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Prerequisites and scenarios for the EU economy transformation inlight of Industry 4.0 development

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Abstract. The purpose of this study is to verify the condition of European Union economy and its ability to effectively implement the concept of sustainable development in the era of the fourth industrial revolution. To achieve the goal settled by this research, we used the technical indicator MACD (Moving Average Convergence / Divergence), based on the assessment of the convergence and divergence of moving averages of macroeconomic indicators. The studies carried out made it possible to identify three scenarios for the state

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of the EU economy after 2022. All these scenarios pose a high risk of a crisis phenomena in this economic system. According to the optimistic scenario, after 2022, a downward correctional wave is predicted in the EU-27 economy with the emergence of a situation similar to the situation in 2008. The search for a new economic model based on the active implementation of Industry 4.0 technologies can become a way for the EU economy to recover from the crisis and move to a qualitatively new level of socio-economic development.

Keywords: European Union economy, economic model, Industry 4.0, economic development, scenarios of economic development.

JEL Classification: F63, Q28, Q43, Q55

1. INTRODUCTION

The beginning of the 2000s, marked the end of the third industrial revolution, which was a system characterized by the starting displacement of intellectual labor due to the development of electronics, computer, and Internet technologies. According to this specificity, this economic business model was deeply highlighted by the spread of the service sector (including the "virtual finance sector") dominating the global economy (Schwab, 2017). Such a structural arrangement rushed the accumulation of financial capital generating significant disproportions between the real and financial sectors of the economy. Financial sector, due to speculative operations, has ceased to fulfill its original role, piling up and redistributing investment resources, directing them towards the real economy. Consequently, financial bubbles appeared, causing a chronic overheating of the stock market. These structural imbalances between the real and financial sectors led to a slowdown in global economic growth after 2000 and the emergence of the 2008 financial crisis (which was only overcome by pumping the economy with money), that in turn produced real risks for the collapse of the global economy in early 2020. In other words, the economy of services and virtual finance has become obsolete, and ignoring this fact provoked a deepening of crisis phenomena, both in national and global economic systems. This situation creates the objective prerequisites to find new concepts and models for the development of the global economy.

The purpose of this study is to verify the condition of the European Union economy and its ability to effectively implement the concept of sustainable development in the era of the fourth industrial revolution. For this purpose, a statistical analysis of the quarterly growth/decrease rates of the selected macroeconomic indicators of the EU economy for 1999-2021 was carried out and presented on the official website of Eurostat. The technical indicator MACD (Moving Average Convergence / Divergence), used as a research tool, an instrument based on the assessment of convergence and divergence of moving averages, was developed by Gerald Appel in 1979 (Murphy, 1999; Appel, 2005; Patterson, 2014). The use of this indicator allows to present and visualize the presence of an established trend in the economy in a convenient form, as well as to predict with a high probability the direction of its movement.

2. LITERATURE REVIEW

The origins of the development of the Fourth Industrial Revolution were laid in the 60s of the last century, when computer communications began to develop and the so-called information society began to form. As a result, the widespread use of information technology has become a characteristic feature of our

days. In addition to the three classical types of production resources (labor, capital and natural resources), the modern world also widely uses information resources for the implementation of production and commercial activities. The availability of high-quality information (information resources) is a necessary condition for the effective use of the first three types of resources. All modern business processes are built on this basis. The information itself acquires the classical properties of a commodity and a market is created in which information is bought and sold (Goodwin & Wright, 2004; Hanson, 2005). At the same time, income growth, on the one hand increases the level of Internet technologies, and, on the other hand, it increases the public availability of the Internet benefits and creates a new quality of life. Thus, the main distinguishing feature of modern society is the rapid and free movement of information. In such a society, knowledge and information function as the source and foundation for all socio-economic and political processes (World Development Report, 2016).

The fourth industrial revolution, which conditionally started in 2010 and began entering its active phase in 2020, involves the development of the trend of informatisation of society in the direction of the total displacement of mental labor through the creation of complex digital systems and algorithms. Characteristic features of the Fourth Industrial Revolution will include deserted production, widespread robotisation, a massive transition to renewable energy sources, as well as the widespread use of artificial intelligence and digital platforms in all socio-economic and socio-political processes. The key technologies of the new technological paradigm will be the Internet of Things, Big Data Analytics, Artificial Intelligence, Neuro-technologies, Micro and Nano Satellites, Nanomaterials, Additive Manufacturing, Advanced Energy Storage Technologies, Synthetic Biology, Block-chain (Hermann et al., 2016; Maynard, 2015; An OECD Horizon Scan, 2016; Broday, 2021). The main concepts implemented during the Fourth Industrial Revolution are the concept of Smart Cities, the concept of Distributed Manufacturing and the concept of Virtual Reality (Müller et al., 2018; Sanghavi et al., 2019; Muscio & Ciffolilli, 2020; Seyedghorban et al., 2020).

Smart cities, in essence, are large-scale cyber-physical systems that operate on the basis of built-in technologies for tracking, coordinating and optimizing all digital and physical indicators of a city's life. Cyber-physical systems are symbiotic structures that combine elements of innovative mechanics, information and digital technologies and physical resources. Thanks to this symbiosis, cyber-physical systems have adaptive abilities, are easily integrated into the information space, analyze it and quickly respond to its changes. The smart city system can be represented as a set of six main interconnected cybernetic subsystems: Smart Governance – creation of digital public services; Smart People – development of social and human capital as personnel for a developed economy; Smart Living – Improving the quality of life by testing and adapting new solutions in the organization of urban space and its functions; Smart Mobility – Integration of transport and information and communication technologies (ICT); Smart Economy – increasing international competitiveness at the level of urban agglomerations; Smart Environment – economical management of natural resources using ICT. The key technology for implementing the concept of smart cities is the technology of the Internet of Things (IoT). The Internet of Things – intelligent devices that interact with each other and the outside world based on technologies for tracking, processing and transmitting information via the Internet network (Mehmood 2017; Palattella et al. 2016; Abdel-Basset et al. 2020). The emergence of IoT became possible primarily due to the development of Artificial Intelligence (AI), as well as technologies for Radio Frequency Identification (RFID), Cloud Storage and Machine to Machine, (M2M) (OECD, Artificial Intelligence in Society, 2019; Dragicevic et al., 2020; Di Nardo et al., 2020).

