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Regional Economic Security in Innovative Digital Environment of Russia

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Abstract

In the progressing socio-economic development, digitalization has become of special significance in the economy. The risks and threats are inherent in the introduction of innovative technologies that impact digitalization on economic security. Based on Russian regions statistics 2014-2020, we made a correlation analysis, to prove the development of digital technologies that determines the dynamics of the economic security level. The assumption is that the digital economy development causes higher economic security levels in regions. The research conjoint assumption is that the digital economy development preconditions the economic development in the regions. We found a direct relationship between gross regional product (GRP) per capita and the dynamics of costs for information and communication technologies, investments in fixed assets to purchase information technology, computer, and telecommunication facilities, a number of Internet organization users, share of people who use the Internet to order goods, works, and/or services. In most cases, the correlation coefficients are higher than 0.9 indicating very high direct relationships. We differentiated the digitalization factors influencing economic security levels. This study finds a direct positive relationship between the dynamics of costs for information and communication technologies and GRP. There is an inverse relationship between the index of readiness of regions for the information society. The higher values of the index cause higher levels of economic security give correlation coefficient values close to 1 indicating a strong relationship.

Disciplinary: Digital Economy, Sustainable Development, Innovation Management.

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1 Introduction

The digital economy is becoming a driver in social development. It is a new direction in science. Hence, it is taking new, previously unknown threats and risks. The COVID-19 pandemic highlighted a need for accelerated development in the digital economy. It conditioned the importance of developments in the field of decision-making technologies, management, and operations based on advanced digital solutions.

This led to the contradiction between traditional economic activities and the new processes available in society. The contradiction covers various velocities in economic activities and, accordingly, various business tools. The usages of digital technologies, mobile communications, and the Internet have changed the nature of the impact that the driving forces in social development make on economic security (Chernova *et al.*, 2019; Dulatova, 2020; Sai Ram & Surya Samantha, 2019; Toomsalu *et al.*, 2019). At the present stage of social development, it is the methods and tools of the digital economy that make it possible for business entities to respond most quickly and efficiently to emerging internal and external threats (Alam et al., 2018; Razvan, 2020). New knowledge-based technological development is the main driver for higher levels of economic security (Mahmoudi *et al.*, 2019).

The digital economy has significantly changed the lifestyle of particular agents and numerous aspects of social life. At the same time, it has had an essential impact on economic growth and sustainable development (Kolodko, 2020; Na *et al.*, 2020). The differentiation between socio-economic development indicators highlights the regional aspect. And an important matter here is understanding the nature of the impact that digital technologies make on regional economic security. To achieve the mentioned goal, we stated the following objectives: explore the techniques that are available for evaluation of the economic security level and the techniques that are available for evaluation of the digital economy development level; analyse the impact of the digital economy on the economic security. The regions in Central Russia are a bright example for empirical testing. We can describe their differentiation issue as highly variable (Ivankova, 2011), which will make it possible to verify the assumptions that we put forward for the research.

2 Literature Review

Numerous researchers confirmed the research relevance of the processes that cause better economic security. In most papers, economic security refers to the condition when the interests of economic entities are secured from internal and external threats at various management levels (Orlinskaya, & Kostjukov, 2016). Providing higher levels of economic security both at the macro level, and a level of each enterprise is a necessary condition for the sustainable and innovative development in socio-economic systems (Gureeva & Larionov, 2019; Kruglova, 2019; Ghobakhloo & Fathi, 2020; Häckel *et al.*, 2019; Kuzmin *et al.*, 2019; Kuzmin *et al.*, 2020).

Some researchers believe that it is the influence of the digital economy that determines higher levels of economic security. In the active development of the digital economy, it is possible to replace traditional socio-cultural and economic values with instinctive ones that precondition

the relevance of this discussion regarding the impact of the digital economy on economic security at all management levels (Fomicheva *et al.*, 2019).

Discussing the digital economy development, Ahmed (2019) believes that the international policy based on cooperation in the field of digital economy administration might provide for the development of such fundamental national interests, as consistency, confidentiality, and economic security. Imamov (2018) shows that today's information technologies are one of the most efficient channels for the complex impact made by globalization. Therefore, the study of economic security in the digital environment is urgent (Popova *et al.*, 2019; Limba *et al.*, 2019).

