framework

Our paper involves the qualitative presentation of the ISEW its precursors and other ramifications. This section also contains a comprehensive sample with all the countries and regions that have calculated the ISEW.

3.1 Classification schemes of alternative well-being measurement indicators

The classification schemes that have been proposed in the literature, apart from the classification of alternative measures of GDP, also aim to assist policy makers in selecting appropriate sets of indicators [22].

Bleys [23] distinguishes two categories of classification schemes. The first has to do with the research field to which each indicator refers and is applied, while the second classifies the alternative indicators based on the objectives for which each has been proposed. Goossens et al. [24] propose the distinction of the measures belonging to this category in three sub-categories:

a. Indicators that replace the GDP: this category includes indicators aimed at a more direct assessment of socio-economic well-being such as the Human Development Index (HDI), the Environmental Performance Index (EPI), the Index of Economic Well-Being, the Ecological Footprint, the Better Life Index and the Italian Measure of Equitable and Sustainable Well-being (Benessere Equo e Sostenibile-BES). Of course, they have the disadvantage that they give a broader interpretation and are not directly comparable to GDP.
b. Indicators that complement GDP: indicators in this category aim to "supplement GDP with additional information on the environment and social conditions, either by creating satellite accounts or by correlating GDP with other social and environmental indicators" [23].
c. GDP-adjusting indicators aim to enhance national accounts by incorporating or excluding components that pertain to society and the environment. Examples of these measures include the Measure of Economic Welfare (MEW) introduced by Nordhaus and Tobin [25], the Economic Aspects of Welfare Index proposed by Zolotas [26], and the Index of Sustainable Economic Welfare (ISEW) developed by Daly and Cobb [1].

3.2 Precursor indicators of socio-economic well-being

The current section aims at casting light on the most important information and functions of each of the predominant alternative indicators, which have been widely used in literature.

3.2.1 Human Development Index

The Human Development Index (HDI) was introduced in 1990 by the United Nations Human Development Report [5] and is a widely adopted index to measure the state of development in the environment and socio-economy [27]. The HDI ranges from 0 to 1, with a score of 1 corresponding to the highest level of development. Based on the HDI, a country is classified as underdeveloped, developing or developed. Together with the Environmental Performance Index (EPI), they are closely linked to the UN Sustainable Development Goals [28].

The HDI measures human development in three dimensions related to life expectancy, level of education and quality of life. An important point is that it has an expanded application scope, which can be small research scales, such as the level of regions [29] and provinces [30], but also larger, such as the level of countries [31, 32].

3.2.2 Environmental Performance Index (EPI)

The EPI (Environmental Performance Index) is a widely recognized indicator for assessing sustainable development in relation to the natural environment. Created through a collaboration between Yale and Columbia universities and the World Economic Forum [33], the EPI measures and quantifies the effectiveness of environmental policies. It is based on objectives related to environmental health, evaluating threats and disturbances to human health and ecosystem sustainability, and assessing the provision of ecosystem services [33].The Environmental Performance Index (EPI), as shown in Table 1, comprises 40 distinct sub-indicators organized into 11 subject categories. These categories address various aspects of environmental quality, including air quality, water and sanitation, heavy metals in agriculture, water resources, air pollution, climate and energy, fisheries, forests, biodiversity, and habitats [34]. The EPI value is measured on a scale from 0 to 100, where 0 represents the worst performance and 100 represents the best performance. This scoring system serves as a scorecard, highlighting the top performers and those lagging in environmental performance.

3.2.3 Measure of economic welfare (MEW)

The Measure of Economic Welfare (MEW), proposed by Nordhaus and Tobin [25], was a groundbreaking approach among GDP adjustment measures. While preserving the fundamental structure of GDP, it introduces several modifications.

Table 1 The EPI organizes 40 indicators into 11 issue categories and three overarching policy objectives

Policy objective	Issue category	Indicators
Climate change	1 Climate change mitigation	CO_2, CH_4, N_2O, F-Gas, Black Carbon, Projected GHG Emissions in 2050, Land Cover, GHG int., GHG/pop
Ecosystem vitality	2 Biodiversity & Habitat	Biome Protect (National), Biome Protect (Global), Marine Protected Areas, PARI, BHI, SPI, SHI
	3 Ecosystem Services	Tree Cover Loss, Grassland Loss & Wetland Loss
	4 Fisheries	Stock Status, MTI, Trawling & Dredging
	5 Acid Rain	SO_2 Trend & NO_x Trend
	6 Agriculture	SNMI & Pesticides
	7 Water Resources	Wastewater
Environmental Health	8 Air Quality	$PM_{2.5}$, Household Solid Fuels, O_3, NO_x, SO_2, CO & VOC_s
	9 Sanitation & Drinking Water	Sanitation, Drinking Water
	10 Heavy Metals	Lead
	11 Waste Mgmt	Solid Waste, Recycling & Ocean Plastics

