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Sustainability Indicators – the Boundaries and Alternatives of GDP*

Csaba Kandrács – Renátó Ritter

To quantify economic performance, 'gross domestic product' – a measure created in the 1930s – is used worldwide. The indicator is suitable for measuring the performance of an economy and the welfare of individuals at a given point in time, but its capabilities are limited. The well-being of people, the impact of the environmental damage caused by production and the sustainability of economic performance are all issues that fall outside the scope of the metric. Since the 1970s, there has been a debate about the shortcomings of this indicator and its possible alternatives. Joining the dialogue, our goal was to present the principles of sustainability, to give an overview of the alternative indicators considered to be more relevant in Hungary and abroad, and to present the new sustainability indicator of the Hungarian central bank.

Journal of Economics Literature (JEL) codes: D60, O11, O44

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1. Introduction

The continuous increase in prosperity and welfare has always been one of the objectives of human activity. This is true both at the individual and the societal level. While at the individual level this can be perceived and measured through the quantitative and qualitative possession and ownership of various goods, at the community and societal level it is the performance of the economy that measures the success of a nation in this dimension. Designed to measure economic performance, the Gross Domestic Product (GDP) indicator has thus become one of the most important measures of our times. Although the concept of measuring national economic performance emerged as early as the 1700s (*Lepenies 2016*), its modern form was developed in the 1930s during the Great Depression and the Keynesian reform of economic thinking. Macroeconomic regulation has become

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Csaba Kandrács: Magyar Nemzeti Bank, Deputy Governor. Email: kandracscs@mnb.hu
Renátó Ritter: Magyar Nemzeti Bank, Analyst. Email: ritterr@mnb.hu

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the main objective to avoid a new recession. Consequently, measuring economic performance became a priority, for which Simon Kuznets, commissioned by the US Congress, developed a measurement methodology based on value added. The indicator is now used worldwide to measure and compare the economic performance of countries.

However, GDP's relative simplicity limits its ability to capture factors other than material welfare. Kuznets himself saw the limitation of the indicator, namely that the country-level analysis would result in material inequalities remaining below the surface, masking the extent of possible social inequalities between countries (*Kuznets 1934*). Like Kuznets, others have also recognised the limitations of GDP. The main claim of *Stiglitz et al.* (*2018*) is that what we measure affects what we do, and measuring the wrong thing may lead to the wrong action. If we focus only on material welfare, such as the production of goods, rather than health, education and the environment, we ourselves become more like the object of our measurement, and therefore more materialistic. While the authors acknowledge that GDP is a good measure of economic performance, they believe that conclusions about the well-being of a society beyond material welfare based on this indicator are wrong. Similarly, *Hoekstra* (*2019*) envisages a world where decisions are not based on GDP primarily, but neither he nor the authors mentioned above have proposed a specific measure.

Not only the capabilities of GDP, but also the sustainability of economic growth are increasingly being called into question today, as since the onset of the industrial revolution, the presence of humans has begun to consume, to an unprecedented extent, the planet's previously seemingly infinite resources. To illustrate this, in 2009 a team of scientists divided our planet into seven – and later, nine – ecosystems, and determined the thresholds at which human activity on Earth is considered sustainable in each system. By 2023, we had crossed six of the nine planetary boundaries (*Richardson et al. 2023*), which means that our presence places stress on several global systems such as climate, biosphere or biochemical flows which nature's regenerative capacity can no longer balance. One of the most cited definitions of sustainability, found in the Brundtland Report, reflects this overload: sustainable development is a form of development that meets the needs of the present without compromising the ability of future generations to meet their own needs (*Brundtland Commission 1987*). The problem is that our current widely-used GDP indicator does not take into account factors relating to the state of the environment and society; consequently, decisions are not taken with the primary objective of improving the state of the environment and society, or if they are, the results are not clearly measurable.

This is why we attempt to present and compare the alternatives to the GDP indicator that are available. The indicators are classified into three categories and then assessed on the basis of their relevance and resource requirements, taking into account the sustainability principles presented below. Where available, data for Hungary are also presented. At the end of the paper, we present the new sustainable GDP measure of the Hungarian central bank.

2. The framework for understanding sustainability

2.1. The principles of sustainability

Before presenting the various measures that complement GDP, we briefly introduce the theory of sustainable development. Among other things, *Solow* (*1974)* researched the possibility of infinite economic growth even under the assumption of exhaustible natural resources. Solow's macroeconomic model defines output as a function of three input factors.

$$\mathrm{Q} = Q(L, K, N), \tag{1}$$

where Q is output, L is labour, K is man-made capital and N is natural capital. The defined output function had two important features. On the one hand, the author assumed that natural capital is indispensable in the function, since without natural capital there is no production; therefore, if $N = 0$, the result will be $Q = 0$. The second assumption is that there is no upper limit to the average product of natural capital.[1] Solow used the Cobb-Douglas production function, which ensured that the two desirable properties described above were satisfied. The first assumption was necessary because without that it would be assumed that production was conceivable without the use of natural capital. The second assumption is justified by the fact that if the average product of natural resources were finite, only finite amounts of output would be produced; consequently, the only infinitely sustainable level of per capita consumption would be zero. At this point, it is important to stress that the need to introduce this second attribute is directly related to the original aim of *Solow*'s (*1974*) study, namely to find conditions under which a positive level of per capita consumption can be sustained indefinitely. For this reason, if natural resources are limited and substitution between resources is restricted, per capita consumption may not remain constant forever (*Cabeza Gutés 1996*). Even though the first of the two criteria for sustainable development [*Equations* (*2*)–(*3*)]

[1] The average output produced by each input is called 'average product'. Average product is the method used to measure the total output produced by a firm from a given combination of inputs. It is defined as the output per unit factor input or the average of the total product input per unit input, which can be calculated by dividing the total product by the inputs (variable factors).

is precisely to increase, or at least maintain, welfare continuously. The second condition captures the constancy or growth of capital goods.

$$U_{t+1} \geq U_t, \tag{2}$$

where U_{t+1} is future welfare, U_t is current welfare, and

$$K_{t+1} \geq K_t, \tag{3}$$

where K_{t+1} is future capital and K_t is current capital.

Pearce and Atkinson (*1993*) formulated a number of criteria for weak sustainability, which they referred to as the Hicks-Page-Hartwick-Solow rule (*Kerekes 2012*). In their study, they distinguished three types of capital [*Equation* (*4*)].

$$\sum K = K_M + K_H + K_N, \tag{4}$$

where K_M is produced (man-made) capital, K_H is human capital, and K_N is natural capital (broadly defined, minerals, biodiversity, air).

Weak sustainability is the case where natural capital can be substituted without limit by the other two types of capital described. In this case, it is only necessary that our total capital does not decrease over time [*Equation* (*3*)]. Strong sustainability is when natural capital cannot be substituted by the other two and accordingly, the permanence of natural capital must be ensured.

$$K_{N_{t+1}} \geq K_{N_t}, \tag{5}$$

where K_{Nt} is the current value of natural capital and K_{Nt+1} is the future value of natural capital.

The assumption of the permanence of natural capital raises complex questions. For example, classical environmental economics, created to protect the environment and reduce pollution, belongs to the category of weak sustainability, since it aims to associate a price with pollution and to internalise the costs (externalities) indirectly caused to third parties (having to pay for pollution). In other words, according to this concept it is acceptable to reduce natural capital in exchange for paying the price of pollution. This approach naturally raises numerous questions about the price we should attach to the destruction of our environment.

