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Digitalization and its impact on economic growth

Digitalização e seu impacto no crescimento econômico

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RESUMO: A digitalização transforma os conceitos tradicionais de crescimento econômico e competitividade. Este artigo estuda o efeito da digitalização no crescimento econômico da Rússia. Como indicadores que medem o impacto dos processos de digitalização sobre o crescimento econômico, o estudo usou o Produto Interno Bruto per capita, o Índice de Competitividade Global, o Índice de Vida Digital, o Índice de Adoção Digital e o Índice de Resiliência. Seu exame aprofundado com base em um modelo de três frentes mostrou que o estado do macroambiente e a prontidão da população para a transformação digital não permitem que as tecnologias digitais afetem seriamente a taxa de crescimento econômico.
PALAVRAS-CHAVE: Índice de adoção digital; transformação digital; índice de competitividade global; índice de vida digital; índice de resiliência; modelo de avaliação em três frentes.

ABSTRACT: Digitalization transforms the traditional concepts of economic growth and competitiveness. This article studies the effect of digitalization on Russia's economic growth. As indicators measuring the impact of digitalization processes on economic growth, the study used the Gross Domestic Product per capita, the Global Competitiveness Index, the Index of Digital Life, the Digital Adoption Index, and the Resilience Index. Their in-depth examination based on a three-pronged model showed that the state of the macroenvironment and the readiness of the population for digital transformation do not allow digital technologies to affect the economic growth rate seriously.
KEYWORDS: Digital adoption index; digital transformation; global competitiveness index; index of digital life; resilience index; three-pronged assessment model.
JEL Classification: F43; O34; O4.

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INTRODUCTION

Today's world is on the verge of the Fourth Industrial Revolution, characterized by the capitalization of the Internet of Things (IoT) and digitalization, which are radically changing the way of doing business in production value chains (Parida et al. 2019; Rojko 2017). The accelerated development of the internet enforced by the digitalization processes has already led to the emergence of a digital economy. This consequence has opened humanity access to unprecedented services, transformed the traditional concepts of economic growth and competitiveness, and changed the economy and society as a whole (Heimerl and Raza 2018; Watanabe et al. 2018). As stated by Bukht and Heeks (2017), the digital economy stimulates economic growth, increases capital and labor productivity, reduces operating costs, and promotes access to global markets. In view of this, the impact of digitalization on the economy has attracted the attention of many researchers in recent years.

Industrial production is undergoing a fundamental transformation leading to digitized and interconnected manufacturing, subsumed under the term Industrial Internet (of Things) in the American version or Industry 4.0 in the German interpretation. In 2017, Beier et al. (2017) examined the changes that digitalization is expected to bring about in the industrial sector by comparing highly industrialized (Germany) and major emerging industrial economies (China). Researchers conducted two empirical surveys questioning German and Chinese manufacturing companies from different sectors regarding the possible impact of digitalization of manufacturing and business processes on these enterprises. Their findings intimate that digital transformation may affect not only the environmental aspect (resource efficiency, renewable energy sources) but also social transformations and economic growth.

As indicated by Yao (2019), the top position in terms of capital investment in key technologies in Asia is rightfully assigned to China. The country is the world second after the United States (US) in fintech, virtual reality, autonomous driving, wearables, education technology, 3D printing, and robotics and drones. In some areas, China stands third, as in the case of attracting investments in big data, artificial intelligence, and machine learning (this position is topped by the United Kingdom (UK)). Largely due to the development of the internet and digitalization, China has moved to the fore in terms of gross domestic product (GDP), labor force, stock of narrow money, stock of broad money, stock of domestic credit, exports, and foreign exchange and gold reserve.

Danilin (2019) carried out an in-depth study of the digital economy in the US and China and confirmed their growing economic influence and dominance. The underlying reasons for their leadership in the digital economy were defined as the growing investment in research and development (R&D), increased attention to digital innovation and human resources development, the dynamism of the information and communication technology (ICT) sector, possible synergies between the development of personal electronics and online markets, and powerful internet

infrastructure. All this together was declared to affect the rates of economic growth in both countries positively.

A grounded review of the empirical literature on the relationship between the use of the internet and well-being allowed Castellacci and Tveito (2018) to conclude that new technologies contribute greatly to fostering economic performance (economic growth and competitiveness). As a consequence, they were defined to have a favorable effect on the well-being of the population.

According to a study by Parviainen et al. (2017), digitalization implies gradual economic growth. In view of this, countries at the most advanced stage of digitalization derive 20% more in economic benefits than those at the initial stage. Scholars reported digitalization to be effective in reducing unemployment, improving quality of life, and boosting citizen access to public services. They stated that it allows governments to operate with greater transparency and efficiency, which also impacts the country's economic growth beneficially.

Mićić (2017) argued that high-tech solutions and digital transformation are among the key areas of investment for the world's leading economies. He recognized increasing financing in digital transformation through the development of the private and public ICT sector to be advantageous for economic growth and such decisive indicators as GDP, productivity, and employment. Besides, by means of the so-called technological map of Europe, he demonstrated that countries with high ICT investment levels have equally high GDP per capita.

