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## DIGITAL SEGMENT OF THE REAL ECONOMY: DIGITAL ECONOMY IN THE CONTEXT OF ANALOG ECONOMY

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Formation, development and institutionalization of digital economy (DE) is in its third year now in the Russian Federation. However, there is still no comprehensive understanding of DE in foreign or Russian economic science, and no fundamental studies have been carried out on digital economy's relationship with the analog and real economies. The goal of this article is to gain further insight into the phenomenon and analyze the results of the fourth information revolution (using Peter Drucker's definition) and the fourth industrial revolution (using Klaus Schwab's definition), institutional environment of digital economy, and, ultimately, the digital segment of the real economy. The study presents the theoretical and practical fundamentals of analog, real and digital economies, refining their definitions. Digital economy, or, rather digital information economy, is represented in the context of a new type of mixed economy, analog-to-digital; this concept is introduced for the very first time. Information, or, more precisely, energy and information, technological and production know-how are considered as the main resource of the digital economy. Original appraised interpretation is provided for DE as an emerging system (and possibly antisystem) of production and/or economic relations that can function without direct human participation «in the field of production as Industry 4.0 (cyber systems together with the «Internet of Everything»), virtual distribution, exchange via digital platforms and individualized consumption as the main phase of reproduction of information goods» in digital form. Technological essence, parameters in the form of digital technologies and the role of digital economy as a digital segment of the real economy have been defined. The new practically important results obtained in the study are the correlation between the digital sector and the real economy, exceeding economic growth rates of DE compared to those of analog economy at the present time. Viability of the analog economy is demonstrated in contrast to speculations on the «demise of analog economy» (discussed at the Information Technology of Industrial Russia conference). Interaction and direct correlation of analog and digital economies have been revealed.

**Keywords:** digital segment of real economy, analog economy, real economy, digital economy, analog and digital economy, information and digital economy, information, technological and production know-how, digitalization, information technology of Industrial Russia conference

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## ЦИФРОВОЙ СЕГМЕНТ РЕАЛЬНОЙ ЭКОНОМИКИ: ЦИФРОВАЯ ЭКОНОМИКА В КОНТЕКСТЕ АНАЛОГОВОЙ

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Третий год идет формирование и развитие цифровой экономики, ее институционализация в России, однако целостного ее осмысления, фундаментального исследования ее взаимодействия с аналоговой и реальной экономикой в зарубежной и российской экономической науке не произошло. Цель данного исследования – дальнейшее осмысление и анализ результатов четвертой информационной (по Питеру Друкеру) и четвертой промышленной (по Клаусу Мартину Швабу) революций, институциональной среды цифровой экономики, а в конечном итоге – цифрового сегмента реальной экономики. Отражены результаты исследования теоретических и практических основ аналоговой и реальной, а также цифровой экономик, уточняются их определения, параметры. Цифровая экономика, а точнее, информационно-цифровая экономика, позиционируется в контексте нового типа смешанной экономики как аналогово-цифровой – понятия, введенного автором впервые в научный оборот. Информация, а конкретнее, энергия и информация, технологическая производственная информация, представлены как основной ресурс цифровой экономики. Дана оригинальная апробированная авторская трактовка цифровой экономики как формирующейся системы, а возможно, и антисистемы производственных и/или экономических отношений, которая может функционировать и без непосредственного участия человека «в сфере производства как Индустрии 4.0 (киберсистемы в купе с “интернетом всего”), виртуального распределения, обмена посредством цифровых платформ и индивидуализированного потребления как главной фазы воспроизводства информационных благ» в цифровой форме. Определены технологическая сущность, параметры в форме цифровых технологий и значение цифровой экономики как цифрового сегмента реальной экономики. С точки зрения практической новизны показано соотношение цифрового сектора в реальной экономике, а также превосходящие темпы экономического роста цифровой экономики, по сравнению с аналоговой, на современном этапе. Показана жизнеспособность аналоговой экономики, в отличие от концепта конференции ЦИПР–2017 «Цифровая индустрия промышленной России» об «умирании аналоговой экономики». Определены взаимодействие и прямая связь аналоговой и цифровой экономик.