A good example to illustrate this difficult issue is when different actors try to quantify the social cost of carbon emission (SCC). The SCC aims to estimate the monetary cost (in US dollars) of emitting one additional tonne of carbon. To a large extent, the result depends on the expected output, the expected damages and the discount rate applied to future damages (*Nordhaus 2017*). The SCC is mainly used by North American countries when making regulatory decisions. In the United States, under various administrations, the estimated value of the SCC has ranged from USD 1 to USD 7 for a while, while the current estimated value is around USD 51. It is apparent that its value can be strongly manipulated depending on the expectations. In the European Union, this practice mainly corresponds to the emissions trading scheme where various high carbon emitters are required to pay the cost of environmental damage. The value of allowances reached a historic high in February 2023, when the companies concerned had to pay EUR 107 per tonne of carbon emissions. Currently, the price of a tonne of carbon emissions ranges between EUR 60 and EUR 70.

3. Alternative indicators available

3.1. Comparison of specific indicators

Discussions about alternative indicators commenced in the 1970s, when numerous experts started to question the sustainability of the growth rates experienced theretofore. In addition, there were increasingly visible signs of environmental pressures around the world. The most important study of the time was a 1972 paper entitled 'The Limits to Growth' (*Meadows et al. 1972*), which outlined the social, economic and environmental problems humanity would face in the decades to follow. It was along these lines that experts started to think about creating a measure that was able to break the monopoly of GDP. The alternative sustainability indicators to be presented below have been classified into three categories: (i) inventory-type indicators, (ii) composite indicators, and (iii) GDP-adjusting indicators. There was a difference in what exactly was measured, the methodology used and the unit of measurement applied to interpret the result of the measurement. Indicators can be judged according to the sustainability concept in which they are developed (strong or weak), and also according to their producibility, resource requirements and relevance. We will start with the inventory-type indicators, which are the basic measures, then move on to the more abstract composite indicators that measure several factors at once, and finally – as a golden mean – we present GDP-modifying indicators.

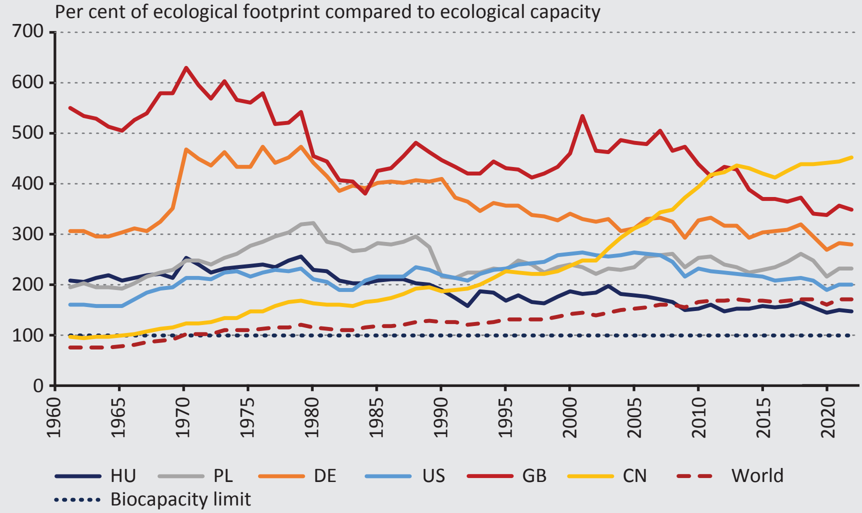
3.2. Inventory-type indicators

The more tangible group of sustainability indicators includes inventory-type indicators. Their purpose is to measure a resource, capital, or asset item in order to track changes over time, thereby indicating the degree of sustainability. The advantage of these measurements is that they measure a specific thing based on established methodologies. The disadvantage is that they only capture one phenomenon at a time, and since sustainability is a multi-factor process, it is difficult to assess a country's performance by analysing one indicator only. Two important inventory-type indicators are presented below: *ecological footprint* and *biocapacity*.

The ecological footprint indicator aims to measure how much biologically productive land and water an individual, population or activity needs in order to produce all the resources it consumes and absorb the waste it produces, using prevailing technological and resource management practices (*Wackernagel – Rees 1996*). Biocapacity measures the ability of ecosystems to produce the biological materials we use and absorb the wastes we produce under current management systems and extraction technologies. Biocapacity can vary from year to year depending on changes in climate, farming and factors considered as useful inputs for the human economy (*Wackernagel – Rees 1996*). Ecological footprint and biocapacity are both expressed in global hectares. The result of comparing the two is how many planet Earths, i.e. how much land area, humanity would need in order to maintain the present state of affairs in the long term, given the current quality of life.

Ecological deficit or *reserve* is the difference between biocapacity and the ecological footprint of a region or country. Ecological deficit is a situation where the footprint of a population exceeds the biocapacity of the area available to that population. By contrast, ecological reserve is defined as the biocapacity of a region in excess of the footprint of its population. When a regional or national ecological deficit occurs, it means that the region or country is importing biocapacity through trade, or is liquidating the ecological assets available there, or is releasing waste into global public assets, such as the atmosphere. In contrast to the national scale, the global ecological deficit cannot be compensated by trade, and therefore, by definition, it is equivalent to exceeding the Earth's carrying capacity (*Wackernagel – Rees 1996*).

Figure 1
Ecological footprint of Hungary, the world and selected countries vs. their biocapacity, 1961–2022



Source: Footprint Data Foundation, York University Ecological Footprint Initiative, and Global Footprint Network: National Footprint and Biocapacity Accounts, 2023 version (https://data.footprintnetwork.org)

Similar to countries in the Western world, Hungary has been facing an ecological deficit since the beginning of the survey in the 1960s (*Figure 1*). Hungary currently has a smaller ecological deficit than the global average (71 percentage points overrun), but it is still almost one and a half times over its natural limits (47 percentage points overrun), stretching further than the blanket reaches. One of the most unfavourable trends and values is in China. Since the 1970s, the country's footprint has been increasingly diverging from its ecological capacity, and now exceeds it by four and a half times. However, the inclusion of population size can also help to provide a more accurate view of a country. For example, China scores better on almost all environmental indicators when measured in relation to its population. The situation is complicated further by the rise of global trade in goods and the separation of the places of production and consumption of products. While most developed countries can be identified as carbon exporters (i.e. the emissions of the products they consume occur elsewhere), numerous – mainly developing – countries are carbon importers and absorbers (i.e. they emit carbon from products they did not consume) (*Al-mulali – Sheau-Ting 2014; Malik – Lan 2016; Rahman 2020*). It is important to note that globalisation does not necessarily mean an increase in carbon emissions. There are cases where relocation of production, for example to a country with a cleaner energy mix, leads to a reduction in global carbon emissions and thus in the ecological footprint (*Baumert et al. 2019*); usually, however, the opposite is true.