There are many techniques to evaluate the digital economy development. OECD proposed a system of indicators to evaluate digital economy levels (Tsvetkov, 2016). Table 1 explains various indices of the digital economy development of many works, as well as the advantages and disadvantages of the techniques.

Table 1: Comparative analysis of the evaluation techniques for the digital economy development

Main features	Advantages	Disadvantages
OECD technique (Tsvetkov, 2016)		
Criterion-related to the employment sector		
Replacement of manual labour with informational labour	Higher numbers of employees in the service industry	Difficulties in the evaluation of data about the employed
Spatial criterion		
High attention is paid to the data transfer networks that link various locations	They are geographically based	The technological aspect is only considered instead of quantity, quality of transmitted data, etc.
Economic criterion		
Growth in the economic value in: creation, transfer, processing, and storage of data	Data are considered as an object in economic relations	Impacts of data on corporate activities are considered in a superficial manner
Technological criterion		
Increased volume of technology innovations is an impetus for restructuring in socio-economic relations	Development of such services, as e-mail	Technological aspects are mostly considered instead of data transmission quality
Information Society Readiness Index (Batov et al., 2013)		
It shows the extent and potential of the country's participation in the digital economy	It evaluates the development efficiency in the digital economy in a deep manner	Technological aspects are mostly considered instead of data transmission quality
E-commerce Readiness Index (Khisaeva, 2011)		
It involves five interrelated indicators	It shows countries' ability to participate in the digital economy	Technological aspects are mostly considered instead of data transmission quality
Society Informatization Index (Zavivaev et al., 2016; Arkhipova et al., 2018)		
It uses 22 indicators that enable citizens to exchange data internally and with the outside world	It makes it possible for citizens to have easier data exchange	Technological aspects are mostly considered instead of data transmission quality

In addition to the technological aspects considered in these techniques, we should add such aspects, as the education level of the population, computerization growth in the society, more user networks, as well as national mentality. Hence, for a correct and reliable evaluation of the digital economy development, the techniques need improvements. We need to involve the country-specific criteria (that mirror the development specifics).

The completed review of approaches to the influence of digital economy factors on economic security made it possible to conclude the following. First, many researchers believe that better economic security at all management levels is the main condition for sustainable development in

socio-economic relations. Second, the digital economy and modern technology are critical factors that influence economic security. Third, despite the other well-considered issues in the digital economy development, the researchers have not properly measured the digital technology influence on changes to the dynamics of the economic security levels in regions. To eliminate this drawback, we try to do an empirical investigation of the mentioned features with the correlation analysis toolkit. We intend to identify interconnections and the nature of the influence that various factors in the digital economy make on the dynamics of changes to the economic security level, which is a pressing academic objective.

3 Method

To measure the economic security level, we involved the indicative method for assessments of the economic security (Tatarkin *et al.*, 2003). We measured manifestation levels of threats to the economic security by comparing current (actual) values of indicative indicators (indicators) with their threshold (critical) values. We form indicators of the economic security for various spheres of life (spheres of economic security). For each region, we might distinguish 13 such spheres, which, grouped into three large blocks, are shown in Table 2. We measure economic security levels by estimated indicators for each of the abovementioned 13 spheres.

Table 2: Areas of the economic security in terms of the indicative approach to the evaluation (Tatarkin et al., 2003)

1. Economy's capacity for sustainable growth	1.1. Investment security. The capacity of the local economy for growth and expanded reproduction 1.2. Occupational safety. Evaluation of crises in terms of local production capacity 1.3. Academic and technical safety. Condition of the local scientific and technological potential and leading national schools of thoughts 1.4. Export security. Dependence of local economy on imports of the most important types of products and foods. 1.5. Financial security. Sustainability of a local financial system 1.6. Energy supply security. The ability of the fuel and energy sector to meet the needs of the economy in fuel and energy resources
2. Ensuring an acceptable standard of living	2.1. Standards of living. Available conditions for the normal vital function of the local population. 2.2. Labour market. The ability of local economy to provide sufficient jobs. 2.3. Demographic security. Resistance of the local population to depopulation. 2.4. Law and order. Criminalization level in the local society, economy, and finance. 2.5. Food security. Sufficient supply of national foods to the local population. 2.6. Infrastructure security. The balance between accompanying and support systems.
3. Environmental security	3.1. Local area capacity to maintain a balance between human beings and the nature

