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MANAGEMENT OF INNOVATIONS IN PUBLIC ADMINISTRATION: STRATEGIES TO PREVENT THE PARTICIPATION OF FINANCIAL INTERMEDIARIES IN SHADOW OPERATIONS

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Abstract. *This article summarizes the arguments and counterarguments within the scientific discussion on improving public administration tools in the context of implementing innovative mechanisms for combating shadow financial transactions. The main purpose of this research is to formalize innovative strategies to counter the shadow withdrawal of capital with the participation of financial intermediaries. The systematization of scientific sources and approaches to solving the problem of the de-shadow economy proved that a characteristic feature of the functioning of the shadow market is the active participation of financial intermediaries in shadow operations. The information base is data from the World Bank and the Organization for Economic Cooperation and Development, the Group for the Development of Financial Measures to Combat Money Laundering, Transparency International, and the World Economic Forum. The period of the study is 2003-2021. The EU countries, Ukraine, Moldova, and Montenegro, as candidate countries for EU membership, were selected as the object of the study. This study applied the methods of bibliometric analysis to generalize the existing scientific work on the investigated issue, analysis of changes in the number of search changes on the problems of shadowing the economy, and clustering regions by the number of search queries on the shadow economy. Intellectual data analysis methods (one-dimensional branching CART and agglomeration methods) were used for clustering countries depending on the nature of the policy of countering the shadowing of the economy. Based on the results of the bibliometric analysis, theories describing the shadow economy, in particular: innovation theory, the theory of centralization, and institutional theory, were summarized. The article presents the results of cluster analysis, which proved the practicality of selecting three clusters of countries: cluster 1 – Cyprus, Czech Republic, Denmark, Finland, Greece, Ireland, Italy, Luxembourg, and Portugal; cluster 2 – Bulgaria, Croatia, Estonia, France, Malta, Netherlands, Spain, Sweden, Belgium, Greece, Austria, Hungary, and Slovak Republic, Slovenia; cluster 3 – Lithuania, Latvia, Romania, Poland, Moldova, Montenegro, and Ukraine. The study empirically confirmed and theoretically proved that the entire set of innovative scenarios for implementing economic de-shadowing policy could be divided into three types (evolutionary scenario, sequential transformation scenario, and forced scenario). The above scenarios depend on the speed of change in the indicators of developing the shadow economic sector and their sensitivity to the implemented measures.*
Keywords: shadow economy, financial intermediaries, innovative strategies, innovations in public administration, modeling, innovative development.
JEL Classification: H20, H71, F49, K34

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Introduction. The problems of the rapid economic crisis aggravation in Ukraine and the world, the shortage of financial resources, the bankruptcy of a significant number of companies, which only worsened in the conditions of the COVID-19 pandemic, and in some countries, acquired critical importance, became a trigger for the revision and shift of the main emphases in the formation of the innovative mechanisms of state economic policy implementation aimed at ensuring the national economic stability. The volume of shadow financial flows plays an important role in these processes, in the structure of which there is a constant increase in the share of shadow operations with the participation of financial intermediaries (Boyko, 2011; Gaspareniene et al., 2017; Kremen et al., 2018; Lyeonov et al., 2021; Affandi and Malik, 2020).

At the same time, Yang and Chang (2020) proved the asymmetric impact of financial intermediaries on economic growth in low- and high-income countries based on the quantile regression method. The authors substantiated that the development of financial intermediation is the main driving force of economic growth only for countries with a high-income level. Aramonte et al. (2021) analyzed structural changes in the financial intermediation market. According to the analysis of the scope of activity of non-bank financial intermediaries, the authors claimed their significant growth after the Great Financial Crisis.

The role of financial intermediaries in corporate profit management mechanisms was studied by Lord et al. (2019). According to the authors, professional intermediaries (lawyers or financial advisors) create opportunities for the prevention of financial crimes to gain profit, control, convert and hide their illegal finances. Thus, the authors concluded that the activities of financial intermediaries facilitate control over other dirty money. Every year, the world observes an increase in shadow withdrawal of capital channels, intensifying efforts to find new schemes for concealing income, including shadow activities with the participation of investment, banking, and insurance subjects. These problems are most relevant for countries with medium and low levels of economic development and those that are developing (Surovicova et al. (2022); Borlea et al. (2022)). The analysis of changes in the level of economic shadowing in EU countries evidenced a steady trend towards a decrease in this indicator (Figure 1). So, if in 2003 the average level of economic shadowing was 22.6%, then according to the results of 2021, its value was 17.42%. At the same time, in Ukraine and some countries that are not part of the EU, the value of the shading level is much higher.

