How the Covid-19 Pandemic Affects Sustainable Development: The Impact on the Social, Economic and Energy Parameters of Sustainable Development

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Abstract

The Covid-19 pandemic has been a challenge for all countries of the world. Although the most negative impact was on public health, the pandemic also caused damage to the economic, social and energy sectors.

The research puts forward a hypothesis about the differentiation of countries due to the impact of the Covid-19 pandemic on the economic, social and energy parameters of sustainable development. A negative impact on indicators such as GDP, the number of unemployed, electricity generation was identified.

The following methods were used in the article to analyze the impact of the Covid-19 pandemic on the economic, social and energy parameters of sustainable development: systems analysis, deductive approach, regression and correlation analysis and extrapolation.

Theoretical and empirical research show that the economies of countries were not ready for the negative transformation processes caused by the quarantine restrictions. The after-effects of the pandemic will manifest themselves for the long period without concerted action of governments, businesses and the international community. It will negatively affect the social and economic development of countries and undermine the progress towards achieving the sustainable development goals until 2030.

This article will be useful for researchers, political elite and international organizations while developing the anti-crisis programs and programs for the social and economic development of the countries.

Keywords: Economic, energy and social parameters of sustainable development, Sustainable Development Goals, social and economic development, the Covid-19 pandemic, GDP, forecasting, crisis.

List of Notations and Abbreviations

World Health Organization (WHO), Sustainable Development Goals (SDGs), Gross Domestic Product (GDP).

1 Introduction

Relevance. The World Health Organization (WHO Director-General's Opening Remarks, 2020) declared COVID-19 a global pandemic in March 2020. In most countries of the world, the economic growth has slowed due to a significant drop in demand for key financial and industrial markets, the disruption of international supply chains, the closure of borders and the impossibility of tourism activities (Cohen, J., 2020; Ray, A., 2021). The demand for product of some industries has skyrocketed (for example for facemasks, medicines, disinfectants, everyday goods, delivery services) and far outstripped the supply. At the same time, some industries, on the contrary, felt the sharp drop in the demand for their product (for example, the automotive industry, restaurant business, tourism and recreation, etc.), which led to the threat of bankruptcy of these industries and the need for government support (Ivanov, D., 2020, Minchenko, M. and Demchuk, K., 2021).

The pandemic has drawn the attention of scientists to the problem of countries' vulnerability to sudden crises and emergencies. The experience of functioning during a pandemic made it possible to identify bottlenecks of the economic, social and energy fields. The pandemic proved that country's

government must timely develop the strategies to minimize the economic and social effects of crises and shift to energy efficient consumption, which will increase the resilience of countries.

Most researchers consider the impact of the Covid-19 pandemic on the economy as a country-specific experience. The authors used a systematic approach in analyzing the impact of Covid-19 pandemic on parameters of sustainable development: the experience of many countries of the world (High-income, Upper middle-income, Lower middle-income and Low-income economies) and parameters of sustainable development (society, economy and energy) was considered. The impact of the Covid-19 pandemic depends on the preparedness of the economy and governments for crises. Therefore, it is not possible to draw total conclusions for all countries.

The study was conducted in several stages (Figure 1). In the first stage, a literature review was conducted using VOSviewer software based on a study of the Scopus database.

In the second stage, the countries of the world were selected for further analysis. The countries of the world were grouped into four following types according to the level of GDP per capita: high-income economies, upper middle-income economies, lower middle-income, low-income group.

In the third stage it was investigated the impact of the pandemic on the parameters of sustainable development. The impact was considered by three following periods: preCoronavirus, Coronavirus and postCoronavirus periods. The authors suggested to consider GDP as the main indicator of economic development during the preCoronavirus period. The research identified such factors of impact on GDP as the number of unemployed people, the volume of exports and imports, inflation, energy generation. A correlation analysis of the relation between GDP and the above mentioned indicators was carried out based on the primary data.

During the Coronavirus period, one of the indicators that affected the parameters of sustainable development was the incidence of Covid-19. The research analyzed the impact of rate of COVID-19 cases on the economic, social and energy parameters of sustainable development. It was proved that this impact has regional differentiation. The countries of the high-income economies group and the lower middle-income group were the most vulnerable to the Covid-19 pandemic.

In the fourth stage, authors suggest the scenarios for the development of an economic indicator, i.e. GDP, for the countries (of each analyzed group) most affected by the pandemic. The authors proved that the period needed for overcoming the crisis will be different for each country. It depends
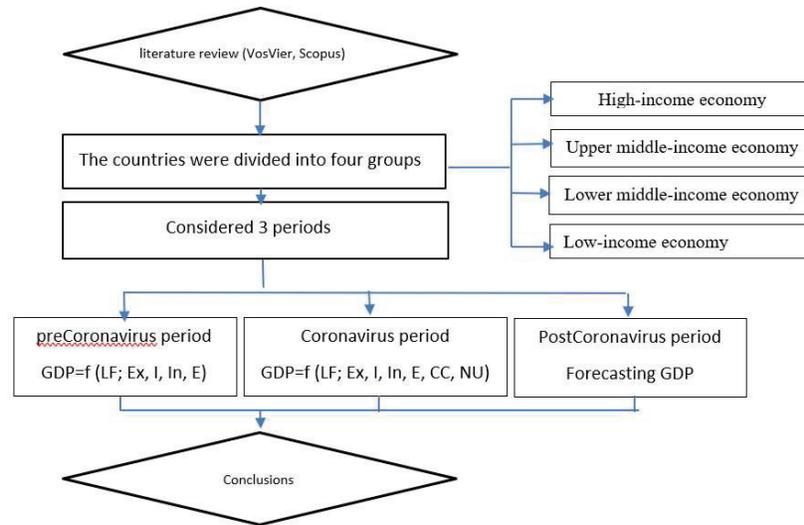
LF - Labor force, Ex - Exports of goods, I - Imports of goods, In – Inflation, E - Electricity generation, CC - Cumulative confirmed Covid-19 cases, NU - Number of unemployed

Figure 1 Stages of research.

on the social and economic development of the country, the institutional environment and the specific features of the country's economy.

