MODELING OF REGIONAL STRATEGY OF FINANCIAL SECURITY MANAGEMENT IN THE CONTEXT OF DIGITALIZATION AND MIGRATION RISKS

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Abstract

One of the characteristic features of the modern world is the actualization of security issues at various levels of management - from the global level to the level of an individual. The protection of financial interests of all economic entities in all financial relations, the capability of a financial system to resist external and internal threats, as well as to support the sustainable development of the country, play a crucial role in the national defense. The high level of financial security at the national level can be achieved by ensuring an appropriate level of financial security at the level of individual regions. Therefore, the formation of a regional financial security strategy is an element of the national security system. Modeling of regional strategy implies analysis of the factors that directly or indirectly affect the financial security of the region. Effectiveness of the modeling of the regional strategy largely depends on the ability during the process of strategy formation to take into account all factors of financial security, which may differ significantly from one region to another. In the current realities of Ukraine, special attention is drawn to such factors as migration processes taking place in the country and the process of digitalization, which penetrates all spheres of public life, especially in economic activities and public administration. The aim of the study is to develop methodological approaches to modeling financial security strategy taking into account the impact of digitalization and migration processes at the regional level.

The data for the research, which characterize 24 regions of Ukraine and the city of Kyiv for the period from 2015 to 2019, were obtained from the State Statistics Service of Ukraine. Involved data allowed to conduct a taxonomic analysis taking into account the indicators that reflect the impact of digitalization and migration risks on the financial security of a particular region. It has helped to separate three levels of migration security and digitalization such as high level, moderate level, and low level.

The use of taxonomic analysis of regions in the process of modeling the regional financial security strategy has identified three clusters, which include the relevant regions with specific levels of migration security and digitalization The analysis shows that the first cluster includes only one region with high levels of migration security and digitalization, two regions belong to the third cluster with low ones, and the others belong to the second cluster including two subclusters with moderate levels of migration security or digitalization. For each cluster, recommendations were developed to increase the level of financial security by influencing the process of digitalization of the region and eliminating

regional migration risks. The development of indicators that characterize the impact of digitalization and migration risks on the financial security of a region is the subject of further research.

Analysis of the process of digitalization and migration risks of the regions shows them as the factors of the economic development and financial security of the regions. Clustering of regions using taxonomic analysis during the process of modeling of a regional strategy is appropriate and allows to assign a region to the cluster characterized by the appropriate level of migration security and digitalization, as well as formulate recommendations on financial security measures for the cluster.

Key words: *Financial security, Migration, Digitalization, Regional, Taxonomic analysis.*

1. Introduction

In today's world there are many processes that reflect the transformation of the worldview paradigm of society, in particular the growth of the value of human life and as a result - the ever-increasing actualization of security aspects of life. In modern conditions in Ukraine, a critical element of public administration is to ensure national security, in particular in the economic sphere, it is important to ensure financial security, because the level of financial security determines the degree of effectiveness of any public function. Over the last decade, the level of financial security of the state has been assessed as unsatisfactory. The main reasons for such a low level are the constant state budget deficit, low level of stock market development and lack of adequate long-term investment lending to the economy. First of all, with a low level of national financial security, solving economic problems that are characteristic of modern Ukraine is impossible.

Achieving a high degree of financial security at the national level is derived from the state of financial security that is characteristic of the regional level. The actualization of financial security problems stimulates the scientific interest of many scholars who study certain aspects of financial security. Thus, Goede, [1], explores the conceptual and empirical relationship between the concepts of finance and security, namely: the instrumental links between these concepts, the causes and consequences of the interaction of these concepts. The author also emphasizes that financial security is not a new concept, because in history there is much evidence of the application of measures aimed at ensuring financial security. Vaitkus and Vasiliauskaitė, [2], study the concept of financial security at the macro and micro levels. The authors also propose theoretical models of financial security, which implement financial

instruments in the process of managing economic well-being. Financial security at the state level is studied in the works of Dankiewicz *et al.*, [3], Kalinichenko and Lesyuk, [4], Reznik *et al.*, [5], and many others.

In their article, Kalinichenko and Lesyuk, [4], assess the financial, banking and monetary systems as factors of financial security at the national level. Kalinichenko and Lesyuk note that the biggest destabilizing effect in the context of financial security is the imbalance of the state budget, the growing number of banks with foreign capital and the foreign trade deficit. Zhukova and Shabaldas, [6], also study the budget deficit as a factor of financial security and note the importance of effective management of the state budget. Reznik *et al.*, [5], analyzing the current threats that affect the financial security of the state, emphasize the negative impact of corruption, financial crimes, fiscal decentralization, as well as the impact of hybrid war on the financial security of Ukraine. Reznik et al. emphasize the importance of implementing a state strategy that will protect the financial and economic interests of economic entities from internal and external threats.

In their study, Dankiewicz *et al.*, [3], analyze certain factors of financial security of the state, namely: all aspects of the tax system, budgeting and moral principles of citizens that affect the effectiveness of tax collection, which in turn affects the level of financial security.

Vasylieva *et al.*, [7], devoted their research to the problems of assessing financial security at the state level. Vasylieva *et al.* offer a method of calculating the quality management index in the country for the financial system in the form of a weighted average of the country's overall compliance with key international standards in this area. Grikietytė-Čebatavičienė, [8], also assesses financial security in the EU using the aggregate financial security index, which incorporates sub-indices: human development index, economic globalization index, financial development index, economic freedom index and financial stress index. The results of the study identify countries with market economies as the countries with the highest level of financial security, and the countries of Eastern Europe as the countries with the lowest level of financial security among the EU countries.