Pradhan et al. (2019) studied the relationship between ICT infrastructure and economic growth based on annual data from 25 European countries. For this, they used indicators that reflect the state of ICT infrastructure in various areas (landlines, mobile phones, internet users, internet servers, fixed broadband) and calculated a composite ICT infrastructure index. According to the authors, the obtained empirical results confirm the close relationship among the use of ICT, economic growth, and venture capital investments. Using panel-data estimation techniques and GDP per capita indicator for the European Union member states as the dependent variable, another group of researchers confirmed that ICT infrastructure has a salutary and strong effect on economic growth (Toader et al. 2018). In particular, an increase of 1% in the use of ICT infrastructure was found to contribute to a GDP per capita growth between 0.0767% (fixed-broadband subscriptions) and 0.396% (mobile cell subscriptions).

Habibi and Zabardast (2020) devoted their study to scrutinizing and comparing the contribution of ICT and education to economic growth in the Middle East countries and the states included in the Organization for Economic Cooperation and Development (OECD). Their central findings indicate that ICT technology presents positive implications to economic growth, regardless of a country's development level. In addition, they state that with the advent of more advanced technologies, the contribution of broadband technologies to economic growth is referred as diminishing in the OECD, whereas the impact of mobile phones gathers its pace.

Bahrini and Qaffas (2019) examined the impact of ICT on economic growth in developing countries of the Middle East, North Africa, and the Sub-Saharan Africa

region using a Generalized Method of Moment growth model over the period from 2007 to 2016. Researchers found that mobile phones, internet usage, and broadband adoption are the main drivers of economic growth in the considered area.

While investigating a similar topic, Raeskyesa and Lukas (2019) conducted a descriptive analysis of eight ASEAN middle-income countries for the period from 1999 to 2014 and performed a panel regression analysis with a dependent variable of GDP per capita growth and independent variables of physical capital, human capital, and ICT indicators. Their results suggest that ICT indicators have notable beneficial consequences for economic growth and physical and human capital. Apart from this, their examination proved that the usage and intensity of ICT have more pronounced implications than access to it.

Myovella et al. (2020) focused on reviewing the development of African economies and the impact digital transformation causes on them. For this, they compared business changes occurring in Sub-Saharan Africa with those in OECD by analyzing an 11-year panel dataset (from 2006 to 2016) for 41 countries of Sub-Saharan Africa and 33 OECD member states. Their findings allowed the conclusion about a positive contribution of digitalization to economic growth in both groups of countries, regardless of their development levels.

Examination of the service sector and small and medium-sized enterprises in India by Maiti and Kayal (2017) unveiled that digitalization leads to their high performance and, as a consequence, facilitates the inclusive growth of overall India's economy and trade. Vijayan (2019) paid particular attention to the success of the Digital India campaign in terms of creating new job opportunities, improving literacy rates, eliminating corruption, granting technological advancements, and boosting GDP. She disclosed that India's digitization improves the socio-economic situation of people living in rural areas through the development of non-agricultural economic activities and providing access to education, health, and financial services. As a consequence, this was defined to trigger further economic development as financial resources to support social amenities and other public infrastructures became available.

Maiti et al. (2019) believed that the digitalization of the economy is a fundamental strategy for solving problems related to economic growth and social inclusion. Their study found that faster ICT adoption enhances productivity and economic efficiency, brings greater transparency in the delivery of public services and welfare programs, reduces corruption, connects remote places with cities and towns, and improves the level of democratic engagement. At the same time, Erumban and Das (2020) pointed out that the lack of accurate data on ICT in the Indian economy is the central reason for limited knowledge on the impact of ICT on the country's economic growth. Using various data sources and overcoming obstacles related to data availability, consistency, and measurement, the authors estimated aggregate and sector ICT investments in India over time. This data analysis exposed the rise of ICT investment and the decline of its share in GDP. Correspondingly, India was determined as the country lagging behind the more mature economies. In their study,

Erumban and Das also expanded the international IndiaKLEMS (capital-labor-energy-materials-services) database to include ICT capital. Using the new data, the authors found that the contribution from ICT investment to India's growth increased insignificantly, but the manufacturing sectors were still lagging behind the aggregate economy.

Rath and Hermawan (2019) also paid considerable attention to the topic under consideration. Based on annual data for Indonesia from 1980 to 2014 and using an Autoregressive Distributed Lag cointegration technique on an augmented neoclassical growth model, they revealed a positive effect of progress in ICT on economic growth in both the long and short-term horizon. The other regressors, such as total factor productivity, human capital, and capital per worker, were also regarded as beneficial for economic growth.

Bongomin et al. (2019) investigated aspects of introducing digital financial innovations, such as mobile money services, and their impact on economic advancement. The survey of 379 Ugandan micro, small, and medium enterprises unveiled that the adoption and use of mobile money services can result in greater access to financial markets, which will subsequently increase the use of financial services and reduce risks for achieving stable and inclusive growth in developing states.

Marinković et al. (2018) emphasized that ICT is among the key tools for ensuring the development of the economy. They argued that the increasing significance of ICT is confirmed by the rapid growth in employment in this area.

A steady rise in the quantitative indicators of digitalization of the Russian economy was recorded by Bogoviz et al. (2017). Scholars declared that digitalization and internetization of the human-oriented economy of Russia are able to better the level of GDP per capita in constant prices, the value of happiness index, the state of business climate, and macro-economic effects. Simultaneously, they considered the focus of digitalization efforts solely on improving the country's macro-indicators not justified in terms of results.