Source: Adapted by the authors [35]

Specifically, it accounts for the value of leisure time and the amount of unpaid work within an economy, thereby enhancing the welfare value of GDP. Additionally, it factors in the cost of environmental damage resulting from industrial production and consumption.

Nordhaus and Tobin, showed that the MEW had grown less rapidly than GDP in the United States but concluded that "although GNP and other national income aggregates are imperfect measures of welfare, the broad picture of secular progress which they convey remains after correction of their most obvious deficiencies" [25]. The MEW can be seen as the forerunner of later efforts to create a sophisticated sustainable development indicator.

3.3 The Index of Sustainable Economic Welfare (ISEW)

The ISEW belongs to the category of GDP adjustment indicators and is essentially an extension of the MEW. It was introduced by Daly and Cobb [1] and includes variables not included in the national accounts. Later, it was improved by several authors, both conceptually in terms of its methods and in the number of elements it includes [36–38].

In addition to being heavily revised, the ISEW has been allocated a variety of different names following from its revisions. For example, the Genius Progress Indicator (GPI) [39] and the Sustainable Net Benefit Index (SNBI) [40, 41].

The main contribution of ISEW is that with the adjustments it proposes to GDP, it aims to overcome most its claimed disadvantages, in order to introduce the concept of sustainable development, environmental degradation as well as to include information of social issues.

For example, it adjusts household consumption to account for inequalities, includes only public expenditure related to health and education, takes into account domestic and voluntary work. It also takes into account the negative effects of environmental emission costs, defense costs, travel costs, traffic accidents and personal pollution control, social costs e.g. road accident health costs and the depreciation of physical capital. Finally, it considers the long-term costs of climate change (Table 2).

The ISEW is perhaps the only effort so far that is able to overcome most of the shortcomings of GDP as a measure of well-being by taking into account the effects that economic growth has on the environment and well-being [42].

The construction of the ISEW involves five main steps: 1. The adaptation of private consumption to inequality, 2. The inclusion of benefits resulting from unpaid work, 3. The removal of defense costs and environmental damage [43], 4. The inclusion of environmental degradation and 5. The inclusion of effects on social issues that are generated through the functions of the economy.

3.4 Calculation methods of the ISEW

The ISEW is an indicator that integrates the traditional measurement of macroeconomic performance (GDP) with additional information on social and environmental aspects. More specifically it is the sum shown in Eq. 1:

$$ISEW = C_{ISEW} + G_{ISEW} + I_{ISEW} + W - D - E - N - Cs \quad (1)$$

4 Results and discussion

4.1 Implementation of the ISEW at national level

The ISEW has been extensively implemented so far for the following countries, as we can observe in Table 3.

America was the first country in which the ISEW index was first calculated by Daly and Cobb [1]. We observe that the GDP per capita follows a steadily increasing course over the years, while the ISEW index follows the same course until a point, around 1970, while it continues a decline which remains at the same level for the following years.

In the case of Germany, we see that the GDP per capita shows a steady increase during the period 1950–1990, while the ISEW follows an upward trend until 1980 and then shows a decrease [46].

For the Netherlands, GDP per capita also grows at a constant rate until 1990. ISEW also grows at a steadily increasing rate until 1960, but we notice that this rate becomes more pronounced, especially in the period 1975–1980. This is due to the measures taken at the time to create a welfare state and reduce income inequality. Then follows a downward trend of the ISEW [47].