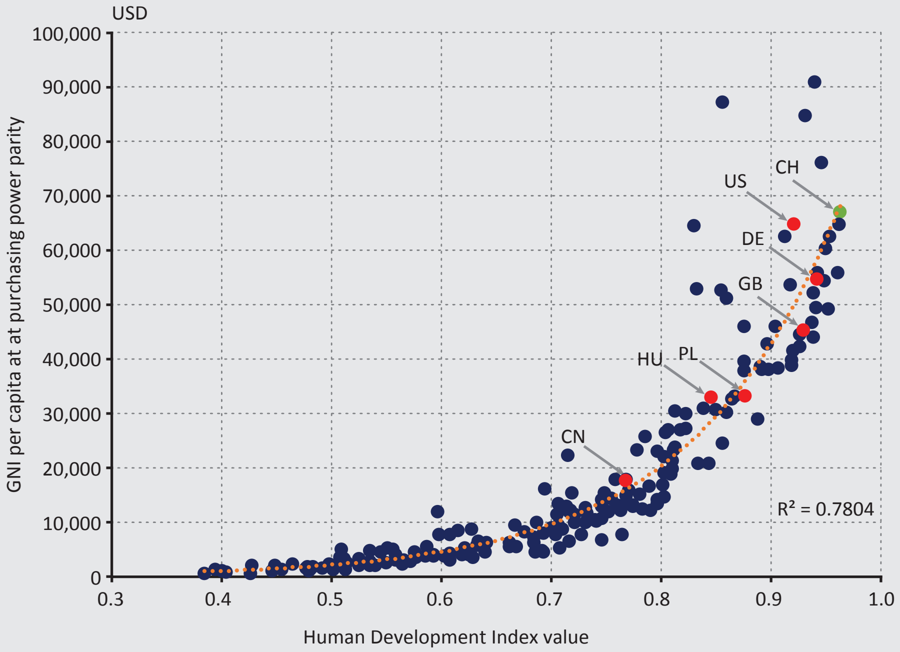
Of course, biocapacity and ecological footprint calculations have also been criticised. For example, biocapacity does not take into account the long-term depletion of arable land and water resources. The ecological footprint does not take into account technological change; indeed, it assumes that the consumption observed in the past will require at least the same amount of resources as before, even though production is becoming more intensive and efficient. It also places unrealistic expectations on small countries with high population density (*Fiala 2008*).

3.3. Composite metrics

The indices presented below provide a more abstract and difficult-to-grasp numerical value than inventory-type indicators. These indicators aim to measure sustainability in a broader sense. Today, the most commonly used composite indicators attempt to quantify different aspects of a country's sustainability and progress. Depending on the type of the indicator, they take into account a country's economic performance (welfare), educational, health, political factors (well-being) and the state of the environment. The biggest problem and criticism of composite indicators is precisely that they aggregate different factors into an elusive number, using different weighting methods, for example by conflating the state of the environment with less important factors. For this reason, the assumption of weak sustainability holds for almost all composite indicators. The result can only be interpreted in a broader context; therefore, efforts should be made to calculate the index for as many countries as possible.

One of the first and best-known composite indicators is the Human Development Index (HDI) developed by the United Nations Development Programme (UNDP) in 1990 (*UNDP 1990*). The aim of the indicator is to measure the development of countries not only in terms of their material welfare, but also in terms of the quality of life available there. The first version of the HDI consisted of three components: life expectancy, quality of education (mean years of completed schooling and expected years of schooling) and GNI per capita. Those who preferred alternative development indicators considered this indicator a good starting point, but felt that it lacked, *inter alia*, the inclusion of information on environmental sustainability. Apart from the fact that it captures few factors, most of the criticism of the indicator centred on the aspect that the HDI is overly influenced by the value of a country's national income per capita (*Sagar – Najam 1997*), as aptly shown in *Figure 2*. The latest 2021 results put Hungary in 46th place in the development ranking.

Figure 2
Relationship between HDI and GNI per capita



Note: Figure 2 is based on 2021 data. Liechtenstein was excluded due to its extremely high income value.
Source: UNDP (2022)

In the following, we present two international and three national composite indices. Each of the selected indices relies on its own logic in approaching sustainability. One of the major shortcomings of the HDI was the fact that it ignored environmental factors, which *Hickel* (*2020*) addressed by modifying the methodology to create a Sustainable Development Index (SDI). In his study, the author found that per capita material footprint and CO_2 emissions moved relatively in line with changes in HDI. In his view, it is not the right message to have countries leading the list of development level when the same countries have serious deficiencies in environmental sustainability. Taking into account the limits of our planet is essential when considering long-term sustainability. This is why the SDI corrects the three components of the HDI for material use and CO_2 emissions. Thus, countries with a high environmental footprint are not able to compensate their pollution with high development values; consequently, the indicator belongs to the school of strong sustainability. All this shows a markedly different country ranking compared to the HDI ranking (*Table 1*). Based on the index, Hungary ranked 39th in the world, much better than the surrounding countries. This type of adjustment of the level of development is considered innovative and should be considered when designing a new index.

Table 1

Results for the best and worst performing countries in terms of HDI, SDG and SDI, and for Hungary and its immediate surroundings

	Human Development Index (HDI)			Sustainable Development Goals (SDG)			Sustainable Development Index (SDI)		
	Country	**Score**	**Ranking**	**Country**	**Score**	**Ranking**	**Country**	**Score**	**Ranking**
Best performing countries	Switzerland	0.96	1	Finland	86.76	1	Costa Rica	0.85	1
	Norway	0.96	2	Sweden	85.98	2	Sri Lanka	0.84	2
	Iceland	0.96	3	Denmark	85.68	3	Georgia	0.82	3
	Hong Kong	0.95	4	Germany	83.36	4	Cuba	0.81	4
	Australia	0.95	5	Austria	82.28	5	Dominican Republic	0.81	5
Hungary and its neighbours	Austria	0.92	25	Austria	82.28	5	**Hungary**	**0.73**	**39**
	Poland	0.88	34	Poland	81.80	9	Croatia	0.71	43
	Croatia	0.86	40	Croatia	81.50	12	Romania	0.69	53
	Slovakia	0.85	45	**Hungary**	**79.39**	**22**	Poland	0.42	128
	Hungary	**0.85**	**46**	Slovakia	79.12	23	Slovakia	0.29	149
	Romania	0.82	53	Romania	77.46	35	Austria	0.24	155
Worst performing countries	Burundi	0.43	187	Somalia	48.03	162	Australia	0.16	161
	Central African Republic	0.40	188	Yemen	46.85	163	Qatar	0.15	162
	Niger	0.40	189	Chad	45.34	164	United Arab Emirates	0.13	163
	Chad	0.39	190	Central African Republic	40.40	165	Kuwait	0.10	164
	South Sudan	0.39	191	South Sudan	38.68	166	Singapore	0.10	165

Note: The latest available data are 2021 for HDI, 2022 for SDG and 2019 for SDI.

Source: Edited based on UNDP (2022) for HDI, Sachs et al. (2023) for SDG, Hickel (2020) for SDI

One of the most ambitious indicator projects is the UN's Sustainable Development Goals (SDG) indicator system, which is also classified as a composite indicator. The organisation first set out long-term development goals in 1992, and in autumn 2015 adopted its Agenda 2030, which includes the 17 SDGs that are still in effect (*UN 2015*). The objectives also cover balanced social development, sustainable economic growth and environmental protection. A total of 231 individual indicators are used to measure their achievement, which represents an enormous data collection effort. The results are published annually in the UN's Sustainable Development Report, which tracks changes in countries' performance on each SDG, as well as their aggregate performance on all SDGs. It has been repeatedly suggested that some SDGs may be more important than others (for example, climate action should take priority over other goals such as health and welfare), but no agreement has been reached on the different significance of each goal, and therefore each is given equal weight in the final index calculation, which is also suitable to rank countries. As the availability of basic data for the indicators varies, a total of 'only' 124 indicators are used to produce the ranking (*Sachs et al. 2023*). Hungary is ranked 22nd in the index and also ranks well in the region.