Kasimova et al. (2020) indicated that the digital transformation of the world economy is followed by a systemic digital transition to new forms of relations in the production sector. They concentrated on the impact of digitalization on GDP as the main indicator of economic growth by analyzing the dependence of Russia's GDP on capital costs, labor costs, and the costs of ICT and their forecasting. However, even though Kasimova et al. (2020) set their sights on predictive GDP values by sector and for the whole economy, they failed to consider the level of adoption of digital technologies by business, population, and the public sector. This made it impossible to measure the impact of digitalization on the country's economic performance adequately.

Despite the growing pace of digital transformation in all spheres of the economy, some authors remain skeptical about the results achieved and believe that digitalization processes are still in their early stages. In this respect, Van Ark (2016) suggested that the New Digital Economy (mobile technologies, the internet, and cloud services) has not yet generated any visible improvement in productivity growth.

The analysis of data from the US, UK, and Germany allowed registering a rapid drop in ICT prices, a shift from ICT investment to ICT services, and a steady increase in knowledge-based assets supporting ICT. Notwithstanding this, van Ark came to the view that the New Digital Economy is still in its installation phase, and productivity effects may occur only once the technology enters the deployment phase. As stated by Maurseth (2020), the macro-impact of ICT on productivity and economic growth is of mixed nature and is still moderate. The spread of ICT coincided with slower economic growth in industrialized countries that started in the 1970s. Even though higher growth rates in the 1990s aided in renewing optimism, ICT's beneficial impact was more pronounced in the US than in Europe or Japan, and subsequent slower economic development pace dampened the initial enthusiasm. Outcomes from studies using macro data enabled the suggestion that the impact of internet use on economic growth was positive before the year 2000. However, for rich countries after 2000, the effect was even negative.

Despite the abundance of studies describing the link between digital transformation and economic growth, the process of investigation of the impact of digitalization in the context of individual countries still has some room for improvement. To date, there is no unified approach to the choice of methods and indicators allowing a thorough assessment of such an impact.

In view of the foregoing, this work aims to study the impact of digitalization on the country's economic growth rate using a set of indicators and the example of the economy of the Russian Federation.

This goal achievement is possible after addressing the following tasks:

1. Conduct quantitative analysis of indicators measuring digitalization and economic growth, including those used in global rankings and reports;

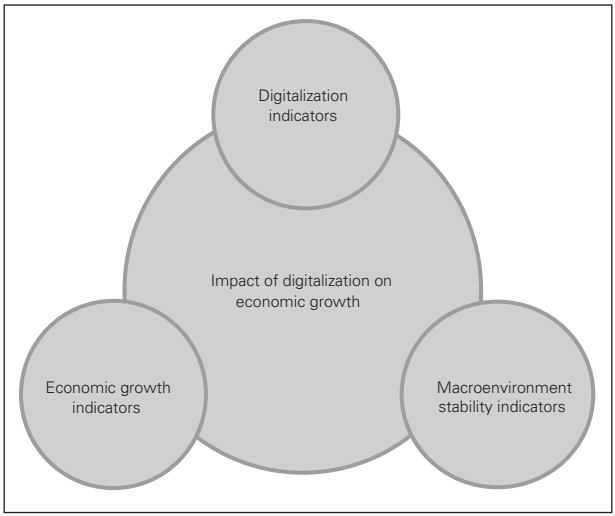
2. Compare the indicators of the studied country with those of economies leading the rankings;

3. Determine the degree of impact of digitalization on the economic growth rate of the studied country and outline factors capable of enhancing or weakening such an impact.

MATERIALS AND METHODS

Achievement of the ultimate goal of the study requires not only measuring the digitalization of the country's economy and assessing its impact on economic growth but also analyzing the risks that can neutralize the positive effect of digital transformation. Therefore, a logical-heuristic approach was used to form a comprehensive system of indicators (Figure 1).

Figure 1: System of indicators for measuring
the impact of digitalization on economic growth



Source: Developed by the authors.

As shown in Figure 1, the study was based on a system of indicators consisting of three groups:

1. Economic growth indicators, reflecting the level of development of the economic environment:

- GDP per capita – a general measure of the state of the economy (for 2009-2019) (World Economic Forum 2018);
- Global Competitiveness Index 4.0 – assesses the factors that collectively determine the level of a country's productivity. Thus far, it is the central driving force of long-term improvements in living standards. The Index provides evaluations in 12 areas (pillars): institutions, infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labor market, financial system, market size, business dynamism, and innovation capability (World Economic Forum 2018);

2. Digitalization indicators, reflecting all aspects of digital transformation in the country:

- Telefonica's Index on Digital Life – reflects a country's potential in terms of digital transformation. It takes into account ensuring open access to information based on the country's digital infrastructure, ease of interaction with the digital infrastructure within the country, and ease of use of digital infrastructure for entrepreneurship and innovation (GEDI 2016);
- Digital Adoption Index – assists in evaluating countries' digital and technological maturity. The Index measures countries' digital adoption capabilities across three dimensions: people, government, and business (The World Bank 2016);

3. Resilience indicators (risk assessment):

- FM Global Resilience Index – measures the ability of different countries to withstand various disruptions. It is a composite indicator combining 12 main parameters (drivers) of resilience and provides ranked estimates for countries around the world. These drivers are classified as related to economic factors, risk quality factors, and supply chain factors. A unique feature of this Index is that it draws on the experience and data collected by the Property Risk Management team of FM Global insurance company that visits and evaluates a substantial number of properties worldwide annually (FM Global 2020).