Table 2 Summary of the ISEW methodology

Items	Value direction	Description
C_{ISEW}	+	Private consumption expenditure, which is calculated in the same way as in GDP but adjusted for income inequality, using the Gini index as follows: Consumption-adjusted inequality = consumption * (1-Gini Index)
G_{ISEW}	+	Non-defense public expenditure is derived from public expenditure measured in GDP, but modified to take into account only non-defense costs, as an increase in public defense expenditure and rehabilitation costs does not lead to an increase in welfare. In fact, as pointed out by Guenno and Tiezzi [44], about 50% of the total public expenditure included in GDP is defense expenditure and should not be added to the ISEW
I_{ISEW}	+	Durable goods are treated as a capital investment, calculating a flow of services arising from the net inventory of durable goods during each year, reduced by their purchase cost
W	+	Non-commercial contribution to well-being, such as domestic and voluntary work
D	–	This item refers to private defense spending. For example an increase in defense spending due to health costs from a car accident or costs related to crimes, divorces, etc., increase social costs and therefore reduce welfare
E	–	Environmental degradation costs that can be related to soil, air and water pollution, climate change, long-term environmental damage, loss of natural and agricultural land, etc
N	–	Devaluation of natural capital (depletion of non-renewable resources)
Cs	–	The cost from some measurable social problems

Source: Adapted by the authors[45]

Table 3 Calculation of ISEW in different countries

Country	Study	Period
USA	Daly and Cobb, 1989	1950–1986
Germany	Diefenbacher, 1994	1950–1990
Netherlands	Oegema-Rosenbey, 1995	1950–1992
Austria	Stockhammer, 1997	1955–1992
Sweden	Jackson & Stymne, 1996	1950–1992
United Kingdom	Jackson, 1997	1950–1996
Italy	Guenno and Tiezzi, 1998	1960–1991
Chile	Castaneda, 1999	1965–1995
Scotland	Hanley, 1999	1980–1993
Finland	Hoffren, 2001	1985–2000
Czech Republic	Scary, 2002	
Poland	Gil and Sleszynski, 2003	1980–1997
Wales	Mathew, 2003	1990–2000
Holland	Bleys, 2007	1971–2004
Australia	Lawn, 2008	
Belgium	Bleys, 2006 and 2008	1970–2000
France	Nourry, 2008	1990–2002
Thailand	Clarke Shaw, 2008	1975–2004
Greece	Menegaki, 2015	2000–2015
Turkey	Menegaki, 2018	2001–2012
Spain	O´Mahony, 2018	1970–2012
Luxembourg	Rugani, 2018	1960–2010

Source: Compiled by the authors

As for Sweden, the results are similar, GDP per capita and ISEW have the same growth path until 1970, with a stronger rate for the following years and from around 1980 ISEW decreases [48].

For the case of the United Kingdom [49] and Austria [50] the study reaches similar results to the a fore mentioned for the other countries, which were referred to as examples. It is understood that the different values between the two magnitudes being compared, may be due to different factors applicable in a country.

It is also worth referring to the calculation of the ISEW in other countries, such as Chile [51] and Thailand [21], which, due to their particular economy and society characteristics, have incorporated parameters such as corruption, debt and commercial sex into their calculations work. However, their results are also consistent with those of the previous countries, even though they are economies with completely different characteristics.

It would be remiss if we did not refer to the calculation of the ISEW index for Greece [52]. Due to the lack of statistical data on social magnitudes in Greece, the ISEW has been calculated twice. In the first application the social parameter had been omitted, while in the second application the available at that time social parameters such as the cost of divorces, family breakups and noise pollution had been included. The conclusion was that whether or not the specific social parameters would be included, Greek GDP warranted a far from sustainable wellbeing for is citizens, increase in environmental protection and support of social structures.

In general, these country-specific empirical studies showed that the ISEW and GDP trends were quite similar only up to a given time period (around the 1970s or early 1980s). Then the trends of the two indicators started to diverge. Thus, we observe that keeping GDP as a guide for the economic genuine economic prosperity of a country, would generate distorted results and thus GDP be restrictive in the information it provides. Economic growth can increase the wellbeing up to a point. This point is the threshold point supported by Max-Neef [17].

4.2 Implementation of the ISEW at regional level

While the ISEW index has been calculated in many countries, it has rarely been calculated at the regional level. This can partly be justified by the lack of adequate sources of statistical data that would contribute to the construction of the appropriate indicators.

In recent years there has been an increased interest in measuring the ISEW at regional and local level. As Daly [36] pointed out referring to the global dimension of the sustainability of human actions, sustainability must start from and be applied at a local level. Local–regional authorities, having knowledge of the characteristics and particularities of their area, are essentially the natural link between the population and national or supranational governmental entities.