**Ключевые слова:** цифровой сегмент реальной экономики, аналоговая экономика, реальная экономика, цифровая экономика, аналого-цифровая экономика, информационно-цифровая экономика, энергия и информация, технологическая производственная информация, цифровизация, цифровая индустрия промышленной России (ЦИПР–2017)

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«I know everything,» said Wikipedia.

«I can find everything,» said Yandex.

«I am the greatest of them all,» said the Internet.

«Well now,» grinned the electricity.

*Mikhail Kovalchuk*

*Introduction.* It was only in January 2016 that the President of the Russian Federation announced a policy towards building a digital economy (DE) as the economy of the new technological generation. Over the next two years (2017–2018) and in early



2019, the digital economy has become a key sociocultural, institutional and economic concept in the vast majority of foreign, Russian and international economic information platforms, such as summits, conferences, congresses, forums, symposia, round tables, lectures, seminars, reports, speeches, programs, as well as in publications in the media and in academic publishing. Since 2018, our country is facing the challenge of a digital technology breakthrough [10]. It has been three years now that digital economy has been integrated into Russian economic practices (although it has been first introduced into practice much earlier) as digitalization of different aspects of human life (including economic aspects); moreover, simultaneous digitalization of the entire society (transformation of the information society into a digital society, referred to as society 5.0 and society 6.0) is underway.

The World Bank 2016 Report on Developing the Digital Economy in Russia ranked the country 28th in the world in terms of the human capital development index [1, p. 6], and 41st in terms of the social and economic benefits obtained from digital transformation. Russia was ranked 61st in terms of the impact of information and communication technologies (ICT) on the efficiency of public administration, 75th in terms of the impact of ICT on new forms of organization, 88th in terms of the impact of ICT on the availability of basic services [1, p. 12].

Holding a speech before the students of the Sirius Educational Center, the President of the Russian Federation said that the prize for creating a digital economy would be to rule the world. This situation with DE is similar to the creation and possession of nuclear weapons in the 1940s. Many countries of the world are participating in the big digital game to rule the world, with the digital economies of USA and China leading the race. However, no comprehensive analysis has been carried out so far on the most urgent and vital problem of digital economy and digital society in the context of analog and real economies. Digital practice and its institutionalization (in the form of World Bank Reports, Decree of the President of the Russian Federation, Government Program on Digital Economy of the Russian Federation, etc.) are currently ahead of fundamental and even applied

studies on socio-economics and philosophy of economics. In the context of information warfare and cyberwarfare, there is much speculative, false, fake or non-professional data on DE, including the data given in the scientific literature. The prospects for the real and analog economies of the Russian Federation, its neo-industrialization, re-industrialization and digital transformation have not been clearly outlined, given the country's digital dependence and Internet dependence on the United States. Fundamental economics, whose foundations were laid down by Lomonosov, should be able to answer the question put forward by the President of the Russian Federation, namely, how the Russian economy could move into a «higher league of economies».

*Problem statement.* The goal of this study is to better comprehend and analyze the results of the fourth information and fourth industrial revolutions, the digital information economy (DIE) as information economy 2.0 and the institutional and economic environment of digital economy, and, ultimately, the digital segment of the real economy through the prism of a new type of mixed economy, analog-to-digital. This problem is the subject of our analysis.

*Research methodology.* The studies of well-known foreign scientists have served as a primary theoretical and methodological basis for the study. For example, Peter Drucker considered the information revolution of the 1970s, without presuming to call it the fourth information revolution (terming the revolution related to invention of the printing press as the third information revolution). The ideas and concepts of digital economy did not originate with Russian scientists and officials. This is a global challenge in the context of hybrid, humanitarian, genetic and cyber warfare, a megaproject and a metaproject, which was first theorized in 1994 by the «cyber-guru of the world», Canadian scholar Don Tapscott [7], and by Nicholas Negraponte [14] from the Massachusetts Institute of Technology (USA) in 1995. Notably, the term digital economy has been adopted in the European Union and in Russia, while the more technology-oriented term «API economy»