The multidimensionality of the concept of financial security is reflected in current trends in the study of this phenomenon, namely, more and more attention is paid to the analysis of various factors that affect the level of financial security. Many scientists study strategies for achieving security and sustainable innovation development by industry, economic sectors [9-12]. In his work, Kudrjashov, [13], examines the impact of

critical infrastructure on the economic development of the state, in particular on its financial security. The author emphasizes the need to clearly identify the priority components of critical infrastructure and implement an appropriate state strategy for their development and protection. Another factor that significantly affects financial security is the shadow economy. Its influence is studied by Meleshko *et al.*, [14], in their work, calculating and analyzing indicators that characterize the level of assessment of the shadow economy and the dynamics of the integrated index of financial security.

In modern conditions, the processes of globalization transform various economic phenomena and processes, including financial. In his work, Han, [15] explores the relationship between financial security and financial internationalization in five dimensions.

Another significant factor that currently affects all aspects of public life is digitalization. Onyshchenko *et al.*, [16] analyze the impact of the digitalization process on the financial security of the state, noting the shortcomings of existing institutions that are unable to adequately meet the challenges associated with digitalization. The authors emphasize the need to incorporate new indicators of financial security that will be able to reflect current threats with the introduction of innovation and digitalization.

Regional aspects of financial security are analyzed by Teshabaev *et al.*, [17], paying special attention to the study of tax potential and the factors that affect it. In their study, Derevyanko B. *et al.*, [18], analyze the indicators of financial and economic security of a particular region of Ukraine, namely Donetsk region. The authors note that their analysis indicates the presence of problems in the financial and economic security of the region, which are primarily related to investment, unemployment and the share of the population earning less than the subsistence level, and proposed a mechanism for monitoring financial and economic security of the region. Many scholars pay attention to ensuring financial security in terms of innovative development of the country [19-21].

In modern conditions, such a factor as migration processes attracts special attention, as they have a significant impact on all socio-economic processes of the regions of Ukraine, in particular on the level of their financial security. Importantly, in the context of the hybrid war that Ukraine faced, migration processes related to forced displacement were added to the usual migration processes that were characteristic of the country until 2014. Among the main reasons that significantly complicate the study of the impact of migration processes and, in particular, forced migration

on the economic development of the regions are the following:

1. All socio-economic contexts of development of individual territories and regions, regardless of whether they are characterized by the impact of forced displacement or not, are constantly undergoing various forms of socio-economic and political change. Therefore, it is objectively difficult to establish a direct and complete causal link resulting from relocation as such, completely separate from general social change, as noted, for example, in the work of Kibreab, [22]. This restriction especially applies to the processes of internal movement significantly distributed over time, which makes it almost impossible to identify and assess the impact of migration processes on socio-economic development. One approach developed to address this problem is presented in a small number of studies and is based on assessing the impact of displacement on internally displaced populations by comparing the characteristics, experiences and outcomes of displaced and indigenous populations. Such studies include:
- the works of Attanasio *et al.*, [23], Ibáñez and Moya, [24-25], written during the 2000s, based on data on Colombian internally displaced persons and persons remaining in the country;
- the report of Lehrer, [26], which presents the results of an assessment of the impact of IDPs based on a comparison of data sets on IDPs in Uganda and those who remained in the country;
- the long-term effects of migration are described by Sarvimäki *et al.*, [27], based on historical data comparing displaced and non-displaced Finnish populations, at a time when Finland ceded part of its territory to the Soviet Union;
- the works of Singh, [28], Karunakara, [29], and others, who used the results of the Demography of Forced Migration study to examine the impact of displacement on population structure, household composition and birth rates among Sudanese refugees, remaining Sudanese and Ugandan citizens.

It should be borne in mind that the main disadvantage of this method of assessing and analyzing the impact of internally displaced persons on socio-economic development is the assumption that there is no impact of the relocation process on remaining communities. Therefore, this method of comparison is not correct enough.

2. The impact of relocation will vary depending on a number of key factors, including the time frame, the duration since the relocation, and whether short-term or long-term effects need to be identified and assessed. Also, the direct impact of relocation can be amplified or offset in different ways, depending on the relocation period and the policy implemented. Similarly, the long-term effects of even short periods of relocation may be difficult to trace directly to relocation as such rather than to general social change. According to

World Bank, [30], this creates special requirements for the methodology of quantitative analysis.

3. High level of subjective judgments and assessments during the analysis. Cingranelli and Richardsnote, [31], that in addition to the problems associated with the limited availability of pre-relocation source data and the extent to which available data cannot be broken down by levels (e.g. different skills, income level or health) and types (e.g. gender, demographics), a number of implicit and explicit evaluative judgments will also prevail during any analysis of the impact of IDPs on the socio-economic development of the region. To reduce the impact on the results of the study of subjective assessments, before the study should determine: a set of characteristics that are quantifiable, independent (to avoid errors in assessment associated with the problem of collinearity); a set of influence variables that can be neglected; if necessary, a list of qualitative indicators that need to be included in the evaluation system; develop a system of summary (for example, the index method) to generalize to one coordinate system of the selected characteristics of the impact.

4. It should be borne in mind that the results of research on the impact of internal migration processes on the socio-economic development of the region are sensitive to the level of aggregation of initial data, their homogeneity and comparability. The researcher must be sufficiently knowledgeable in the subject of the study to rule out the possibility of such errors at the data collection and preparation stage, according to World Bank.

