

## PEDTR 2019

### 18<sup>th</sup> International Scientific Conference “Problems of Enterprise Development: Theory and Practice”

## DIGITALIZATION OF THE NATIONAL ECONOMY AND THE EMPLOYMENT LEVEL: PROBLEMS AND RISKS

M. A. Gundorova (a), N. V. Kapustina (b), S. A. Grachev (c)\*

\*Corresponding author

(a) Vladimir State University named after Alexander Grigorievich and Nikolai Grigorievich Stoletovs, 600000,  
Gorky Str., 87, Vladimir, Russia, mg82.82@mail.ru

(b) Russian University of Transport (MIIT), 127994, Obraztsova Str., 9, Moscow, Russia, kuzminova\_n@mail.ru

(c) Vladimir State University named after Alexander Grigorievich and Nikolai Grigorievich Stoletovs, 600000,  
Gorky Str., 87, Vladimir, Russia, grachev-sa@yandex.ru

### *Abstract*

Digitalization of the world economic system affects all spheres of our society, including labor, in terms of maintaining a certain employment level and reducing the unemployment risk. The article is aimed at analyzing existing experience on these issues. The hypothesis was that there is a relation between the employment level of the population and the ongoing processes of the mass application of digital and network technologies. One of the research tasks is modeling the digitalization degree of the national economy depending on the employment level on the example of the Russian economy (2013-2017). The authors used economic and mathematical methods, regression analysis. The digital development index was formed on the basis of objective statistical data. There is a relation between the formed indicator and the employment level of the population. The constructed regression model is acceptable in terms of accuracy. The relation between the use of digital and network technologies and the qualification level of employees was not considered in this model because of the lack of statistical data in the context of economic activities. The further research is seen in the formation of a universal methodological approach that would allow an inter-regional comparison of ongoing processes. It is also necessary to take into account and describe in detail specific features of the national economy in terms of the employment and unemployment structure, depending on functioning of digital technologies in various areas. The results of this study could be of interest to public authorities, representatives of the real economy sector.

2357-1330 © 2020 Published by European Publisher.

**Keywords:** Digitalization, employment rate, model, regression analysis, risk.



This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 Unported License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## 1. Introduction

Nowadays, the objective fact is the process of global transformation of the economic system. Changes occur as a result of the mass application of network and digital technologies in all spheres of the national economy, as well as the whole society. Social development tools in these conditions are intelligent systems based on the use of cloud computing and data storage, online communication systems and social networks (D'Asaro, Di Gangi, Perticone, & Tabacchi, 2017).

According to Schwab (2017), the world is on the threshold of the fourth industrial revolution, which will fundamentally change our life, work and the process of communication. And these are digital technologies that play a key role, providing people with a possibility to meet people's needs at a completely different level. The spread of digital technologies increases the labor mobility, making it easier for human resources to move within and between countries (Baldwin, 2016). Complex tasks that were previously considered to require unique professional skills can increasingly be replaced by network and digital technologies (McAfee & Brynjolfsson, 2017).

The competition is based on high-tech sectors that attract significant resources for their own development. Corresponding changes are also taking place in the associated sectors, as well as in their resource provision. An important factor in this process is human resources, since the use of digital technologies also causes certain changes in the social environment (Popov & Semyachkov, 2019). Thus, there may be risks of unemployment in the formation of new economic areas and the death of "outdated" industries and professions. Similar experience is described in a number of scientific works on the US economy. For a long time, jobs that were cut in agriculture and industry flowed into service professions, as it can be seen from statistics of this country (Lysy, 2017) and the International labor organization (The World Bank, 2019).

Several approaches have developed in the research on the relation between digitalization and employment. Works aimed at creating new jobs and working places are usually positive, since they are based on the idea of the multiplicative growth based on the creation and development of high-tech industries (Moretti & Thulin, 2013). However, other authors suggest that this process has a negative impact on the level and quality of life of the population. In particular, without denying the process of creating new jobs and working places, it is pointed out that wages are relatively low and, consequently, the standard of life is declining (Florida, 2018). It is obvious that the issue of differentiation in wages and quality of life is closely related to the level of qualification of employees. It is widely believed that technological changes can lead to an increase in short-term unemployment, but their impact on long-term unemployment remains highly controversial (Garcia-Murillo, MacInnes, & Bauer, 2018).

For Russia, these issues are quite relevant in view of the prevalence of extractive, rather than high-tech, sectors in the national economy. The digitalization of the economy is associated with the employment growth of highly skilled labor. At the same time, human resources with low and medium qualifications tend to decrease or stagnate in their employment. This issue is a key one in a number of papers by foreign scientists who have studied national (for example, the experience of the UK (Lee & Clarke, 2019) and Germany (Arntz, Gregory, & Zierahn, 2018) and industrial (Balsmeier & Woerter, 2019) features of this process. Thus, the impact of digitalization processes on the global employment is an objective fact that has both positive and negative aspects.

