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QUALITATIVE DIMENSIONS OF ECONOMIC GROWTH: A NEW PERSPECTIVE

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A B S T R A C T

Scientific efforts are aimed at evaluating and improving quality rather than increasing quantity. Economic growth can be characterized as high quality, when it is inclusive, environmentally friendly, sustainable and effective, ensures technological progress, improves the well-being of society and boosts the competitiveness of country. We propose to distinguish two main dimensions in measuring the quality of economic output, which refer to its generation and effects. Based on this principle, an index of quality of economic output has been calculated for 78 countries spanning from 2005 to 2022. It turns out that underperforming countries struggle to effectively translate the formed economic output quality into high-quality manifestations. On the other hand, they had better prioritize expansion of the production frontier rather than optimize production process itself. In addition, an online platform has been developed for monitoring quality of economic output, performing simulations and processing policies aimed at enhancing the qualitative aspects of economies.

1. INTRODUCTION

Modern economics, which studies the current economic reality full of many challenges, various limitations and uncertainties, reveals new terms and directions of research from year to year. Perhaps one of the most important of them is the quality of economic growth. When examining the current economic reality, economists detect and confront various empirical evidences documenting the tangible gap between economic output and the well-being of society.

From the point of view of a comprehensive study of the country and its economy, quantitative assessments are not enough, because the nature of economic growth implies not only quantitative, but also qualitative changes. After all, targeting, planning and recording economic growth are not an end in themselves: they are aimed at increasing the level of welfare of society, as well as creating new opportunities for further grow. Their implementation directly implies an assessment and improvement of the quality of economic growth.

On the other hand, in recent decades the issue of assessing growth has shifted from national income accounting to human-oriented measurements. In this context, scientific efforts are aimed at evaluating and improving quality rather than increasing quantity. Thus, today the qualitative characteristics of various economic phenomena are the object of many debates, discussions

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and scientific papers. As a result, they outline the characteristics of a quality of economic growth to a certain extent: The high quality economic growth is inclusive, environmentally friendly, sustainable and effective economic growth, which improves the well-being of society, ensures technological progress and the competitiveness of the country.

2. LITERATURE REVIEW

Economists and sociologists, based on data of different countries and regions, have already discovered a number of interesting facts about qualitative manifestations in the economies. According to findings of Hanushek and Kimko (2000), international test scores in math and science are strongly linked to growth. Jamison et al. (2007, p. 20) state that a one standard deviation increase in international student performance test score in mathematics causes an annual increase in per capita income by 0.5-0.9%.

Since the beginning of the 21st century, the previously noted tendencies expanded, namely, they were directed towards the general production process and the quality of economic growth. Back in the last decade, Easterlin and Angelescu (2007, p. 27), referring to subjective measures of well-being rather than objective indicators, as a result of the analysis, conclude that breakdown between economic growth and quality of life becomes even greater. Although the common pattern both in rich and poor countries is that per capita income typically increases ranging from a doubling to quintupling, they fail to raise levels of happiness and life satisfaction.

In this context, an important effort makes the Legatum Institute (2024), which has been calculating the aggregate prosperity indicator for more than 160 countries since 2007 (The Legatum Institute Foundation, 2021). Over time, the methodology of calculating the index has been developed, and the range of indicators that generate it has expanded. In the report, published in 2021, the calculation of the index was based on 12 pillars, one of which is economic quality. It measures how well an economy is equipped to generate wealth sustainably and with the full engagement of the workforce. The value of this pillar is expressed through 5 main elements: fiscal sustainability, macroeconomic stability, productivity and competitiveness, dynamism, labour force engagement. Each of them, in turn, is formed on the basis of relevant indicators. 19 of the 300 indicators included in the prosperity index relate to the level of economic quality.

One interesting trend was noted during the research of the current study. Especially in the works of recent years, within the framework of the EGQ, the authors put forward new ideas and terms, for example, the "synthetic efficiency indicator for economic growth", through which Kokocińska et al. (2020) described the conversion efficiency of expenditures towards economic growth into results pertaining to sustainable development. The authors noticed that the smaller EU member states are characterized by significantly higher efficiency of converging expenditures exemplifying economic growth into results pertaining to sustainable development in the researched area.

The complex nature of the quality of growth implies the calculation of composite indicators for its evaluation. In particular, from year to year, more and more importance is attached to the environmental problems and the issues related to natural resources in that process. Within this framework, the Global green growth institute (2024) has a major contribution. For 2005-2019, the institution calculated the green growth index based on materials of more than 240 countries and regions. It is framed on a green growth economic development model, which aims to deliver equal opportunities from economic prosperity while protecting the environment (Acosta et al., 2020).