We measured the economic security, following the technique, in accordance with the following procedure:

- identify a row of research objects,
- make a set of indicative indicators for each research object,
- collect raw statistics,
- make threshold values for indicative indicators,
- calculate current values of indicative indicators,
- evaluate a condition of each indicator by comparing its current value with a threshold value (by normalized estimates),
- based on estimates, analyse the situation by areas of economic security,
- for the areas with high levels of the crisis, collect data for additional indicators for a deeper and more detailed analysis of threats to the economic security,

- develop program-targeted measures to neutralize threats to economic security.

To rate the economic security level, let us take the scoring-based approach (evenly uniform scale) (Table 3). The nature of the economic security situation might look like the following: normal condition, pre-crisis 1 (initial), pre-crisis 2 (developing), pre-crisis 3 (critical), crisis 1 (unstable), crisis 2 (threatening), and crisis 3 (emergent).

Table 3. Condition scale by indicative indicators of the economic security

Condition by indicative figure	Notation	Score
Normal	N	1
Pre-crisis 1	PC1	2
Pre-crisis 2	PC2	3
Pre-crisis 3	PC3	4
Crisis 1	C1	5
Crisis 2	C2	6
Crisis 3	C3	7

In the research, to measure the digital economy level in regions, we used the Information Society Readiness Index (Figure 1). It is calculated from the indicators that describe development factors in the information society (human assets, economic environment, and ICT infrastructure), as well as ICT usage. The index is calculated from aggregated values of indicators, making it possible to rate regions by specific areas and factors with varying levels of detail.

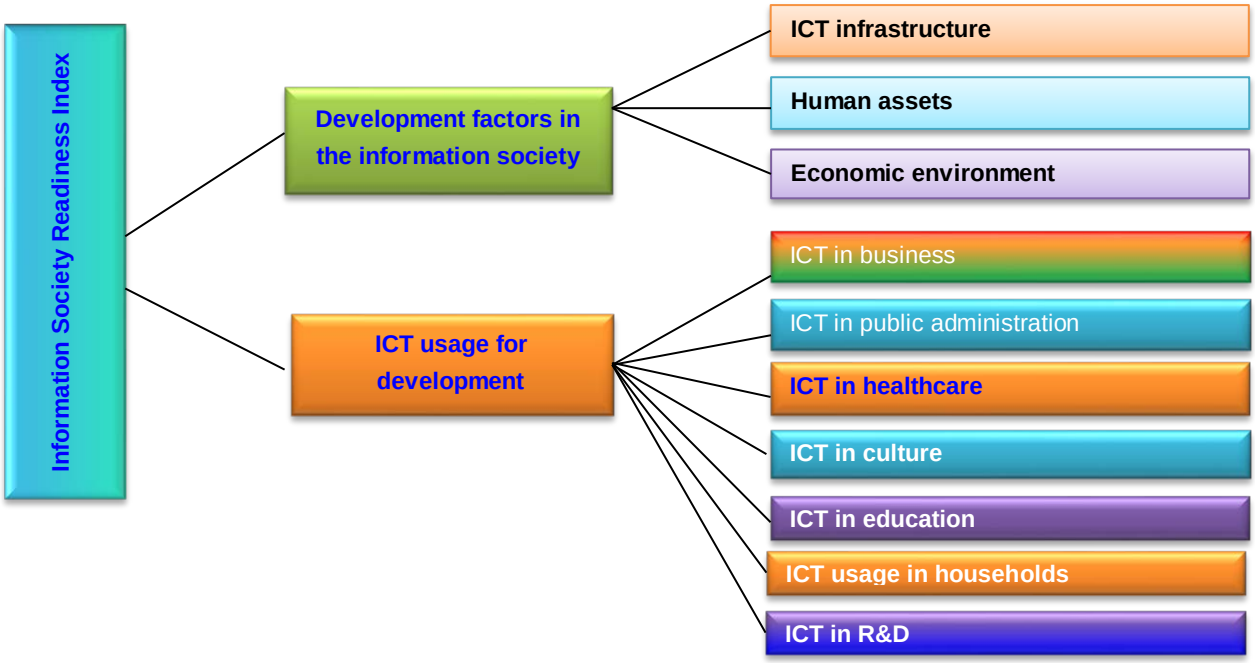

Figure 1: Structure of the Information Society Readiness Index

To calculate the Information Society Readiness Index, we normalized all the indicators (converted to non-dimensional values within 0-1). Normalized values of indicators are calculated from

$$Nx = Rx/Rn \quad (1),$$

where Rx is the value of an indicator for region x, Rn is the normalized reference value.