The problem with the SDGs is that they try to quantify a number of difficult-to-measure factors (e.g. freedom of the press), which are also incorporated into the composite indicator. Therefore, although one receives an index value covering a very large number of aspects, it can in fact be misleading as to how sustainable a country actually is. The indicator assesses socio-economic-environmental dimensions together; consequently, socio-economic performance may compensate for a weaker performance in the environmental dimension, and the indicator can therefore be classified as weak sustainability. Despite the problems, the breadth of both the calculation and the data collection is exemplary, and the metrics used are worth sampling when developing a new set of indicators.

After the international overview, we present three composite sustainability indicators developed in Hungary. In spring 2022, the HÉTFA Research Institute and Analysis Centre published its conceptual proposal for a Sustainable Performance Framework Index (SPFI). The composite indicator is intended to indicate changes in the state and quantity of factors of production, resources or capital goods; however, it is not aimed at measuring socio-economic welfare (*Bartus et al. 2022*). In contrast to the previous statement, however, the 35 indicators that are ultimately used include, for example, indicators on education, health and well-being which are also included in the SPFI.

The indicator not only provides an all-inclusive value as a result, but can also be interpreted at lower levels of aggregation. The indicators are classified according to 10 subcategories (e.g. education, biodiversity, quality of governance); this is the first level of aggregation. Related indicators were aggregated according to thematic themes by averaging, which is similar to the aggregation method used for indicators measuring each SDG goal. The second aggregate level shows the evolution of each resource (human, social, natural, economic) and finally, we can assess the country's performance according to the aggregate value. The role of each group in the index was determined using factor analysis.

The factor analysis is intended to classify the numerous, observed variables into factors, thus obtaining information on phenomena for which no specific data are available. For example, economic indicators such as GDP per capita and the number of hungry children per 1,000 persons are correlated and exhibit co-movement; consequently, some relationship is assumed between the two. Factor analysis groups these variables together, ideally reducing our multivariate analysis to 2–4 factors. The aim is to explain as much of the observed variance as possible using as few factor components as possible. Factor analysis therefore eliminates expert bias in the weighting of individual variables. By contrast, however, it makes it very difficult to understand the impact of each variable on the final outcome.

As with the SDGs, another problem is that only two of the 10 sub-category groups include information on the environment; therefore, it is easy to offset environmental degradation with good performance in the remaining 8 sub-categories, thereby measuring weak sustainability. The survey was carried out for only 10 countries,[2] making it difficult to assess the global situation of Hungary. Lagging behind the performance of its peers in the region, Hungary ranked 7th out of the countries surveyed. While it scored well in human and economic capital, it scored less well in natural and social capital, the latter being the worst. The SPFI and GDP, like the HDI, move closely together, which means that economic performance can excessively affect the overall value of an indicator designed to measure several aspects.

Also in 2022, the Makronóm Intézet, which studies economic development in Hungary, published its Harmonic Growth Index (HNI), which aims to assess the long-term equilibrium growth trajectories of countries around the world, taking into account not only economic development but also the factors necessary for the sustainability of such (*Makronóm Intézet 2022*). The indicator was calculated

[2] The 10 countries surveyed are Hungary, Poland, Slovakia, Czech Republic, Norway, Canada, Brazil, India, Singapore and Benin.

for the period of 2005–2019, with the selected 32 variables grouped along the lines of 6 dimensions: economic development; work and knowledge-based society; and economic, environmental, social and demographic sustainability. Similar to the SPFI indicator presented above, factor analysis was used to determine the weights assigned to each dimension. With HNI, we are able to get a more accurate picture of the extent[3] to which each dimension affects the final result. Economic development and growth have the largest impact on the index value (25.8 per cent), while environmental sustainability has the second smallest impact (11.1 per cent).

The analysis was carried out on a broader scale, covering 87 countries, which is unprecedented by Hungarian standards. Countries are ranked according to their 2019 results, and those that perform similarly in terms of each dimension are grouped into 5 distinct clusters for easy comparison. The results show that developed countries dominate in 5 out of 6 dimensions, with the only one to fall out of the top 10 being demographic sustainability. Hungary stagnated between 2005 and 2012, then improved year by year after 2012, and the latest data for 2019 ranks Hungary in the 29th place. Looking at the individual dimensions, Hungary showed significant improvements in the components of economic sustainability and the work and knowledge-based society, while the other dimensions were characterised by stagnation and a slight decline can be observed in social sustainability.

Although the HNI is broad in terms of the countries covered, the time horizon and the number of variables included, the factor analysis makes it difficult to assess the impact of each indicator on the final result of the index. This compromises the extent to which the results can be communicated and interpreted. Due to the incomplete publication of the data, it is not possible to compare the results with those of the already presented other indicators. Hungary's overall ranking shows no marked difference (HNI: 29th, HDI: 46th, SDG: 22nd), although the HNI was calculated for far fewer countries.

In 2024, the experts of the Magyar Nemzeti Bank (the central bank of Hungary, MNB) also contributed to the wide range of composite indicators with their new sustainable growth index (SGI). The methodology was based on the Banking System Competitiveness Index presented in 2017 (*Asztalos et al. 2017*). The new composite indicator provides a view of sustainable development in European countries based on 64 indicators. The value of the index is composed of 4+1 pillars, with each pillar having a weight of 20 per cent in the final score: economic sustainability, financial

[3] Economic development and growth: 25.8 per cent; Social sustainability: 19 per cent; Demographic sustainability: 17.6 per cent; Work and knowledge-based society: 17.5 per cent; Environmental sustainability: 11.1 per cent; Economic sustainability: 9.1 per cent.

sustainability, social sustainability and environmental sustainability. The last pillar is GDP itself, which is also weighted at 20 per cent (*MNB 2024*). The authors present each pillar and its indicators, detailing the trends suggested by each indicator. The results of the SGI are calculated by the MNB for the EU Member States. Based on data for 2022, Hungary ranked 20th out of 27 Member States. The MNB's experts found that Hungary was below the EU average in both GDP per capita and sustainability indicators. In addition, it is important to note that Hungary has seen the 4th highest increase in the value of the index since 2010 (*MNB 2024*). The SGI has the advantage of being based, to a large extent, on objective indicators and its weighting and calculation method is also transparent. The disadvantage is that the environmental-social dimensions only affect 40 per cent of the indicator's value; thus, a good performance in the economic-financial domain can compensate for weaker performance in the two aforementioned domains.

3.4. GDP-adjusting indicators

After describing easy-to-understand inventory-type indicators, the methodology of which is also relatively simple, and then hard-to-understand, complex indicator systems, which are often produced relying on complex and questionable methodologies, in the following we present a middle-ground solution. GDP became an indicator of the economic performance of countries worldwide after the Bretton Woods Conference in 1944. However, this most familiar economic indicator is not intended to measure the state of the environment, the sustainability of economic activity or health. It is no coincidence that the first pioneers of alternative indicators were various indicators that adjust GDP in order to take into account factors other than value added. The aim of any indicator of this type is to adjust the measure of welfare for the monetised value of sustainability factors.

The first major step in focusing on factors other than growth was the development of the Measures of Economic Welfare (MEW) by *Nordhaus and Tobin* (*1972*). In addition to the Gross National Product (GNP), the indicator took into account the monetary value of leisure time and other economic activities not mediated by the market (e.g. household work). The aim was also to convert intermediate expenditure into consumption or investment (*Varga et al. 2019*). The changes resulted in a more accurate indicator of economic welfare. A sustainable version was also developed at the same time, which reduced the value of MEW by the value of the excessive exploitation of natural resources. The results showed that both sustainable and unsustainable MEW were higher than GNP, as MEW took into account the value of activities not previously quantified, while assigning a negligible value to the caused environmental damage. Nordhaus and his co-author conclude that MEW and GNP were well correlated in the United States between 1929 and 1965; therefore, other than GNP, no other measure of welfare is needed (*Nordhaus – Tobin 1972*). Similar conclusions can be drawn for the HDI, SDG and SPFI composite indicators presented above.