Different authors studied the connection between the shadow economy and the development of the country's financial sector (Farhi and Tirole, 2017; Hughes and Mester, 2018), and company performance indicators (McCann and Bahl, 2017; Perez et al., 2019). Thus, Farooq et al. (2022), based on an analysis of the results of a survey of enterprises conducted by the World Bank in 121 developing countries, concluded that firms that are more prone to informal competition are more likely to innovate than firms that are less prone to it. According to the results of the study, the authors concluded that the business environment at the firm level and the economic environment at the country level affect the sensitivity of innovations to informal competition.

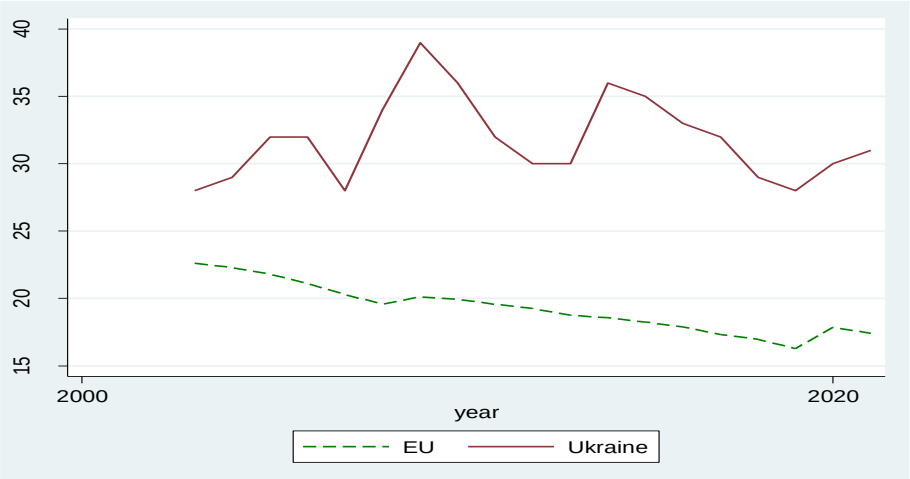

Figure 1. Average values of the level of the shadow economy in EU countries

Sources: developed by authors on the basis of (World Bank data,2022).

The significant consequences of these processes for the economic and social development of countries led to the introduction at the national and international levels of several initiatives aimed at consolidating the efforts of the international community in the direction of combating shadow financial flows (Kuzior and

Zozulak, 2019; Kuzmenko et al., 2018; Onyshchenko et al., 2022; Plastun et al., 2020; Vasilyeva et al., 2020; Yarovenko et al., 2021). Thus, the European Parliament adopted: Directive (EU) 2015/849 of the European Parliament and the Council of 20 May 2015 on the prevention of the use of the financial system for money laundering or terrorist financing; Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions, etc. The main purpose of these documents is to form the basis for detecting and countering suspicious activity and identifying and eliminating opportunities for money laundering.

Figure 2 demonstrates the different effects of these measures in the EU countries. Even though the average level of shadowing of the economy in the EU from 2003 to 2021 is 19.26%, the indicators of individual countries testify to the lack of effective tools for countering shadow operations and the need for more detailed research and dissemination.