Literature Review

The paper provides an overview of research on the impact of COVID-19 on the social, economic and energy parameters of sustainable development.

Scientific and theoretical research relating the impact of the Covid-19 pandemic on the energy development parameters were carried out by such scientists as M.M. Mohideen et al. (2021), C. Zhou et al. (2021), E.B. Barbier (2020), C. Felgueiras (2020), K. Li (2021), Z. Yang (2020), A. Abu-Rayash and I. Dincer (2020).

In particular, Abu-Rayash, A., and Dincer, I. (2020) considered the impact of COVID-19 and the global pandemic on the energy sector dynamics. Chiaramonti D., Maniatis K. analyzed the consequences from the Covid19 (Coronavirus) pandemic that could possibly apply to the energy sector.

Elavarasan, R. M. et al. (2020) studied aims to investigate the global scenarios of power systems during COVID-19 along with the socio-economic

and technical issues faced by the utilities. Humphreys, R. M. et al. (2020) summarized the current evidence of the impact on the maritime and logistics sector in African countries. On the other hand, Koirala, J. & Acharya, S. (2020) proved the impact of COVID-19 outbreaks on Nepalese Economy as Nepal is fully dependent on other countries and imports. Liverpool-Tasie, L. S. O. et al. (2021) proved the impact of the COVID-19 pandemic on the Nigerian economy to, seeing the important role of food security. Mohideen, M.M. et al. (2021) made a hypothesis about the expediency of switching to green energy in the post-coronavirus period.

Letunovska, N. et al. (2021) tested the hypothesis that there is a link between the consumption of non-renewable resources in leaders economies in the European region in terms of value-added industry and health.

Modern publications devoted to determining the impact of the Covid-19 pandemic on the parameters of social and economic development belong to R.M. Elavarasan, et al. (2020), M. Irfan (2021), A. Anvari-Moghaddam (2021), M. Mofijur et al. (2020).

Antonyuk, N., et al. (2021) discovered the peculiarities of business development of quarantine measures and the pandemic. Trade policy responses to the COVID-19 pandemic crisis was considered Evenett, S., Fiorini, M. et al. (2021) Halbrügge, S et al. (2021) discussed impact the COVID-19 pandemic to German and other European electricity systems. Kadar, B., and Reicher, R. Zs. (2020) suggested ways to overcome rising unemployment and changes in trade relations between countries. Khurana, S. et al. (2021) highlighted essential factors which can help companies to overcome this crisis and other types of crises, by learning from the approaches taken in India, which has a unique and diverse economic system.

Some sectors of the economy, such as tourism, trade has been hit hardest by the COVID-19 pandemic. This is confirmed by such authors: Rutynskyi, M., and Kushniruk, H. (2020), Vidya, C. T. and Prabheesh, K. P. (2020).

Minchenko, M., and Demchuk, K. (2021) developed scenarios of economic recovery after the pandemic crisis.

The social component, namely the impact of motivation on work efficiency during the COVID-19 pandemic was studied in Tovmasyan, G., Minasyan, D. (2020). Vasilyeva, T. et al. (2020) proposed a methodology to calculate the institutional development gap of social sector: social capital development, social infrastructure development, social security system development.

The issue of sustainable development in a pandemic has been studied by such scientists: Barbier, E. B., and Burgess, J. C. (2020), Boyacı-Gündüz

et al. (2021), Elavarasan, R. M. et al. (2021), Ivanov, D. (2020), Karmaker, C. L. et al. (2021), Kim, M. et al. (2021), Kumar, A. et al. (2020), Leal Filho, W. et al. (2021), Lozano, R., and Barreiro-Gen, M. (2021), Mofijur, M. et al. (2020), Sachs, J. et al. (2020).

The pandemic has revealed the unprecedented unpreparedness of the health care system to respond effectively to challenges. Duggal, R. (2020), Kuzmenko, O. V. et al. (2021), La, V. P. et al. (2020). Smiianov, V. A. et al. (2020) investigated the demand and supply for the vocational medical professionals in the labor market in a pandemic.

The Scopus Database was selected to analyze the scientific publications on the impact of the COVID-19 pandemic on the social, economic and energy parameters of sustainable development. The search of publications was obtained without applying a filter by industry in the titles of papers, short descriptions and keywords for the search words sustainability and pandemic. The output sample consisted of 1309 publications for 1994–2021. The visualization of the concept network is shown in Figure 2. Thematic orientation of publications was carried out with a frequency of ≥3 and a minimum cluster size =10 in the VOSviewer software environment (version 1.6.15).
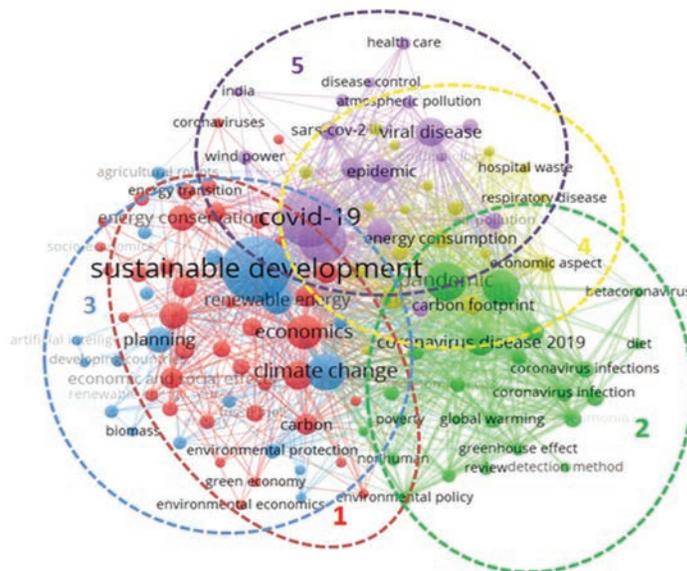
Figure 2 Research clusters for 1994–2020 in Scopus Database, using filters TITLE-ABS-KEY *sustainability* and *pandemic* (*Source*: compiled by authors based on Scopus Database, https://www.scopus.com/).