The MEW index was developed further by *Daly and Cobb* (*1989*), who formulated the Index of Sustainable Economic Welfare (ISEW). As part of the enhancement, the authors intended to adjust GNP to take into account the impact of consumption inequality on welfare and the present value of environmental degradation (*Varga et al. 2019*). Based on *Málovics* (*2012*), the ISEW can be broken down into the following components:

$$ISEW = C_{adj} + P + \mathrm{G} + \mathrm{W} - \mathrm{D} - \mathrm{E} - \mathrm{N}, \tag{6}$$

where C_{adj} is individual consumption expenditure adjusted for income inequality (Gini coefficient), *P* is the value of non-defensive public expenditures (e.g. infrastructure), *G* is the net change in capital formation and international (investment) position, *W* is the non-monetary items that increase welfare, *D* is private defensive expenditures[4] (education and health), *E* is the cost of environmental degradation (e.g. water, air, sound pollution) and *N* is the depreciation of natural capital (e.g. the consequences of CO_2 emissions). In contrast to the MEW index presented above, the ISEW has had a strong global resonance. Several countries calculated the indicator for themselves in the 1990s. This notwithstanding, it failed to bring about a breakthrough or achieve lasting success. The lack of theoretical grounding and different calculation practices make the results difficult to compare. *Neumayer* (*1999*) negatively assessed the fact that many components in the calculations are based on assumptions. An example is the value of the loss of natural capital. The complexity of its estimation and the different ways of calculating it are illustrated by the SCC calculation presented above. Questions are raised by the application of weighting by income distribution, or estimating the rate of depletion of non-renewable resources; ignoring technological change and human capital growth is also questionable. Finally, since we wish to judge a country's performance by a metric, the dimensions of economic welfare and sustainability are inevitable to merge, which assumes the perfect substitutability of natural capital, and therefore the indicator follows the theory of weak sustainability.

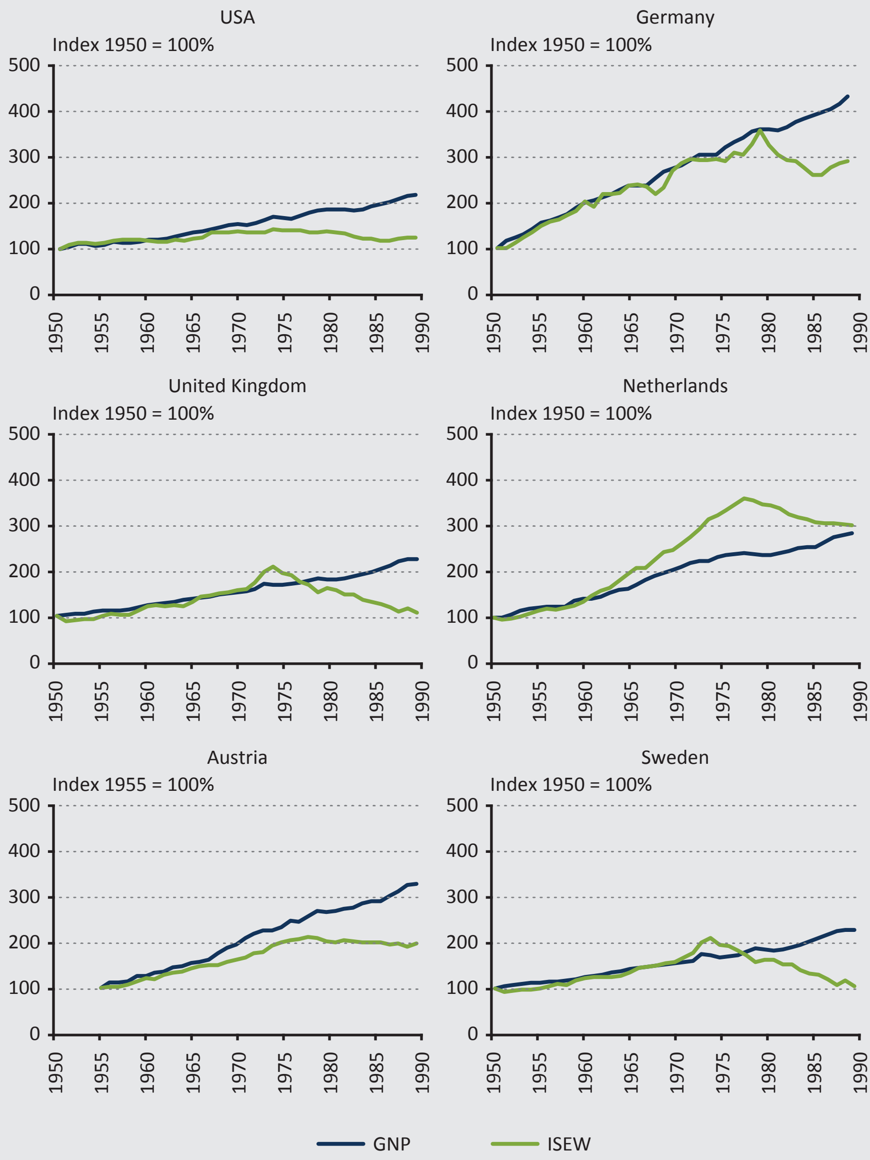
[4] Private defensive expenditures refer to individual consumption decisions to protect against the negative externalities stemming from economic growth. Examples include crime, divorce, commuting, unequal income distribution, knowledge acquired at cost, and rising health costs due to road and workplace accidents, all of which lead to a deterioration in welfare.

Despite the inconsistent calculation methods (mainly due to the variation in the data available and the different weights), a similar trend emerges for the ISEW–GNP relationship in various countries. The ISEW rose at a much slower rate than GNP and then started to decline from the 1980s. *Max-Neef* (*1995:3*) referred to this phenomenon as a 'threshold hypothesis', whereby 'for every society there seems to be a period in which economic growth (as conventionally measured) brings about an improvement in the quality of life, but only up to a point – the threshold point – beyond which, if there is more economic growth, the quality of life may begin to deteriorate'. The upward trend, followed by a point of decline, can be observed in several countries, such as the United States, the United Kingdom, the Netherlands, Sweden, Germany and Austria (*Figure 3*). In addition to these world-leading surveys, calculations have been carried out, among others, for Chile (*Castañeda 1999*), Spain (*O'Mahony et al. 2018*), Turkey (*Menegaki 2018*), Germany (*Held et al. 2018*), Japan (*Makino 2008*), France (*Nourry 2008*), and Italian and Belgian regions (*Pulselli et al. 2012, Bleys 2013*). The most recent European study on this topic was published in 2024 (*Van der Slycken – Bleys 2024*), which provides recent ISEW figures for the EU-15[5] for the period of 1995–2018.

The ISEW indicator has been criticised for not taking into account the decline in environmental values in a sufficiently robust way to a sufficient extent. *Cobb et al.* (*1995*) elaborated further on the concept of ISEW to include a broader range of environmental factors, namely, the value of leisure activities and the value of voluntary work. As a result of their efforts, a new measure, the Genuine Progress Indicator (GPI), has been developed, but because of confusion between ISEW and GPI calculations in both the literature and practice, we refer to them collectively as ISEW.