5. Limited statistical information available, especially in real time when the internal movement process is ongoing. This limitation leads to the fact that the existing research in the direction of assessing and analyzing the impact of relocation processes are mainly in the nature of the problem.

The above reasons that complicate the analysis and quantification of the impact of migration on the socio-economic development of regions formed a list of economic and mathematical approaches that are most often used to study this problem. These include, in particular, the following: theory of statistics; probability theory; indicative analysis.

Based on the above, ensuring the protection of financial interests of economic entities at all levels of government, including financial security of the regions is extremely important. However, many aspects of financial security management of regions remain insufficiently studied, namely: the structure of financial security of the region and its components, the impact of various factors on the level of financial security, the set of indicators that characterize this impact, the methodology of strategy for financial interests. All of the above highlights the purpose of this study. The aim

of the study is to develop methodological approaches to modeling financial security strategy taking into account the impact of digitalization and migration processes at the regional level.

2. Materials and Methods

Ensuring the financial security of regions is a complex and multifaceted task, as it requires the need to take into account a combination of various factors and unique, specific to individual regions of economic conditions in the management process.

Achieving the required level of financial security of the region involves the formation of an appropriate strategy that identifies long-term goals and management practices, which will protect the financial interests of the region from negative trends, external and internal threats, as well as help, through the implementation of the financial interests of the region, to achieve solutions and ensure sustainable development of the region with the necessary resources.

Usually, the formation of the strategy is largely based on the regional development program, which reflects the priority goals and objectives of sustainable development of the region, as well as methods of achieving them. Therefore, the process of modeling the financial security strategy of the region should be presented in the form of the following algorithm, which includes the following stages: determining the purpose of financial security management in the region; study of factors of potential external and
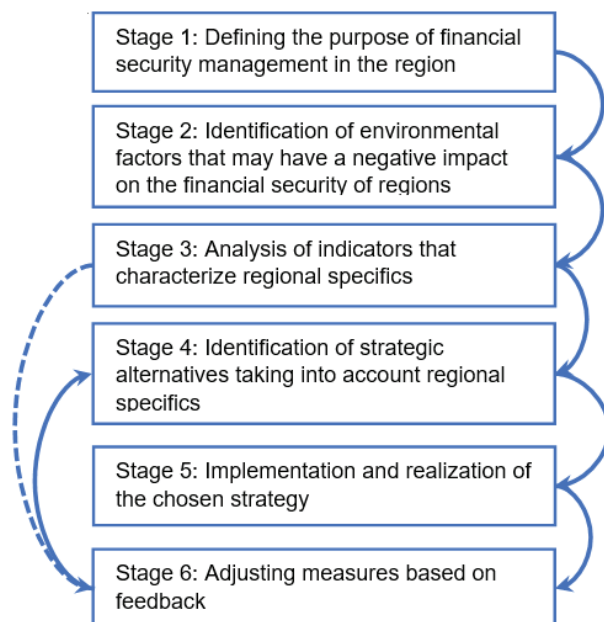

Figure 1. Algorithm for forming the financial security strategy of the region
(Source: Author's development)

internal threats that a particular region may face; analysis of regional indicators that characterize regional features; determination of a strategic alternative taking into account the results of the analysis of indicators that characterize regional features; implementation and implementation of the strategy with further adjustment of measures on the basis of feedback. The proposed algorithm of forming the financial security strategy of the region is shown in Figure 1.

At the first stage, the most important thing is a clear formulation of long-term, medium-term goals and priorities that will realize the financial interests of the region and ensure its sustainable development. Achieving the stated goals largely depends on the ability to respond quickly and adequately to emerging financial threats. Therefore, in the second stage, the analysis of the functional environment of the region becomes especially important in order to identify factors of both external and internal genesis that may have a negative impact on the level of financial security of the regions. It is advisable to pay attention to migration and digitalization processes taking place in the region. After all, they have an impact on financial security both through direct action and through indirect action. Thus, in the conditions of the hybrid war, all regions faced an increase in migration flows due to internally displaced persons, but the changes were uneven, and therefore each region received a different degree of burden associated with migration processes. As mentioned earlier, migration processes have a bidirectional impact on the level of socio-economic development of the region, in particular on financial security, and are reflected in several dimensions, namely: ethno-cultural, demographic, political and socio-economic. The positive effects of migration include the reduction of tensions in the regional labor market due to the departure of "surplus" labor, increased tax revenues, increased share of the working population, and cash from emigrants to help families, or invest in regional business. However, in the context of modeling a financial security strategy, it is first necessary to pay attention to the risks that the region may face in the long run, in particular through migration processes. Migration risks are associated with the negative impact of migration processes, which may occur due to the rapid deformation of the demographic structure of the region, low integration of immigrants in the regional community, reducing the share of highly skilled labor in the region's workforce, infrastructure and budgets, rising unemployment and deteriorating crime situation in the region. Therefore, one of the goals of modeling a financial security strategy is to maintain migration security at the appropriate level, which in turn implies the protection of regional interests in the migration sphere by preventing the transformation of potential risks into real threats.

Another important factor is digitalization, which has a greater positive impact on the regional socio-economic environment, which is manifested through: increase of labor productivity, development of innovative industries, new business formats, acceleration of business processes in the region, creation of new jobs, increase of work efficiency of financial institutions and state authorities.

At the next stage, the key elements of the analysis are qualitative and quantitative assessment of the identified factors. Unfortunately, this process is complicated by a large number of factors that affect the financial security of a particular region, as well as the inability to quantify the impact of some of them.