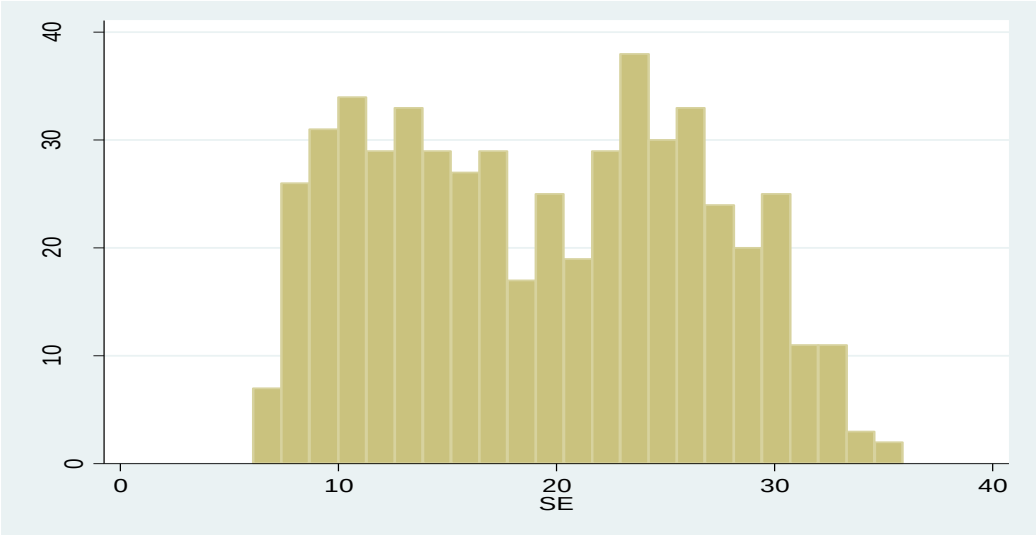

Figure 2. Frequency of average level of the shadow economy in the EU, 2003-2021

Sources: developed by authors.

The given data testify to the need to apply more complex approaches to the fight against the shadow economy due to the structural transformation of the shadow capital market, changing the existing mechanisms of the functioning of the financial market, and revising the procedures of financial monitoring and control over economic entities.

However, nowadays, the tools for implementing the strategy of countering shadow financial transactions are poorly researched. Currently, several problematic issues are related to timely identification of a shadow operation, assessment of the risk of its implementation, and identification of all potential participants that require more detailed research.

Literature Review. The COVID-19 pandemic, economic crisis, and the war against Ukraine have been a trigger for shifting the emphasis on the formation of organizational, economic, and practical mechanisms for managing socio-economic processes in the world, in particular, in the implementation of policies to reform the economic system. Significant influence on the indicators of socio-economic development of the country is played by the levers of macroeconomic instability, among which one of the priority positions is occupied by the volume of informal (shadow) activity. Implementing an effective and consistent anti-corruption policy in the country would reduce, and in some cases avoid, economic and financial risks and help improve the population's quality of life, increasing its level of well-being.

Despite the permanent increase of attention of the world community to the problems of shadowing of the economy (Fig. 3), unified understanding of its content, attractors, and consequences of its existence, comprehensive studies of the impact of shadow operations on certain sectors of development, the role of financial intermediaries in shadow operations are currently lacking. Scientists and analysts have developed a wide range of tools for approaching the interpretation of this definition, measuring illicit financial flows (Kar and Cartwright-Smith, 2009; Zdanowicz, 2009; Bourhaba and Hamimida, 2016; Johannesen and Pirttilä, 2016; De Beer and Wunsch-Vincent, 2016). The notion of shadowing is often identified with the notions of informal or informal economy, black or gray economy, parallel, an unregistered or informal activity, and so on.