It should be emphasized that the implementation of the Fourth Industrial Revolution requires not only the creation of smart cities, but also a fundamental change in production and management processes. To this end, it is necessary to implement the concept of Distributed Manufacturing, which is based not

only on total automation and robotisation of production, the widespread use of artificial intelligence, but also on the creation of a fundamentally new production environment that is little dependent on humans and is able to work with a giant set of incoming and outgoing information (Baldwin, 2016; Gupta et al., 2021; Capello & Lenzi, 2021; Shet & Pereira, 2021; Khanzode et al., 2021). The concept of distributed production is an alternative to the traditional concept of economic globalization based on the international division of labor. According to Distributed Manufacturing, production facilities should be located as close as possible to the consumer, since the consumer will play an active role in the process of forming a production order. The entire design of manufactured products will be based on decentralized additive technologies (technologies for layer-by-layer building up and synthesis of an object using computer 3D technologies) and cloud technologies (physical supply chains will be replaced by electronic communications and data transmission), as well as technologies of a closed production cycle and renewable energy. Such a production process will significantly increase the level of adaptability of products to customer requests and at the same time reduce time and transport costs. As a result, a radical modification of the current global economy is taking place – direct production becomes local and its structure is even more global, since it relies on global network communications and digital solutions (Impact of the Fourth Industrial Revolution, 2017; Choi, 2018; Machado et al., 2020).

The third concept of Industry 4.0, without which the existence and effective functioning of neither smart cities nor a distributed production system is the virtualization of space, the creation of Virtual Reality, based on the widespread introduction of various kinds of digital platforms. In this concept, virtuality is seen as a new space of compatibility and represents a rejection of physical mobility and a transition to the mobility of consciousness. Virtualization will be implemented (and is already widely used today) everywhere, from simple human communication, the search for user information for everyday life, and ending with complex educational, banking, production, financial and social and legal processes. The main opportunities that virtualization provides are expanding the boundaries of the field of activity, reducing transaction costs, accelerating the processes of information exchange and performing various types of operations (organizational, financial, etc.) (Hermann et al., 2016; Schwab, 2017; Rainnie & Dean, 2020; Wagire et al., 2021; Li et al., 2020).

The fourth industrial revolution, like any socio-economic phenomenon has its positives and its negatives aspects. On the one hand, it opens up for humanity the broadest opportunities for the development and virtually unlimited growth, since there are no boundaries for the development of intelligence, and the new technological order is based precisely on intelligent systems. But on the other hand, the fourth industrial revolution raises many problematic issues and brings new challenges to humanity. One of these challenges is the energy challenge. The implementation of total technological changes is impossible without the widespread use of renewable energy sources and advanced energy storage technologies (Calabrese et al., 2021; Dorman, 2020; Pegkas, 2020; Pollin, 2021). At the same time, the technologies of the Fourth Industrial Revolution contribute to the sustainable development of the energy sector, allowing the industry to change its structure based on the use of intelligent equipment for the production and distribution of energy (Ghobakhloo & Fathibc, 2021).

Summarizing the theoretical studies devoted to the problem of transition to a new technological order, it can be argued that in the world economy there is an objective and urgent need to intensify the processes of the implementation of the Fourth Industrial Revolution. I It means in practice abandoning the "virtual finance system" and the method of production based on the global division of labor and the far from always rational use of production resources (including energy), in favor of a system of distributed mode of production based on the widespread use of artificial intelligence, renewable energy sources and advanced energy storage technologies (Preuveneers & Ilie-Zudor, 2017; Hecklau et al., 2017; Carvalho et al., 2018; Caruso, 2018; Xu L. et al., 2018; Morgan, 2019; Bareiß, 2020; Bilgen, 2021).

3. METHODOLOGY

To check the current state of the European Union economy and its ability to effectively implement the concept of sustainable development, the following macroeconomic indicators were selected for detailed analysis: gross domestic product; fixed capital formation; exports of goods; exports of services; imports of goods; imports of services; real labor product person; real labor product per one hour work; money supply in circulation (basic and chain) in the EU economy.The analysis of the dynamics of changes in the above ratios makes it possible to assess the ability to economic development, foreign trade activity, labor productivity and the effectiveness of the financial system and efforts to allocate capital in the real sector of the economy. The MACD technical indicator was used as a basic research tool. The proposed methodology for calculating the MACD(A) (an adapted calculated indicator of convergence/divergence of averages aimed at determining the presence and direction of a trend for the dynamics of changes in macroeconomic indicators) indicator for analyzing and evaluating the development indicators of the EU economy is as follows:

$$MACD(A)_{is} = MA_F(X_{if}) - MA_S(X_{is}), \quad (1)$$

where $MACD(A)_{is}$ – *i-e* value of the adapted calculated indicator of convergence/divergence of averages for period *s*; S – the maximum averaging period taken for analysis; F – the minimum averaging period taken for analysis; MA (Moving Average) – a moving average that is used to quickly assess the presence of a trend and the position of the current value in relation to it (this indicator is a curved line, the points of which are calculated based on the arithmetic average for a given period of time); MA_f – fast moving average for period *f*; MA_s – slow moving average for period *s*; $MA_F(X_{if})$ – the value of the fast moving average for the indicator X in the *i*-th period for *f* periods; $MA_S(X_{is})$ – the value of the slow moving average for the indicator X in the *i*-th period for *s* periods.

At the same time, it is proposed to use the zero level on the histogram of the MACD(A) indicator as a signal line. Thus, the indicator crossing the zero mark from the bottom up means the resumption of positive dynamics of development, and the indicator crossing the zero level from top to bottom means the economy is entering a recession. In such a situation, one of the eight scenarios of economic development presented in Table 1 is possible.

It should be noted that the number of periods selected for calculating the fast and slow moving averages used in the calculation of MACD(A) will affect the final result of the study. At the same time, an increase in the number of periods when calculating a slow moving average can lead to a delay in signals relative to the dynamics of the situation. On the other hand, a small number of periods can cause the indicator to respond chaotically to every slightest change in the system, which will not allow a reliable assessment of the development dynamics. In connection with the above, when conducting this study, it was proposed to use: for a fast moving average, an averaging period of 4 (which corresponds to four quarters); for a slow moving average the averaging period is 8 (corresponding to eight quarters). This combination of averaging periods will allow a quick assessment of short-term changes and increase the reliability of long-term forecasting.

Table 1

Interpretation values of the adapted calculated indicator of convergence and divergence of averages MACD(A)

		The position of the histogram bar in relation to the zero level	
		Value above zero (Economy in a state of growth)	**Value below zero (Economy in crisis)**
Histogram bar color	**Red histogram bar**	The red column after the blue one means the beginning of a corrective wave (the beginning of the weakening of the pace of economic development).	The red column after the blue one is the end of the corrective wave in a downtrend (means an increase in negative trends in the economy, the appearance of pronounced crisis phenomena).
		The red column after the red one is a continuation of the corrective wave (each subsequent red column increases the likelihood of crisis phenomena).	The red bar after the red characterizes the continuation of the downtrend (the continuation of the crisis, each subsequent red bar increases the likelihood of a deep and long-term crisis).
	Blue histogram bar	The blue bar after the red one is the end of the corrective wave (resumption of economic growth rates).	The blue bar after the red one is the beginning of a corrective wave (an attempt to resume economic growth).
		The blue column after the blue one means the continuation of the positive dynamics of development.	The blue bar after the blue one is a continuation of the corrective wave on a downtrend (an attempt to stabilize the situation, i.e. each subsequent blue bar increases the likelihood of overcoming the crisis).