The result of a comprehensive assessment of indicators that characterize the regional features of the functional environment and the level of socio-economic development of a particular region is the construction of characteristics of regions. Therefore, in the third stage, it is advisable to use data aggregation, which allows you to take into account a large number of different indicators, even if they have different natures and different units of measurement.

In order to take into account the impact of migration risks and the digitalization process, comprehensive assessment should be carried out using integrated assessments in the following areas: budget sector (B), financial activity sector (F), social sector (S), migration sector (M), digital development sector (D), as well as the overall integrated indicator, which characterizes the overall level of financial security of the region.

At this stage, it is advisable to conduct a taxonomic analysis, which allows you to divide the regions into clusters, taking into account their regional characteristics. This approach allows you to develop a set of measures for a specific cluster.

The next step is to identify strategic alternatives that provide comprehensive measures to mitigate the negative impact of various factors that are specific to each region. After choosing an adequate strategic alternative, the relevant measures are implemented, and the next step is to study the relevant indicators in order to determine the effect and make adjustments to the financial security strategy.

In order to cluster the regions of Ukraine, it is advisable to use the method of taxonomic analysis. The expediency of taxonomy is due to the fact that this method allows you to build an integrated indicator that characterizes complex multidimensional objects, and allows you to group these objects according to the selected reference vector. The complexity and

ambiguity of the studied objects requires the use of a system of multidirectional indicators, so the method of taxonomic analysis allows them to systematize and analyze, which can form a rational financial security strategy of a region or cluster that includes similar regions of Ukraine in terms of development and potential threats.

Data for the analysis were obtained from the State Statistics Committee of Ukraine. The clustering algorithm involves collecting the necessary data that characterizes the clustering objects; the next step is to determine the set of parameters that will evaluate the objects, and the resulting step - the distribution of objects in relatively homogeneous groups due to the built feature space.

For the taxonomic analysis at the first stage, indicators were selected that characterize the regions of Ukraine and grouped into five sectors according to the areas in which the objects are characterized, namely: budget sector, which incorporates indicators K1 – K4; business activity sector, which includes indicators K5 – K9; the social sector, which incorporates indicators K10 – K13; the migration sector and the digital development sector, which incorporate indicators K14 – K16 and K17 – K19, respectively. The integrated indicator of the migration sector monitors the level of migration security of the region due to the following indicators: migration increase or decrease (K14), the number of migrants aged 20 to 64 (K15), the share of men among migrants (K16). The integrated indicator of the digital development sector reflects the level of digitalization of the region and is assessed through the following indicators: the number of Internet subscribers in the region (K17), the number of operating enterprises in the region that repair computers and peripherals (K18), the share of enterprises in the field of information and telecommunications in the total number of enterprises in the region (K19). The higher the value of these indicators, the higher the probable level of regionalization of the region. The level of migration security and digitalization can be defined as low, moderate, high according to the values of the relevant integrated indicators. Indicators and units of measurement are shown in Table 1.

According to the selected indicators for 25 regions, observation matrices for the period from 2015 to 2019 were built.

The next stage of taxonomic analysis is the standardization of observations, because the diversity of units of measurement requires to get rid of the difference in the scale of measurement. Standardization involves the transition from the values of indicators to the coefficients calculated by formula 1 and characterizes the ratio of the deviation of each observation from the mean value of the indicator for all studied objects to the standard deviation of this indicator:

$$W_{ij} = (a_{ij} - \bar{a}_j) \cdot \left(n^{-1} \cdot \sum_{i=1}^{n} (a_{ij} - \bar{a}_j)^2\right)^{\frac{-1}{2}} \quad (1)$$

Table 1. Indicators that characterize the regions of Ukraine, their symbols and units of measurement

Indicator, units of measurement	Symbol
GRP per capita of the economically active population of the region, euros	K1
Share of gross regional product in GDP, %	K2
Growth rates of actual personal income tax revenues, %	K3
Receipt of real estate tax, thousand euros	K4
Share of unprofitable economic entities in the total number of enterprises, %	K5
Volume of foreign direct investment per capita, euros	K6
Volume of fixed capital investments per capita, euros	K7
Inflation rate, %	K8
Share of employed population in economically active population of the region, %	K9
The amount of arrears of wages, million euros	K10
Median age of the region's population, year	K11
Income of the population per capita, euros	K12
Share of expenses in household income, %	K13
Migratory increase (decrease) of population, persons	K14
Number of migrants aged 20 - 64, persons	K15
Share of men among migrants, %	K16
Number of Internet subscribers, thousand people	K17
Number of operating enterprises that repair computers and peripherals, units	K18
Share of enterprises in the field of information and telecommunications, %	K19

Source: author's development.

Where: W_{ij} is a standardized value of the i-th observation for the indicator j

n – the number of observations

$\overline{a_j}$ – the average value of the j-th indicator

a_{ij} – the value of the i-th observation for the indicator j.

Table 2 shows an example of standardized values of indicators that characterize 25 regions of Ukraine in 2019.