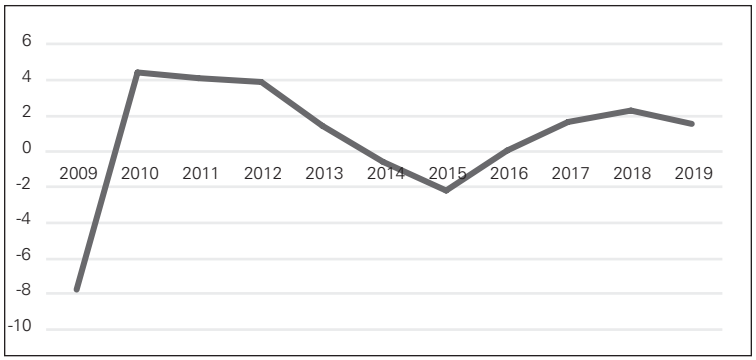
An additive weighted convolution of the normalized values of indicators from each group was used to conduct a qualitative and quantitative analysis of the digital transformation process and gain an integrated assessment of the above indicators. Calculations and visualization of results obtained were done utilizing MS Excel tools.

The impact of digital transformation on economic growth rates was studied using the example of the Russian Federation. The choice of this country was affected by the fact that its economy, which only in 1990 began a transition to a market type, is characterized by a fairly high development level comparable to that of leading mature markets. According to the World Bank, Russia's GDP growth rate in 2019 was 1.3%, while for the European Union, it constituted 1.5% (The World Bank 2016). At the same time, the state of Russia's political and social environment is notably behind that of developed states, and the economy remains predominantly resource-based and resource-dependent.

RESULTS

The first research stage presupposed considering the rating of Russia in terms of GDP per capita. The generally accepted way of measuring economic growth lies in determining changes in the production volumes or in the real income of residents. The United Nations System of National Accounts offers three indicators for calculating growth: GDP, real gross domestic income, and real gross national income (The World Bank 2018). Data retrieved from the World Bank's official reports indicate that in 2019, global economic growth weakened significantly. On top of the general slowdown in external demand, Russia's export performance was aggravated by the agreement of the Organization of Petroleum Exporting Countries, due to which crude oil prices fell. Figure 2 presents a graph of Russia's GDP per capita growth rates for 2009-2019.

Figure 2: GDP per capita growth in Russia for 2009-2019

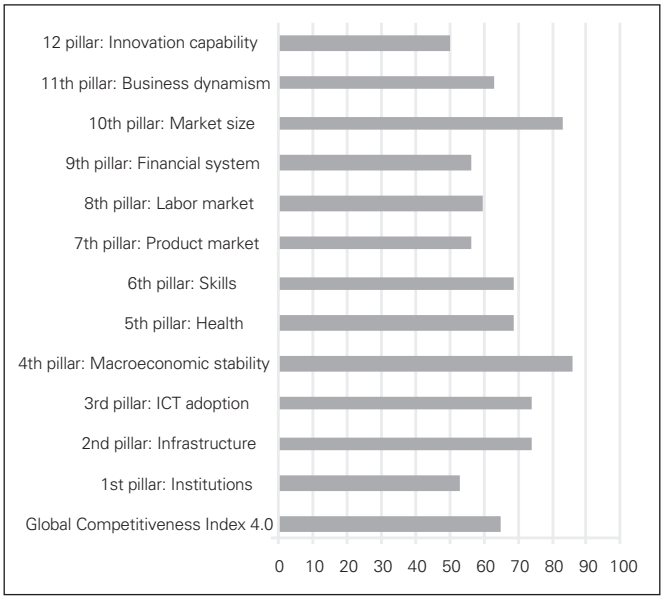


Source: Developed by the authors based on The World Bank (2018).

The diagram above indicates that, in 2019, Russia's real GDP increased by about 1.34% compared to the previous year. With the exception of 2009, its rate was relatively stable and only in 2015 showed a downward trend. In view of this, it can be assumed that, in general, the country has positive GDP growth dynamics, which allows considering the position on this indicator as satisfactory.

The second research step implied analyzing data on the Global Competitiveness Index (GCI). Figure 3 exhibits a diagram of its values for the Russian Federation in the context of 12 pillars.

Figure 3: Global Competitiveness Index 4.0

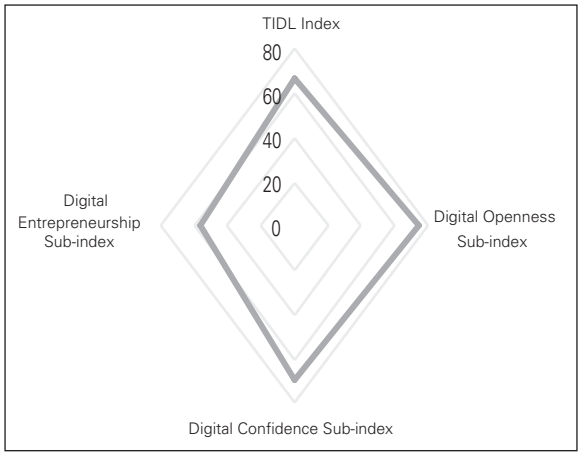


Source: Developed by the authors based on World Economic Forum (2018.)

In overall GCI, the Russian Federation is ranked relatively high (43rd out of 140). An analysis of the country's position by GCI pillars demonstrates that its scores vary from 51 to 88, determining the place of Russia from 100th (5th pillar: Health) to 6th (10th pillar: Market size). The largest gap in values is observed for the ICT adoption pillar (the degree of spread of specific ICT) in relation to the income level – Russia takes the 25th position, which in general indicates sufficient potential for digital transformation processes. On the whole, the Russian Federation exposes growth in all pillars, which has naturally led to an increase in the GCI score from 64.0 to 65.6.