Source: Developed by the authors

4. RESULTS AND DISCUSSION

4.1. Assessment of general trends in the development of the economy of the European Union

The first stage is devoted to assessing the general dynamics of the economic development of the European Union. In this context, the following macroeconomic indicators are taken into account: growth rates of gross domestic product (Figure 1); growth rates of gross fixed capital formation in the EU economy (Figure 2); the growth rate of exports of goods and services in the EU economy (Figure 3 and 4); growth rates of imports of goods and services in the EU (Figure 5 and 6); growth rate of real labor productivity per person per hour in the EU economy (Figure 7 and 8); growth rates of the money supply in circulation in the EU economy (Figure 9 and 10).

Based on the data presented on the histogram of the MACD(A) indicator (Figure 1) it can be argued that the prerequisites for the current crisis in the EU were laid back in the early 2000s - during that period, a decrease in economic growth rates is observed (the red columns of the histogram signal on economic issues). The first clear manifestation of the crisis in the EU economy was triggered by the 2008 US financial crisis. The beginning of the economic crisis is reflected in the upper graph in point A (2008Q2) and one period earlier in the lower graph (the intersection of the histogram and the α_1 trend line from top to bottom). The bottom of this crisis was in the second quarter of 2009 (point C on the top graph). As a result, the economies of the EU countries in 2009Q2 rolled back to the level of the first quarter of 2006 (point D, line β_0). The recovery from the crisis took place in the first quarter of 2015 (point B on the top graph). Thus, for the EU economy, the transition from point D to point B took 36 quarters or 9 years.

When conducting this analysis, the proposed MACD(A) indicator allows to identify in advance possible slowdowns in economic growth (point A_0 (2007Q2)), determine the bottom of the crisis (point C_0 (2009Q3)) and the beginning of a correction wave with an attempt to resume economic growth (point C_1 (2009Q4)). Point A_1 (2011Q2) showed a possible slowdown in economic growth and the beginning of

a corrective wave, which ended in point C_2 (2011Q2). The final exit of the 2008 crisis, according to the drawn trend line α_2 on the histogram of the MACD(A) indicator, occurred at point A_2, which corresponds to point B on the upper chart. Thus, the crisis of 2008-2015 can be divided into four waves, which are visually represented on the histogram of the MACD(A) indicator, namely: I wave - A_0C_0 (2007Q2; 2009Q4); II wave - C_0A_1 (2009Q4; 2011Q2); III wave - A_1C_2 (2011Q2; 2013Q1); IV wave - C_2A_2 (2013Q1; 2015Q1).

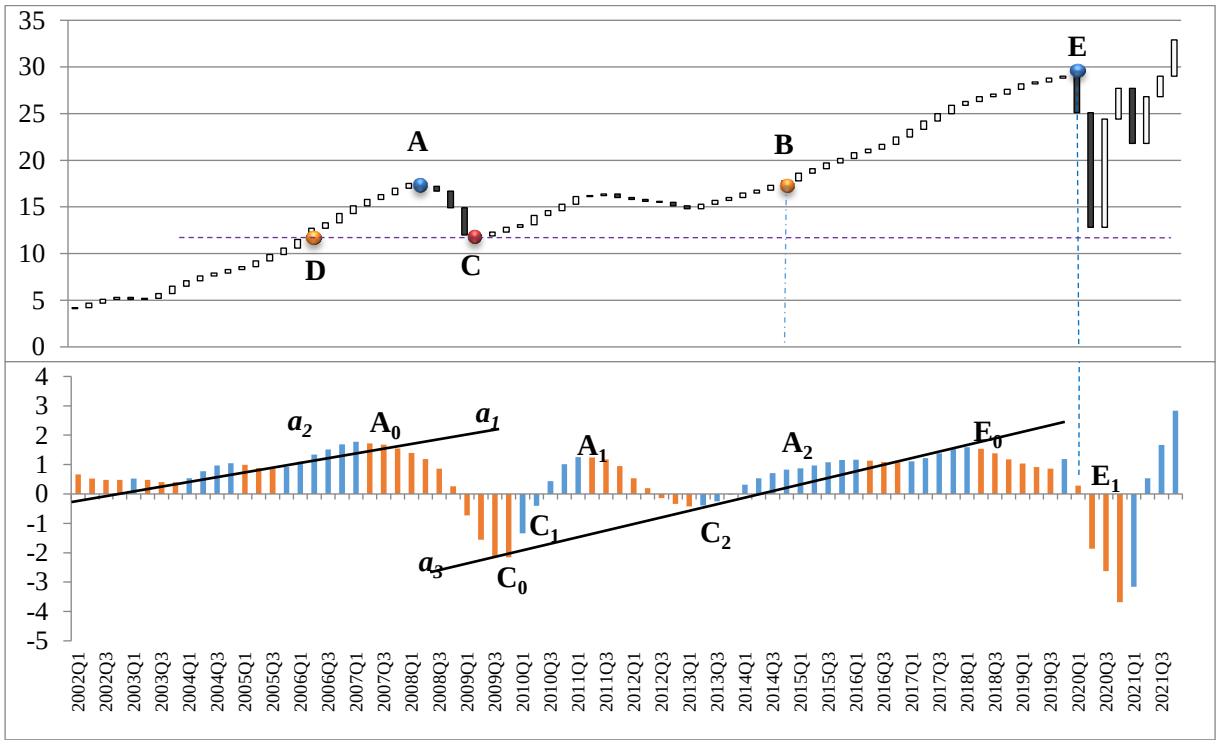

Figure 1. Base gross domestic product growth rate of the EU*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

An analysis of the results obtained allows to designate the crisis of 2008 for the EU economy as a correction on an uptrend, which amounted to 32%. Referring to the so-called Fibonacci numbers (series), namely 0, 1, 1, 2, 3, 5, 8, 13, 21, 34 ..., where each subsequent number is the sum of the two previous ones, we can come to the next Fibonacci levels – 23.6%; 38.2%; 61.8%; 161.8%; 261.8%; additionally strong levels are 50% and 100%. According to the theory, the minimum corrective wave should have a decrease of 23.6%, the next support level is the level of 38.2%, then 61.8%. It is natural that the larger the corrective wave, the harder it will be to return to the original trend.