Important studies regarding the ISEW index at the regional level have been carried out by Italian researchers. The first case concerns the city of Siena, Italy [45]. Regional research focused on environmental issues such as air pollution, water pollution and reduction of physical capital. Siena's economy is based on agriculture, tourism and services and in terms of the environmental data it presents lower noise and air pollution than a large city. In the second case, Gigliarano et al. [22], proceeded with an empirical application of the ISEW for Italy and for all its regions and macro-regions in the years 1999–2009, with the corresponding classifications based on GDP. The results showed significant differences between the regional ranking based on the ISEW and the traditional one based on GDP. The "threshold hypothesis" becomes apparent here as well, and beyond this point, the genuine economic growth has stopped improving.

4.3 The ISEW revisions

Over the years, the ISEW index, in addition to being revised, has also received a variety of different names. Such examples are the Genius Progress Indicator—GPI [37] and the Sustainable Net Benefit Index—SNBI [41–43].

4.3.1 Genuine Progress Indicator (GPI)

Since the mid-1990s, the GPI has established itself as a more practical successor to the ISEW, aiming to approximate economic well-being. Both measures include a range of social and environmental benefits and costs, which are taken into account, positively or negatively-valued in monetary units, in the final calculation of the indicators. Essentially, their difference lies in the name. The Table 4 below lists the typical items that are added together to calculate the ISEW and GPI.

For the above economic and environmental data, the main data collection sources are the Greek Statistical Service, Eurostat, the Bank of Greece and the World Bank. Certainly, such an effort will not be easy, given the insufficiency of data at the regional level. Even more difficult will be the case of social variables. However, social data can be derived from individual surveys that have been conducted by independent research organizations, agencies and services and have been made public. Even if there are such data at the national level, they can be adjusted to the data of the regions, so that we receive respresenative information.

4.3.2 Sustainable Net Benefit Index (SNBI)

Sustainable Net Benefit Index-SNBI is almost identical to the ISEW and GPI. The only difference related to explanation of the rationale for using an alternate index. The data used in its calculation are not much different from the data in the above table, they are simply classified into "benefit" and "cost" accounts [43]. The total of the cost account is deducted from the benefit account, to receive the SNBI.

4.4 Definitions of income and the theoretical basis of GDP-ISEW-SNDP

4.4.1 Sustainable Net Domestic Product (SNDP) and Hicks' definition of income

According to Hicks [53] definition of income, its calculation is to indicate the maximum amount that people can produce and consume, without compromising their ability to produce and consume the same amount in the future. But in reality this statement is impossible. A nation cannot consume its entire GDP without undermining its ability to produce and consume the same amount in the future.

First, a part of the GDP is allocated to the replacement of worn out consumer and productive goods, second, production and consumption involve activities that are ecologically unsustainable, and third, a part of consumer goods is not consumed immediately, but is reserved for the future. Finally, a major accounting shortcoming of GDP is that it treats all defense and rehabilitation spending as revenue.

A better measure of national income according to Daly [54], could be the following:

Table 4 Typical components used in the ISEW and GPI construction

Index of inequality in consumption (±)
Production of goods and services (at basic prices)
Weighted personal consumption expenditure
Cost of consumer durables (–)
Services provided by consumer durables (+)
Services provided by roads and highways (+)
Services provided by voluntary work (+)
Services provided by unpaid domestic work (+)
Noise pollution cost (–)
Commuting cost (–)
Cost of crime (–)
Underemployment cost (–)
Cost of lost leisure time (–)
Domestic pollution abatement costs (–)
Cost of road accidents (–)
Cost of breaking up the family (–)
Net capital investment (±)
Net external borrowing (±)
Loss of agricultural land (–)
Resource depletion cost (–)
Cost of ozone depletion (–)
Cost of air pollution (–)
Cost of water pollution (–)
Cost of long-term environmental damage (–)
Wetland loss (–)
Loss of old growth forests (–)
TOTAL = Sum of all positive and negative -GPI items
(+) = positive element
(–) = negative element
(±) = element that can be either positive or negative

Source: Adapted by the authors [39]

$$\text{SNDP} = \text{GDP} - \text{depreciation}$$

which subtracts depreciation of capital goods and depletion of physical capital. After deducting depreciation and depletion of natural capital, we can arrive at a better measure of the maximum amount a country can produce and consume without compromising its ability to produce and consume the same amount in the future. The above adjustment is important, because it shows the need to maintain an income-producing capital stock. Here the question arises whether a combination of human and natural capital stock should be maintained (complementary) or whether there are two separate forms of capital (substitutes) that require their individual maintenance.

If substitute forms of capital are considered, a combined stock of both of them should be maintained. In this case, SNDP is a measure of sustainable income, since enough goods have been produced to compensate for the combined depreciation of human and natural capital, but the resulting final SNDP is considered not to be a robust measure of national income sustainability.