The analysis of data on GDP per capita and GCI allows the inference that, by and large, Russia has positive dynamics in terms of economic development, which is expressed in GDP growth and an improvement in the country's competitiveness indicators. The high level of ICT adoption in Russia (25th place out of 140) is a sign of the fact that economic upswing is expected to impact the spread of ICT positively. In order to prove or confute this assumption, it is necessary to consider digitalization indicators and the macroenvironment's stability. For this, the next step entailed examining the group of indicators reflecting Russia's digitalization level. Figure 4 shows data on Telefonica's Index on Digital Life (TIDL) for the Russian Federation.

Figure 4: Telefonica's Index on Digital Life



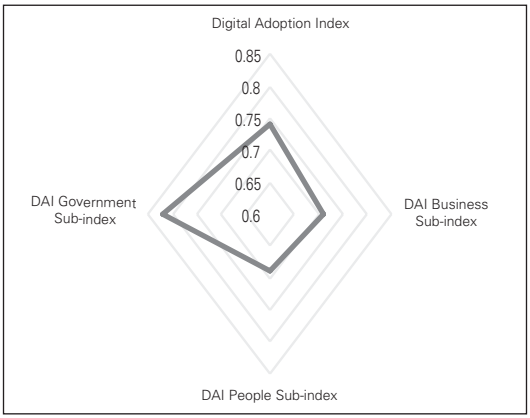
Source: Developed by the authors based on GEDI (2016).

According to TIDL, in terms of Digital Confidence (69.6) and Digital Openness sub-indexes (74.5), Russia is approaching the leading countries but lags far behind in the context of Digital Entrepreneurship (56.7). The country's overall TIDL score at 66.9 designates a sufficient state of digital transformation processes. On the other hand, the slowdown from the perspective of Digital Entrepreneurship suggests that the macroenvironment in which Russian business operates poses a number of obstacles in using digital infrastructure for entrepreneurship and innovation. They may be caused by low digital literacy rates, which result in passiveness in the adop-

tion of digital technologies and, consequently, to the failure to use the benefits of digitalization in organizing and conducting business processes.

Data on the Digital Adoption Index (DAI) for the Russian Federation are presented in Figure 5.

Figure 5: Digital Adoption Index



Source: Developed by the authors based on The World Bank (2016).

The data presented above give evidence that the scores of DAI's sub-indexes for Russia differ significantly. DAI's overall value of 0.74 is coherent with estimates for internet access and displays the real level of ICT penetration and use. By way of contrast, the values of both the US and Israel equal 0.75, while the leader in this ranking is represented by Singapore with a score of 0.87 (The World Bank, 2016). A more detailed examination of DAI's components explicates that the scores of DAI Business (0.71) and DAI Population sub-indexes (0.69) lag behind the values of that characterizing the digitalization of government (0.82). In the meantime, the estimates of leading countries for these sub-indexes are 0.97 for DAI Business, 0.91 for DAI Population, and 0.98 for DAI Government. This situation intimates challenges associated not only with the introduction of ICT but also with the willingness of people to change the mechanisms of doing business and the essence of the work performed. Their sharpening may negate all digitalization efforts and throw obstacles in achieving the expected effect.

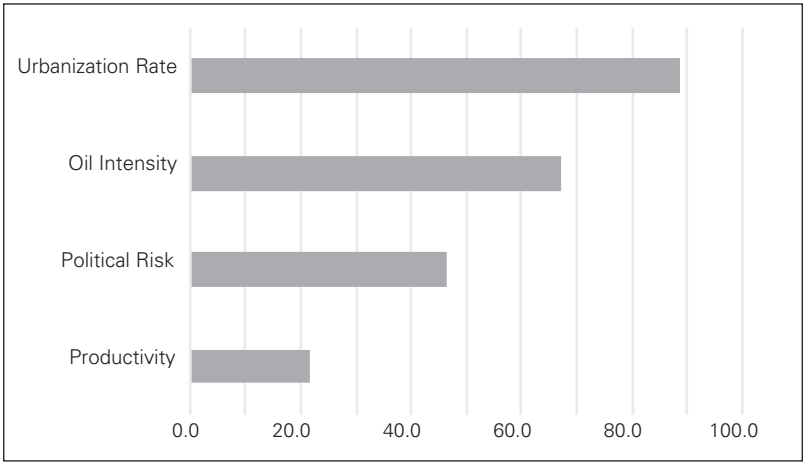
Russia's score in FM Global Resilience Index (GRI) equals 57.2, which corresponds to the 53rd rank. It should be borne in mind that the overall GRI score is an integral characteristic that determines the country's position in the ranking and averages the factors affecting resilience. The GRI combines 12 main resilience drivers, classified as related to economic factors, risk quality factors, and supply chain factors. The fourth parameter, country score, characterizes Russia's overall state of affairs in the context of resilience. Figure 6 below depicts how the estimates differ by factors considered.

Figure 6: Resilience Index

Source: Developed by the authors based on FM Global (2020).

Given that two core resilience factors (economic and supply chain) were scored 43.7 and 46.0 out of 100 possible, one can assert that the economic situation in Russia is relatively weak. The economic factor assessment relies on four elements: productivity, political risk, oil intensity, and urbanization rate. As can be seen in Figure 7, the estimates of productivity and political risks are at the level of 21.6 and 46.5, respectively, which determines the overall low rating.