is common in the USA (used by such companies as Deloitte, IBM, etc.). Klaus Martin Schwab's fundamental works are dedicated to the fourth industrial revolution, the «conceptual framework for understanding the technological revolution» [8, p. 11] and to digital revolution technologies [9]. The Oxford Dictionary defines digital economy as «an economy which functions primarily by means of digital technology, especially electronic transactions made using the Internet» [15]. Many studies of both foreign and Russian economists have been written on the subject of DE, namely, on information and digital economies (Apatova, Babkin, Dyatlov, Lugachev, Strelets, Chinaeva, Yudina, and others). Particular attention has been paid to applied problems of DE: electronic commerce (Lapidus et al.); digital platforms, platform economy (Geliskhanov, Markova, Shastitko and others). Nevertheless, there has been as yet no comprehensive study of digital economy, and its purposes, essence and beneficiaries have been largely left ignored; moreover, the concepts of analog and real economies are fading into oblivion in academic discussion.

The study used the following methods of economic analysis: comprehensive, systemic, deductive, institutional, historical/economic, philosophical/economic, statistical, as well as the project method.

**Digital, analog and real economy.** Let us try to provide theoretical and methodological answers to the difficult question of the relationship between digital and analog economies, defining the very concepts of digital, analog and real economics in terms of digitalization as one of the current trends in the development of national and global economies and explaining their practical significance, parameters and directions. In the context of real economy, digital economy should not be confused with augmented reality as a technique that allows to use information and digital technologies to supplement the real world with data about it. Back in 1997, Ronald Azuma postulated that augmented reality is a system combining the virtual and the real, which «interacts in real time; is registered in three dimensions» [12, p. 356].

Extensive debate on the topic of digital economy started in the Russian Federation after the World

Bank's Digital Dividends report was presented at the Open Innovations platform in Skolkovo in the autumn of 2016. The concept of institutionalizing the «digital economy» of the Russian Federation was compiled and circulated by the World Bank in 2016 and is described in the Digital Dividends World Development Report (2016 World Bank Review). The report pointed out the following directions for digitalization in Russia: «open data, e-government system, efforts of domestic digital giants like Yandex, Kaspersky, online order services, reducing the term of registration of ownership rights by using information technology to 10 days» [19]. Within this document, the World Bank defined digital economy as «a system of economic, social and cultural relations based on use of digital information and communication technologies» [19]. However, some methods proposed in the 2016 WB Report for digitalization in the Russian Federation contradict the Russian Government's 2017 statements on digital economy. For example, according to the summary program of the Government of the Russian Federation in 2017, the following directions for forming DE in the Russian Federation emerged: legal regulation, competences, education and personnel, cybersecurity, infrastructure [4].

However, it was earlier that the era of digital economy began in Russia and around the world: it was in the early 2010s with the advent of affordable smartphones. The user of a smartphone, i.e., not a supercomputer but a terminal with access to the global network is the very image of the digital economy itself. The economic and institutional origins of digitalization in the Russian Federation are thus intertwined. Meanwhile, the digital economy has begun to expand, interacting with the real and analog economies.

The concepts of analog and digital computers and analog and digital signals from the theory of signals should be introduced to facilitate understanding of analog and digital economies from the standpoint of technology and information as the main production factors of information economy. Analog and digital computers, as well as their corresponding analog and digital technologies and carriers are the criteria for analog and digital



economies only in the narrow (technological) sense of the word.

Analog economy in the narrow sense of the word is connected with use of analog computers, technologies and carriers. They process information presented in analog or continuous form by reproducing the connections and relationships between constantly and continuously varying physical quantities equivalent to the original data, which are typical for this class. Electrical currents and voltages are used as machine variables in electronic analog computers. There are analog computers with automatic software and with manual control. The difference between analog and digital computers is in the set of problems solved and the methods for their execution; in addition, the latter have higher speeds and are easy to program. Digital computers also process information represented in digital form. Each digit in digital computers corresponds to one or several discrete signals, with a digital algorithm (1,0 binary code) used. Modern digital computers are represented by computers and supercomputers whose wide use actually marked the beginning of the digital economy.