The use of software allowed identifying five clusters of studies in the context of the pandemic impact on sustainable development (*sustainability* and *pandemic*).

The economic, social, environmental and energy factors are identified in red cluster (the first cluster). Within the framework of this cluster, aspects of the environmental protection, green economy, alternative energy, investment activities, emission control, social and economic efficiency are studied. The issues of energy policy are also considered in close relationship with clusters, which includes the key terms *Covid-19* and *sustainable development.* Most links in the first cluster are found by the concept *economy* (94 links in total, with a link strength equal to 225).

Green cluster (the second one) is associated with pandemic, humanity, coronavirus infections, disease and policy. Studies relating to the economic development also belongs to the second cluster. In the cluster, most of the links are formed by the concept *pandemic* (93 links). The pandemic is considered in a broad sense in this cluster, therefore the study covers the period from 1994 to 2021.

Blue cluster (the third cluster) reflects the relation between sustainable development and COVID-19 (Figure 3). Most of the links in this cluster are found by the concept *sustainable development* (112 links in total with a moderate link strength equal to 370). Within the framework of this cluster, issues of climate change, environmental protection, energy management, renewable energy, etc. are studied.

Yellow cluster (the fourth one) is formed by the keywords *energy concept, economic aspects, recycling, waste management, global economy* and *virus*. The cluster analyzes China (60 links).

The fifth cluster (lilac one) considers the factors of sustainable development, epidemics, air pollution, Covid-19 and health care. In particular, India is being investigated. Most of the links in this cluster are found by the concept *Covid-19* (104 links in total).

The analysis of key terms *sustainability* and *Covid-19* provided 1.330 publications over the last 2 years (2020–2021). In 2020, the number of publications was 611 and in 2021 – 724.

The authors studying the impact of COVID-19 on sustainable development are as follows: N.J. Rowan (2021), W. Leal Filho (2021), C.M. Galanakis (2021), C.M. Hall (2021), C. L. Karmaker, T. Ahmed, S. Ahmed, S.M. Ali, M. A. Moktadir and Kabir, G (2021), R. Lozano and M. Barreiro-Gen (2021), W. Leal Filho, A. M. Azul, T. Wall, C. R. Vasconcelos, A. L. Salvia, and F. Frankenberger (2021), S. Khurana, A. Haleem, S. Luthra, D.

Figure 3 Links of concept *sustainable development* among publications in Scopus Database for period from 2009 to 2020, received by using filters TITLE-ABS-KEY TITLE-ABS-KEY *sustainability* and *pandemic* (*Source*: compiled by authors based on data retrieved from Scopus Database, https://www.scopus.com/).

Huisingh and B. Mannan (2021), D. Ivanov (2020), A. Kumar, S. Luthra, , Mangla, S. K., and Kazançoğlu, Y. (2020), Tiutiunyk, I., Humenna, Yu., and Flaumer, A. (2021), Antonyuk, N., Plikus, I., and Jammal, M. (2021).

The topics related to Covid-19 are most actively studied by such countries as the United States (266), the United Kingdom (159), Italy (118), Spain (100), Australia (83), Germany (83), China (81), India (79), Canada (77), France (41), the Netherlands (41), Indonesia (39) Sweden (39), Brazil (37), Malaysia (36), South Africa (33).

The following organizations carry out the study on the impact of COVID-19 on sustainable development: University of Cambridge, Harvard University, University of Waterloo, University of Toronto, UNSW Sydney, CNRS Centre National de la Recherche Scientifique, Harvard Medical School, Wageningen University & Research, Consiglio Nazionale delle Ricerche, University College London.

Figure 4   Research clusters for 2020–2021 in Scopus Database by filters TITLE-ABS-KEY *sustainability* AND *Covid-19* (*Source*: compiled by authors based on data of Scopus Database, https://www.scopus.com/).

The use of software allowed identifying four clusters of research on the Covid-19 pandemic impact on sustainable development (*sustainability* and *pandemic*) (Figure 4).

The first – red cluster – is associated with Covid-19 research and crisis-management, crisis, education, innovation, public health, safety, economic factor, risk assessment, corporate social responsibility and strategic approaches. This cluster reflects the largest number of links (171 links) by keyword *Covid-19*.

The second cluster (green one) includes the keywords *environmental sustainability, waste management* and *air quality*. The largest number of links in this cluster was formed by the keyword *environmental sustainability* (141 links).

The third cluster (blue one) identifies such factors as *human, organization and management, sustainability programs, health care personnel* and *risk factors*. The largest number of links was formed by the keyword *people* (159 links).

The fourth cluster (yellow one) covers such key factors as *climate change* and *environmental protection*. The main factor is *sustainable development*.

Based on the analysis of all four clusters, it was concluded that scientists pay special attention to the study of such countries as Spain, Italy, India, China, the USA and the EU.

2 Research

The key directions of countries' development are described by 17 global sustainable development goals: economic (preservation of aggregate capital, increasing the flow of social income), social (ensuring healthy lives and equitable quality education, ending poverty), environmental (ensuring the integrity of biological and physical systems).

Sustainable Development Goals (SDGs) proved to be vulnerable to such global stress factor as a pandemic. The Covid-19 pandemic has significantly affected the following goals:

– Goal 3: Good health and well-being
– Goal 7: Affordable and clean energy
– Goal 8: Decent work and economic growth
– Goal 9: Industry, innovation and infrastructure.

The authors propose to describe Goal 3 and Goal 8 by social parameters, Goal 9 by economic parameters and Goal 7 by energy parameters.