Aghajanyan et al. (2014) developed an index of the quality of economic growth based on 31 indicators, which are grouped into 10 subsystems, then evaluated it based on the materials of the Republic of Armenia for 2002-2012. As a result, the unfavorable dynamics recorded by the country in terms of the acquisition of information technologies and scientific and educational activities is obvious.

The origin of the underlying idea of the current study comes from the growth quality index proposed by the International Monetary Fund (IMF) in 2011 based on materials of developing countries (Mlachila et al., 2016). Building on the quality of growth index, the authors also investigate the main drivers of the quality of growth. Thus, the quality of growth index is designed as a composite index of subindices capturing the growth nature and the desirable social outcomes. Empirical investigations of the authors point to the fact that main factors of the quality of growth are political stability, public pro-poor spending, macroeconomic stability, financial development, institutional quality and external factors such as FDI.

3. RESEARCH METHODS AND DATA

Based on the studied literature, we have assessed the index of quality of economic output (EOQI). It is fundamentally different from the assessments presented so far, except for the IMF proposal. In particular, referring to the quality of economic growth, the already developed metrics primarily or exclusively focus on its social aspect, which is already quite comprehensively described by international, widespread and substantiate indicators, such as prosperity index. Obviously, the most important effect of economic growth is social welfare gained as a result, but the approach would be complete if the preconditions and causes of economic growth and the formation of its quality were taken into

account. This study aims to include these characteristics of the quality of economic output. Thus, it will be possible to take into account the presumption that the transition of the economy to a more efficient production and creating preconditions of the high level of potential will lead to an improvement in social outcomes.

Thus, we propose to distinguish two main processes that characterize the economic growth quality: the formation of and the manifestation of the quality of growth. The first refers to qualitative characteristics of production process, and the second refers to the qualitative side of the consequences of growth, as well as the preconditions and opportunities created for further growth. From the both interpretational and methodological perspectives, confining ourselves only to the study of growth effects, we cannot understand the factors and possibilities of their improvement. The proposed EOQI will be calculated according to this approach, and the index will consist of two subindices – economic output quality generation index (EOQGI) and economic output quality effect index (EOQEI). Now let us present the index and its calculation procedure.

3.1 Selection of indicators

In the first stage, we select certain socio-economic indicators specific to each subindex. The prerequisite for selection has been each indicator's relationship with the quality of economic growth, which has been justified by professional circles as a qualitative indicator of the economy or used in assessing the quality of the economic output. Thus, based on the findings of professional literature and the definition of quality of economic growth, which we derived earlier, in Table 1, we present the bands of indicators selected as components for each subindex.

Table 1. EOQI components and their notations

Indicator	Notation
EOQGI components	
GDP per capita (constant 2015 US$)	gi_1
Total factor productivity (0-100)	gi_2
Gross fixed capital formation per labour force unit (constant 2015 US$)	gi_3
Market concentration index (0-1)	gi_4
Government expenditure on education (% of GDP)	gi_5
Research and development expenditure (% of GDP)	gi_6
Domestic credit to private sector (% of GDP)	gi_7
Medium and high-tech manufacturing value added (% of manufacturing value added)	gi_8
CO2 emissions (kg per 2015 US$ of GDP)	gi_9
EOQEI components	
Prosperity index (1-100)	ei_1
Global Competitiveness Index (1-7)	ei_2
Happiness index (1-10)	ei_3
Gini index (1-100)	ei_4

As we mentioned, the indicators, based on which the EOQGI is going to be calculated, together form the qualitative characteristic of the economy at the phase of production of economic output. They outline the efforts and the potential of the country to ensure high-quality economic result. First, let us consider the composition of the indicators that form the EOQGI and examine the main concepts the subindex covers.

3.1.1 Production

The most popular indicator characterizing the production of the country's economy is gross domestic product (GDP). It is a standardized and objective quantitative indicator for modern macroeconomic analysis, which first allows policymakers to get a summary of the economy, observe it over a certain period, track its changes and determine whether an action is needed to stabilize or grow the economy (Fraumeni, 2017). Within the framework of the current research, we consider the GDP from a production perspective, as a result generated in the economy. In order to exclude the influence of prices and scales of economies on the EOQI and prevent distortion of the dynamics of real production, the level of GDP in fixed prices per capita (World Bank, 2023f) is selected as a component covering the production aspect of the EOQGI.

On the other hand, the size of the real GDP per capita of the population, both from the point of view of calculation and content, is incomplete for making judgments about the quality of production in the economy. From a calculation point of view, sometimes the figure can be distorted, as, for example Luxembourg and, to a lesser extent, Switzerland has a relatively large number of frontier workers, who contribute to GDP but are excluded from the population figures (OECD, 2013, p. 20).