## **2. Problem Statement**

The working hypothesis that led to this study is the assumption that there is a relation between the unemployment rate and the processes of the mass application and use of network and digital technologies at the level of the Russian economy. This assumption is made based on the analysis of works of domestic and foreign scientists. This relation is supposed to be diagnosed and described by applying mathematical statistics methods.

## **3. Research Questions**

In this research, the authors have formulated the following tasks:

- To form a comprehensive indicator of the development of the digital economy for the period 2013-2017 (this period was selected due to the availability and sufficiency of statistical data);
- To evaluate and analyze a relation between the development of the digital economy and the employment in the Russian Federation;
- To simulate the development of digitalization processes depending on the employment level.

## **4. Purpose of the Study**

In view of the relevance of this issue for the national economy, the authors set a task of building a model reflecting the interdependence of the employment level and the digitalization level. In the context of digitalization, qualitative forecasting of the main indicators for the long term can be the key to successfully overcoming the accumulated backlog and ensuring the economic growth (Greenberg, 2017).

## **5. Research Methods**

Before revealing the essence of the proposed methodology, it should be noted that a fairly limited number of works are devoted to assessing the potential of the economy digitalization, but their development does not always give a completely objective result. In practice, the use of existing methods for evaluating digitalization is largely difficult, since they do not provide a complete picture because of the current acute shortage of statistical data and specific features of calculating certain indicators by statistical agencies.

In this regard, the authors are more interested in circumstances caused by the development of the national economy in the context of digitalization in general. For this purpose, economic, mathematical methods and regression analysis were used. To build a model that reflects existing relations between the digitalization processes in the economy and the employment of human resources, a number of indicators were analyzed. The analysis was based on indicators identified at the national level. The initial data is presented in Table 01.

Based on the data in Table 01, an updated list of indicators was formed for the determination of the aggregate index for the digitalization development of the national economy (hereinafter the index). Clarification was made based on the evaluation of the strength of a relation between the indicators and the resulting value. The latter was the employment level of the population. Interpretation of the obtained coefficients (Table 02) allowed forming the following list: X2, X3, X4. The strength of the relation for

these indicators can be described as high. The indicator X1 was excluded because of the lack of a relation to the resulting value (correlation coefficient 0.04).

**Table 01.** Initial data for analyzing the relation between the economy digitalization and the state of human resources

		2013	2014	2015	2016	2017
<b>Digitalization of business sector organizations</b>						
X1	Broadband Internet, %	80,8	81,4	78,9	80,5	81,6
X2	Web-sites, %	40,5	39,8	41,4	43,4	44
X3	Cloud services, %	11	13,8	15,3	17,3	19,2
X4	ERP-systems, %	12,6	15,7	18,4	20,5	22,6
<b>Indicators of the state of human resources</b>						
X5	The employment-of the population, ratio	0,648	0,653	0,653	0,657	0,655

Source: authors based on (Abdrakhmanova et al., 2019).

**Table 02.** Correlation coefficients

	X5
X1	0,04
X2	0,71
X3	0,88
X4	0,88

Source: authors.

The formation of the digitalization development index of the national economy was carried out in two stages. At the first stage, the indicators (X2-X4) were converted to dimensionless coefficients. Since the measurement units of the initial values are percentages, this procedure was performed by dividing their value by 100. The second stage was the formation of a single indicator based on the results of the previous step by applying the geometric mean formula in compliance with the condition of values' equivalence. The value of the digitalization index of the national economy obtained in this way is shown in Table 03.

**Table 03.** Index of digitalization of the national economy

	X2	X3	X4	Index (I)
2013	0,4050	0,1100	0,1260	0,0749
2014	0,3980	0,1380	0,1570	0,0929
2015	0,4140	0,1530	0,1840	0,1080
2016	0,4340	0,1730	0,2050	0,1241

Source: authors.

According to the Table 03, we can speak about the continuous growth of the index and its components. It should also be noted that the generated indicator is quite closely correlated with the employment parameter. The coupling strength of these values is high (with a correlation coefficient of 0.86). These facts allow us to model the relation between the employment level (X5) and the level of the economy digitalization. To perform this operation, the authors applied the regression analysis and the results are shown below:

$$I=-4,12612+6,4815*X5.$$

The parameters of the specified model can be considered as satisfactory ( $R^2= 0.75$ , with  $p=0.049$ ). The value of the F-criterion is 0.005. Since the result obtained is less than 5%, we can conclude that the regression model is significant. It should be noted that the construction of this model proves the existence of an objective relation between the economy digitalization processes and the employment formation of the population.