[5] The EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and (historically) the United Kingdom.

Figure 3
Trends in GNP and ISEW per capita in the United States, the United Kingdom, Germany, the Netherlands, Austria and Sweden, 1950–1990



Note: The values are presented in indexed form for better comparability, following the Jackson – Stymne (1996) model.

Source: United States: Cobb et al. (1995), Germany: Diefenbacher (1994), United Kingdom: Jackson – Marks (1994), Netherlands: Rosenberg – Oegema (1995), Austria: Stockhammer et al. (1997), Sweden: Jackson – Stymne (1996)

Another measure, 'green GDP', was published in 1993 as an annex to the UN System of National Accounts. The organisation had developed an integrated System of Environmental-Economic Accounting (SEEA) to assess the value of environmental capital and ecosystems. Similar to the ISEW calculations, it seeks to monetise the environmental burden associated with each sector and economic activity. An important difference compared to the ISEW calculation is that green GDP focuses exclusively on environmental factors and does not include the measurement of socio-economic sustainability. The United Nations Statistical Commission adopted the SEEA as an official standard in 2012. However, the SEEA did not offer a solution to all of the criticisms of the ISEW calculations, as evidenced by the fact that several proposals have since been made to improve the indicator (*Lawn 2003, 2013; Beça – Santos 2010)*.

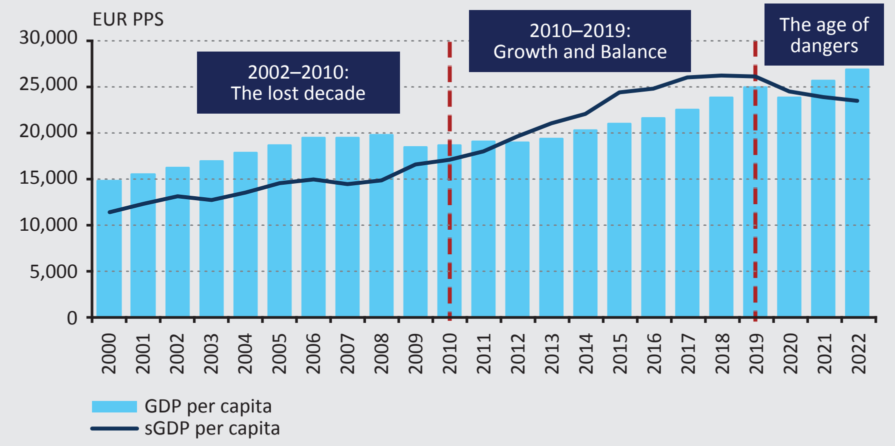
3.5. The Magyar Nemzeti Bank's sustainable GDP indicator

From the 2020s, an increasing number of central banks started to address financial risks of environmental origin in a structured way. Indeed, it is increasingly accepted that environmental changes have multiple effects on both price stability and financial stability, the two most important mandates of central banks. A sustainable financial system can play a key role in meeting the climate change challenge and in the transition to a low-carbon economy (*Halmai 2023*). This provides an opportunity for central banks to be involved, as an ancillary consequence, in the efforts to create an ideal indicator that focuses on sustainability.

The Magyar Nemzeti Bank has been working for several years to make the domestic financial system more sustainable and to facilitate 'green' economic thinking. In 2019, the Hungarian central bank published its textbook entitled '*Long-term sustainable econo-mix*' (*MNB 2019a*), launching a series of publications on sustainable economics. The MNB declared that we needed to achieve progress that was financially, environmentally and socially sustainable over the long term. Also in 2019, in its capacity as a supervisory authority, the MNB launched its Green Programme, which aims to green the operation of the domestic financial system and the MNB's own operations, as well as to build relevant social and professional relationships (*MNB 2019b*). In spring 2021, the MNB was the first European central bank to receive a green mandate from the parliament. The series of publications continued in 2022 with the publication of a global discussion paper entitled '*New Sustainable Economics*' (*MNB 2022a*) and the accompanying expert background paper '*New Economics for Sustainability*' (*MNB 2022b*), in which experts of the MNB declare that 'without a fundamental transformation of economic thinking, the sustainability turnaround is unattainable' (*MNB 2022b:7*).

After a thorough theoretical review of the new sustainable foundations of economics, a new global discussion paper, '*Sustainable GDP'* (*MNB 2024*), was published by the MNB in 2024. In the volume, in addition to the SGI indicator mentioned among the composite indicators, MNB experts also proposed a sustainable GDP (sGDP) indicator. According to the MNB definition, 'GDP is sustainable if it has been or could have been generated while maintaining the balance of (i) the product and labour markets; (ii) the financial sector; and (iii) net lending, and it (iv) preserves ecological resources, and (v) ensures a fair distribution of the goods and services produced' (*MNB 2024:230*). Each of these criteria is represented by a key indicator and accordingly, 5 indicators are used in total to adjust the original GDP value. The advantage of a methodology based on relatively few input indicators is that the results are comparable over time and space for all 27 countries of the European Union. With sGDP, the MNB examines the extent to which the 5 indicators described above deviate from what is considered to be an equilibrium situation. If a certain indicator falls below equilibrium, it reduces sGDP; i.e. GDP is not sustainable, while values above equilibrium increase sGDP, indicating that there is room for GDP growth. Since sGDP can be increased at the expense of environmental capital, this indicator also follows the theory of weak sustainability. The MNB's results show that in Hungary, sGDP consistently underperformed GDP in the 2000s, which indicates that GDP performance at that time was based on unsustainable factors. Since 2012, sGDP has exceeded GDP; in other words, the conditions were right for further GDP growth. In 2021 and 2022, sGDP fell below actual GDP levels due to the impact of the crises (*Figure 4*).

Figure 4
Trends in GDP per capita and sGDP in Hungary, 2000–2022



Source: MNB (2024)

The advantage of sGDP is that it is produced using a common methodology for all 27 EU Member States; therefore, while the calculation of green GDP and ISEW indicators varies from country to country, sGDP is able to provide a view of country performance on a common basis. In light of this, it is important to note that the methodology for sGDP was developed by the MNB based on a different approach from the GDP modification exercises presented earlier, and therefore the results of the exercise cannot be compared with the green GDP and ISEW calculations presented above.

In our view, based on the presentation of the calculation practices in the study (*Table 2*), the Hungarian scientific community should consider joining the set of green GDP and ISEW calculation practices. The advantage of this is that no such research has yet been performed in Hungary and accordingly, a unique calculation could be made, the results of which could be compared with ISEW practices in other countries, for which historical data and recent studies are available. If such a calculation is made, efforts should be made to ensure the transparency of the methodology and the results. The index requires a great deal of computing capacity, data and research and may also require the involvement of several institutions. For the new indicator, it is indispensable to aim for as long a time series as possible, preferably covering at least 30 years.