The key indicators describing the social, economic and energy parameters of sustainable development in the research were chosen the following: cumulative confirmed Covid-19 cases (SDG 3), number of unemployed people (SDG 8), GDP, foreign direct investment, exports of goods and services, imports of goods and services, inflation (SDG 9) and volume of energy production (SDG 7).
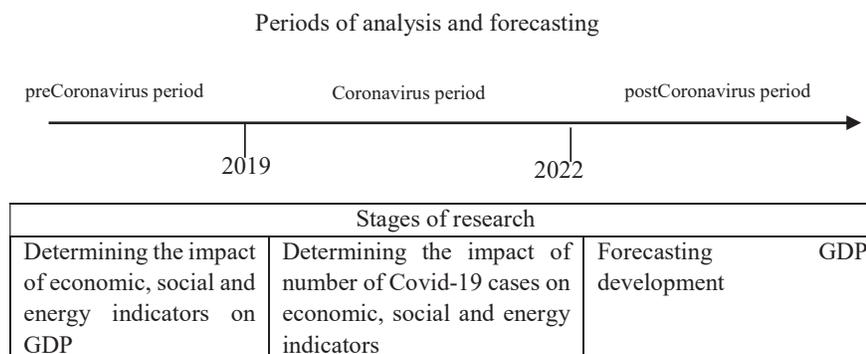
The scientists analyze the economic and social effects of the pandemic in the context of both developed and developing countries (Sharifi, A., and Khavarian-Garmsir, A. R., 2020). Thus, the countries are divided in four categories in the research: high-income economies (49 in total), upper middle-income economies (37 in total), lower middle-income and low-income group

High-income economies

Lower middle-income

Upper middle-income economies

Low-income group
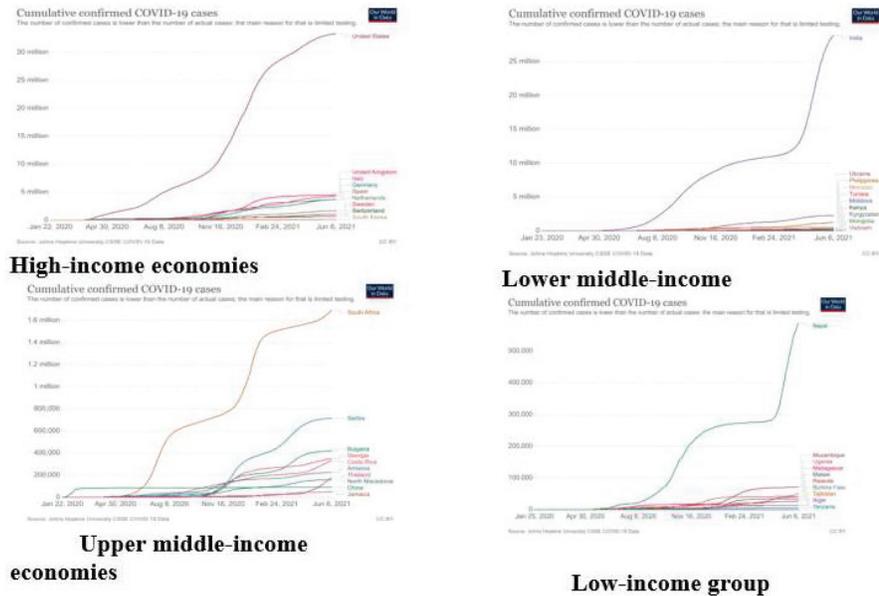
Figure 5   Dynamics of the number of cases of 40 countries during the period from January 22, 2020 to June 6, 2021. (Compiled by authors based on data https://ourworldindata.org/covid-cases.)

by level of GDP per capita. The study was carried out for 40 countries. 10 countries with the highest GDP per capita was chosen from each group, which did not affect the accuracy of the study. The Covid-19 pandemic suddenly emerged and plunged the world into a deep recession, the economies of the countries of the world were not ready for the crisis and the rapid increase in the incidence. The global increase in rate of confirmed Covid-19 cases and mortality has led to significant changes in the social and economic development of countries. The authors analyzed the Cumulative confirmed Covid-19 cases for 40 countries during the period from January 22, 2020 to June 6, 2021 based on https://ourworldindata.org/covid-cases (Figure 5). There is a positive dynamics in confirmed Covid-19 cases in the studied countries during the period from January 22, 2020 to June 6, 2021.

In order to study the impact of the Covid-19 pandemic on the economic, social and energy parameters of sustainable development, the factors of influence were considered in the context of three stages: preCoronavirus; Coronavirus and postCoronavirus periods (Figure 6).
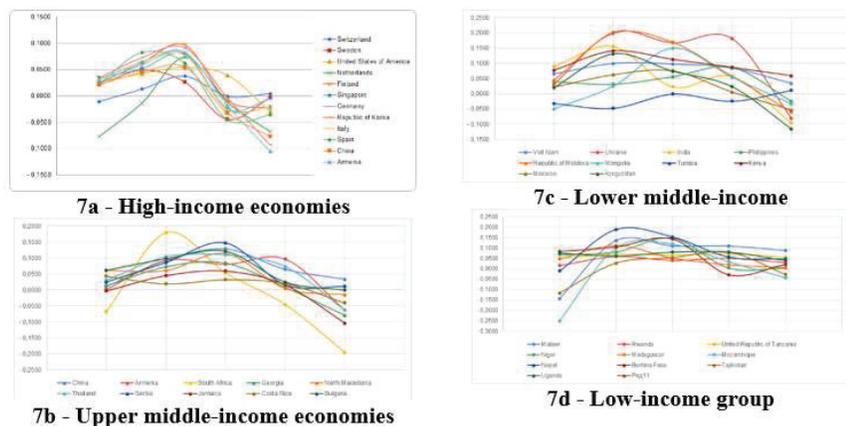
Periods of analysis and forecasting

preCoronavirus period	Coronavirus period	postCoronavirus period

2019   2022

Stages of research		
Determining the impact of economic, social and energy indicators on GDP	Determining the impact of number of Covid-19 cases on economic, social and energy indicators	Forecasting GDP development

Figure 6   Stages of research of the economic, social and energy parameters of sustainable development.