Analog economy is connected to analog technologies used in the real economy (for example, analog television, photography, etc.), as well as analog information carriers (gramophone records, videotapes, etc.). In the broad sense of the word, analog economy can be synonymous with the real economy. Real economy, according to reproduction theory (political economy, economic theory), is the economic activity of the society associated with reproduction of real non-digital goods and services. This is also a set of production and economic relations that evolve in the system of production, distribution, exchange and consumption of material and non-material, real, non-virtual goods, which has its own institutions and anti-institutions, i.e., rules and regulations.

However, use of computers, supercomputers, the Internet, mobile phones, smartphones, etc., and in the long term, quantum computers and neural networks (Neuronets) has brought on institutional changes into the functioning of the economy as a whole. Use of the Internet and gadgets should be

regarded as a kind of consumption, industrial and individual. The digital economy can be then represented as part of economic relations mediated by the Internet, cellular communications, ICT, etc. The phenomenon of real digital enterprises emerges.

There is a direct dependence of digital economy on electricity and other energy information resources and potential which are one of the main products of the real economy [5, p. 40–41], as well as on natural phenomena (for example, solar eclipses), etc. Docking of the Soyuz (USSR) and Apollo (USA) spacecraft is vivid evidence of the advantages of Soviet analog technologies over the American digital technologies. All of these dependences are well understood by specialists integrating information and communication technologies (ICT) and digital technologies in modern business processes, as well as by scientists using interdisciplinary analysis.

Indeed, an independent digital economy cannot exist without real and analog economies; only control over the economy and society can be digital, or, more precisely, electronic. According to V.V. Ivanov (Doctor of Economic Sciences, Corresponding Member of RAS), digital economy is «a virtual environment that complements our reality». There is another similar definition of DE as a supplement to analog economy.

Let us define digital economy, understood within this study as a supplement to the analog and only partly to the real economy, in the following manner: digital economy is an emerging system (and, possibly, an anti-system) of production and/or economic relations that can function without direct human participation «in the sphere of production of both Industry 4.0 (cyber systems together with the Internet of Everything comprising the Internet of Things, Internet of Ideas and Internet of Agreements), virtual distribution, exchange through digital platforms and individualized consumption as the main phase of reproduction of information goods» in digital form [11, p. 14]. Digital economy is a web-based, computerized and, in the future, neural-network-based mechanism as information economy 3.0, which is also simultaneously virtual economy, including, for example, gamers (players who, along with real products and services, consume large quantities of digital and virtual goods).

The difference between real economy (RE), analog economy (AE) and digital economy (DE) can be also traced in terms of the main resource that is the production factor for the economy (this is labor and accumulated labor in the form of capital for the real and the analog economy, and information, knowledge, data, big data, digital twins for the digital economy); in terms of type of economic relations (vertical, hierarchical for AE and RE; horizontal, network, platform for DE); in terms of the market (geographical markets (local, regional, national, world, global) for RE and a multilateral communication space of network interactions, hybrid global organized space for DE), etc.

Digital economy also differs from real economy by the results of its production that are information and digital goods and services (DGS). Given the characteristics of production and consumption of DGS, they can be divided into four groups:

firstly, the DGS produced from the start in digital format are «cloned» and do not have a material prototype (for example, software, films and video materials shot with a digital camera, e-books without paper equivalents, etc.);

secondly, these are digital copies of material non-digital goods that retain the functional qualities of their real prototypes (digital copies of films that were originally made using analog film technologies, digitized printed books, materials, documents, original works of art, etc.);

thirdly, these are digital images of traditional goods in the service sector, which do not replace their prototypes in consumption but allow to manage these prototypes more effectively (for example, the Uber system, managing a fleet of taxi cars with a digital image, and the similar Yandex. Taxi system); fourthly, these are material goods created using digital technologies such as additive technologies, 3D printing or robotization when digital images are transferred to real products while consuming real material products produced on the basis of their digital images (for example, a bridge in Amsterdam 3D-printed using robots, a motorcycle 3D-printed in Sweden, «printed houses», etc.).