3.1.2 Production efficiency

In production, there is always a portion of output not explained by the amount of inputs used in production, which is most commonly known as total factor productivity (TFP). As such, its level is determined by how efficiently and intensely the inputs are utilized in production (Comin, 2010, p. 260). It is customary to consider the efficiency of the country's economy through the production function, as TFP. It characterizes the level of economic development and is an indicator of the quality of economic activity (Zeng et. al., 2022). TFP is considered as a complex effect of non-measurable factors (psychological, technological, organizational, etc.) on the output.

In modern economics, perhaps the most common of the approaches to the assessment of TFP is stochastic frontier analysis (SFA). Taking the indicators of labour force (International Labour Organization, 2022), gross

fixed capital formation (World Bank, 2023d) and primary energy consumption[1] (Our World in Data, 2023) as input factors of production, and real GDP (World Bank, 2023c) as a result, we preliminarily calculated the efficiency levels of GDP production of the considered countries using the SFA. Stata provides the appropriate tooling and commands (Belotti et al., 2013) for the calculations.

3.1.3 Investments in physical capital

The influence of investment on economic outcomes is likely one of the most straightforward. Many authors at different times and with different research methods have studied it, and in that category, different types of investments can be considered.

First, the gross fixed capital formation (World Bank, 2023d) was included in the EOQGI set of indicators as a component, because investments are considered a fundamental factor ensuring economic growth in both theoretical (Keller et al., 2009) and empirical (Neanywa and Makhenyane, 2016) evaluations. In order for the indicator to be comparable at different scales and to be integrated into the labour market, we calculated it per unit of labour force.

3.1.4 Market concentration

A variety of indicators and indices are used in professional literature to assess the level of market concentration. The most common is the Herfindahl-Hirschman (HH) index (Herfindahl, 1950), which is one of the most common and accurate ones. The main advantage of the index is that it is highly sensitive to the redistribution of individual market shares. On the other hand, professional literature often uses this indicator when looking for connections between concentration and economic output (Bajaj et al., 2022) or productivity (Rodriguez-Castelan et al., 2020). We have added HH market concentration index (World Bank, 2023b) to the EOQGI indicators list, which is a measure of the dispersion of trade value across an exporter's partners. A country where a foreign trade is characterised by a high level of concentration is not able to provide inclusive growth. Diversified foreign trade, on the other hand, is more sustainable and creates greater opportunities for inclusive and long-term growth.

3.1.5 Investments in human capital

In addition to investments in fixed assets, the formation of the quality of economic output also implies investments in human capital. Countries are investing in education to improve the skills of human resources, which will boost growth. A number of studies have been devoted to the exploration of its impact on growth, as a result of which the fact is substantiated that targeting resources to improve education is one of the primary ways of stimulating economic growth (Suwandaru et al., 2021). Investing in education means, first and foremost, investing in human resources, i.e., creating a skilled labour force that will influence the creation of innovations, increase productivity and wages, reduce the demands on the state to finance various social programs, and increase the state budget by accumulating taxes, and all this is expected to have a positive impact on the economic growth of the country (Ziberi et al., 2022). The share of government expenditure on education (World Bank, 2023h) has also been considered as a component of the EOQGI.

3.1.6 Investments in R&D

Another important aspect of investments that has to be considered as an indicator of the qualitative dimension of economic output is investments in research and development (R&D). This direction of expenditure predominantly entails allocating funds towards technological development, which allows increasing the potential of the economy, to ensure intensive growth of production, to expand the borders of production, to go along the path of new economic opportunities and the expansion of markets. There are many studies in the professional literature concerning the positive impact of R&D expenditures on economic result (Blanco et al., 2015; Szarowská, 2018; Tung et al., 2023). To cover this facet, we have included R&D expenditures' share in GDP (World Bank, 2023j) in the index components list as well.

3.1.7 Private sector incentive

From the qualitative perspective of the economy, we have selected the ratio of credit to the private sector to economic output (World Bank, 2023e) as EOQGI component too. It not only indicates the level of investment activity, but also describes the inclusion of the existing financial and banking system in it. Leogrande (Leogrande, 2023) concludes from a review of materials from a comprehensive list of countries that countries with low rates of economic growth tend to have low levels of domestic credit as a percentage of GDP, that is, financial institutions play a significant role in promoting economic growth. Other empirical studies, conducted for individual countries or groups of countries, document the presence of a positive relationship between domestic lending and economic activity (Jammeh, 2022; Ozili et al., 2023).

3.1.8 Technology level of the manufacturing

A manufacturing industry equipped with medium and high technologies is an important driver of economic growth and industrial enhancement (Zhou, 2016). In contrast to the mining industry, manufacturing exhibits

[1] The energy as a resource is also one of the main factors of economic growth and often it is placed as an independent factor next to the main factors of the Cobb-Douglas production function (Shahbaz et al., 2017; Keen, 2019; Dong et al., 2021; Pokrovski, 2023).

a higher degree of technological sophistication. The level of technologies used in the processing and obtaining final products from raw materials is also an important indicator of the quality of the economy. Therefore, the components of EOQGI have been supplemented by the share of medium and high-tech manufacturing value added in total manufacturing value added (World Bank, 2023i).