If they are considered complementary, deducting the depreciation of capital goods and the depletion of natural capital, the cost of depletion of natural capital should essentially be the cost of maintaining stocks of natural capital. To do this, the revenue from growing additional stocks of renewable resources must be calculated, or in the case of non-renewable resources, the cost of growing some substitutes. A formula that has been proposed is by El Serafy [55] to calculate the so called set-aside amount. This set-aside amount is the 'user cost' or otherwise the replacement cost of resource depletion.

Since user costs subtracted from GDP estimate the amount needed to maintain the stock of natural capital, this second measure of Sustainable Net Domestic Product (SNDP) serves as an indicator of national income sustainability. Although

SNDP is a more accurate measure than GDP, it still overlooks crucial aspects of well-being and does not consider the income distribution between the rich and the poor [56–58].

4.4.2 The concept of income according to Fisher and "psychic income"

Fisher [59] argued that national income is not comprised of the goods produced in a given year, but rather the services enjoyed by the final consumers of those goods. He termed these consumer-enjoyed services as "mental income," which most economists now refer to as "utility satisfaction." The idea of "psychic income" can be expanded to "psychic output" by excluding any disruptive activities. Fisher's views on income are fundamental and can be summarized into two main points: First, any durable productive or consumer goods created during the year do not count as this year's income but are additions to the stock of capital goods. Second, only the services provided this year by non-durable and previously manufactured consumer goods are included in this year's income.

According to Lawn [41] Fisher's view of income is superior to that of Hicks. The latter's view of economic well-being is based on the rate of production and consumption of goods. Fisher, on the contrary, bases economic well-being on the mental enjoyment of life, certainly considering the existence of physical goods necessary but not confusing it with the rate of production and consumption of goods. Pigou [60] was also a supporter of Fisher's concept of income.

Another crucial aspect of Fisher's concept of income is that the maintenance of capital goods, including human capital, incurs costs rather than benefits, as they wear out and depreciate over time. Maintaining human capital necessitates producing new goods, which requires a continuous flow of matter and energy. Calculating Sustainable Net Domestic Product (SNDP) addresses the issue of counting natural capital services as income by subtracting the cost of natural capital depletion from GDP. Given that Fisher's concept treats the production of replacement goods as a cost necessary to maintain human capital, SNDP effectively serves as an indicator of sustainable costs.

Overall, ISEW and GPI have the advantage of being based on Fisher's view theoretical basis of income and capital and therefore, as indicators they are far superior to GDP and SNDP and can be used as tools by policy makers.

4.4.3 Critical consideration of the ISEW and GPI indicators and the need for a more robust and consistent set of valuation methods

The studies which have criticized the valuation methods in the calculation of the ISEW and GPI are several [61–65]. The most important elements of the criticism focus on the arbitrariness regarding the selection of the elements and the weights used for the calculation of the index but also on the "implicit assumption" that there is perfect substitutability between different elements. More specifically:

a. The ISEW and the GPI need to be complemented by a satellite account of natural capital to determine whether the changing level of the economic well-being is ecologically sustainable.
b. Other parameters can be taken into account in their calculation (e.g. the disutility of certain forms of labor and the existence values of natural capital).
c. Some elements predominate over others [66]. The solution to the problem is to decompose the dominant elements into smaller ones.
d. All personal consumption expenditures are assumed to contribute to human well-being. But eating junk food or consuming tobacco products, alcohol and weapons are not such factors.
e. The three indices ISEW, GPI and SNBI while providing evidence of current events and immediate impact of past and current activities, reveal less about the future impact of current activities. Prediction techniques have been proposed by several authors [67–70].

Overall, the qualitative findings of the study and the realizations that come from it, align with the United Nations' 17 Sustainable Development Goals (SDGs), particularly those focusing on sustainable economic growth, reducing inequalities, and promoting well-being. The inclusion of environmental costs in the ISEW, also the inclusion of income distribution, and non-market labor contributions supports these goals by providing a more comprehensive measure of progress. The study emphasis on environmental degradation costs aligns with existing environmental policies that aim to reduce pollution, conserve natural resources, and promote sustainable resource use. Policies focused solely on boosting GDP may overlook the negative externalities accounted for by the ISEW, such as environmental degradation and social costs. Policies aimed at reducing public expenditure might be re-evaluated, as the ISEW suggests that certain public expenditures