The analyzed data allows to state the fact that the corrective wave of the 2008 crisis ended between the levels of 23.6% and 38.2%. This is quite a good indicator in terms of the insignificant depth of the development of the crisis, nevertheless, it took the EU economy nine years to recover and undergo a correction. At the same time, it should be noted that from 2000 to the first correction in 2008, the EU economy grew by 17.5% (point 2008Q1), which means that the height of the first wave of the trend was 0.175. In this case, the approximate peak of the next ascending wave after the correction should be at the

level: (0.175 * 1.618) * 100 = 28.315%. According to statistics, the peak of the second wave occurred in the fourth quarter of 2019 and settled at around 29.0%, which is slightly higher than the calculated figures. It should be noted that the histogram of the adapted MACD(A) indicator since the second quarter of 2018 indicates that the EU economy had problems with economic growth. According to the data of the histogram, starting from the second quarter of 2018 (point E_0(2018Q2)) the EU economy enters a state of correction on an uptrend, however, the appearance of the next red column of the histogram with the simultaneous intersection of the α_3 trend line indicates a high probability of an increase in crisis phenomena. Thus, point E_0 precedes the onset of a significant weakening of the economy, which is reflected in the upper part of the Figure 1A. The COVID-19 pandemic and the chain of lockdowns that began in March 2020 significantly aggravated the economic problems of the EU (point E_1 (2020Q1) on the MACD (A) histogram reflects the beginning of a new wave of economic crisis). The beginning of the corrective wave and the recovery of the EU economy has been observed since the first quarter of 2021 (point 2021Q1) and continues until the end of 2021 (point 2021Q4). However, the events of February 24, 2022, related to Russia's military aggression in Ukraine and subsequent economic sanctions imposed on the Russian Federation, have already provoked a significant deepening of the crisis in the EU economy, which can completely dismantle the existing economic structure based on the economy of virtual finance and hydrocarbons energy sources.

The results of the analysis of the dynamics of the basic growth rates of gross fixed capital formation confirm the earlier conclusions about the inefficiency of the EU economic system (Figure 2). The upper graph of Figure 1B clearly shows an upward trend up to 1 sq. 2008 (point 2008 Q1). After this point, the growth rate of gross fixed capital formation in the EU economy begins to decline, and the system returns to the position of the beginning of 2008 only in the 4th quarter 2018 (point 2018 Q4), i.e. it took 11 years for the system to restore the potential lost as a result of the financial crisis of 2008.

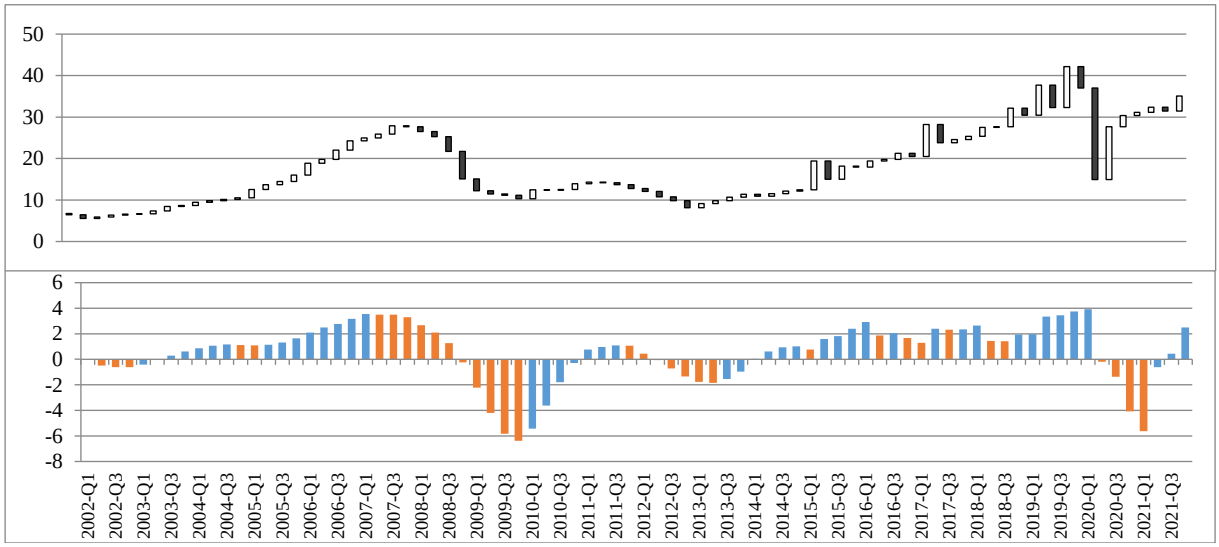

Figure 2. Basic growth rates of gross fixed capital formation in the EU economy *,**

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

An increase in the growth rate of gross fixed capital formation has been observed for 11 years, up to 4 square meters 2019 (point 2019 Q4). However, from 1 sq. 2020 (point 2020 Q1), due to COVID-19 lockdowns, a sharp decline in this indicator will be stopped. In 2 sq. 2020 the value of the indicator fell almost to the level of the middle of the 1st quarter. 2006. From 3 sq. 2020, in the upper graph of Figure 1B, we observe the beginning of the growth of this indicator and at the end of 3 sq. 2021 fixed capital growth in the EU economy reaches the level of the first half of the 4th quarter 2019. However, the lower graph of Figure 1B, built on the basis of the calculation of the MACD (A) indicator, records a decline in the growth rate of gross capital accumulation up to second quarter 2021. In other words, the depth of economic problems in the EU economy is much greater than standard statistical indicators fix.

The next important indicators characterizing the efficiency of the functioning of the economic system are the export and import of goods and services. Export-import operations show the degree of openness of the economy, its integration into the world economy, competitiveness, and hence the ability to develop. An analysis of the basic growth rates of exports of goods and services in the EU countries shows that the general trend of this indicator is increasing (the upper chart in Figures 3 and 4), but MACD(A) signals corrections on an uptrend throughout the analyzed period, in other words, about problems growth, while the situation deteriorates sharply in 2 sq. 2020 (bottom graph in Figures 3 and 4).