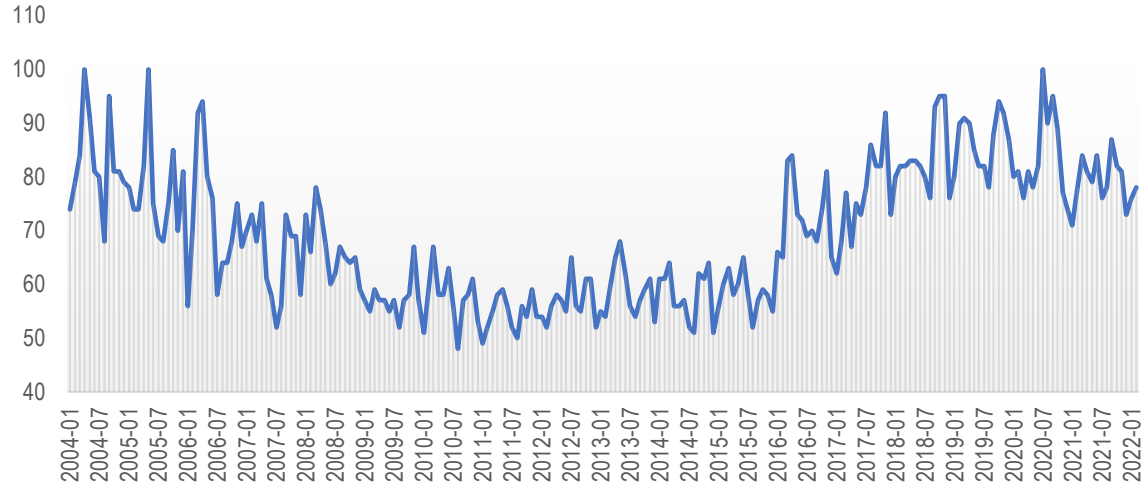

Figure 3. Trend analysis of changes in the number of search queries on the problems of shadowing the economy in the Google search engine

Sources: developed by authors.

The analysis of search queries in the international space (Figure 3) shows a permanent increase in attention to these issues in most countries. For an in-depth analysis of the shadow economic sector functioning, this study conducted a bibliometric analysis of the concept of shadowing the economy and its relationship with other concepts. Based on the analysis of the dynamics of changes in the number of publications on the shadow economy in the journals indexed by the Scopus and Web of Science databases (Fig. 3), a steady increase in their number since 1991 has been confirmed. For the Scopus database in 2009-2010 and 2011-2013, and for the WoS database in 2012-2013, there was a slight decrease in publication activity on these issues. In other years, there was a steady increase in the number of publications. The peak of growth of publishing activity was 2014-2015, during which the number of publications in the WoS database increased from 87 to 160 and in the Scopus database – from 105 to 183. These processes result from the global economic crisis, a prolonged political crisis in some countries, the inefficient state policy of de-shadowing the economy, financial and investment policy, etc. In these conditions, economic entities are increasingly looking for mechanisms to improve their well-being and material well-being in Ukraine and the world. These processes contributed to the growth of the number of publications on the shadowing economy, the implementation of regulations governing the processes of de-shadowing economy, and economic relations regarding the formation and movement of funds (Fig. 5).

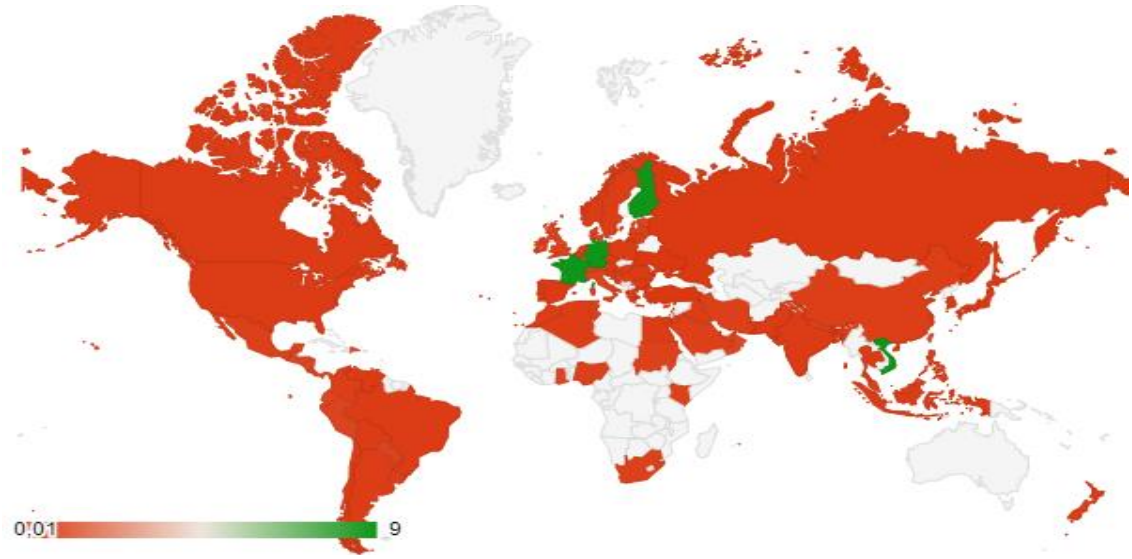

Figure 4. Clustering regions by the number of searches queries on the shadow economy in Google

Sources: developed by authors basis of Google Trends.