The next stage involves determining the group of indicators-stimulants that have a positive impact on the overall level of development of the region, and the group of indicators-disincentives that inhibit its development. The stimulators included indicators: K1, K2, K3, K4, K6, K7, K9, K12, K13, K14, K15, K16, K17, K18, K19, and the destimulators include - K5, K8, K10, K11. Based on the formed groups of stimulators and destimulators, a reference vector $\overrightarrow{E_0}$ is generated by selecting the maximum values for stimulant indicators and the minimum values for destimulators. The elements of the reference vector have the following coordinates, which are formed by formula (2).

$$\overrightarrow{E_0} = (w_{01}, w_{02}, w_{03}, \cdots, w_{0m})$$

where

$$w_{0i} = \begin{cases} \max(W_{ij}), j \in \text{indicators} - \text{stimulators}, \\ \min(W_{ij}), j \in \text{indicators} - \text{destimulators} \end{cases} \quad (2)$$

The reference vector $\overrightarrow{E_0^{2019}}$ for 2019 is as follows:

$$\overrightarrow{E_0^{2019}} = (4.283; 4.287; 2.193; 4.071; -1.876; 4.684; 4.416; -2.396; 1.678; -0.757; -1.846; 4.115; 1.818; 3.628; 4.096; 4.165; 4.062; 4.541; 3.79)$$.

An important step in taxonomic analysis is to determine the distance of a single observation from the reference vector D_{i0} by formula (3).

$$D_{i0} = \left(\sum_{j=1}^{m} (W_{ij} - w_{0i})^2 \right)^{\frac{1}{2}} \quad (3)$$

Where: W_{ij} is a standardized value of the indicator j;

w_{0i} - standardized value of indicator j in the generated standard.

Table 2. Standardized values of indicators that characterize 25 regions of Ukraine in 2019

Region	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19
Vinnytsia	-0.116	-0.163	-0.101	-0.269	-0.334	-0.358	-0.178	-2.396	-0.287	-0.673	0.287	0.035	-0.586	-0.491	-0.453	-0.151	-0.329	-0.277	0.010
Volyn	-0.107	-0.453	0.208	-0.400	-0.005	-0.246	-0.023	1.136	-0.831	-0.631	-1.565	-0.447	0.111	-0.254	-0.096	-0.942	-0.440	-0.394	-0.713
Dnipropetrovsk	0.611	1.255	1.222	0.929	-0.104	0.450	0.613	-0.559	0.465	0.201	0.246	0.946	-1.042	-0.313	-0.203	-0.046	0.070	0.546	-0.219
Donetsk	0.445	0.249	1.796	-0.391	-0.826	-0.214	-0.380	2.689	-2.161	2.590	1.614	-1.006	-2.533	-1.170	-0.967	0.447	-0.166	-0.139	0.038
Zhytomyr	-0.388	-0.401	-0.101	-0.389	1.012	-0.320	-0.412	-0.701	-0.379	-0.713	-0.196	-0.078	0.056	-0.346	-0.099	-0.036	-0.347	-0.296	-0.523
Zakarpattia	-0.746	-0.531	-1.291	-0.525	-0.563	-0.253	-0.377	0.288	-0.140	-0.735	-1.766	-0.666	0.759	-0.186	-0.130	-0.819	-0.424	-0.570	0.301
Zaporizhzhia	0.001	-0.021	-0.233	-0.230	-0.399	-0.058	-0.280	-1.266	-0.306	0.605	0.689	0.469	-0.295	-0.413	-0.416	-0.053	-0.211	0.056	0.040
Ivano-Frankivsk	-0.462	-0.393	0.164	-0.348	-1.417	-0.065	-0.424	0.571	0.712	-0.593	-0.921	-0.339	-0.146	-0.081	-0.063	-0.794	0.425	-0.414	-0.035
Kyiv	0.722	0.323	1.134	0.870	-0.465	0.247	1.156	0.429	1.294	0.231	-0.398	0.458	1.144	3.628	4.096	-0.083	-0.209	-0.139	-0.425
Kirovohrad	-0.188	-0.467	-1.688	-0.596	-1.876	-0.415	-0.311	-0.701	-0.977	-0.707	0.649	-0.227	0.268	-0.576	-0.506	0.059	-0.434	-0.453	-1.234
Luhansk	-0.700	-0.645	-1.424	-0.677	-0.957	-0.315	-0.806	0.288	-2.221	2.866	1.977	-1.603	-2.167	-0.795	-0.811	-0.569	-0.494	-0.453	0.022
Lviv	-0.028	0.300	0.781	0.624	0.684	-0.130	-0.013	0.147	1.013	-0.217	-0.679	0.074	0.328	0.033	-0.313	-0.291	0.012	0.213	1.337
Mykolaiv	-0.201	-0.362	0.296	-0.393	-1.253	-0.266	-0.106	-0.418	-0.224	-0.019	0.085	-0.008	-0.384	-0.407	-0.295	0.005	-0.190	-0.335	-1.209
Odessa	-0.071	0.207	-0.762	0.965	0.618	-0.057	-0.270	-0.277	1.290	-0.302	-0.559	0.363	0.700	1.125	1.292	-0.098	2.192	0.252	-0.083
Poltava	0.876	0.153	-1.159	-0.231	-0.137	0.178	0.291	0.571	-0.824	-0.417	0.729	0.315	-0.418	-0.062	0.026	-0.072	-0.202	-0.179	-0.468
Rivne	-0.582	-0.498	0.605	-0.447	1.275	-0.387	-0.495	0.429	0.216	-0.563	-1.846	-0.394	-0.307	-0.457	-0.325	-0.931	-0.440	-0.061	-0.237
Sumy	-0.438	-0.452	-1.159	-0.565	0.980	-0.334	-0.394	0.994	0.467	1.214	1.051	0.058	-0.565	-0.426	-0.356	-0.181	-0.397	-0.355	-0.218
Ternopil	-0.619	-0.553	0.605	-0.338	0.192	-0.440	-0.273	0.147	-0.538	-0.662	-0.357	-0.571	0.076	-0.163	-0.231	-0.217	-0.326	-0.570	0.187
Kharkiv	-0.032	0.480	-0.453	0.780	1.111	-0.253	-0.291	0.994	1.678	1.187	0.327	0.067	1.578	0.627	-0.670	-0.019	-0.147	0.663	1.354
Kherson	-0.621	-0.527	-0.453	-0.532	-0.826	-0.292	-0.045	-1.124	-0.380	-0.550	-0.035	-0.275	1.145	-0.402	-0.288	-0.536	-0.367	-0.335	-0.793
Khmelnytskyi	-0.420	-0.413	0.737	-0.390	-0.268	-0.352	-0.308	0.429	0.364	-0.663	0.246	-0.239	0.465	-0.192	0.072	-0.162	-0.395	-0.414	-0.766
Cherkasy	-0.103	-0.302	-0.806	-0.365	-0.727	-0.245	-0.225	-1.266	0.205	-0.339	0.971	-0.206	0.521	-0.410	-0.213	1.583	-0.410	-0.061	-0.124
Chernivtsi	-0.850	-0.637	0.252	-0.609	1.964	-0.432	-0.588	-0.418	0.837	-0.757	-1.041	-0.635	1.818	-0.111	-0.282	-0.173	-0.426	-0.551	0.389
Chernihiv	-0.268	-0.440	-0.365	-0.544	0.487	-0.129	-0.276	0.288	-0.621	-0.635	1.132	-0.202	0.129	-0.391	-0.206	4.165	-0.408	-0.277	-0.422
City of Kyiv	4.283	4.287	2.193	4.071	1.833	4.684	4.416	-0.277	1.348	0.281	-0.639	4.115	-0.654	2.235	1.440	-0.084	4.062	4.541	3.790