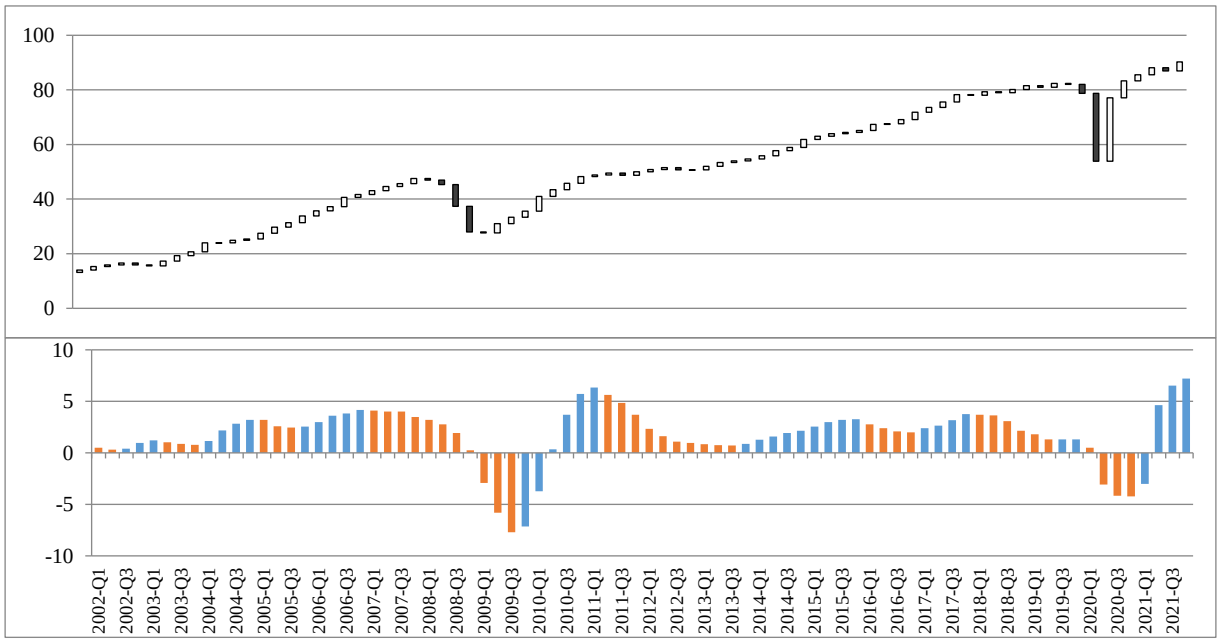

Figure 3. Basic growth rates of exports of goods in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

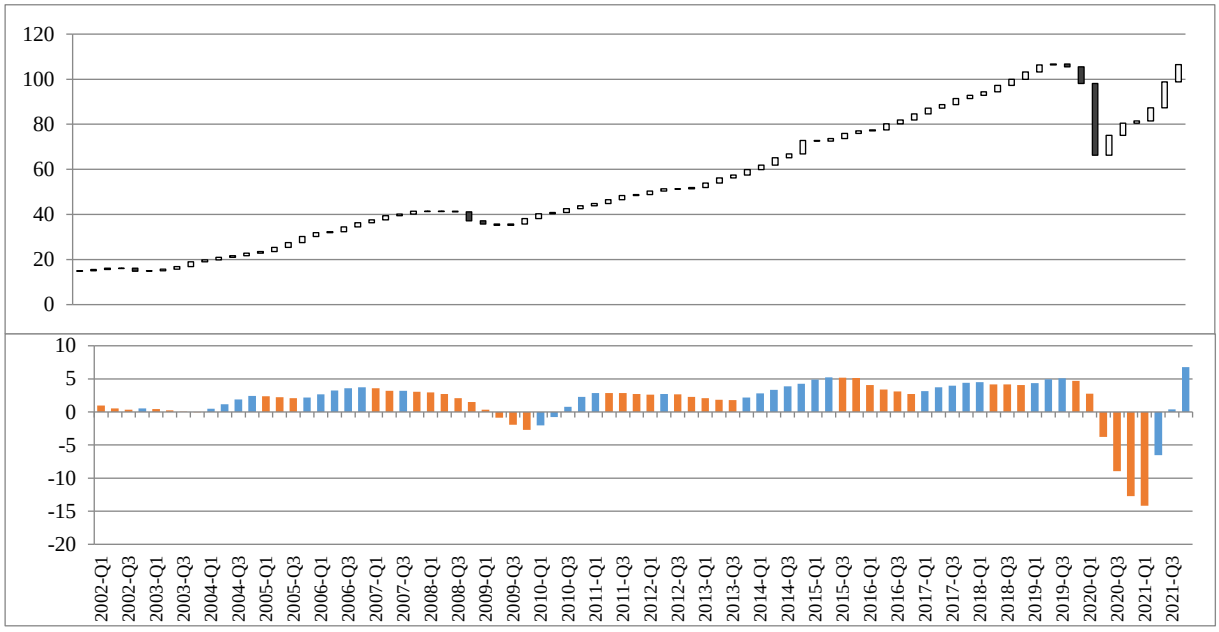

Figure 4. Base growth rates of exports of services in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

A similar situation is observed for import operations (Figures 5 and 6).

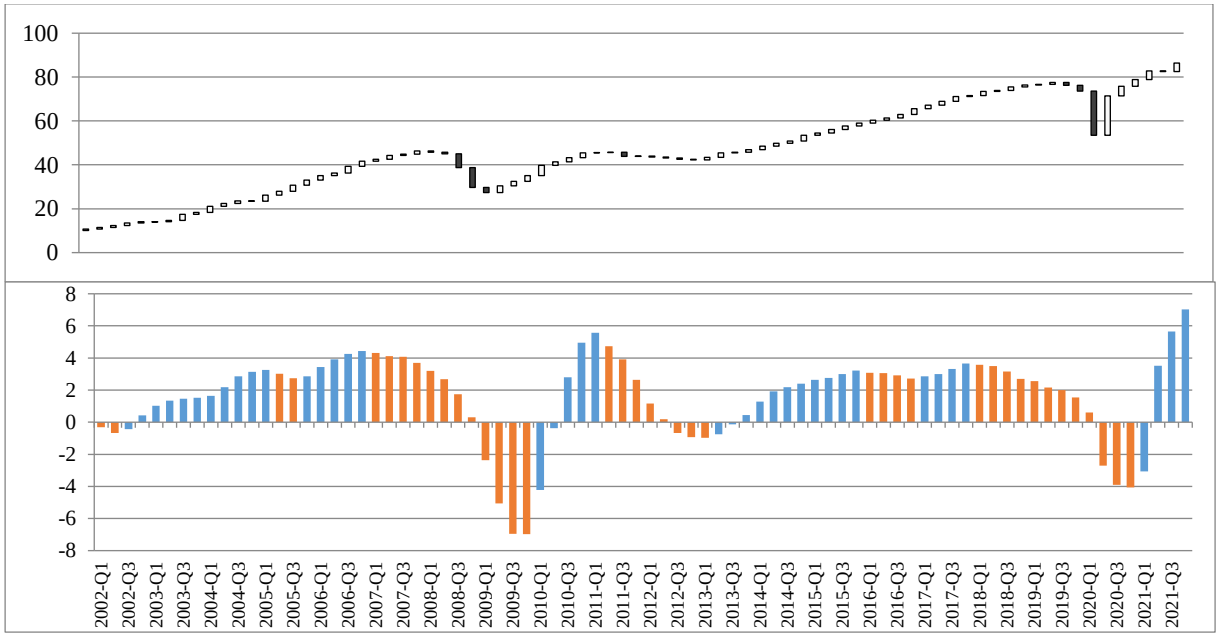

Figure 5. Basic growth rates of imports of goods in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

Thus, the analysis of the dynamics of EU export-import operations indicates a decrease in the efficiency of the system in foreign markets, which in turn causes a decrease in the internal efficiency of the economic system and unwinds a spiral of crisis phenomena.