During the research, we used official statistics provided by Rosstat (Federal State Statistic Service), covered 2014-2018, making it possible to verify the author's assumptions in dynamics.

The main assumption in the first stage says that the digital economy development causes higher economic security levels in regions. The conjoint assumption of the research says that the digital economy development preconditions the economic development in regions. To verify the assumptions, we considered the following dependencies:

- more costs for information and computer technologies cause higher gross regional product (GRP) per capita,
- more investments in fixed assets to purchase information, computer, and telecommunication equipment cause higher GRP per capita,
- higher numbers of the organizations that use the Internet cause higher GRP per capita,
- a larger share of people in the population who use the Internet to buy goods, works, and (or) services, causes higher GRP per capita.

At the second stage of the research, we verified the assumption saying that higher values of the information society readiness index cause higher economic security levels in regions.

From the correlation analysis, we measured how strong the dependence between the parameters was and verified the assumptions. The correlation coefficient value mirrors the strength of the relationship between time series. To interpret the correlation analysis results, we used the Chaddock scale (Ishkhanyan, 2016).

4 Result and Discussion

Statistics show that funding for digital technology development mainly goes to the Central Federal District of Russia (76% of all-Russian costs), while in other federal districts, a volume of funding for digital technology is significantly smaller and less than 5% (Table 4). Thus, to analyse the impact of digital technologies on economic security, we need to consider the Central Federal District of Russia. This justifies the correct choice of the research object.

Table 4: Share of costs for the introduction of digital technologies by federal districts of Russia in 2019. (Rosstat(2021)-based calculations)

Federal district of Russia	Share of costs for digital technology, %
Russian Federation	100
Central Federal District	76
North-western Federal District	5
Southern Federal District	3
North Caucasian Federal District	1
Volga Federal District	4
Ural federal district	5
Siberian Federal District	4
Far Eastern Federal District	2

To proceed with the research, it is necessary to check the available influence of the digital economy on the economic development in regions in the Central Federal District of Russia. First, we explored the interrelation between such indicators, as costs for information and computer technologies and GRP per capita (Table 5). We might conclude that in all of the studied regions, there is a direct positive relationship between the dynamics of costs for information and communication technologies and GRP.

Table 5: Correlation for the group of indicators in regions of the Central Federal District of Russia

Region	Costs for ICT and GRP per capita		Investments in fixed capital (ICT) and GRP per capita	
	Correlation	Relationship	Correlation	Relationship
Belgorod Oblast	0.99	Very high direct	0.99	Very high direct
Bryansk Oblast	0.98	Very high direct	0.73	High direct
Vladimir Oblast	0.99	Very high direct	0.97	Very high direct
Voronezh Oblast	0.68	Non-negligible direct	0.96	Very high direct
Ivanovo Oblast	0.61	Non-negligible direct	0.76	High direct
Kaluga Oblast	0.99	Very high direct	0.98	Very high direct
Kostroma Oblast	0.62	Non-negligible direct	0.72	High direct
Kursk Oblast	0.79	High direct	0.87	Very high direct
Lipetsk Oblast	0.41	Moderate direct	0.73	High direct
Moscow Oblast	0.92	Very high direct	0.97	Very high direct
Oryol Oblast	0.55	Non-negligible direct	0.89	High direct
Ryazan Oblast	0.45	Moderate direct	0.95	Very high direct
Smolensk Oblast	0.88	Very high direct	0.97	Very high direct
Tambov Oblast	0.99	Very high direct	0.99	Very high direct
Tver Oblast	0.98	Very high direct	0.99	Very high direct
Tula Oblast	0.68	Non-negligible direct	0.82	High direct
Yaroslavl Oblast	0.94	Very high direct	0.95	Very high direct

Then we considered the relationship between investments in fixed assets (to purchase information, computer, and telecommunications equipment) and GRP per capita (Table 5). There is a high direct relationship between investments in fixed assets and GRP.