It follows then that digital economy cannot replace the real economy associated with reproduction

of tangible and intangible non-virtual goods using analog and even partially digital technologies necessary for vital human activities. Digital television, digital photography, digital medicine, digital education, etc., increase the amount of information goods produced, but not their quality. Digital economy does not have a life-affirming basis, acting instead as a supplement to the analog and the real economy. DE can become a system for control over the real economy and for managing it. Indeed, there are two segments of the real economy: the analog segment as a synonym for the real economy itself and the digital segment in the context of digital enterprises and information and digital goods («printed» real houses, bridges, motorcycles, components, etc.).

**Digital segment of real economy: life in reality instead of the digital world.** The new interpretation of digital economy as a supplement to the real economy and, so to speak, the complementary component of the analog economy is in principle capable of stimulating the development of real sectors of economy and of the national economy as a whole. There have been attempts in some Western European countries (Great Britain, Denmark, Norway, Germany, etc.) to organize and accelerate the DE; however, these attempts proved somewhat artificial, bearing no correlation to the analog economy. Accelerated development of the DE without taking into account the development of the analog and the real economy resulted in a slowdown in the overall economic development of the country. In practice (for example, considering railways in the UK, energy in the US, etc.), there is a direct link between the development of the real and the analog, the material and the analog (technological) sectors of the economy and the digital one. Real processes of digitalization of objects and production processes stimulate the development of goods and services of analog and real economies. Digital economy cannot exist and evolve without the analog and the real economy, since life itself is analog, and analog technologies are, in practice, of better quality and more effective for production of unique products. DE, RE and AE can complement each other, participating in the growth of goods.



The example of e-commerce in the world where digital and real economies are interconnected is particularly illustrative: exchange of real goods happens through digital platforms (DP). In 2015, the US was the leader in electronic commerce (without a financial market) with a volume of \$287.39 billion, «ahead of China (\$247.03 billion), Japan (\$76.11 billion), Great Britain (\$66.7 billion) and Germany (\$57.33 billion)» [6, p. 80]. This is mainly explained by two reasons: firstly, many transnational digital platforms present in the USA [3] and, secondly, the volume of the more expensive American digital information product that is traded electronically. Another important factor for American leadership in the field of e-economics is a huge amount of available venture capital in the US compared to other countries. In view of this, even foreign startups in the field of digital economy prefer to launch in the United States due to more affordable financing and a large domestic digital economy market in North America. China is second because it has fewer transnational electronic platforms (the main one is the Ali Baba transnational digital platform) and cheaper real, i.e., material product. The main reasons for China's leadership in e-commerce and digital economy are the following:

- Protectionism of the Chinese government, which limits the presence of international players (Google, Facebook, Amazon, instant messengers, etc.) in the country;
- Underdeveloped classic analog retail platforms (a significant proportion of China's population still lives in rural areas with no modern trade);
- Cheap mass domestic production of electronic equipment (computers, smartphones, etc.), accessible even to people with low incomes, increased Internet usage;
- Large population.

From the standpoint of the digital segment of real economy, a new type of mixed economy can be said to have evolved, that is, from the standpoint of technologies, the analog-to-digital economy. Some sources even describe «symbiosis of man and computer» (according to Eric Schmidt, Executive Chairman of Board of Directors at Google) because, indeed, digital economy is positioned as a person with a smartphone which is a terminal for accessing the

Internet and the «cloud». «For me, there is no independent digital economy: there is a digital segment of the real economy» [17], claimed Dzhomart Aliev, top manager of a number of large companies, who introduced new management systems and technologies. As Aliev stated, «People are material beings living in a non-virtual world. So digital contracts for supply of oil are still based on the fact that real oil is needed for sale. Like food, clothes, etc. Of course, there are some people (such as gamers) who spend more on «life in the digital world» than on «life in reality» but they are few and they do not set economic trends» [17].