3.1.9 Ecology

One of the most important aspects in the modern economics is the consequences of human economic activity on the ecological system, which are often irreversible. If the formation of economic output is accompanied by a significant negative impact on the environment, because of which threats to ecological security arise, then it is self-deception to consider a high level of production useful for society. In the studies on the interaction between the economic output and the natural environment, various indicators are considered, through which attempts are made to evaluate the impact of economic activity on the environmental system (Grossman et al., 1994; Galeotti, 2006; Rifa'I and Dewi, 2018). One of the most common indicators is the level of CO2 emissions. Th long-run relationship between GDP and CO2 emissions is negative, because the development of new low-carbon technologies enables in the long-run to reach the same production level at lower CO2 emissions (Kasperowicz, 2018). Thus, in order to cover the ecological aspect of the production in the EOQGI structure, we have selected the level of CO2 emissions corresponding to the scale of production (World Bank, 2023a) as an index component.

Thus, consolidating the indicators covering production, its efficiency, physical and human capital investments, market concentration and applied technologies, as well as the ecological consequences of the economic activity, we propose that it is viable to articulate a depiction of the formation of the economic output quality. Next, we make a transition to look at the qualitative characteristics of the economic output effects.

The EOQEI can be described by 2 main aspects of economic performance: social and competitive. For such qualitative indicators, experts propose clear approaches and methods, which have garnered trust among economists and sociologists over many years. Below we briefly consider the economic output effects separately. The corresponding indicators are included in the calculation of EOQEI as its components.

3.1.10 Prosperity

According to Moore, development agenda should go beyond just re-writing goals and targets that adhere to 'sustaining' the same old economic and social models. He states that we should turn our attention to prosperity rather than to development per se, recognising the critical role political and social innovation should have in unleashing individuals' potential to flourishing in a context of finite resources (Moore, 2015). On the other hand, the goal of governments has to be not just "painting" a higher level of growth, but they have to improve prosperity. Perhaps the most widespread indicator of its quantitative assessment is the index of prosperity (Legatum Institute, 2021), which, as a basic indicator of the quality of the economic output effect on society, we have included in the EOQI system.

3.1.11 Happiness

The quality of the economy implies the study of subjective indicators, one of the most circulating of which is the level of happiness of the population. Many modern studies attempt to analyse the relationship between economic growth and the level of life satisfaction, and these trends have expanded so much that they have become the basis for the formation of a new direction of study, happiness economics. It is a modern direction, interest in which began to develop in the 1990s. Clark found out an interesting statistic: four of the 20 most-cited articles ever published in the Economic Journal explicitly had the word "happiness" in their title, and two of the three most-cited articles in Journal of Public Economics deal with the question of subjective well-being (Clark, 2018).

In economics, discussions about the happiness arise from the following question: money is not everything, so how important is it? In this context, researchers can be categorized in two camps. Some argue that there is no correlation between these two concepts, suggesting that the relentless pursuit of economic growth has become meaningless and, furthermore, it does more harm than good. Representatives of the other side claim that economic growth and happiness are interconnected (Rus and Blajan, 2021). Despite these differences, we cannot consider the production of the GDP to be of high quality, if it does not imply a happy society. The annual reports published by the Sustainable Development Solutions Network (2022) examine the level of happiness in more than 140 countries, based on the Gallup (2024) survey results. Respondents rate their level of happiness on a scale of 0 to 10. The happiness index is calculated by averaging the survey results. As an indicator of the quality of the economy, we have included it (Sustainable Development Solutions Network, 2023) in the calculations of the EOQEI too.

3.1.12 Competitiveness

Many economic phenomena are characterized by their competitive or non-competitive nature. At the theoretical level, Berger (2008) distinguishes four main structural components of national competitiveness: the ability to sell its goods to another nation, the ability to earn, the ability to adjust to changes in the external environment, and the ability to attract. On the other

hand, competitiveness can be defined as the ability of a country to achieve goals other than generating GDP for its citizens. From another perspective, a country's competitiveness is an assessment of its ability to create competitive advantages and enter new markets through them. That is why we find competitiveness of the country is one of the qualitative effects of the economic growth. In the EOQEI, we included the competitiveness index assessed in the global competitiveness reports published by the World Economic Forum (2023), which reflects the microeconomic and macroeconomic foundations of national competitiveness.