Table 6: Correlation for the group of indicators in regions in the Central Federal District of Russia

Region	Number of the organizations that use the Internet on GRP per capita		Share of people in the population who use the Internet to buy goods, works/services, on GRP per capita	
	Correlation	Relationship	Correlation	Relationship
Belgorod Oblast	0.79	High direct	0.97	Very high direct
Bryansk Oblast	0.95	Very high direct	0.99	Very high direct
Vladimir Oblast	0.99	Very high direct	0.92	Very high direct
Voronezh Oblast	0.99	Very high direct	0.99	Very high direct
Ivanovo Oblast	0.80	High direct	0.99	High direct
Kaluga Oblast	0.92	Very high direct	0.94	Very high direct
Kostroma Oblast	0.90	High direct	0.66	Non-negligible direct
Kursk Oblast	0.71	High direct	0.97	Very high direct
Lipetsk Oblast	0.95	Very high direct	0.99	Very high direct
Moscow Oblast	0.73	High direct	0.66	Non-negligible direct
Oryol Oblast	0.76	High direct	0.88	High direct
Ryazan Oblast	0.95	Very high direct	0.80	High direct
Smolensk Oblast	0.52	Non-negligible direct	0.99	Very high direct
Tambov Oblast	0.98	Very high direct	0.97	Very high direct
Tver Oblast	0.99	Very high direct	0.99	Very high direct
Tula Oblast	0.71	High direct	0.94	Very high direct
Yaroslavl Oblast	0.82	High direct	0.66	Non-negligible direct

The next stage assumes the measurement of the impact of such indicators, like many organizations that use the Internet, on GRP per capita, the share of people in the population who use the Internet to buy goods, works/services, on GRP per capita (Table 6). The analysis of the obtained correlation coefficients makes it possible to conclude that there is a direct relationship between these indicators.

Having considered the abovementioned results, we might conclude that digital economy indicators are closely related to GRP per capita. The assumption of the first stage of the study about the influence of the digital economy on regional economic development was confirmed (the average correlation for Costs for ICT and GRP per capita is 0.79; in terms of Investments in fixed

capital (ICT) and GRP per capita is 0.89; for the indicator Number of the organizations that use the Internet on GRP per capita is 0.85; according to the indicator Share of people in the population who use the Internet to buy goods, works/services, on GRP per capita is 0.90).

Thus, we verified the main assumption in the first stage of the research about the available influence of the digital economy on regional economic development. Hence, there are all grounds for the second stage of the research.

The assumption in the second stage is that higher values of the index of readiness for the information society cause higher economic security levels in regions. To evaluate the impact of the digital economy on economic security levels, let us consider their correlation. Remember that the higher the index is, the higher the level of the digital economy development is, while a situation with economic security is exactly the opposite. The lower the value of the economic security level is, the better its level is according to the indicative technique. Therefore, we assume an inverse relationship. Estimated values for the digital economy development level and economic security level in regions are given in Table 7.

Table 7: Development levels of the digital economy and economic safety in regions in the Central Federal District of Russia in 2014-2020.