Source: calculated by the authors.

Distances D_{i0} were calculated for 25 regions by sector for the period 2015-2019. The result of calculating the distance D_{i0} by individual sectors for 25 regions of Ukraine for 2019 are shown in Table 3.

Next step is to calculate the taxonomic coefficient R_i which reflects the degree of proximity of the i-th region to the standard and is calculated by formulas (4 - 7):

$$R_i = 1 - D_{i0}D_0^{-1} \qquad (4)$$

Where D_0 is the maximum distance to the reference vector, which is calculated taking into account the "rule of three sigma" by the formula:

$$D_0 = \overline{D_0} + 3S_0; \qquad (5)$$

$\overline{D_0}$ is the average value of the distance to the reference vector, which is calculated by the following formula:

$$\overline{D_0} = n^{-1} \cdot \sum_{i=1}^{n} D_{i0} \qquad (6)$$

S_0 standard deviation of the distance, which is calculated by the following formula:

$$S_0 = (n^{-1} \cdot \sum_{i=1}^{n} (D_{i0} - \overline{D_0})^2)^{\frac{1}{2}} \qquad (7)$$

Calculated taxonomic coefficients allow ranking the regions according to the level of development of individual sectors and in general.

3. Results and Discussion

The conducted taxonomic analysis allowed rankings the regions on integrated indicators on individual sectors and on the general taxonomic coefficient. Table 4 shows the results of the calculation of the total taxonomic coefficient and by individual sectors, as well as the ranking of 25 regions for 2019.

The dynamics of rankings by individual sectors for individual regions for the period from 2015 to 2019 is shown in Fig. 2. Analysis of the ranking by the coefficient T, which is an integral indicator of the level of financial security, taking into account all indicators, indicates that the regions with a relatively high level of financial security, for this group the value of the ranking $\text{Rank T} \in [1; 6]$, include the following: the city of Kyiv, Kyiv region, Dnipropetrovsk region,

Table 3. The distance between the indicators of individual regions and the reference vector for 2019

Regions	Sectors					
	Budget (B)	Financial activity (F)	Social (S)	Migration (M)	Digital development (D)	Total (T)
Vinnytsia	7.953	7.264	5.195	7.502	7.535	16.002
Volyn	8.104	8.141	4.881	7.663	8.056	16.715
Dnipropetrovsk	5.787	6.354	4.850	7.193	6.926	14.039
Donetsk	7.149	9.418	8.267	7.903	7.339	18.013
Zhytomyr	8.303	7.987	4.838	7.144	7.838	16.389
Zakarpattia	9.042	7.719	4.898	7.566	7.643	16.763
Zaporizhzhia	7.828	7.207	5.103	7.380	7.240	15.689
Ivano-Frankivsk	8.250	7.478	4.958	7.459	7.239	16.019
Kyiv	6.306	6.359	4.111	4.248	7.610	13.155
Kirovohrad	8.913	7.633	5.243	7.463	8.390	17.067
Luhansk	9.207	8.690	8.736	8.126	7.738	19.040
Lviv	6.954	7.500	4.495	7.226	6.414	14.771
Mykolaiv	8.077	7.271	5.111	7.271	8.176	16.246
Odessa	7.348	7.437	4.146	5.683	6.073	13.988
Poltava	7.644	7.444	5.117	6.937	7.654	15.708
Rivne	8.337	8.359	4.989	7.886	7.594	16.856
Sumy	8.802	8.333	5.867	7.426	7.740	17.215
Ternopil	8.332	7.994	5.217	7.231	7.639	16.468
Kharkiv	7.137	8.182	4.994	7.016	6.219	15.190
Kherson	8.684	7.185	4.801	7.587	8.024	16.493
Khmelnytskyi	8.138	7.744	5.017	7.036	8.072	16.310
Cherkasy	8.305	7.114	5.335	6.444	7.516	15.686
Chernivtsi	8.733	8.401	4.818	7.208	7.591	16.723
Chernihiv	8.420	7.953	5.511	5.887	7.805	16.128
City of Kyiv	0.000	4.285	2.940	5.201	0.000	7.352

Source: calculated by the authors.