3.1.13 Income inequality

In the social context of the quality of the economy, the distribution of income and its connection to economic activity stand out as one of the most debated phenomena and crucial issues confronted by specialists in their studies. Since the 1960s, economists have widely accepted the Lorenz curve as the tool for deriving measures of income inequality in society, among them the Gini coefficient (Kristensen, 2022). This indicator (World Bank, 2023g), as an important one covering one of social manifestations' aspects of the quality of economic output, we also included in the EOQEI as a subindex component.

3.2 Data collection and processing

Following the selection and classification of indicators, we have collected and processed the annual data of the selected 13 indicators across 78 countries spanning from 2005 to 2022. Data sources are referenced for each indicator section above. Some data points for some indicators for some years might be missing for some countries. At first, the countries that are not provided with at least one of the 13 selected indicators for any year during the considered period, have been simply removed from the list of studied countries. Eventually, out of more than 200 countries considered, 78 remain in the filtered sample. The problem of data imperfection has been addressed according to the priorities specified in the prosperity index methodology ((The Legatum Institute Foundation, 2021). Where missing data are detected for a country, we first use the latest known value for that indicator. Where data are missing and no prior data are available, which mainly happens with the earlier years, the earliest data available are employed.

3.3 Normalization

In order to make the collected indicators comparable, they have been normalized according to the distance to frontier approach. In case of indices, the need for normalization is due to the precondition of bringing indicators with different measurement units and scales to the same dimension of comparability.

$$X'_{ij} = \frac{X_{ij} - X_{min}}{X_{max} - X_{min}},\ i=\overline{1,78},\ j=\overline{1,13}, \qquad (1)$$

where *i* and *j* represent the certain country and indicator, respectively. X_{ij} is the raw value of the *i*-th country for *j*-th indicator. X_{min} and X_{max} are the recorded minimum and maximum values of *j*-th indicator for the entire period observed, respectively.

We are typically guided by the 4th and 96th percentiles for observed values in excluding outliers. For indicators where a higher value indicates worse performance, the distance to the frontier is reversed so that higher scores indicate better performance. Among such selected indicators are three - CO2 emissions' indicator, the HH market concentration the Gini indices. Eventually, each indicator is scaled to a range between 0 and 100. The closer the value is to 100, the higher rank the economy record.

3.4 Weighting

Next, the two subindices are calculated independently. There is no unanimously accepted and impeccable approach to determining the weights of composite indices. However, three main approaches are applied by experts – equal, statistical or objective, explicit or subjective. The main disadvantage of the equal weighting is considered an unreasonably primitive interpretation of the content of the phenomenon under consideration. The disadvantage of the objective methods is that they determine criteria weights by solving mathematical models automatically without any consideration of the decision. On the other hand, the weights obtained as a result of their application often appear to be absurd from the point of view of interpretation. The limitations of their calculation and application are problematic as well. For example, the principal component analysis is difficult to apply when it comes to aggregating more than three variables (Mlachila et al., 2016). Potential problems are also the multifaceted nature of the coefficient to be calculated by us and the wide range of considered entities. It turns out that if we were to consider the values of each country for each indicator, we would have to study 1014 time series, as a result of which it is practically impossible to achieve a stable result for the EOQI ecosystem. The subjective methods can be categorized into 3 main groups: expert opinion-based survey, survey weighting or public opinion-based weighting, and analytic hierarchy process (AHP). The names of the first two suggest how the determination of weights is performed, and the third is a separate technique not only for determining weights, but also for organizing and making complex decisions in general. It was put forward in the late 1970s by Saati (Saaty, 1977; Saaty, 1988) as a psycho-mathematical system of decision analysis. Later, developing and being applied in many fields, it started being utilized in diverse professional environments as a methodological basis of the research

or its constituent part, as in our case. AHP provides an opportunity to handle decision-making situations where subjective judgments are present, as well as to provide an assessment of the stability of the obtained system. The weights of indicators within AHP can be determined by the pairwise comparison (Poledníková and Melecký, 2017, p. 1256). These are expressed on an ordinal scale with nine levels, ranging from "equally important" to "much more important", representing how many times more important one criterion is than another one (Greco et al., 2018). At the same time, the evaluation can also be in reverse logic, from 1/9 to 1, that is, how many times the considered indicator is less important in the system than the other is. For example, a rating of 1/4 means that the observed indicator is 4 times less important than the compared one. Thus, there is elicited a matrix of judgments of the relative preference between each pair of indicators with respect to each attribute.

Using AHP, we gain two main advantages of it. It brings the decision-making process in a complex system to a simple hierarchical solution, in particular, the expert makes a decision at each step in the context of two indicators, independently of the whole system. On the other hand, AHP are less prone to errors of judgement, as inconsistency ratio can be applied to check the reliability of the result (Gompf et al., 2021) .