2.1 PreCoronavirus Period

According to the Resolution adopted by the General Assembly on 25 September 2015 Transforming our world: the 2030 Agenda for Sustainable Development, the sustainable development goals were to be achieved by 2030. They are of integrated and indivisible nature and provide a balance between three dimensions of sustainable development – economic, social and environmental one. The article analyzes the impact of social and economic components on the economic development.

The key indicator of the economic development of countries is GDP. GDP of high-income economies began to fall in 2018 (Figure 7a). This is due to the global economic crisis. The downward trend for the upper middle-income economies began in 2019 (Figure 7b). Annual fluctuations are observed for the lower middle-income. There was growth in 2017 and 2019. The decrease was observed in 2018 (Figure 7c). In most countries of the low-income group, GDP began to decline in 2017 and this trend continued until 2019 (Figure 7d).

Scientists consider that the dynamics of GDP can be affected by economic, political and social factors. Dhiraj Jain, et al., (2015) proved that the main macroeconomic factors of impact on GDP are as follows: FDI, Net FII equity, Net FII debt, Import and Export. Brian Kapotwe, Gelson Tembo (2018) consider the following factors: labor productivity, agriculture and manufacturing share to GDP. Aziz, R. N. A. R., and Azmi, A. (2017) studied the impact of such factors on GDP of Malaysia during the period 1982–2013: Inflation, Foreign Direct Investment (FDI) and Female Labor Force Participation. Farooq, MU, Sabir, HM, Tahir, SH, Rasheed, MK, and

7a - **High-income economies**

7c - **Lower middle-income**

7b - **Upper middle-income economies**

7d - **Low-income group**

Figure 7   Dynamics of GDP growth for 2015–2020 (Compiled by the authors based on data: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD).

Table 1   Correlation analysis of the impact of macroeconomic factors on GDP

Groups of Countries	Relation Between GDP and Labor Force	Relation Between GDP and Exports of Goods and Services	Relation Between GDP and Imports of Goods and Services	Relation Between GDP and Inflation	Relation Between GDP and Electricity Generation
High-income economies	−0.71	0.90	0.91	0.64	0.32
Upper middle-income economies	−0.46	0.98	0.97	0.46	0.41
Lower middle-income	−0.45	0.78	0.65	−0.25	0.44
Low-income group	0.35	0.68	0.78	−0.61	0.59

Scholar, MP (2013) using time series data for 37 years (1975–2011) in Pakistan identified the impact of such factors as agriculture, industrial and the services sectors output, exchange rate and the trade openness. Vasilyeva T., et al., (2020) propose to analyze social factors through Social Capital Index, Social infrastructure Index and Social Security Index.

In the article, the authors assumed that the GDP is affected by the following factors: the number of unemployed people, the volume of exports and imports, inflation, and the volume of electricity generation. The primary data of the World Bank for 2015–2019 for the analyzed countries were taken for the research. The results of the analysis are given in Table 2.

The table shows that the GDP indicator for countries of all groups depends on Exports of goods and services (the correlation coefficient varies

from 0.68 to 0.98) and Imports of goods and services (the correlation coefficient varies from 0.65 to 0.97). A high negative relation between GDP and Labor force was identified for the high-income economies group (correlation coefficient -0.71). For countries of the upper middle-income economies, lower middle-income and low-income groups, the relation between GDP and Labor force is weak. The relation between GDP and Inflation and Electricity generation was not observed for the countries of the upper middle-income economies, lower middle-income and low-income groups. The relation between GDP and Inflation is moderate for high-income economies. The relation between GDP and Electricity generation for low-income group countries is moderate.

2.2 Coronavirus Period

Cases of COVID-19 were first reported in December 2019 and in 2020 the Covid-19 pandemic began, which significantly influenced the development of countries around the world. One of the key influence factors during the pandemic was the COVID-19 incidence.

The authors of the article put forward a hypothesis about the regional differentiation of the impact of the COVID-19 incidence on the economic, social and energy parameters of sustainable development.

Thus, Kuzmenko, O. et al., (2020) propose to carry out the research on regional vulnerability to COVID-19 in three stages:

(1) formalization of nonlinear multifactor regression equations:

$$y = a_0 + a_1 x_1 + a_2 x_2 + \cdots + a_4 x_4 \tag{1}$$

where a_0 – intercept term, a_i – coefficients of the linear regression equation, x_i – coefficients that are the independent variables, $i = (1, \ldots n)$.
(2) formation of correlation matrices and identification of factors, the influence of which will be the most statistically significant.
(3) determination of the degree of relation between the parameters based on the correlation coefficient R.

Based on the suggested methodology, the article studies the relation between the result (GDP) and variables – electricity generation and cumulative cases Covid-19, number of unemployed people, volume of exports and imports, inflation rate.

According to formula 1, the article provided a matrix of relation between GDP and the proposed factors, considering the regional differentiation of the impact of cumulative confirmed Covid-19 cases.

$$\begin{cases} y = -120,95 + 4,265\text{x}1 - 4,537\text{x}2 - 0,144\text{x}3 - 1,295\text{x}4 \\ \qquad\quad + 2,945\text{x}5 - 122,045\text{x}6, \\ \qquad R = 0,999, \textit{ for High-income economies} \\ y = 25,136 + 1,482\text{x}1 - 0,052\text{x}2 + 0,041\ \text{x}3 + 3,945\text{x}4 \\ \qquad\quad - 3,650\text{x}5 - 6,652\text{x}6, \\ \quad R = 0,9999, \textit{ for Upper middle-income economies } y \\ y = 42,435 + 2,867\text{x}1 - 0,542\text{x}2 + 0,146\text{x}3 - 1,990\text{x}4 \\ \qquad\quad + 2,438\text{x}5 - 6,734\text{x}6 \\ \qquad R = 0,9999, \textit{ for Lower middle-income} \\ y = 1,224 + 1,233\text{x}1 + 0,008\text{x}2 + 0,0197\text{x}3 + 7,653\text{x}4 \\ \qquad\quad - 7,679\text{x}5 + 0,2933\text{x}6 \\ \qquad R = 0,790, \textit{ for Low-income group} \end{cases}$$

where

    y – GPD, billion dollars
    x1 – electricity generation, billion watt
    x2 – cumulative confirmed Covid-19 cases, thousand cases
    x3 – number of unemployed, thousand people
    x4 – exports, billion dollars
    x5 – imports, billion dollars
    x6 – inflation rate.