Region	2014		2015		2016		2017		2018		2019*		2020*		Correlation
	ES	DE	ES	DE	ES	DE	ES	DE	ES	DE	ES	DE	ES	DE	
Belgorod Oblast	0.44	0.45	0.4	0.47	0.38	0.49	0.35	0.51	0.33	0.52	0.43	0.45	0.41	0.47	-0.97
Bryansk Oblast	0.55	0.32	0.50	0.34	0.47	0.37	0.42	0.39	0.40	0.41	0.54	0.32	0.51	0.34	-0.98
Vladimir Oblast	0.76	0.45	0.74	0.46	0.70	0.49	0.68	0.51	0.67	0.53	0.76	0.45	0.74	0.47	-0.99
Voronezh Oblast	0.56	0.40	0.54	0.43	0.50	0.47	0.43	0.48	0.40	0.50	0.57	0.41	0.53	0.43	-0.93
Ivanovo Oblast	0.96	0.43	0.93	0.44	0.88	0.45	0.80	0.47	0.75	0.50	0.97	0.42	0.92	0.44	-0.99
Kaluga Oblast	0.84	0.46	0.83	0.47	0.81	0.49	0.80	0.51	0.78	0.53	0.84	0.46	0.83	0.47	-0.99
Kostroma Oblast	0.70	0.40	0.69	0.41	0.67	0.43	0.64	0.46	0.62	0.48	0.71	0.39	0.69	0.41	-0.99
Kursk Oblast	0.52	0.37	0.50	0.38	0.47	0.40	0.40	0.40	0.38	0.39	0.53	0.38	0.49	0.38	-0.83
Lipetsk Oblast	0.91	0.42	0.90	0.43	0.90	0.44	0.88	0.46	0.89	0.48	0.91	0.42	0.90	0.43	-0.92
Moscow Oblast	0.99	0.48	0.97	0.51	0.94	0.53	0.93	0.56	0.90	0.57	0.99	0.48	0.97	0.51	-0.91
Oryol Oblast	0.82	0.37	0.80	0.40	0.78	0.41	0.77	0.42	0.75	0.44	0.82	0.38	0.80	0.39	-0.90
Ryazan Oblast	0.68	0.38	0.64	0.41	0.59	0.43	0.53	0.47	0.52	0.49	0.68	0.38	0.64	0.41	-0.99
Smolensk Oblast	0.76	0.41	0.74	0.42	0.71	0.44	0.69	0.46	0.68	0.72	0.76	0.36	0.74	0.42	-0.99
Tambov Oblast	0.67	0.40	0.64	0.42	0.61	0.44	0.59	0.45	0.58	0.47	0.66	0.40	0.64	0.42	-0.99
Tver Oblast	0.82	0.40	0.79	0.42	0.77	0.43	0.73	0.45	0.71	0.46	0.82	0.40	0.79	0.42	-0.99
Tula Oblast	0.65	0.40	0.62	0.44	0.60	0.47	0.52	0.50	0.50	0.53	0.66	0.40	0.62	0.43	-0.96
Yaroslavl Oblast	0.41	0.47	0.40	0.50	0.36	0.52	0.34	0.53	0.31	0.54	0.42	0.48	0.39	0.49	-0.98

Note: * is forecast values; *ES* is economic security level as calculated following the procedure proposed by Tatarkin *et al.* (2003); *DE* is digital economy development level as calculated by the index of Russian regions' readiness for the information society.

The data in Table 7 show that the higher the digital economy development level is, the higher the economic security level is (it tends to a normal value, namely, zero). To visualize the relationship between these indicators, let is make the correlation analysis. There is an inverse relationship between the index of readiness of regions for the information society. It makes it possible to state that higher values of the index cause higher levels of economic security. The correlation coefficient is close to 1, hence, the relationship between the economic security level and index is very close. This means that we verified the assumption of the second stage (the average correlation was -0.96).

Thus, having completed the research, we confirmed all the assumptions. The obtained results might in the future be useful to schedule the introduction of digital technologies to achieve better economic security at all management levels.

5 Conclusion

The correlation analysis shows that all the regions that we studied have the direct relationship between GRP per capita and dynamics of costs for information and communication technologies, investments in fixed assets aimed at purchases of information, computer, and telecommunication equipment, numbers of the organizations that use the Internet, and shares of people who use the Internet to buy goods, works, and (or) services. The considered cases mostly show that the correlation coefficient is over 0.9 (very high direct relationship). This proves that the digital economy development preconditions the economic development in regions. To verify assumptions about the influence of dynamics in the digital economy development level on dynamics of changes in the economic security level, we made an additional correlation analysis. There is an inverse relationship between the index of readiness of regions for the information society. This makes it possible to suggest that higher values of the index cause higher levels of economic security. The research is relevant as we identified factors in the digital economy that influence higher economic security levels. The stated assumptions are confirmed. The study made it possible to identify factors in the development of the digital economy that affects sustainable changes in the level of economic security.

6 Availability of Data and Material

Data can be made available by contacting the corresponding authors.

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