Table 4. The results of calculating the coefficients and rankings of individual regions for 2019

Region	R_i^b	R_i^f	R_i^s	R_i^m	R_i^d	R_i^t	Rank B	Rank F	Rank S	Rank M	Rank D	Rank T
						2019						
Vinnytsia	0.387	0.302	0.391	0.224	0.368	0.275	10	7	18	19	10	10
Volyn	0.375	0.218	0.428	0.207	0.324	0.243	12	19	9	22	22	18
Dnipropetrovsk	0.554	0.390	0.432	0.256	0.419	0.364	2	2	8	10	5	4
Donetsk	0.449	0.095	0.031	0.182	0.385	0.184	6	25	24	24	8	24
Zhytomyr	0.360	0.233	0.433	0.261	0.343	0.258	15	17	7	9	20	15
Zakarpattia	0.303	0.259	0.426	0.217	0.359	0.241	24	14	10	20	15	20
Zaporizhzhia	0.396	0.308	0.402	0.236	0.393	0.289	9	6	15	15	7	8
Ivano-Frankivsk	0.364	0.282	0.419	0.228	0.393	0.274	14	11	11	17	6	11
Kyiv	0.514	0.389	0.518	0.561	0.362	0.404	3	3	2	1	13	2
Kirovohrad	0.313	0.267	0.386	0.228	0.297	0.227	23	13	20	18	25	22
Luhansk	0.290	0.165	0.0	0.159	0.351	0.138	25	24	25	25	17	25
Lviv	0.464	0.280	0.473	0.252	0.462	0.331	4	12	4	12	4	5
Mykolaiv	0.377	0.302	0.401	0.248	0.314	0.264	11	8	16	14	24	13
Odessa	0.433	0.286	0.514	0.412	0.491	0.366	7	9	3	3	2	3
Poltava	0.410	0.285	0.400	0.282	0.358	0.289	8	10	17	6	16	9
Rivne	0.357	0.197	0.415	0.184	0.363	0.237	18	22	12	23	12	21
Sumy	0.321	0.200	0.313	0.232	0.351	0.220	22	21	23	16	18	23
Ternopil	0.357	0.232	0.389	0.252	0.359	0.254	17	18	19	13	14	16
Kharkiv	0.450	0.214	0.415	0.274	0.479	0.312	5	20	13	7	3	6
Kherson	0.330	0.310	0.438	0.215	0.327	0.253	20	5	5	21	21	17
Khmelnytskyi	0.372	0.256	0.412	0.272	0.323	0.261	13	15	14	8	23	14
Cherkasy	0.359	0.317	0.375	0.333	0.370	0.290	16	4	21	5	9	7
Chernivtsi	0.326	0.193	0.436	0.254	0.363	0.243	21	23	6	11	11	19
Chernihiv	0.351	0.236	0.354	0.391	0.346	0.269	19	16	22	4	19	12
City of Kyiv	1.000	0.588	0.655	0.462	1.000	0.667	1	1	1	2	1	1

Source: calculated by the authors.

Odessa region, Lviv region, Kharkiv region. Regions with a higher than average level of security include regions with a $\text{Rank T} \in [7; 12]$, namely: Cherkasy region, Zaporizhzhia region, Poltava region, Vinnytsia region, Ivano-Frankivsk region, Chernihiv region. The following regions with a $\text{Rank T} \in [13; 19]$ belong to the regions with a lower than average level of security: Mykolaiv, Khmelnytskyi, Zhytomyr, Ternopil, Kherson, Volyn and Chernivtsi regions. Regions with a low level of security include regions with a ranking of $\text{Rank T} \in [20; 25]$: Zakarpattia region, Rivne region, Kirovohrad region, Sumy region, the lowest ranking was recorded in Donetsk and Luhansk regions. Analysis of the dynamics indicates that in the period from 2015 to 2019 there are slight fluctuations in the value of the ranking of regions Rank T, but the regions are not characterized by a qualitative shift from one group to another. Only a few oblasts managed to improve their

place in the ranking, namely: Kherson and Chernihiv regions. At the same time, Kirovohrad region lost 4 positions in the ranking and moved to a group with a low level of financial security, Poltava region, having lost 3 positions, moved to a group with a higher level of security than average.