(e.g., in health and education) are critical for genuine welfare. The study suggests a need for progressive taxation and robust welfare programs to address income inequality, aligning fiscal policies with the holistic view of economic welfare presented by the ISEW. Current subsidies and incentives that promote activities harmful to the environment may need to be restructured. For example, fossil fuel subsidies could be redirected towards renewable energy investments. Traditional GDP growth often fails to account for negative externalities. The ISEW corrects this by internalizing these externalities, thereby promoting policies that mitigate environmental damage and social disparities. By highlighting the costs of environmental degradation and social issues, the ISEW supports policies that incentivize sustainable investments and green technologies. The results support redistributive policies that aim to reduce income inequality, which is often masked by GDP growth alone. This includes progressive taxation, increased minimum wages, and enhanced social safety nets. Recognizing the value of non-market labor and voluntary work emphasizes the importance of social capital, suggesting policies that support work-life balance, community engagement, and social cohesion.

5 Concluding remarks

The empirical applications of the ISEW across different countries reveal significant insights into the limitations of GDP and the benefits of more holistic measures. The study shows that while GDP per capita generally follows an upward trend, the ISEW diverges, particularly after the 1970s, indicating that economic growth alone does not equate to increased welfare. This divergence is attributed to factors such as the environmental degradation and social costs, which GDP fails to capture.

Notably, the ISEW results for countries like the USA, Germany, and the Netherlands demonstrate a plateau or decline in genuine welfare despite rising GDP, supporting the "threshold hypothesis" which suggests that beyond a certain point, economic growth can lead to a decrease in overall welfare. This reinforces the necessity of adopting alternative measures like the ISEW that provide a more accurate reflection of true economic prosperity.

Moreover, the study emphasizes the importance of capturing sustainable economic prosperity at the local level. Regional applications of the ISEW, such as those in Italy, highlight significant differences between regional rankings based on ISEW and traditional GDP measures. These differences reveal the need for region-specific policies that address unique local challenges and opportunities.

In conclusion, the study supports a comprehensive approach to measuring economic welfare that includes environmental, social, and cultural dimensions. By revisiting and enhancing the ISEW, the study contributes to the discussion on sustainable development and economic welfare, offering valuable insights for policymakers to develop more balanced and inclusive economic strategies.

The findings strongly align with the United Nations' 17 Sustainable Development Goals (SDGs), particularly those focusing on sustainable economic growth, reducing inequalities, and promoting well-being. By including environmental costs, income distribution, and non-market labor contributions, the Index of Sustainable Economic Welfare (ISEW) offers a more comprehensive measure of progress. This alignment supports existing environmental policies aimed at reducing pollution, conserving natural resources, and promoting sustainable resource use.

The study highlights that policies focused solely on boosting GDP often overlook negative externalities such as environmental degradation and social costs. The ISEW corrects this oversight by internalizing these externalities, thereby promoting policies that mitigate environmental harm and social disparities. Consequently, policies aimed at reducing public expenditure should be re-evaluated, as the ISEW suggests that public investments in health and education are crucial for genuine welfare.

Furthermore, the study implies the need for progressive taxation and robust welfare programs to address income inequality, aligning fiscal policies with the ISEW's holistic view of economic welfare. Current subsidies and incentives that promote environmentally harmful activities may need restructuring; for instance, redirecting fossil fuel subsidies towards renewable energy investments would be more sustainable.

The results support redistributive policies that aim to reduce income inequality, which is often masked by GDP growth alone. This includes implementing progressive taxation, increasing minimum wages, and enhancing social safety nets. Additionally, recognizing the value of non-market labor and voluntary work emphasizes the importance of social capital, suggesting policies that support work-life balance, community engagement, and social cohesion.

By highlighting the costs of environmental degradation and social issues, the ISEW supports policies that incentivize sustainable investments and green technologies. Overall, this study challenges the traditional GDP-centric approach, advocating for a shift towards more holistic and sustainable economic strategies that ensure genuine prosperity and well-being for all segments of society.

Sustainability and its achievement requires changes. These changes concern our way of life and everyday life, but they must certainly be organized on a political-economic and social level in a broader perspective. The ISEW largely overcomes the traditional problems of measuring economic well-being presented by GDP and gives us a new perspective on its capture. An important element is that sustainability data can be captured starting from the regional level and include more local elements, such as the cultural characteristics of each region. Overall, this study serves as a guiding framework for future sustainability research and a trigger for its measurement at sub-national levels.

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Declarations

Competing interests The authors declare no competing interests.

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