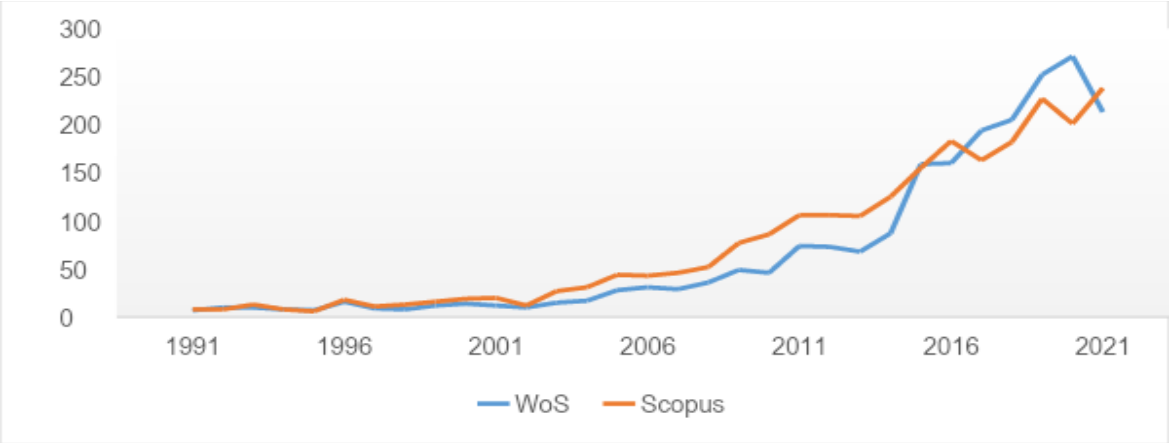

Figure 5. Dynamics of publications on the shadow economy in journals indexed by Scopus and WoS databases

Sources: developed by authors.

The analysis of scientific works devoted to the problems of the shadowing economy (Table 1) confirms the low quality of publications. The vast majority of the publications are published in journals of the second quarter or those without the quarter.

Table 1. Journals with the largest number of works on the shadow economy, indexed by the Scopus/Web of Science database

Journals	Number of publications		Quarter
	Scopus	WoS	
Financial and Credit Activity: Problems of Theory and Practice	-	28	-
Baltic Journal of Economic Studies	-	30	-
Sustainability	18	22	Q1
Applied Economics	17	20	Q2
International Tax and Public Finance	14	18	Q2
Russian Journal of Criminology		15	Q2
Actual Problems of Economics	26	14	-
Handbook on the Shadow Economy	13	14	-
Economic Systems	-	13	Q2
AEBMR Advances in Economics, Business and Management Research	-	12	-
Journal of Cleaner Production	-	12	-
International Journal of Entrepreneurship and Small Business	13	-	Q2
Economic Analysis and Policy	14	-	Q1
Contributions to Economics	14	-	Q4
Journal of Public Economics	16	-	Q1
International Economic Journal	16	-	Q3

Sources: developed by authors.

One of the first scientific papers to investigate the shadow economy, which was indexed by the Scopus database, was Werlin (1974). The author examined the possibilities of Kenya to implement the recommendations of the International Labor Organization to combat the shadow economy. Becker (1968) examined the peculiarities of implementing operations in the formal and shadow sectors of the economy, substantiating the differences between formal and informal activities.

The bibliometric analysis of the connection of the shadow economy with other categories conducted with the help of VOSviewer tools allowed concluding the significant connection of shadowing with economic categories (Fig. 6). The bibliometric analysis singled out the main theories describing the shadow economy:

1. Innovation theory – explains the phenomenon of the shadow economy by the decrease in indicators of the country's economic development as a result of an ineffective system of state management of the economy and the use of outdated methods of managing economic development. According to the supporters of this theory, the implementation of the policy of de-shading economy should involve the application of innovative methods of economic management and control over the activities of economic entities.