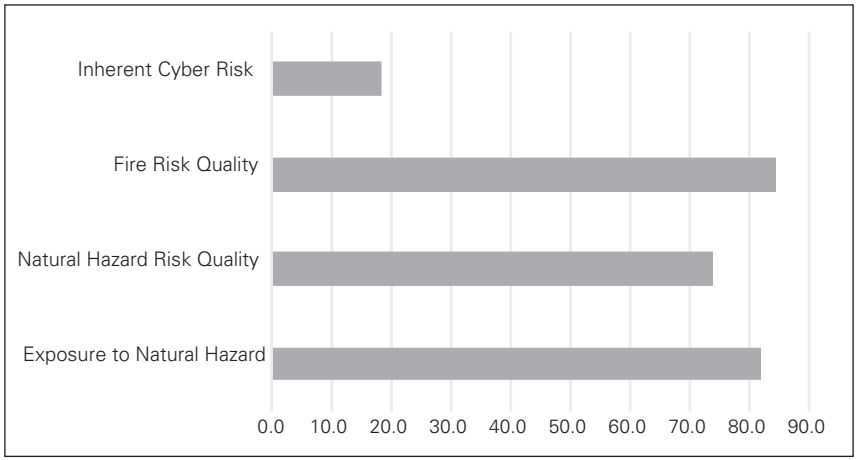
Figure 7: Economic Factor Scores



Source: Developed by the authors based on FM Global (2020).

Figure 8 explicates the scores assigned to the components of the GRI's risk quality factor for Russia.

Figure 8: Risk Quality Factor Scores

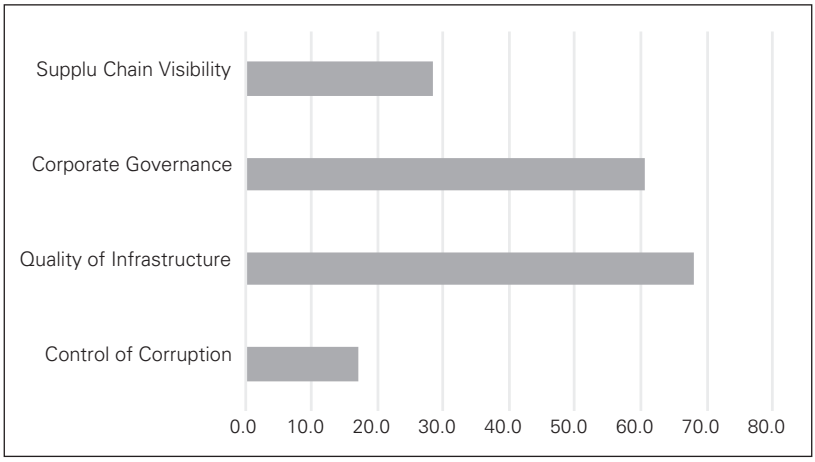


Source: Developed by the authors based on FM Global (2020).

It should be noted that there is a generally favorable situation in this area, with the only exception for the score of the cyber risk component (18.5). It reflects both vulnerabilities to cyberattacks and the country's ability to recover and is related to the share of the population with internet access. For the most part, Russia is characterized by fairly high scores in terms of natural hazard risk quality and fire risk quality, which results in a relatively high estimate of the overall risk factor.

Under the methodology of FM Global, the supply chain factor evaluation presumes the assessment of the following areas: control of corruption, quality of infrastructure, corporate governance, and supply chain visibility (FM Global 2020). Figure 9 exhibits their estimates for Russia.

Figure 9. Supply Chain Factor Scores



Source: Developed by the authors based on FM Global (2020).

Russia shows satisfactory ratings for the quality of infrastructure but is assessed comparatively low in supply chain visibility and corruption control. Provided that these low estimates reflect high uncertainty in decision-making in the given macroenvironment, management risks increase, leading to a drop in trust at the global level and hindering economic efficiency growth.

Thus, a rather low GRI rank is determined by low productivity, political risks, ineffective anti-corruption legislation, and the presence of cyber risks. The analysis of GRI components enables the conclusion that the current macroenvironment is marked with uncertainty in decision-making. This reduces business confidence and slows down the pace of integration into the global economic space, which in the modern world is inherently associated with the digital transformation of the economy. A comprehensive analysis based on a three-pronged model showed that, despite the growth of the economy and the development of ICT infrastructure, the state of the macroenvironment and the readiness of the population for digital transformation do not allow progressive digital technologies to impact the economic growth rate in a meaningful way.

DISCUSSION

In the modern sense, digitalization of the economy is a shift from the Third Industrial Revolution to the Fourth. Digitalization itself is manifested as not just using a computer in everyday life or simple automation of routine functions. It is a new form of doing business. Development of the ICT infrastructure, increasing access to the internet, and raising the level of education are prerequisites for the transition to a new level of doing business and transforming the economy, which together leads to economic growth (Bukht and Heeks 2017; Heimerl and Raza 2018; Hajiyev 2019).