Digital economy is in fact digital information economy (DIE), since reproduction of an information product is its essence, and digitalization is its form. Collection, storage, processing of data and Big Data as inefficient assets and digital twins as effective assets should be goal-oriented. The three institutional principles of the digitalization of the economy in each country should be clearly understood: «goal, ideology and mechanisms of implementation» of DE. The main phase in digital economy is consumption, a person can become a consumer instead of a creator or a producer (although consumerism is also described as a combination or symbiosis of the consumer and the producer in one person); accordingly, the society makes the ultimate transition to consumerism, with consumer addiction through digital control systems.

The Government Program of the Russian Federation on the «digital economy» considered the relationships between the «digital» and the «analog» worlds in a special, Russian way. According to the Program, a new digital economic model that is not based on raw materials and is not neo-industrial is created in Russia. Without defining a common strategic life-affirming goal, the Program lists the following tactical objectives: «create at least 10 high-tech IT enterprises, 10 industrial digital platforms for the main sectors of the economy» (education, healthcare, etc.), 500 small and medium-sized enterprises in the field of digital technologies. An additional task is to ensure annual graduation of 120,000 IT specialists and to provide 97% of Russian households with broadband Internet access at a speed of at least 100 Mbit/s (the average speed was 12 Mbit/s

in 2016) [4]. According to this Program, it is necessary to «make sure that 95% of network traffic goes through domestic networks. To establish sustainable 5G coverage in all cities with a population of over one million and to ensure that Russia's share in the global market for information storage and processing services is 10 percent (it is currently less than 1 percent). All of this should be accomplished by 2024 with annual funding of 100 billion rubles from the state budget. The implemented program should decrease the share of foreign computer and telecommunication equipment purchased by government agencies to 50 percent, and of software to 10 percent» [18]. The problem of the digital divide between regions and industries, with the continued Internet dependence on the US, does not lose its relevance in Russia.

The program «Digital Economy of the Russian Federation», dated July 28, 2017, is based on the concept of the fourth industrial revolution according to Schwab, consisting of three waves in the opinion of its developers. The first wave involves «digital development of banks, telecommunications companies, public services, i.e., the areas where technologies only affect the transformation of work algorithms» [4]. Implementing these measures may result in creating a so-called «digital concentration camp» and/or electronic concentration camp, like in China, earlier than the digital segment of the real economy can evolve. For example, the Chinese project of the Social Credit System was widely described in scientific publications as «digital dictatorship» and/or «electronic concentration camp» («electronic concentration camp» is a concept that was introduced in 2016 by the British magazine *The Economist*). Complex technological changes in industry and transport should be introduced only in the second wave, taking into account the relationship between the digital and the analog economy. Finally, the third wave is the era of institutional and technological breakthroughs in such areas as genetics, quantum and energy technologies, neural networks, etc., which can essentially change the institutions or rules of the game. This can be the start of a big digital game without rules, maybe with anti-institutions.

Thus, theoretical discussions as well as practical confirmations can only concern the digital segment

of the real economy, the analog-to-digital economy from a technological standpoint as a new type of mixed economy and also life in the real rather than the digital world; there is no speaking of an independent digital economy and its boundaries.

#### **2017 Conference on Information Technology of Industrial Russia: «the analog economy is dying».**

There is a point of view in the global information space that the analog economy is dying. Our task here is to weigh the pros and cons of this concept and to draw a balanced science-based conclusion taking into account socio-economic considerations and aspects of philosophy of economics.

In May 2017, the annual conference on Information Technology of Industrial Russia was held at Innopolis, an innovation center in the Republic of Tatarstan. The conference serves as a modern digital intersectoral platform, connecting representatives of the Russian industry as the real sector of the economy, in particular, its military-industrial complex, information and communication technology professionals as representatives of the digital economy, investors and the state. The discussions cover a range of practical issues on forming and developing digital economy in the Russian Federation. Systemic fundamental theoretical and methodological problems of the digital economy are not considered at the conference, which does not provide a comprehensive view of the digital economy.