Coefficient of determination $R = 0.96$ indicates a strong relation between the dependent and independent variables. The R Square indicator reflects the reliability of the model and is equal to 0.998.

In addition to economic parameters, the social and energy parameters of sustainable development decreased during the Covid-19 pandemic. Table 2 shows the correlation relation between GDP and the cumulative confirmed Covid-19 cases, the number of unemployed people and the cumulative confirmed Covid-19 cases, the volume of electricity generation and the cumulative confirmed Covid-19 cases, the volume of exports and the cumulative confirmed Covid-19 cases, the volume of imports and the

cumulative confirmed Covid-19 cases in the context of the suggested groups of countries.

There is a strong relation between cumulative confirmed Covid-19 cases and such indicators as GDP, the number of unemployed people, the volume of electricity generation, the volume of exports and imports in countries with high-income economies. These countries are the most vulnerable to Covid-19. For example, in the United States, GDP growth amounted to −2.9% in 2020; the unemployment rate was 3.37 in 2019 and 8.31 in 2020; the volume of electricity generation decreased by 2.7%, which indicates a decline in economic activity. The decline in economic activity is observed in all countries of this group, which was caused by a tough lockdown.

For countries, which belong to the upper middle-income economies group, no correlation between the incidence rate and GDP, the number of unemployed people and the volume of energy generation, volume of exports and imports is observed. This is due to the dispersion of countries in this group by the number of Covid-19 cases. For example, as of June 6, 2021 the number of cases per million population in China was 63.45, and in Serbia – 104,881.76.

For the countries of the lower middle-income group, there is a strong correlation between the number of Covid-19 cases, GDP and the number of unemployed people, the volume of exports and imports. The correlation coefficient between the number of cases and the volume of electricity generation is 0.17, which indicates that there is no relation between these indicators. This group includes countries with different energy intensity of production. For example, Vietnam specializes in agriculture (Takeshima, H. et al., 2012), and India (Erkan, B., and Bozduman, E.T., 2018) and Ukraine (State Statistics Service of Ukraine, 2020) – in the industry. Amidst the Covid-19 pandemic, a lockdown was also enforced in these countries, which caused a decrease in energy generation.

The Covid-19 pandemic almost did not affect the indicators of social and economic development of the countries of the low-income group that was proved by the correlation analysis. Thus, the correlation coefficient between cumulative confirmed Covid-19 cases and GDP was 0.20, between cumulative confirmed Covid-19 cases and the number of unemployed people – 0.57. This is due to the small number of Covid-19 cases, with the exception of Nepal, as it is completely dependent on other countries and imports. (Koirala, J., and Acharya, S., 2020). Fluctuations in GDP in the countries of this group are insignificant compared to 2019 and is connected with other factors. In 2020, the rise in unemployment is observed in these countries. For example,

Table 2   Relation between economic, social and energy parameters of sustainable development and the cumulative confirmed Covid-19 cases

Groups of Countries	Correlation Coefficient Between GPD and the Cumulative Confirmed Covid-19 Cases	Correlation Coefficient Between the Number of Unemployed People and the Cumulative Confirmed Covid-19 Cases	Correlation Coefficient Between the Volume of Electricity Generation and the Cumulative Confirmed Covid-19 Cases	Correlation Coefficient Between the Volume of Exports and the Cumulative Confirmed Covid-19 Cases	Correlation Coefficient Between the Volume of Imports and the Cumulative Confirmed Covid-19 Cases
High-income economies	0.987	0.985	0.987	0.711	0.902
Upper middle-income economies	−0.151	−0.010	−0.138	−0.187	−0.200
Lower middle-income	0.985	0.998	0.170	0.651	0.780
Low-income group	0.200	0.568	0.005	0.429	0.691
Countries of the world	0.724	0.305	0.438	0.429	0.639

in Nigeria, the rise in unemployment was 55%, in Nepal – 50%, Uganda – 41%. The main reasons for the rise in unemployment rate are the population explosion and the imbalance between the supply and demand of skilled labor.

Thus, considering the conducted research it can be concluded that contries with the high-income economies and the lower middle-income economies were affected the most by the Covid-19 pandemic.

The COVID-19 pandemic has led to enforcing tough restrictive measures that have affected not only the global economy, but also the unemployment rate. The decrease in demand in the world labor market is caused by the factors as follows:

1. During the lockdown, the entry bans and border closures were enforced, resulting in large numbers of workers unable to travel in search of work. This is typical for countries where labor force migration is active.
2. The decline in the economic activity of business led to a slowdown in investment processes, a drop in the production of goods and services, and a reduction in employment proposals (Kadar, B., and Reicher, R. Zs., 2020).
3. Moving business from offline to online has caused changes in the working hours and staff reduction.
4. Resignation of some employees caused by panic and fear of contracting COVID-19 (Smiianov, V. A. et al., 2020; Tovmasyan, G., Minasyan, D., 2020).

According to the International Labor Organization data, nearly 25 million jobs were lost during the pandemic (International Labor Organization, (2020)).

The lockdown, caused by the pandemic, in addition to the rise in unemployment badly affected the energy sector. Chiaramonti D., Maniatis K. and the International Energy Agency note that electricity consumption has dropped in many countries. It ultimately led to various short-term effects that affected electricity systems around the world (Halbrügge, S. et al. (2021); Letunovska, N. et al. (2021)). That is why the multifactor model includes the electricity generation indicator.