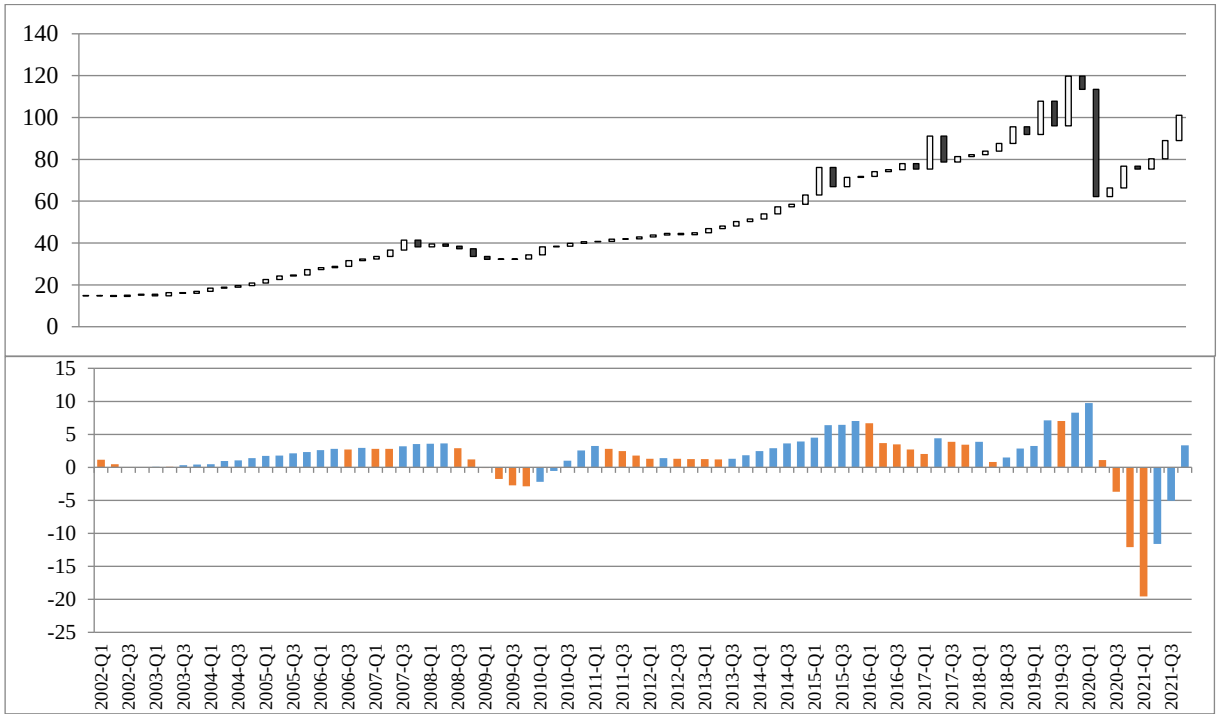

Figure 6. Base growth rates of imports of services in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

Labor productivity is the next indicator subjected to analysis. This indicator most clearly reflects the effectiveness of the current technological order. It links together economic, organizational and technological processes, shows what are the investment opportunities and potential for the development of the system, and also to what extent the technologies used can increase the economic efficiency of the system.

Figure 7 shows the baseline growth rate of real labor productivity per person in the EU economy. The top graph reflects an uptrend, in other words, it shows an increase in labor productivity. But when analyzing the MACD(A) indicator (lower graph), we can observe the lack of stability in the processes of labor productivity growth. During 2020, there has been a significant decline in labor productivity associated with the pandemic and lockdowns of the economies. However, since the beginning of 2021, statistics have recorded an increase in labor productivity, which is largely due not only to the resumption of economic activity, but also to the widespread introduction of technologies of the Fourth Industrial Revolution (digitization and automation of the economy) into production and economic processes.

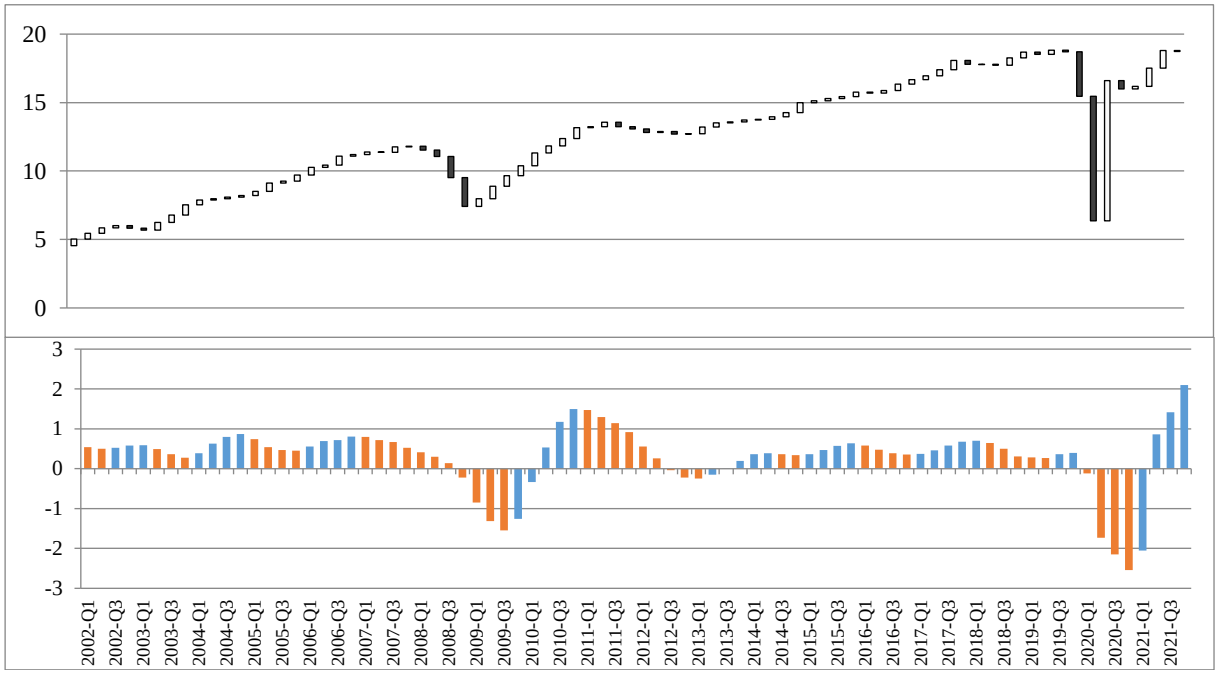

Figure 7. Real labor product person*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

At the same time, the analysis of statistical data on labor productivity per one hour of working time shows a long-term upward trend (upper graph of Figure 8).