Table 2
Classifying the indicators presented in the study by type

Inventory-type metrics	GDP-adjusted indicators	Complex (composite) indicators
Ecological footprint	Measures of economic welfare (MEW)	Human Development Index (HDI)
Biocapacity	Index of Sustainable Economic Welfare (ISEW)	Sustainable Development Index (SDI)
	Genuine Progress Indicator (GPI)	Sustainable Development Goals (SDG)
	Green GDP	Sustainable Performance Framework Index (SPFI)
	Sustainable GDP (sGDP)	Harmonic Growth Index (HNI)
		Sustainable Growth Index (SGI)

4. Summary

GDP is an excellent measure of economic welfare. However, it does not take into account factors that contribute to a large degree to people's quality of life. The focus on increasing GDP can undermine other factors that contribute to quality of life, such as the quality of the environment. This is why it is important to look beyond GDP when making decisions. For sustainable growth, we need to ensure not only that wealth increases, but also that environmental capital remains intact. There are three types of indicators available to assess sustainability. Inventory-type indicators describe changes in measurable phenomena such as biocapacity or ecological footprint. Composite indicators aim to condense the different dimensions of sustainability (welfare, environment, society) into a single indicator. The green indicators that modify GDP are designed to correct economic performance by taking into account other factors, notably, environmental damage. It may be possible that central banks will find the key to the solution through their respective research.

References

Al-mulali, U. – Sheau-Ting, L. (2014): *Econometric analysis of trade, exports, imports, energy consumption and CO_2 emission in six regions.* Renewable and Sustainable Energy Reviews, 33: 484–498. https://doi.org/10.1016/j.rser.2014.02.010

Asztalos, P. – Horváth, G. – Krakovský, Š. – Tóth, T. (2017): *Resolving Conflicts in Measuring Banking System Competitiveness – MNB Banking System Competitiveness Index.* Financial and Economic Review, 16(3): 5–31. https://doi.org/10.25201/FER.16.3.531

Bartus, G. – Csite, A. – Herczeg, B. –Jakab, G. – Tuan, V.T. – Varjú, V. – Varró, A. (2022): *Integrált előzetes fenntarthatósági vizsgálati módszertan és fenntarthatósági teljesítmény indikátorrendszer* (*Integrated Ex-Ante Sustainability Assessment Methodology and Sustainability Performance Indicator System*). HÉTFA Research Institute and Analysis Centre. https://kekbolygoalapitvany.hu/wp-content/uploads/2022/05/hetfa-efv-es-spfi-tanulmany-2022-04-29.pdf. Downloaded: 4 March 2024.

Baumert, N. – Kander, A. – Jiborn, M. – Kulionis, V. – Nielsen, T. (2019): *Global outsourcing of carbon emissions 1995–2009: A reassessment*. Environmental Science & Policy, 92: 228–236. https://doi.org/10.1016/j.envsci.2018.10.010

Beça, P. – Santos, R. (2010): *Measuring sustainable welfare: A new approach to the ISEW.* Ecological Economics, 69(4): 810–819. https://doi.org/10.1016/j.ecolecon.2009.11.031

Bleys, B. (2013): *The Regional Index of Sustainable Economic Welfare for Flanders, Belgium*. Sustainability, 5(2): 496–523. https://doi.org/10.3390/su5020496

Brundtland Commission (1987): Our Common Future: Report of the World Commission on Environment and Development. UN, Geneva. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf. Downloaded: 4 March 2024.

Cabeza Gutés, M. (1996): *The concept of weak sustainability.* Ecological Economics, 17(3): 147–156. https://doi.org/10.1016/S0921-8009(96)80003-6

Castañeda, B.E. (1999): *An index of sustainable economic welfare (ISEW) for Chile*. Ecological Economics, 28(2): 231–244. https://doi.org/10.1016/S0921-8009(98)00037-8

Cobb, C. – Halstead, T. – Rowe, J. (1995): *The Genuine Progress Indicator: Summary of data and methodology.* Redefining Progress. https://www.academia.edu/2130370/The_Genuine_Progress_Indicator_summary_of_data_and_methodology. Downloaded: 4 March 2024.

Daly, H.E. – Cobb, J.B. (1989): *For the common good: Redirecting the economy towards community, the environment, and a sustainable future*. Beacon Press.

Diefenbacher, H. (1994): *The Index of Sustainable Economic Welfare in Germany*. In: Cobb, C. W. – Cobb, J. B. (eds.): The Green National Product. University of Americas Press.

Fiala, N. (2008): *Measuring sustainability: Why the ecological footprint is bad economics and bad environmental science*. Ecological Economics, 67(4): 519–525. https://doi.org/10.1016/j.ecolecon.2008.07.023

Halmai, P. (2023): *Fenntarthatóság a közgazdaságtanban. Kiindulópontok és megválaszolandó kérdések* (*Sustainability in economics. Starting points and questions to answer*). In: Halmai, P. (ed.): Fenntarthatóság a közgazdaság-tudományban (Sustainability in economics). Akadémiai Kiadó, pp. 11–43. https://doi.org/10.1556/9789634549475

Held, B. – Rodenhäuser, D. – Diefenbacher, H. – Zieschank, R. (2018): *The National and Regional Welfare Index (NWI/RWI): Redefining Progress in Germany*. Ecological Economics, 145: 391–400. https://doi.org/10.1016/j.ecolecon.2017.11.026

Hickel, J. (2020): *The sustainable development index: Measuring the ecological efficiency of human development in the anthropocene*. Ecological Economics, 167, 106331. https://doi.org/10.1016/j.ecolecon.2019.05.011

Hoekstra, R. (2019): *Replacing GDP by 2030: Towards a Common Language for the Well-being and Sustainability Community*. Cambridge University Press. https://doi.org/10.1017/9781108608558

Jackson, T. – Marks, N. (1994): *Measuring sustainable economic welfare: A pilot index: 1950–1990*. Stockholm Environment Institute.

Jackson, T. – Stymne, S. (1996): *Sustainable economic welfare in Sweden: A pilot index 1950–1992*. Stockholm Environment Institute. https://mediamanager.sei.org/documents/Publications/SEI-Report-1996-SustainableEconomicWelfareInSweden.pdf. Downloaded: 4 March 2024.

Kerekes, S. (2012): *A fenntartható fejlődésről válság idején* (*Sustainable development in times of crisis*). In: Kerekes, S. – Jámbor, I. (eds.): Fenntartható fejlődés, élhető régió, élhető települési táj 1 (Sustainable development, liveable regions, liveable settlement landscapes 1). Corvinus University of Budapest, pp. 15–36.

Kuznets, S. (1934): National Income 1929–32. NBER. https://www.nber.org/system/files/chapters/c2258/c2258.pdf. In: *National Income, 1929–1932.* U.S. Government Printing Office, Washington. https://fraser.stlouisfed.org/title/971. Downloaded: 30 April 2024.

Lawn, P. (2013): *The failure of the ISEW and GPI to fully account for changes in human-health capital – A methodological shortcoming not a theoretical weakness.* Ecological Economics, 88: 167–177. https://doi.org/10.1016/j.ecolecon.2012.12.028

Lawn, P.A. (2003): *A theoretical foundation to support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and other related indexes*. Ecological Economics, 44(1): 105–118. https://doi.org/10.1016/S0921-8009(02)00258-6

Lepenies, P. (2016): *William Petty and Political Arithmetic: The Origins of GDP*. In: Lepenies, P. (ed.): The Power of a Single Number: A Political History of GDP. Columbia University Press, pp. 9–30. https://doi.org/10.7312/columbia/9780231175104.003.0002

Makino, M. (2008): *Genuine progress in Japan and the need for an open economy GPI*. In: Lawn, P. – Clarke, M. (eds.): *Sustainable Welfare in the Asia-Pacific: Studies Using the Genuine Progress Indicator.* Edward Elgar Publishing. https://doi.org/10.4337/9781782542575.00017

Makronóm Intézet (2022): *Harmonic Growth Index*. https://drive.google.com/file/d/173JhoD9_2c266MLqVnPWSUVRUsmdY3E8/view?usp=sharing. Downloaded: 4 March 2024.