When the lockdown was eased, business processes began to recover. In April, quarantine was eased in Italy and Germany and electricity demand showed the first signs of recovery. This trend was confirmed in May, as most countries (India, France, Spain and the UK) eased the lockdown measures. In June and July, in most countries, except for India, where the recovery was more evident, the demand for electricity, taking into account the weather, was 10% and 5%, respectively, below the level of the same month in 2019. In August, a sustained recovery in growth in electricity demand for EU countries brought them closer to the level of 2019. Electricity demand in China fell quickly due to the lockdown measures. After reaching a low point of -11% in February 2020, the demand increased quickly. Since April 2020, the electricity demand in China has been consistently higher than in 2019 (Covid-19 impact on electricity, 2021). As the in the demand for energy resources increased, its supply also increased, that is clearly shown in Figure 8.
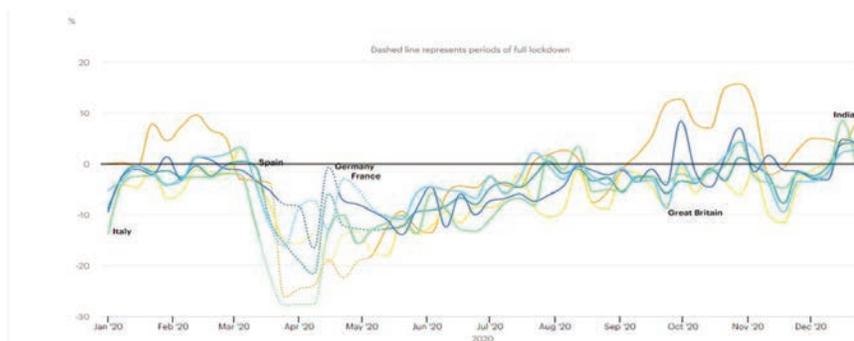
Figure 8   Weekly supply mix in the European Union, 2020 (Covid-19 impact on electricity, 2021).

Moreover, the pandemic has a negative impact on global trade. The world trade indicators sharply decreased. Changes are observed in the structure of trade, which is associated with a decrease in production volumes. Trade diversification has led to the growth of resellers. India, China and Korea have become leaders in the export of goods in the world market (Vidya, C. T., and Prabheesh, K. P., 2020). For most governments the change in trade policy became one of the tool to respond to the challenge of Covid-19. The government eased some requirements to imports of pharmaceutical products, agricultural goods and foods. At the same time, restrictions were enforced on the export of this group of goods. This is due to the attempts of the governments to meet domestic needs for medical supplies and support food security (Evenett, S. et al., 2021).

For example, food security in Africa has been undermined by disruptions and import restrictions caused by the pandemic (Liverpool-Tasie, L. et al., 2021). India, Vietnam and Myanmar and other exporters imposed a ban on rice exports that negatively affected the food security of African countries. Russia, Kazakhstan, Ukraine and a number of other wheat exporters have introduced export quotas, causing a risk for the key wheat importers (Egypt, Algeria and Morocco) (Humphreys, R.M. et al., 2020).

2.3 PostCoronavirus Period

In the short term, the effects of the Covid-19 pandemic may not be fully manifested. The main uncertainties about economy recovery can be formulated in terms of the long-term impact of the pandemic (Vasylieva, T. et al., 2021). According to the research of Frederic S. Pardee Center of International future, the global economy is expected to contract by at least 5% in the short term (Assessing impact of COVID-19 on the Sustainable Development Goals, 2020). Scientists forecast that the global economy will return to its pre-crisis size only in 2023 (World Energy Outlook, 2020).

The authors have created a forecast of one of the key economic indicators of sustainable development, i.e GDP. Using the extrapolation method and the Trends Method software, a realistic, optimistic and pessimistic GDP forecast for the USA, India, South Africa and Nepal was suggested (Figure 8). To create the forecast the authors took the countries from each group with the maximum number of Covid-19 cases as of June 1, 2021.

Figure 9 shows that the US GDP will recover to the 2019 level according to the realistic (21952.7365 billion dollars) and optimistic (22785.0123 billion dollars) forecast in 2021, according to the pessimistic forecast in

USA
$$Yp(t)=17698,6464+627,9468*t$$

South Africa
$$Yp(t)= 2114,5459+120,8511*t$$

India
$$Yp(t)= 326,6600+0,2571*t$$

Nepal
$$Yp(t)= 18,0007+2,4603*t$$
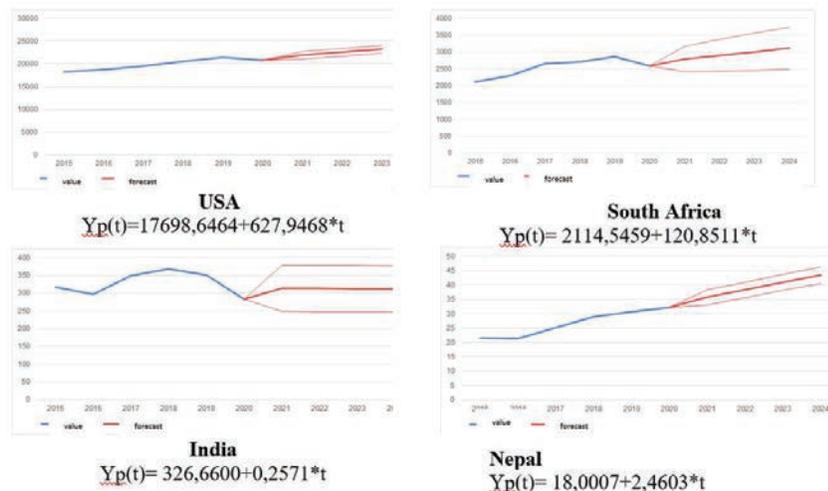
Figure 9   Dynamics and forecasted indicators of GDP for 2015–2024 for the USA, India, South Africa and Nepal, billion dollars.