## 6. Findings

Summing up the analysis, it should be noted that the objectively existing relation between the processes of digitalization of the national economy and the formation of the employment level was described using regression analysis methods with an acceptable level of accuracy. The above-mentioned relation between the use of digital and network technologies and the qualification level of employees was not considered in this model because of the lack of statistical data in the context of economic activities.

## 7. Conclusion

We also emphasize that the results obtained diagnose general processes occurring at the national level. At the same time, it is difficult to identify and analyze specific features of this dynamics at the industrial or regional level. However, it should be noted that the development of territories digitalization occurs to a certain extent spontaneously, because strategies of their socio-economic development in most cases do not mean a widespread application of the digitalization advantages, and the use of information and communication technologies occurs within the general development direction realized by the state.

The further development of this research area is seen in the formation of a universal methodological approach that would allow for inter-regional comparison of ongoing processes. It is also necessary to take into account and describe in detail specific features of the Russian economy in terms of the employment structure and the unemployment risk, depending on the development and functioning of digital technologies in various areas. The results of this study can be interesting for both public authorities and representatives of the real economy sector.

## References

- Abdrakhmanova, G. I., Vishnevsky, K. O., Gokhberg, L. M., Demyanova, A. V., Keves, M. A., Kovaleva, G. G., ... & Fursov, K. S. (2019). *Indicators of the digital economy: 2019: Statistical collection*. Moscow: HSE. [in Rus.].
- Arntz, M., Gregory, T., & Zierahn, U. (2018). *Digitalisierung und die Zukunft der Arbeit: Makroökonomische Auswirkungen auf Beschäftigung, Arbeitslosigkeit und Löhne von morgen*. Mannheim: Bundesministerium für Forschung und Entwicklung (BMBF). [in German].
- Baldwin, R. (2016). *The great convergence: Information technology and the new globalization*. Cambridge, M.A.: The Belknap Press of Harvard University Press.
- Balsmeier, B., & Woerter, M. (2019). Is this time different? How digitalization influences job creation and destruction. *Research Policy*, 48(8), 103765. DOI: 10.1016/j.respol.2019.03.010
- D'Asaro, F. A., Di Gangi, M. A., Perticone, V., & Tabacchi, M. E. (2017). Computational intelligence and citizen communication in the smart city. *Informatik-Spektrum*, 40(1), 25-34. DOI: 10.1007/s00287-016-1007-0

- Florida, R. (2018). *The new urban crisis: Gentrification, housing bubbles, growing inequality, and what we can do about it*. New York, N.Y.: Basic Books.
- Garcia-Murillo, M., MacInnes, I., & Bauer, J. M. (2018). Techno-unemployment: A framework for assessing the effects of information and communication technologies on work. *Telematics and Informatics*, 35(7), 1863-1876. DOI: 10.1016/j.tele.2018.05.013
- Greenberg, R. S. (2017). Results of 25-year transformation of the Russian economy and the formation of a new economic model. *Bulletin of the Institute of Economics of the Russian Academy of Sciences*, 6, 7-12.
- Lee, N., & Clarke, S. (2019). Do low-skilled workers gain from high-tech employment growth? High-technology multipliers, employment and wages in Britain. *Research Policy*, 48(9), 103803. DOI: 10.1016/j.respol.2019.05.012
- Lysy, F. (2017). *Long-term structural change in the US economy: Manufacturing is simply following the path of agriculture*. Retrieved from <https://aneconomicssense.org/2017/03/19/long-term-structural-change-in-the-us-economy-manufacturing-is-simply-following-the-path-of-agriculture/> Accessed: 13.11.2019.
- McAfee, A., & Brynjolfsson, E. (2017). *Machine, platform, crowd: Harnessing our digital future*. New York, N.Y.: W.W. Norton & Company.
- Moretti, E., & Thulin, P. (2013). Local multipliers and human capital in the United States and Sweden. *Industrial and Corporate Change*, 22(1), 339-362. DOI: 10.1093/icc/dts051
- Popov, E. V., & Semyachkov, K. A. (2019). Optimization of the urban environment digitalization processes. *Problems of Territory's Development*, 5(103), 53-63. DOI: 10.15838/ptd.2019.5.103.3
- Schwab, K. (2017). *The fourth industrial revolution*. New York, N.Y.: Crown Business.
- The World Bank (2019). *Employment in Industry (% of total employment)*. Retrieved from <https://data.worldbank.org/indicator/SL.IND.EMPL.ZS> Accessed: 13.11.2019.