Issues of non-resource exports, further conversion in the sectors of the military-industrial complex, ensuring cybersecurity protection of Russia's economic space in an open, public Internet as a modern weapon of the US (following Ashmanov's definition) are also presented at the conference. The conference was held with the support of the Presidential Administration of Russia, the Ministry of Economic Development, the Ministry of Industry and Trade of the Russian Federation, the Ministry of Digital Development, Communications and Mass Media, the Government of the Republic of Tajikistan, the Digital Economy Autonomous Non-Commercial Organization, a strategic partner of the conference, and others.

This representative forum was visited by Dmitry Peskov, the then director of the Young Professionals Department of the Agency for Strategic Initiatives. He stated that the share of the analog economy of the Russian Federation would halve over the next twenty years, commenting, «the analog economy is dying». Peskov pointed out that the main danger in development of Russia's real sector of economy was shortage of highly qualified specialists to work at high-tech enterprises with new equipment. Peskov said, «Today we are stimulating the training of personnel not for the digital but for the analog economy. We are preparing students for weak enterprises. There are currently no programs in the world (at least, not full-fledged ones) for preparing adults for work in the digital economy in the world. We need to develop such programs, we are working in this direction because we see that the analog economy is dying» [16].

Believing that the analog economy is dwindling, Peskov sees the future of the Russian economy, firstly, in searching for «new markets in other countries» and, secondly, in creating «digital enterprises in Russia». Peskov proposed, «We need to look for new markets that emerge in the conditions of the technological revolution. Following this logic, we should stimulate the creation of new digital companies. The share of the analog economy will be halved in 20 years» [16].

First of all, this key thesis of the dying analog economy, put forward by Peskov (who went on to become the special representative of the President of the Russian Federation for Digital and Technological Development) on May 17, 2017 at Innopolis, could be argued, if its proponent would be willing to do so, within the framework of scientific discussions and ethics; secondly, it is quite logical to conclude that this assumption is unrealistic, since life itself is analog. Virtual «life» is only attractive for gamers, satisfying their basic needs for virtual, artificial, digital goods, even though gamers still use real goods as well. The civilized scientific community sees the boundaries of the digital economy and does not at all deny it, regarding it as a digital segment of the real economy and as part of the digital information economy as information economy 2.0.

### **Digital Information Economy: basis for interaction of «physical, digital and biological domains».**

Informatization, computerization, cybernization, intellectualization, internetization, platformization, digitalization, virtualization, and even neuro-cybernization are the processes evolving in the modern «biodigital» world, which is accompanied by increased uncertainty and risks. Digital economy has emerged because of these phenomena. According to Drucker, the information civilization and information economy 1.0 formed as a result of the fourth information revolution of the mid-70s. Historically and ontologically speaking, information as one of the basic concepts of cybernetics is the exchange of data between people, between human and machine, between machine and machine; now it is the result of data conversion and analysis that has become the main factor of production. Technological and production know-how has taken priority over economic data. Technological and production know-how is actually a derivative of fundamental scientific knowledge. Notably, not just economic information or information concerning technological production processes should be taken into account but information as energy and energy as information, which is «a direct expression of economic and productive power», while humans are «the energy and information potential» [5, p. 40]. The amount of information continues to grow exponentially, having increased by more than 90 % over the last 2 years. However, it would be more correct to analyze information together with energy, since «energy-information primarily ensures reasonable organization of economic life» [5, p. 41], and, possibly, vice versa, since energy has two origins, positive and negative.

At the present stage, information economy 1.0 is transformed into digital information economy as information economy 2.0 in the epoch of so-called technological breakthroughs. Digital economy is also «surveillance capitalism» [11, p. 12] and the platform economy [13]. The observed trend is platformization [2, p. 22], destroying the vertical structure of production, creating a post-market.