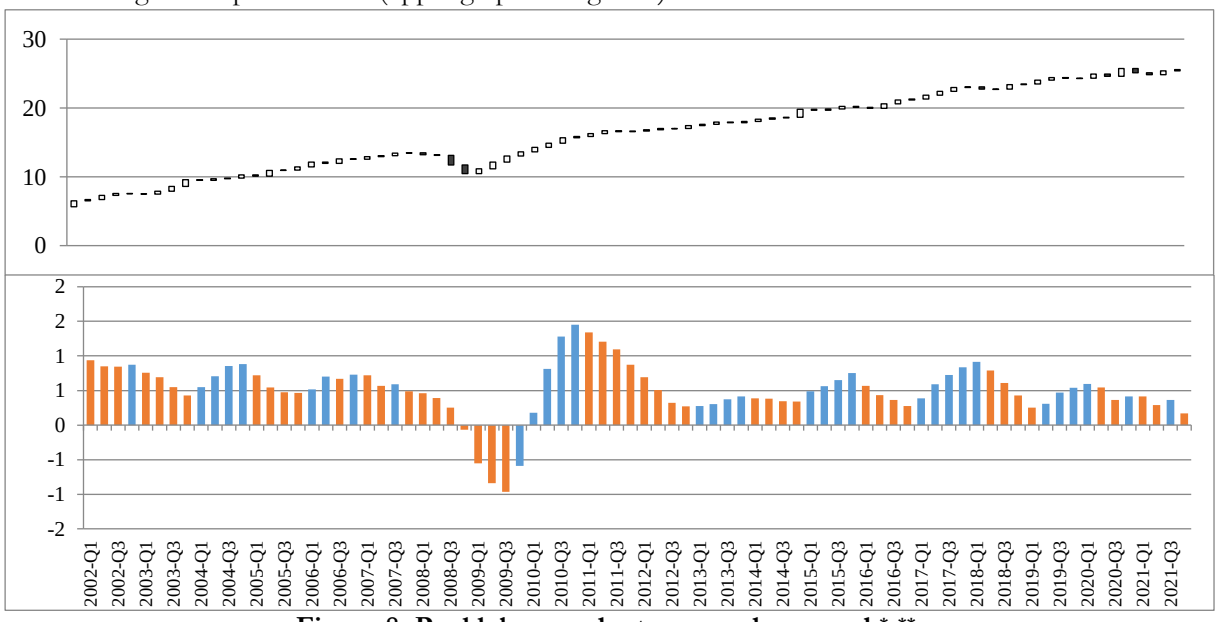

Figure 8. Real labor product per one hour work*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

** Up to 2020 data submitted for EU 28, from the first quarter of 2020 data submitted for EU 27.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

However, from 1 sq. 2018, there is a divergence (multidirectional trends) of statistical indicators (upper chart in Figure 8) and the MACD (A) indicator (lower chart in Figure 8), in other words, there is a periodic slowdown in labor productivity growth, which together confirm the previously put forward hypothesis of inefficiency the existing technological order, generating problems of the economic system.

The next group are financial indicators, which, together with the above data, characterize the overall efficiency of the economic system. Figures 9 and 10 show, respectively, the base and chain growth rates of the money supply in circulation in the EU economy.

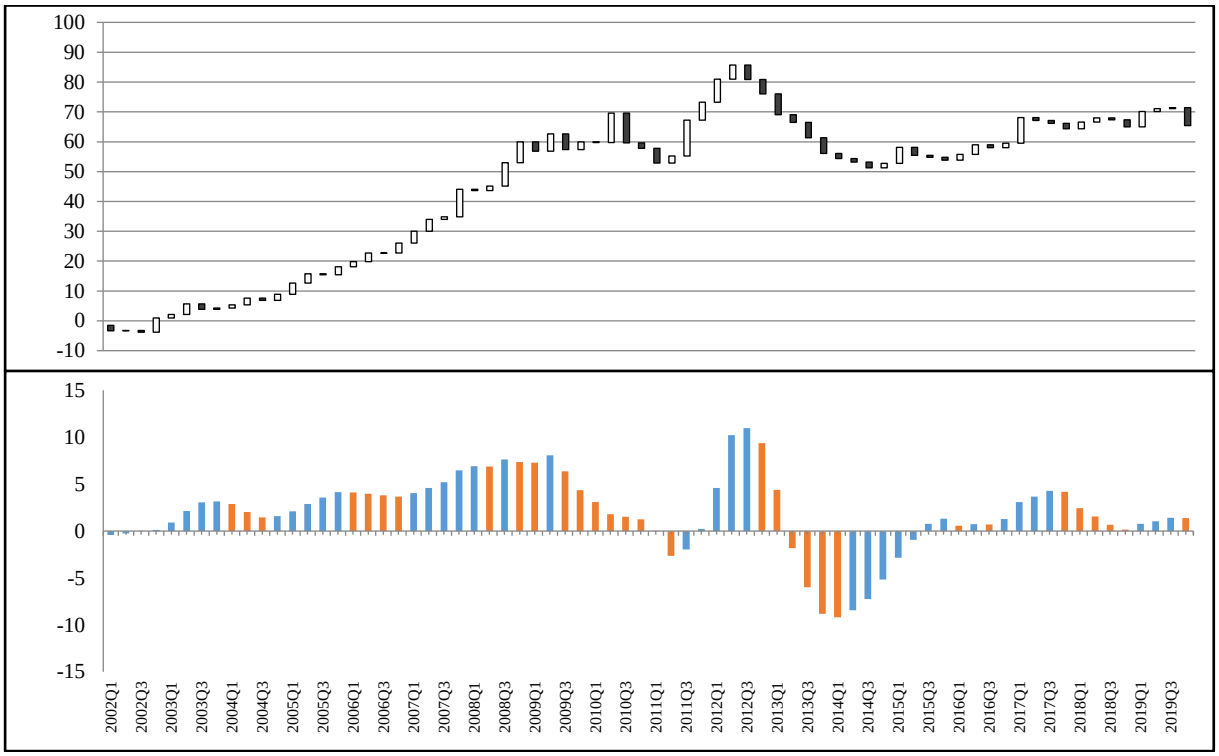

Figure 9. Basic growth rates of the money supply in circulation in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

**Until 2020, the data was submitted for the EU 28, for 1Q. 2020 data submitted for EU 27, after Q1 2020 data not available.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

When analyzing these graphs, one can observe a steady trend towards an increase in the money supply in circulation. Moreover, the peaks of growth in the money supply in circulation match the peaks of economic crises, and the growth rate of the money supply is 10-12 times higher than the rate of economic growth. Thus, the results obtained show that the system emerged from the crisis not due to structural transformations, increased labor productivity and profitability of production and commercial processes, but mainly due to pumping economy with money emission, which in turn predetermined overheating.