Within the modeling of the regional financial security strategy, it is also expedient to consider the clustering of regions by the level of migration security and digitalization. The obtained rankings for the respective sectors Rank M and Rank D allowed to divide the regions into clusters. Thus, three clusters were obtained, namely the first cluster, which is characterized by a high level of migration security and a high level of digitalization, i.e. meet the condition $\text{Rank M} + \text{Rank D} \in [2; 16]$. The first cluster includes the following oblasts: Kyiv oblast, Kyiv, Second cluster, which is characterized by a

Figure 2. Dynamics of rankings by individual sectors for individual regions for the period from 2015 to 2019 (source: calculated by the authors)

moderate level of migration security and or a moderate level of digitalization, i.e. $\text{Rank M} + \text{Rank D} \in [17; 39]$ and incorporates two subclusters: the first subcluster is characterized by $\text{Rank M} \leq \text{Rank D}$, and the second subcluster meets the condition $\text{Rank M} > \text{Rank D}$. The third cluster includes regions with a low level of digitalization and migration security, i.e. meets the condition $\text{Rank M} + \text{Rank D} \in [40; 50]$. Under such conditions, the first cluster includes the following regions: the city of Kyiv, Odessa region, Kharkiv region, Kyiv region, Cherkasy region. The first subcluster of the second cluster includes: Zhytomyr, Mykolaiv, Poltava, Sumy, Ternopil, Khmelnytskyi, Chernivtsi and Chernihiv regions. The second subcluster of the second cluster includes: Vinnytsia, Dnipropetrovsk, Donetsk, Zakarpattia, Zaporizhzhia, Ivano-Frankivsk, Lviv and Rivne regions. The third cluster includes the following regions: Kherson, Kirovohrad, Volyn and Luhansk regions.

Clustering indicates that the second cluster, which has 16 regions and represents regions with a moderate level of migration security and digitalization, is the most numerous. These 16 regions are evenly divided into two subclusters of 8 regions; the first subcluster represents regions where the level of migration

security is higher than the level of digitalization of the region, while the second subcluster represents regions where the level of digitalization is higher than the level of migration security. The next in number are the first and third clusters, which include 5 and 4 regions, respectively.

For the first cluster regions, in the process of developing strategic alternatives, it is advisable to continue implementing measures already implemented to neutralize migration risks and accelerate digitalization, and pay special attention to the development and implementation of measures to mitigate risks related to other sectors. For the regions included in the first subcluster of the second cluster, the strategy development process should pay attention to increasing digitalization by attracting investment in digital infrastructure, raising the digital awareness of the regional community, providing Internet access (especially in rural areas), digital technologies in the work of regional authorities. It is also advisable to pay attention to cybersecurity in the region, as digitalization is a source not only of positive changes in the socio-economic environment, but also challenges to financial security in the region, such as cyberattacks, inconsistencies in government

regulation of financial and credit activities by through the use of cryptocurrency. However, the migration security of these regions should not be completely ignored, as increasing the level of migration security will increase the level of financial security of the region as a whole. For the regions belonging to the second subcluster, in the process of strategy development, on the contrary, it is necessary to pay special attention to improving migration security, to this end it is advisable to use the following measures: develop mechanisms for adaptation and integration of migrants into the regional community and loans for business, to provide tax benefits for up to three years, to provide professional retraining for immigrants. The most difficult situation is typical for the third cluster, because the regions of this cluster must simultaneously address the problems of low migration security and low levels of digitalization. It should be noted that the lowest level of migration security is recorded in Donetsk and Luhansk regions, primarily due to the additional migration burden on these regions due to internally displaced persons. Thus, according to the State Statistics Committee of Ukraine, the largest number of registered internally displaced persons falls on the Donetsk region and is 510,764 people. In the second place in terms of the number of registered internally displaced persons is Luhansk region, in the period from 2014 to 2020 the number of IDPs amounted to 280,437 people. Therefore, these regions are forced to make additional efforts to address the problems associated with a significant increase in migration flows. For IDPs, the biggest problems remain housing and employment. Taking into account these features, it is appropriate to envisage measures to reduce the negative impact of migration processes, including measures aimed at increasing tolerance of IDPs, development of mechanisms for creating new jobs, development of cooperation with other regions in order to solve these problems, development of the rental market.

4. Conclusions

- In the current realities of Ukraine, the main task of public administration is to ensure national security, including financial security, because a high level of financial security is the key to effective implementation of any state functions. Achieving a high level of national financial security is possible only if a high level of financial security is achieved at the regional level.
- Over the last decade, the national level of financial security has been defined as unsatisfactory. First of all, this situation is due to the constant state budget deficit, low level of stock market development and lack of adequate long-term investment lending to the economy. However, there are many factors that need to be explored in order to increase financial security at the regional level. They can be divided into the following sectors: budget sector, financial sector, social

sector, migration sector and digital development sector.
- The impact of the latter two sectors is the least studied. However, the analysis indicates that migration processes have an impact on the financial security of the region, primarily due to changes in the socio-economic environment of the region, including increasing the share of people of working age in the labor force, increasing tax revenues, cash receipts from emigrants or investment in regional business. Also a significant factor in the financial security of the region is digitalization, as transforming business processes leads to changes in the level of financial security, including the development of innovative industries, increases the efficiency of financial institutions and government agencies, accelerates business processes in the region.
- In the process of modeling a regional financial security strategy, the key steps are to identify factors and analyze them using integrated indicators. In the process of factor analysis, the method of taxonomic analysis was used, which allowed the clustering of regions of Ukraine according to the integrated indicator of financial security and the indicator of migration security and digitalization. As a result, in the first case, four clusters were obtained: with a high level of financial security – 6 regions, with a level of financial security above average – 6, with a level of financial security below average – 7 regions and with a low level of financial security – 6 regions. In the process of clustering on the indicator of migration security and digitalization were obtained 3 clusters: with a high level – 5 regions, with a moderate level – 16 regions, which were divided into subclusters of 8 regions according to the ratio of migration security and digitalization, and with a low level – 4 regions. This approach allows formulating strategic alternatives taking into account regional peculiarities.
- The development of indicators that characterize the impact of digitalization and migration risks on the financial security of the region is the subject of further research.

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