In the context of Schwab's concept «Technologies of the Fourth Industrial Revolution» [9], 12 types of digital technologies determine the essence of «digital

economy». These include, first of all, new artificial intelligence and/or machine learning, Big Data, blockchain, 3D printing, cloud and quantum technologies, virtual and augmented reality and others. According to Schwab's theory, outlined in «Technologies of the Fourth Industrial Revolution», chips can be inserted into the brain, transforming humans into cyborgs.

Dmitry Medvedev said at the 2018 Open Innovations International Forum in Skolkovo that the share of digital information products in the global GDP is already about 10%. The digital information economy is growing much faster than the real economy (in fact, about 9 times faster). Not only «smart people», «smart houses» and «smart companies» but also «smart cities», which currently number about 221, and «smart countries» (now still at the stage of strategic development) become products of the digital information technologies. According to Schwab, all recent phenomena are interaction of «physical, digital and biological domains» [8, p. 17]. According to the Strategy for the Development of the Electronics and Radioelectronics Industry in Russia up to 2025, «Every individual should be constantly connected with global information and control networks of the Internet type. Nanoelectronics should be integrated with biological objects and ensure continuous monitoring of the maintenance of their life activities, improving the quality of life, and thus reducing the social costs for the state. Built-in wireless nanoelectronic devices ensuring a person's constant contact with the surrounding intellectual environment should become widespread, along with means for direct wireless contact of the human brain with objects, vehicles and other people» [20].

Thus, interaction of «physical, digital and biological domains» forms a «biodigital world». The modern phenomena of digital transformation of economy can be explored only within the framework of new concepts.

*Results obtained.* The following new results have been obtained in this study:

1) we have given a refined definition to the concept of digital segment of real economy as a digital economy in the context of analog economy;

2) we have substantiated the direct correlation between the development of digital, analog and real economies;

3) we have proved that the idea that analog economy is dying is far from reality;

4) we have refined the important definition of digital economy, previously given in *Theoretical Economics*, 5 (2018) [11, p. 14];

5) we have introduced a new concept of analog-to-digital economy as a new type of mixed economy, where digital economy should represent only the digital segment of the real economy.

### *Conclusions*

1. Finding strategic comprehensive solutions for the problems of forming the digital information economy as information economy 2.0 in the Russian Federation, it is important to see its life-affirming goals, with all economic resources and geopolitics depending primarily on traditional values, on the mentality of the people, on the relationship between the analog and the digital economy as a new type of mixed economy (analog-to-digital). This should help Russia gain access to a «higher league of economies».

2. The Internet dependence of the Russian economy on the USA should be eliminated; at the same time, efforts should be made to reproduce the dependence of digital economy on one of the main products of the real economy that is electricity and other energy information resources.

3. The digital information economy created in the context of analog-to-digital economies should be the result of deeper understanding of the fourth information and fourth industrial revolution, digital information economy as information economy 2.0, keeping in mind that life itself is analog.

4. The idea that analog economy is dying is clearly far from reality.

5. The potential of analog and real economies for forming the digital segment of the real economy should be determined.

6. Digital economy should act as an addition to the real and analog economies; as an emerging system, and possibly, as an anti-system of production and/or economic relations in the field of production as Industry 4.0 (cybersystems together with the



Internet of Things), virtual distribution, exchange through digital platforms and individualized consumption as the main phase of reproduction of information benefits and anti-benefits in digital form.

7. The new interpretation given, in principle and in practice based on the experience of Western European countries, to the digital economy as a supplement to the real and analog economies and humanization of the achievements of scientific and technological revolution are the factors stimulating development of real sectors of economy, of national and world economy as a whole. The new concept that socio-economic progress should be qualitative

rather than quantitative at the current stage of globalization is a challenge and an opportunity to create a digital segment of Russia's real economy and to develop the real economy itself.

*Directions for further studies.* The following directions can be chosen for further research on digital economics:

1. digital transformation of Russian economy at the present stage;
2. digital information economy as information economy 2.0;
3. digital infrastructure;
4. population and digital technologies: relationships and trends.

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