As indicated in the World Bank's World Development Report, despite progress in digitalization, market mechanisms, and competition, new skills needed by the population and businesses to be involved in the digital economy are insufficient to keep pace with the ongoing changes. In such cases, the impact of digital transformation on economic growth can be completely leveled. The Report notes that despite the widespread diffusion of technologies worldwide, there is a considerable imbalance when evaluating the results from the introduction of these technologies associated with the ability of different countries to participate in the global economy and the quality of work in labor markets. The obtained inferences on the importance of taking into account the possibilities of access to ICT together with the state and readiness of the business environment to adopt a new paradigm are fully consistent with the conclusions of the Report (The World Bank 2016) and the judgments of Beier et al. (2017).

The fundamental transformation characteristic of the current industrial production not only affects resource use efficiency. The academic community agrees that it is accompanied by social transformations, which include the readiness of business

and the population to benefit from digitalization and the use of ICT (Beier et al. 2017; Sidorenko 2019).

The research outcomes confirmed that digitalization alone is not enough for economic growth. Digitalization processes give rise to opening borders, facilitate the spread of business transparency and publicity principles, and contribute to the ability to resist cyber threats. An influential factor affecting the efficiency of digitalization processes is the willingness of businesses and the population to accept new technologies. However, the analysis of indicators of Telefonica's Index on Digital Life showed that Russia lags in this domain. As a result, favorable conditions for digital transformation are not fully realized due to the population's ill-preparedness to utilize ICT, which is exacerbated by low estimates of indicators related to the macroenvironment (Parviainen et al. 2017; Khabrieva and Chernogor 2018; Watanabe et al. 2018).

In such a manner, the conducted analysis demonstrates that the examination of various aspects of digital transformation remains relevant, and many authors emphasize the importance of studying them in the context of evaluating economic growth. The approach proposed in this paper makes it possible to assess the relationship among the ICT implementation, economic growth, and macroenvironment stability based on a three-pronged model of indicators that includes data on GDP (Mićić 2017; Toader et al. 2018). A review of previous works on the topic evidence that the results obtained align with the findings of a number of other researchers. This fact gives reason to consider the system used as a basic one in an in-depth investigation of the state and prospects of transformational processes of digitalization and their impact on economic growth (Bogoviz et al. 2017; Mićić 2017; Raeskyesa and Lukas 2019). It should also be noted that the approach put forward take no account of the country's choice and can be applied to analyze digitalization in the regional context. The only limitation is the availability of datasets to determine the selected indicators.

CONCLUSIONS

Digital transformation has already touched almost all states of the world and now is only pushing the pace. ICT technologies are much more widespread these days than they used to be. As of the year 2020, the number of people with access to mobile phones exceeds that with an electricity connection in their homes. This fact brings along the exponential growth of global data production. Nations that have reached advanced digitalization levels – the massive adoption of connected digital technologies and applications by consumers, businesses, and governments – have reaped significant benefits for their economies, societies, and public sectors. In many countries, the use of ICT has encouraged the rise of economic growth rates, improved the quality of services provided, and expanded opportunities for entrepreneurs and consumers. However, in order to get the most out of digitalization, the world needs stronger regulations ensuring competition between enterprises and

the skills of workers adapted to the demands of the modern economy. A positive effect from digitalization can only be achieved when reaching a full-fledged interaction between technology and other economic development components. If cutting-edge solutions are used to automate tasks, but the development of other aspects is not ensured, economic growth through digitalization becomes almost impossible. An additional barrier for this can be represented by the unfavorable business environment, which, as a rule, slow the pace of digital adoption.

The findings of this research imply that the impact of digitalization on economic growth is possible only if the economic environment is ready to accept such a transformation (this can be evaluated using the Resilience Index and its components). An important role is also played by the willingness of businesses and the population to accept advanced digital technologies. Consequently, in order to develop an effective digitalization strategy in a country, its leadership should take into account three aspects: the rate of economic growth, the state of digital life, and the resilience of the environment. Indicators proposed in this study allow for a qualitative analysis of digital transformation processes and their impact on economic growth. Major study limitations are represented by the set of indicators and the market specifics of the Russian Federation. Further research on the matter will seek to provide a comprehensive quantitative substantiation of the relationship between digitalization and the pace of economic development.

REFERENCES

Bahrini, Raéf, and Alaa A. Qaffas (2019) "Impact of information and communication technology on economic growth: Evidence from developing countries", *Economies* 7(1): 21.

Beier, Grischa, Silke Niehoff, Tilla Ziems, and Bing Xue (2017) "Sustainability aspects of a digitalized industry – A comparative study from China and Germany", *International Journal of Precision Engineering and Manufacturing – Green Technology,* 4(2): 227–234.

Bogoviz, Aleksei V., Svetlana V. Lobova, Alexander N. Alekseev, Inga A. Koryagina, and Tatiana V. Aleksashina (2017) "Digitization and internetization of the Russian economy: achievements and failures", in: *International conference on Humans as an Object of Study by Modern Science*, Springer, Cham, pp. 609-616.

Bongomin, George Okello Candiya, Pierre Yourougou, and John C. Munene (2019) "Digital financial innovations in the twenty-first century", *Journal of Economic and Administrative Sciences,* 36(3): 185–203.

Bukht, Rumana, and Richard Heeks (2017) "Defining, conceptualising and measuring the digital economy", *Development Informatics working paper,* 68: 1-7.

Castellacci, Fulvio, and Vegard Tveito (2018) "Internet use and well-being: A survey and a theoretical framework", *Research policy,* 47(1): 308-325.

Danilin, Ivan (2019) "Development of the Digital Economy in the USA and China: Factors and Trends", *Outlines of Global Transformations: Politics, Economics, Law*, 12(6): 246-267.