The choice of a weighting method often depends not only on the advantages of the method or its characteristics, but also on the limitations associated with using other possible approaches in the formed system, or the resulting uncertainty. Considering the advantages of the AHP method, as well as the inexpediency of using other methods in the case of our sample, both from the points of view of interpretation and methodology, we chose this method to calculate the EOQI weights.

Table 2. Weights of EOQGI components and the AHP stability coefficient

Indicator	**Weight**
GDP per capita	22.51%
Total factor productivity	22.51%
Gross fixed capital formation per labour force unit	13.99%
Market concentration index	10.48%
Government expenditure on education	6.82%
Research and development expenditure	6.82%
Domestic credit to private sector	6.52%
Medium and high-tech manufacturing value added	6.39%
CO2 emissions	3.98
Stability coefficient	*0.13*

In Table 2 and Table 3 there are introduced the calculated weights for each indicator and the corresponding AHP consistency ratios in EOQGI and EOQEI, respectively. The calculations are performed by using an online tool developed by Business Performance Management Singapore (2024). The estimated weights are acceptable if the stability coefficient is less than 0.1. In both of the cases, the received coefficients satisfy the stability condition of the corresponding AHP.

Table 3. Weights of EOQEI components and the AHP stability coefficient

Indicator	**Weight**
Prosperity index	55.25%
Global Competitiveness Index	21.33%
Happiness index	14.04%
Gini index	9.39%
Stability coefficient	*0.03*

3.5 Aggregation

At the next stage of constructing the index, the collected and normalized indicators are aggregated into a single measure. The choice of combination method can have a significant impact on the result, the interpretability and sensitivity of the coefficients as well.

Many economic phenomena are interrelated. The indicators we have chosen are no exception. Unlike the arithmetic mean, which assumes the absence of interaction between the components, the geometric mean effectively reflects such relationships, providing a more accurate representation of the interdependence of economic variables (Gini, 1921), that is, the idea of perfect substitutability is removed from the system, admitting possible exchange between the variables. On the other hand, the value calculated by the arithmetic mean is easily distorted in the presence of extreme indicators in the sample, while the geometric mean mitigates the effect of extreme deviations, making the combined value more stable and reliable. Thus, applying the approach of geometrical weighted mean, we calculate the values of each country's EOQGI and EOQEI for each considered year.

$$\mathrm{EOQGI_i} = \prod_{j=1}^{m} x_{ij}'^{\,w_j},\ i = \overline{1,78},\ j = \overline{1,9}, \tag{2}$$

$$\mathrm{EOQEI_i} = \prod_{j=1}^{m} x_{ij}'^{\,w_j},\ i = \overline{1,78},\ j = \overline{1,4}, \tag{3}$$

where $\mathrm{EOQGI_i}$ and $\mathrm{EOQEI_i}$ stand for the aggregated values, that is the corresponding subindices of the *i*-th country in the year under consideration, x'_{ij} – the normalized value of the *i*-th country for *j*-th indicator, w_j – weight of the *j*-th indicator, *m* – indicators count included in the corresponding subindex.

The geometric mean of two subindices represents the EOQI.

$$\mathrm{EOQI_i} = \sqrt{\mathrm{EOQGI_i} \times \mathrm{EOQGI_i}} \tag{4}$$

4. RESULTS AND CONCLUSIONS

In Table 4 there are presented the studied 78 countries and the average values of the subindices of them during the 18 observed years in descending order of the EOQI. The average EOQI of the studied group is about 42.7 points. The leader is Switzerland with 84.9 points, which is 23 times higher than the value recorded by Ethiopia (3.7). The latter's value, as well as the value recorded by Cambodia (3.74) from the low ranking countries, are almost 11 times lower than the average.

Table 4. Geometric means of the values of EOQGI and EOQEI and EOQI of the countries for the years 2005-2022 and their corresponding rankings