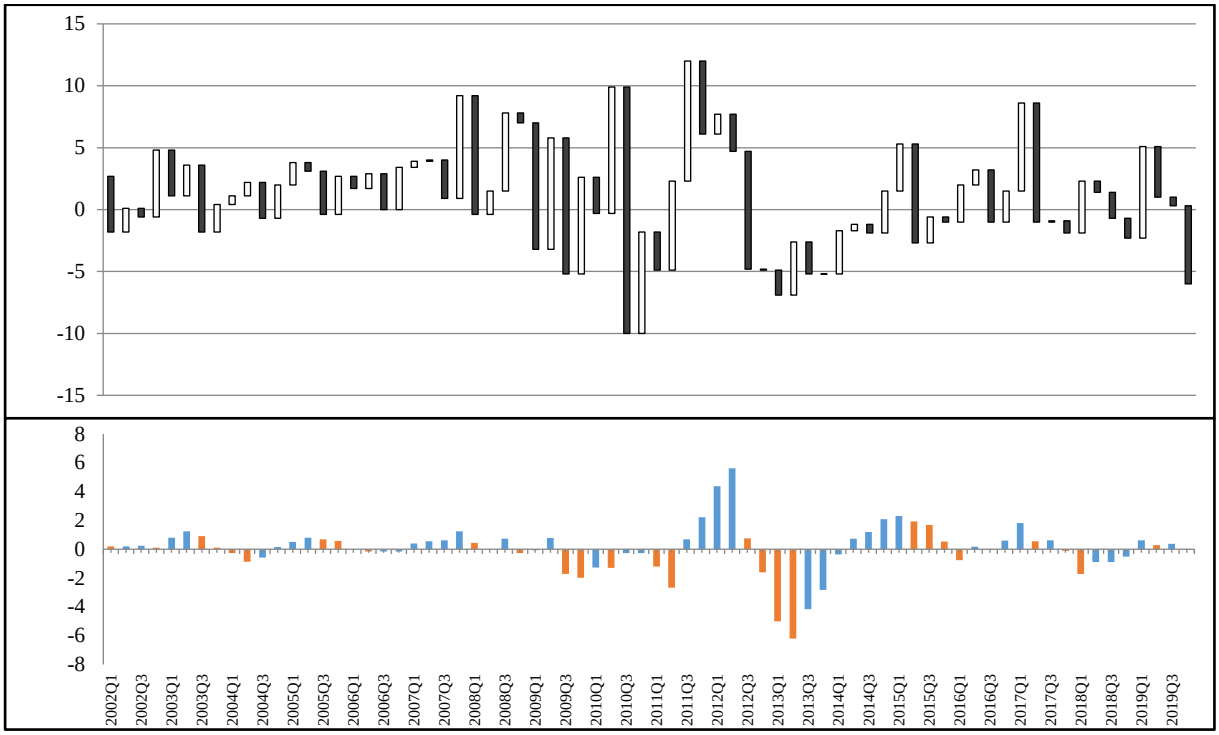

Figure 10. Chain growth rates of the money supply in circulation in the EU economy*, **

* Upper graph: Dynamics of changes in the basic (index 1999 Q1=0) quarterly growth/decrease rates, seasonally and calendar adjusted data. Bottom chart: Histogram of the MACD(A) indicator.

**Until 2020, the data was submitted for the EU 28, for 1Q. 2020 data submitted for EU 27, after Q1 2020 data not available.

Source: Calculations by the authors based on Eurostat data, access mode, https://ec.europa.eu/eurostat/data/database

4.2. Scenarios for the states of the EU economy

The conducted studies of the main macroeconomic indicators of the EU economy confirmed the hypothesis put forward about the inefficiency of the existing economic system of management and the need to transform it in the direction of the development of high technologies. At the same time, it should be noted that the crisis phenomena that began to manifest themselves in the EU economy in the first quarter of 2020 will continue to intensify. Possible scenarios for the development of the EU economy after 2022 are presented in Table 2 below.

Table 2

Possible scenarios for the development of the EU-27 economy after 2022

State of the Economy Scenario	Change in dynamics of EU GDP in relation to 2000		Actual level of GDP growth by 2000, %	The nearest similar level of GDP
	Correction depth limits (Y), %	Correction depth limits (Y), pp		
Optimistic	Y <= 23.6%	Y <= 4.04	24.96%	2017Q3
	23.6% <Y<= 38.2%	4.04<Y<= 6.53	from 22.47% to 24.96%	2016Q4
Realistic	38.2% <Y<= 50.0%	6.53 <Y<= 8,55	from 20.45% to 22.47%	2015Q4
	50% < Y <= 61.8%	8.55 <Y<= 10,57	from 18.43% to 20.45%	2015Q1
Pessimistic	61.8% <= 100%	10.57 <=17.10	from 11.90% to 18.43%	2009Q1
	Downtrend	more17.10	below the level11.90%	before 2009Q1

Source: Scenarios developed by the authors using the Fibonacci method based on statistical data for 1999Q1-2021Q4

The studies carried out made it possible to identify three scenarios for the states of the EU economy after 2022. All scenarios show a high probability of the development of crisis in the EU economy. According to the optimistic scenario, after 2022, a downward correctional wave is predicted in the EU-27 economy and the formation of a situation similar to that of 2008 (at that time, the depth of GDP growth correction was approximately 38%, or in other words, the intensity of the development of the EU economy decreased by 38%). According to this scenario, GDP growth at the end of 2022 compared to 2000 will be 24.96% (for comparison, this Figure at the end of pre-crisis 2019 was at the level of 29%). According to a realistic scenario, the EU-27 economy after 2022 can sink to the level of 1 sq. 2015. The maximum drop in GDP under this scenario will be 10.57 percentage points, and the growth of the economy in relation to the base year 2000 will be at the level of 18.43%. In the event of a pessimistic scenario, EU GDP will roll back to the level of 1 sq. 2009. Thus, the conducted studies have shown that the inefficiency of the current economic structure forms the objective prerequisites for the development of deep crisis phenomena in the EU economy.

5. CONCLUSION

In recent years, the world has been moving very quickly towards the implementation of the Fourth Industrial Revolution technology, based on the widespread use of Internet tools and the digitization of all social and economic processes. The main advantages of these transformations are the optimization of production and service processes, the rationalization of the use of material, natural and human resources, and the greening of the world economy.

The conducted research on the European Union economy has shown the ineffectiveness of the existing system (virtual finance system) and proved the necessity of economic transformations. The search for a new economic model based on the active implementation of Industry 4.0 technologies can become a way for the EU economy to emerge from the crisis and move to a qualitatively new level of socio-economic development.

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