Malik, A. – Lan, J. (2016): *The role of outsourcing in driving global carbon emissions*. Economic Systems Research, 28(2): 168–182. https://doi.org/10.1080/09535314.2016.1172475

Málovics, Gy. (2012): *A környezeti fenntarthatóság statisztikai mérőeszközeinek fejlesztésekor jelentkező operacionalizációs választások* (*Operationalisation choices in the development of statistical measures of environmental sustainability*). In: Bajmócy, Z. – Lengyel, I. – Málovics, Gy. (eds.): Regionális innovációs képesség, versenyképesség és fenntarthatóság (Regional Innovation Capacity, Competitiveness and Sustainability). JATEPress, Szeged, pp. 265–282.

Max-Neef, M. (1995): *Economic growth and quality of life: A threshold hypothesis*. Ecological Economics, 15(2): 115–118. https://doi.org/10.1016/0921-8009(95)00064-X

Meadows, D.H. – Meadows, D.L. – Randers, J. – Behrens, W.W. (1972): *The Limits to growth: A report for the Club of Rome's project on the predicament of mankind*. New York, Universe Books. https://doi.org/10.1349/ddlp.1

Menegaki, A. (2018): *The Basic, the Solid, the Site-Specific and the Full or Total Index of Sustainable Economic Welfare (ISEW) for Turkey.* Economies, 6(2): 24. https://doi.org/10.3390/economies6020024

MNB (2019a): *Long-term sustainable econo-mix*. Magyar Nemzeti Bank, Budapest. https://www.mnb.hu/en/publications/mnb-book-series/long-term-sustainable-econo-mix

MNB (2019b): *MNB Green Program*. Magyar Nemzeti Bank, Budapest. https://www.mnb.hu/letoltes/mnb-green-program-en.pdf

MNB (2022a): *New Sustainable Economics*. Magyar Nemzeti Bank, Budapest. https://www.mnb.hu/web/sw/static/file/NEW_SUSTAINABLE_ECONOMICS_-_Global_discussion_paper_2022.pdf

MNB (2022b): *Új közgazdaságtan a fenntarthatóságért* (*New Economics for Sustainability*). Magyar Nemzeti Bank, Budapest. https://www.mnb.hu/web/sw/static/file/az-uj-fenntarthato-kozgazdasagtan-hun.pdf

MNB (2024): *Sustainable GDP – Global Discussion Paper*. Magyar Nemzeti Bank, Budapest. https://www.mnb.hu/en/publications/mnb-book-series/sustainable-gdp-global-discussion-paper

Neumayer, E. (1999): *The ISEW – Not an Index of Sustainable Economic Welfare*. Social Indicators Research, 48(1): 77–101. https://doi.org/10.1023/A:1006914023227

Nordhaus, W.D. (2017): *Revisiting the social cost of carbon*. Proceedings of the National Academy of Sciences, 114(7): 1518–1523. https://doi.org/10.1073/pnas.1609244114

Nordhaus, W.D. – Tobin, J. (1972): *Is Growth Obsolete?* In: Nordhaus, W. D. – Tobin, J. (eds.): *Economic Research: Retrospect and Prospect.* Volume 5, Economic Growth: 1–80.

Nourry, M. (2008): *Measuring sustainable development: Some empirical evidence for France from eight alternative indicators*. Ecological Economics, 67(3): 441–456. https://doi.org/10.1016/j.ecolecon.2007.12.019

O'Mahony, T. – Escardó-Serra, P. – Dufour, J. (2018): *Revisiting ISEW Valuation Approaches: The Case of Spain Including the Costs of Energy Depletion and of Climate Change.* Ecological Economics, 144: 292–303. https://doi.org/10.1016/j.ecolecon.2017.07.024

Pearce, D.W. – Atkinson, G. (1993): *Are National Economies Sustainable? Measuring Sustainable Development*. Centre of Social and Economic Research on the Global Environment, 92(11): 92–110.

Pulselli, F.M. – Bravi, M. – Tiezzi, E. (2012): *Application and use of the ISEW for assessing the sustainability of a regional system: A case study in Italy.* Journal of Economic Behavior & Organization, 81(3): 766–778. https://doi.org/10.1016/j.jebo.2010.12.021

Rahman, M.M. (2020): *Environmental degradation: The role of electricity consumption, economic growth and globalisation.* Journal of Environmental Management, 253, 109742. https://doi.org/10.1016/j.jenvman.2019.109742

Richardson, K. – Steffen, W. – Lucht, W. – Bendtsen, J. – Cornell, S.E. – Donges, J.F. – Drüke, M. – Fetzer, I. – Bala, G. – Von Bloh, W. – Feulner, G. – Fiedler, S. – Gerten, D. – Gleeson, T. – Hofmann, M. – Huiskamp, W. – Kummu, M. – Mohan, C. – Nogués-Bravo, D. – Rockström, J. (2023): *Earth beyond six of nine planetary boundaries.* Science Advances, 9(37), eadh2458. https://doi.org/10.1126/sciadv.adh2458

Rosenberg, D. – Oegema, T. (1995): *A Pilot ISEW for the Netherlands 1950–1992*. Instituut voor Milieu.

Sachs, J.D. – Lafortune, G. – Fuller, G. – Drumm, E. (2023): *Implementing the SDG Stimulus*. *Sustainable Development Report 2023*. Dublin University Press. https://doi.org/10.25546/102924

Sagar, A.D. – Najam, A. (1998): *The human development index: A critical review*. Ecological Economics, 25(3): 249–264. https://doi.org/10.1016/S0921-8009(97)00168-7

Solow, R.M. (1974): *The Economics of Resources or the Resources of Economics*. The American Economic Review, 64(2): 1–14.

Stiglitz, J.E. – Fitoussi, J.P. – Durand, M. (2018): *Beyond GDP: Measuring what counts for economic and social performance*. OECD Publishing, Paris. https://doi.org/10.1787/9789264307292-en

Stockhammer, E. – Hochreiter, H. – Obermayr, B. – Steiner, K. (1997): *The index of sustainable economic welfare (ISEW) as an alternative to GDP in measuring economic welfare. The results of the Austrian (revised) ISEW calculation 1955–1992*. Ecological Economics, 21(1): 19–34. https://doi.org/10.1016/S0921-8009(96)00088-2

UN (2015): *Transforming our world: The 2030 Agenda for Sustainable Development*. Division for Sustainable Development Goals. https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

UNDP (1990): *Human Development Report 1990: Concept and Measurement of Human Development*. New York. https://hdr.undp.org/content/human-development-report-1990

UNDP (2022): *Human Development Report 2021–22: Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World*. New York. https://hdr.undp.org/content/human-development-report-2021-22

Van der Slycken, J. – Bleys, B. (2024): *Is Europe faring well with growth? Evidence from a welfare comparison in the EU-15 (1995–2018).* Ecological Economics, 217, 108054. https://doi.org/10.1016/j.ecolecon.2023.108054

Varga, J. – Bánkuti, Gy. – Csuvár, Á. – Sebestyénné Szép, T. (2019): A *MEW és az ISEW alternatív gazdasági mutatók elméleti áttekintése (A theoretical overview of alternative economic indicators MEW and ISEW).* Acta Scientiarum Socialium, 49: 9–16. https://doi.org/10.33566/asc.2527

Wackernagel, M. – Rees, W.E. (1996): *Our ecological footprint: Reducing human impact on the earth*. New Society Publishers.