Country	EOQGI	EOQEI	EOQI	Country	EOQGI	EOQEI	EOQI
Switzerland	90.49 (1)	79.64 (4)	84.89 (1)	Romania	28.02 (41)	61.50 (36)	41.51 (40)
Norway	85.83 (2)	79.12 (5)	82.41 (2)	Russia	28.93 (39)	57.22 (48)	40.69 (41)
Denmark	81.33 (3)	80.03 (1)	80.68 (3)	Mexico	27.40 (42)	59.86 (37)	40.50 (42)
Sweden	79.19 (5)	79.64 (3)	79.41 (4)	Jordan	24.21 (43)	57.87 (45)	37.43 (43)
USA	80.73 (4)	75.18 (14)	77.91 (5)	Argentina	23.64 (45)	59.00 (40)	37.34 (44)
Finland	71.72 (7)	79.70 (2)	75.60 (6)	Colombia	21.95 (47)	57.31 (47)	35.47 (45)
Luxembourg	74.36 (6)	76.06 (12)	75.21 (7)	Serbia	21.68 (48)	57.63 (46)	35.35 (46)
Netherlands	68.37 (9)	78.93 (6)	73.46 (8)	Botswana	23.09 (46)	53.04 (65)	34.99 (47)
Ireland	68.92 (8)	75.39 (13)	72.08 (9)	Iran	23.94 (44)	50.82 (68)	34.88 (48)
Germany	66.53 (10)	77.02 (7)	71.59 (10)	Ecuador	21.34 (50)	54.91 (57)	34.23 (49)
The United Kingdom	66.21 (12)	76.16 (10)	71.01 (11)	Morocco	21.57 (49)	54.22 (61)	34.20 (50)
Iceland	65.30 (13)	76.08 (11)	70.48 (12)	Kazakhstan	18.33 (51)	58.84 (41)	32.84 (51)
France	66.27 (11)	73.48 (15)	69.78 (13)	Peru	16.96 (53)	58.07 (44)	31.38 (52)
Canada	62.01 (15)	76.41 (9)	68.84 (14)	Azerbaijan	16.85 (54)	55.79 (56)	30.66 (53)
New Zealand	60.95 (16)	76.44 (8)	68.25 (15)	Indonesia	15.63 (56)	58.28 (42)	30.18 (54)
Israel	63.46 (14)	69.99 (18)	66.65 (16)	Moldova	15.86 (55)	56.71 (51)	29.99 (55)
Italy	56.47 (17)	67.82 (21)	61.89 (17)	Egypt	17.82 (52)	50.44 (69)	29.98 (56)
Spain	53.00 (18)	70.14 (16)	60.97 (18)	Albania	15.40 (57)	57.09 (50)	29.65 (57)
Slovenia	49.57 (19)	69.39 (19)	58.65 (19)	Georgia	15.27 (58)	56.56 (53)	29.38 (58)
Portugal	46.12 (20)	67.36 (22)	55.74 (20)	Philippines	14.57 (59)	56.08 (54)	28.59 (59)
Czech	44.24 (22)	70.14 (17)	55.71 (21)	Armenia:	13.97 (60)	56.56 (52)	28.11 (60)
Estonia	43.99 (23)	69.32 (20)	55.22 (22)	Gabon	13.68 (61)	49.77 (72)	26.10 (61)
Cyprus	45.21 (21)	66.64 (23)	54.89 (23)	India	12.52 (62)	53.41 (64)	25.86 (62)
Greece	40.89 (24)	62.87 (34)	50.70 (24)	Senegal	9.72 (63)	51.23 (67)	22.32 (63)
Slovakia	38.26 (27)	66.46 (24)	50.43 (25)	Ukraine	8.23 (65)	55.96 (55)	21.46 (64)
Croatia	39.30 (25)	63.31 (33)	49.88 (26)	Algeria	8.31 (64)	53.54 (62)	21.09 (65)
Hungary	38.89 (26)	63.69 (32)	49.77 (27)	Sri Lanka	7.91 (66)	54.52 (60)	20.77 (66)
Latvia	36.02 (28)	64.92 (29)	48.36 (28)	Mongolia	7.44 (68)	54.68 (59)	20.17 (67)
Lithuania	35.52 (30)	65.79 (27)	48.34 (29)	Ghana	7.69 (67)	52.49 (66)	20.09 (68)
Chile	34.57 (32)	66.41 (25)	47.91 (30)	Guatemala	6.99 (70)	54.87 (58)	19.59 (69)
Poland	34.53 (33)	66.19 (26)	47.81 (31)	Kenya	7.07 (69)	50.09 (70)	18.81 (70)
Malaysia	35.07 (31)	64.76 (30)	47.65 (32)	Zambia	5.50 (71)	47.68 (74)	16.20 (71)
Saudi Arabia	35.66 (29)	58.16 (43)	45.54 (33)	Pakistan	4.16 (72)	47.23 (76)	14.01 (72)
Costa Rica	31.32 (37)	65.06 (28)	45.14 (34)	Kyrgyzstan	1.86 (73)	53.42 (63)	9.98 (73)
Uruguay	30.93 (38)	63.93 (31)	44.47 (35)	Nepal	1.43 (74)	50.03 (71)	8.45 (74)
Turkey	34.52 (34)	57.16 (49)	44.42 (36)	Myanmar	0.71 (75)	45.13 (77)	5.68 (75)
China	33.27 (35)	59.17 (39)	44.37 (37)	Tanzania	0.60 (76)	47.46 (75)	5.35 (76)
Brazil	31.96 (36)	59.35 (38)	43.55 (38)	Cambodia	0.29 (78)	48.43 (73)	3.74 (77)
Panama	28.84 (40)	62.12 (35)	42.33 (39)	Ethiopia	0.30 (77)	44.67 (78)	3.67 (78)

More countries have registered up to 20 points of EOQI (10) than those that have recorded more than 80 points (3). The majority of countries (64%) have achieved to the EOQI score in the range of 20-60, and 75 out of 78 countries scored up to 80 points.