Erumban, Abdul A., and Deb Kusum Das (2020) "ICT Investment and Economic Growth in India: An Industry Perspective", in: D. Maiti, F. Castellacci, A. Melchior (Eds.), *Digitalisation and Development,* Springer, Singapore, pp. 89-117.

FM Global (2020) *2020 FM Global Resilience Index*, https://www.fmglobal.com/research-and-resources/tools-and-resources/resilienceindex

Gadzhiev, Hanlar (2019) "Privacy protection in the Digital Age", *Journal of Foreign Legislation and Comparative Law*, 6: 5–20.

GEDI (2016) *Telefonica's Index on Digital Life*, http://thegedi.org/telefonica-index-on-digital-lifedl/

Habibi, Fateh, and Mohamad Amjad Zabardast (2020) "Digitalization, education and economic growth: A comparative analysis of Middle East and OECD countries", *Technology in Society,* 63: 101370.

Heimerl, Veronika, and Werner Raza (2018) *Digitalization and Development Cooperation: an assessment of the debate and its implications for policy (No. 19),* Briefing Paper, Austrian Foundation for Development Research (ÖFSE).

Kasimova, Taisa, Sabina Magomedova, and Zaur Ismikhanov (2020) "Econometric Models for Russia's GDP Analysis and Forecasting in the Industrial Section of the Economy in Conditions of Its Digital Transformation", *Journal of the Knowledge Economy,* 1: 1-23.

Khabrieva, Taliya Ya., and Nikolay N. Chernogor (2018) "Law in digital reality", *Journal of Russian Law*, 1: 85–102.

Maiti, Dibyendu, Fulvio Castellacci, and Arne Melchior (2019) "Digitalisation and Development: Issues for India and Beyond", in: *Digitalisation and Development,* Springer, Singapore, pp. 3-29

Maiti, Moinak, and Parthajit Kayal (2017) "Digitization: Its impact on economic development & trade", *Asian Economic and Financial Review,* 7(6): 541-549.

Marinković, Sanja, Ilija Nikolić, and Jovana Rakićević (2018) "Selecting location for a new business unit in ICT industry", *Zbornik Radova Ekonomskog Fakultet Au Rijeci,* 36(2): 801–825.

Maurseth, Per Botolf (2020) "ICT, Growth and Happiness", in: D. Maiti, F. Castellacci, A. Melchior (Eds.), Digitalisation and Development, Springer, Singapore, pp. 31-86.

Mićić, Ljubiša (2017) "Digital Transformation and its Influence on GDP", *Economics*, 5(2): 135-147.

Myovella, Godwin, Mehmet Karacuka, and Justus Haucap (2020) "Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies", *Telecommunications Policy*, 44(2): 101856.

Parida, Vinit, David Sjödin, and Wiebke Reim (2019) "Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises", *Sustainability,* 11(2): 391.

Parviainen, Paivi, Maarit Tihinen, Jukka Kääriäinen, and Susanna Teppola (2017) "Tackling the digitalization challenge: How to benefit from digitalization in practice", *International Journal of Information Systems and Project Management,* 5(1): 63–77.

Pradhan, Rura P., Mak B. Arvin, Mahendhiran Nair, Sara E. Bennett, and Sahar Bahmani (2019) "Short-term and long-term dynamics of venture capital and economic growth in a digital economy: a study of European countries", *Technology in Society*, 57: 125-134.

Raeskyesa, Dewa Gede Sidan, and Erica Novianti Lukas (2019) "Does Digitalization Increase Economic Growth? Evidence from ASEAN8 Countries", *Jurnal Ekonomi Indonesia,* 8(2): 267-278.

Rath, Badri Narayan, and Danny Hermawan (2019) "Do information and communication technologies foster economic growth in Indonesia?" *Buletin Ekonomi Moneter dan Perbankan,* 22(1): 103-122.

Rojko, Andreja (2017) "Industry 4.0 concept: Background and overview", *International Journal of Interactive Mobile Technologies,* 11(5): 77-90.

Sidorenko, Andrey I. (2019) "Judicial Protection of Intellectual Rights in the Digital Age", *Journal of Russian Law*, 8: 136-147.

The World Bank (2016) *Digital Adoption Index*, https://www.worldbank.org/en/publication/wdr2016/Digital-Adoption-Index

The World Bank (2018) *Economy & Growth,* https://data.worldbank.org/topic/economy-and-growth?view=chart

Toader, Elena, Bogdan Narcis Firtescu, Angela Roman, and Sorin Gabriel Anton (2018) "Impact of information and communication technology infrastructure on economic growth: An empirical assessment for the EU countries", *Sustainability*, 10(10): 3750.

Van Ark, Bart (2016) "The productivity paradox of the new digital economy", *International Productivity Monitor,* 31: 3.
Vijayan, Aiswarya (2019) "Digital India – A roadmap to sustainability", *International Journal of Innovative Technology and Exploring Engineering,* 8(5): 571–576.
Watanabe, Chihiro, Kuniko Moriya, Yuji Tou, and Pekka Neittaanmäki (2018) "Consequences of the digital economy: transformation of the growth concept", *International Journal of Managing Information Technology,* 10(2): 21-39.
World Economic Forum (2018) *The Global Competitiveness Report 2018*, http://reports.weforum.org/global-competitiveness-report-2018/
Yao, Qiao (2019) "China's E-Economy: An overview of Opportunities and Threats", *Journal of Asian Development,* 5(2): 74.