2022 (21739.6100 billion dollars). GDP of South Africa, according to a realistic forecast, will recover to the level of 2019 after 2024 (311.4738 billion dollars), according to an optimistic forecast in 2021 (378.79 billion dollars). According to a realistic forecast, GDP of India will recover to the level of 2019 in 2022 (2898.6629 billion dollars), according to a pessimistic forecast after 2024 (2493.56 billion dollars), according to an optimistic forecast in 2021 (168.64 billion dollars). There was no drop in GDP in Nepal in 2020. Therefore, according to all types of forecasts, GDP in Nepal will grow.

3 Results and Discussion

Pandemic Covid-19 caused not only great number of human losses and harm to public health, but had a devastating impact on the economic, social and energy parameters of sustainable development. The consequences of this impact are as follows:

- drop in the GDP,
- rise in unemployment and underemployment;
- job losses and income losses of business, especially in the most affected areas;
- closure of small and medium-sized enterprises;

- disruption of supply chains;
- depression and fear as a result of isolation;
- uncertainty about the future;
- increasing social inequality, etc.

The result of the research is the confirmation of the hypothesis that the countries of the high-income economies group and the lower middle-income group are the most affected by the Covid-19 pandemic, but at the same time the recovery of the economic growth quickly began in these countries. Such countries as the USA, Germany and Sweden had a financial cushion and it is forecasted that financial stability will occur in these countries in 2021. In Spain and Italy, tourism is the key source for the GDP growth, so the economies of these countries have been affected the most (de Oliveira and de Aguiar Arantes, 2020). According to a realistic forecast, economic growth in other analyzed countries will take place in 2023–2024 under unchanged conditions.

Although the historical experience shows that previous pandemics, such as the 1918 influenza pandemic, also found social and economic fault lines (Wade, 2020; John, 2020), governments have not made decisions about the need for a preventive anti-crisis measures. Institutional and policy reforms are needed to restore economic stability and stimulate economic growth. These reforms can become economic and social stabilizers in crisis and post-crisis periods. To date, according to the Resolution concerning a global call to action for a human-centered recovery from the COVID-19 crisis that is inclusive, sustainable and resilient (17 June 2021), the following anti-crisis measures have been suggested:

- development of integrated measures of national employment policy;
- formation of an effective fiscal and industrial policy;
- attracting public and private investments in the most affected sectors of the economy (tourism, transport, arts and recreation and retail);
- development of education and infrastructure.

The impact of the pandemic on the social, economic and energy parameters of the country's development is stochastic and cannot be fully predicted.

This is due to the emergence of new exogenous and endogenous factors. They lead to the emergence of new scenarios for the development of parameters of the social, economic and energy parameters of sustainable development. In the short term, the country's economy can quickly return to precoronavirus social, economic indicators and increase the pace of development.

In the long term, there is a negative synergistic effect of the pandemic on the social, economic and energy parameters of sustainable development.

Governments need to develop long-term crisis programs. Rapid recovery of the parameters of sustainable development is possible due to the effective interaction of governments, business and society.

The results of the research can be used in the development of programs for the social and economic development of countries and individual sectors of the economy.

4 Conclusion

The article studied the factors of impact on the economic, social and energy parameters of sustainable development for each of 3 periods: preCoronavirus, Coronavirus and postCoronavirus one.

The authors revealed that GDP, inflation, volume of exports and imports are the key parameters of economic development. The parameter of social development is the number of unemployed people, and the energy parameter is the volume of electricity generation. During the preCoronavirus period, the following relation between GDP and the abovementioned parameters is observed:

- strong relation between GDP and exports of goods and services (correlation coefficient varies from 0.68 to 0.98) and imports of goods and services (correlation coefficient varies from 0.65 to 0.97) is observed for all groups of countries. There is strong negative relation between GDP and labor force in the high-income economies group (R = −0.71)
- moderate relation between GDP and inflation is observed for countries of high-income economies (R = 0.64) and negative moderate relation for low-income group (R = −0.61). The moderate relation between GDP and c.

During the Coronavirus period, the rate of the Covid-19 cases was one of the key factors of the impact on the economic, social and energy parameters of sustainable development. The research analyzed the impact of the incidence rate on the abovementioned parameters. A strong relation between GDP and the number of cases was found for countries of the high-income economies group (R = 0.987) and the lower middle-income group (R = 0.985). For countries of the upper middle-income economies group and the low-income group such relation was not found (R = −0.151 and 0.2 respectively).

The relation between the unemployment rate and the number of cases is observed in the countries of the high-income economies (R = 0.985) and the

lower middle-income group (R = 0.998). For the countries of the low-income group, there is a weak relation (R = 0.567) of this factor and the number of Covid-19 cases. For the countries of the upper middle-income economies group, such relation is absent (R = −0.010).

The relation between the volume of electricity generation and the number of confirmed coronavirus cases has a different trend. The strongest relation was found for countries of the high-income economies groups (R = 0.987). For other groups of countries, such a relation was not identified.

The relation of the export volume and the number of Covid-19 cases has the following tendency: strong relation for countries of the high-income economies (R = 0.711), moderate relation for countries of the lower middle-income group (R = 0.651), no relation for countries of the low-income group (R = 0.429) and for countries of the upper middle-income economies (R = −0.187).

The correlation relation between the volume of imports and the number of Covid-19 cases is high for the countries of the high-income economies (R = 0.902), the lower middle-income group (R = 0.78), the low-income group (R = 0.691). And for the countries of the upper middle-income economies, such relation was not found (R = -0.2)

Achieving sustainable development goals was carried out slow even before the COVID-19 pandemic. Now, it is likely that most of the 169 Sustainable Development Targets will not be met by 2030 (Naidoo, R., and Fisher, B., 2020), which was confirmed by the forecast of the economies development of the countries for the next 5 years. It is forecasted that the economies of most countries in the world will recover only in 2023 in the absence of new waves of coronavirus infections.

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