Overall, data does not exhibit significant dispersion. The coefficient of variation is below 1 (0.49), indicating that deviations from the mean are not substantial. Additionally, the coefficients of skewness (0.16) and kurtosis (-0.76) suggest low significance of extreme values and the lack of noticeable accumulations or outliers in dataset.

The standard deviation (24.17) of the EOQEI exceeds the same indicator of the EOQGI by about 2.5 times. Such a result proves how important it is to include the indicators affecting the formation of the output in the assessment of the qualitative side of the economic output.

If we consider the internal structure of each country's EOQI, we can highlight various features of the qualitative side of the economy. For example, despite the high rating of GDP per capita of the US economy (5), the country ranks 56th by income inequality (Table 5). The opposite can be noticed in Pakistan and Kyrgyzstan: the countries are in the top 20 in terms of Gini index and in the bottom ten in terms of GDP per capita. In Kenya, in the stage of formation of economic output quality, quite high rankings on several indicators are unable to provide qualitative effects.

The ratings indicate that the significant contrast between two groups of countries primarily stems from the EOQEI rather than the EOQGI (Table 5). The variations in the ratings for certain aspects of EOQGI, which are not as extreme, suggest that underperforming countries struggle to effectively translate the formed quality potential into a high-quality performance.

The countries ranked in the top ten and bottom ten of the EOQI rankings show that the underperforming countries need to focus more on technological advancements rather than just technical efficiency. That is they have to expand the production frontier rather than optimize the production process. This is indicated by the relatively small difference in the TFP level between these two groups. Additionally, it is evident from the level of technology within the manufacturing, which directly influences technological efficiency. Moreover, there are noticeable differences in education and R&D expenditures' share in GDP between these two groups, highlighting the need for improvement in technological aspects.

In addition, an online platform has been developed for monitoring the quality of the countries' economic output. It provides an opportunity to study the list of observed countries, their results and ratings, strengths and weaknesses from the perspective of the economic output quality, download the dynamic series of indices and their components. The tool supports dynamic data, that is, it is possible to recalculate the indices after new data is published – just upload them and observe the new results. It is also possible to modify the list of components of the index, their weights, percentiles and normalization limits. Thus, without basic methodological and chronological limitations, the observation of the EOQI is automated. Moreover, having the methodological framework of the simulation model of the EOQI and the functional interactions derived from it, one can carry out relevant simulations and observe the behaviour of the system. Due to the presented simulation model integrated in the platform, various policies aimed at improving the country's quality of economic output can be developed and virtually applied. The use of such tools should be a permanent part of the policy development process, saving time, personnel, financial and other resources.

Table 5. Rankings of EOQI components of 10 leading and lagging countries

Country	**gi_1**	**gi_2**	**gi_3**	**gi_4**	**gi_5**	**gi_6**	**gi_7**	**gi_8**	**gi_9**	**ei_1**	**ei_2**	**ei_3**	**ei_4**
Switzerland	2	67	1	29	31	4	1	4	1	5	1	4	30
Norway	3	7	3	43	5	13	29	10	3	3	10	3	6
Denmark	6	25	7	19	3	5	5	3	6	1	8	1	7
Sweden	8	38	6	6	4	2	6	12	2	2	4	6	12
USA	5	21	5	17	14	7	9	2	32	14	2	13	56
Finland	10	42	8	8	7	3	17	21	16	4	6	2	9
Luxembourg	1	8	2	46	45	20	53	19	11	8	15	11	28
Netherlands	9	39	12	41	23	10	11	16	15	6	5	5	11
Ireland	4	77	4	57	48	18	3	27	10	11	16	14	23
Germany	13	24	14	2	35	6	2	22	19	9	3	16	21
Guatemala	55	50	64	70	67	78	40	58	27	60	57	28	73
Kenya	68	16	74	14	20	39	61	63	21	68	66	72	64
Zambia	72	40	63	69	75	72	65	73	24	69	77	73	77
Pakistan	70	33	75	18	74	57	38	70	60	77	73	54	17
Kyrgyzstan	73	66	73	71	12	67	76	74	75	64	75	52	15
Nepal	77	54	72	75	55	76	72	30	37	72	72	63	29
Myanmar	75	72	70	72	78	77	52	76	35	76	78	70	43
Tanzania	76	51	76	38	56	50	73	78	18	75	74	78	52
Cambodia	74	69	78	67	76	69	78	68	54	73	68	76	67
Ethiopia	78	64	77	21	30	58	60	69	14	78	76	69	35

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