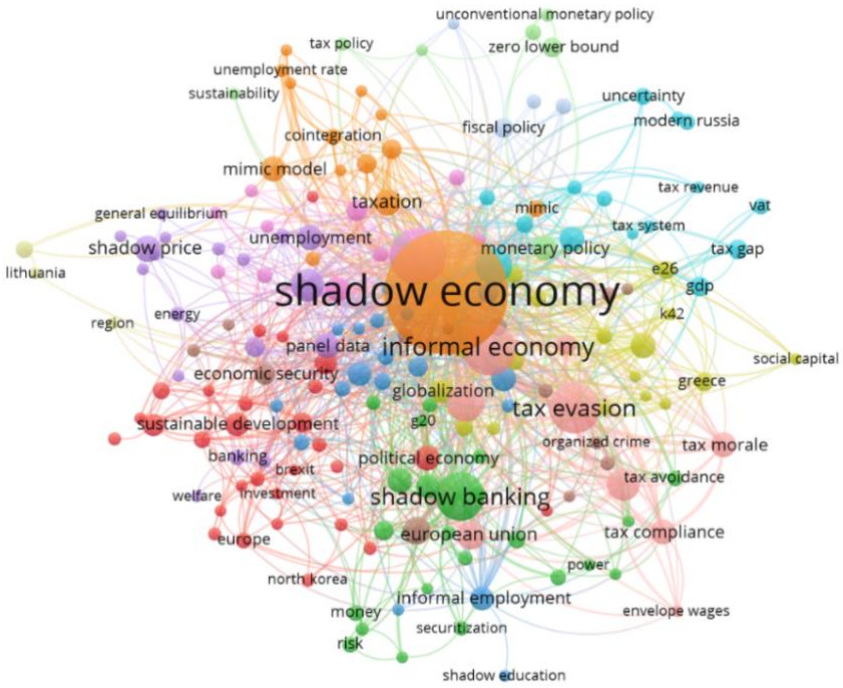

Figure 6. Visualization of the connection of the shadow economy with economic categories.
Source: developed by authors.

2. The theory of centralization explains the shadow economy by the significant level of centralization and liberalization in the country. The transfer of a significant number of powers to local authorities allows to improve the quality of the processes of state regulation of the economy, monitoring, and control over the movement of funds, to reduce the labor-intensiveness of the processes of filling out tax and financial reporting, and to avoid bureaucratization in the country.

3. Institutional theory – proponents of this theory consider the shadow economy as a consequence of ineffective work of state authorities, a gap between actual and declared norms of behavior in society.

Thus, the bibliometric analysis results testify to scientists' significant interest in these issues and the connection of the shadow economy with several economic categories.

One of the aspects of the study of the shadow market is the analysis of its structure and the identification of key participants in shadow operations. Financial intermediaries play a key role in this. Using the example of Nigeria, Julius Otusanya et al. (2012) investigated the role of financial intermediaries in money laundering, regardless of their profession and ethical qualities. Based on the results of the study, the authors concluded that successful laundering of significant amounts of money is impossible without the involvement of financial intermediaries (such as bankers and lawyers) who use their expertise to hide funds and illegal activities. Financial intermediaries create structures that support illegal activities by pursuing organizational and personal interests. The role of banking institutions in the functioning of the shadow sector has been investigated in the papers of a significant number of authors (Mirjalili et al., 2021; Doyle et al., 2021; Farhi and Tirole, 2017 and others). Thus, in the work of Mirjalili et al. (2021), based on the data of 14 G20 countries during 2002-2018, a quantile regression equation was constructed. According to the simulation results, the authors concluded that shadow banking activity negatively affects the financial stability of countries with a high index of shadow banking activity (countries of the fourth group). At the same time, this activity does not significantly affect the financial stability of countries with a low level of shadow banking.

Ozgur (2021) analyzed the nature of shadow banking and its impact on bank lending conditions in the United States. The author researched the most common instruments of shadow credit intermediation and formalized indicators of shadow banking activity. Using Markov switching models and vector autoregression, the author concluded that shadow banking activity is positively related to bank lending in expansion phases and negatively in contraction phases. In addition, it is proven that shadow banking positively affects the risk premium and negatively affects the term spread.

Hepfer et al. (2016) emphasized the active use of shadow insurance tools by insurance companies in life insurance transactions. It allows companies to free up cash for shareholder payments, investments, and compensation, a significant amount of liquid assets that are held as reserves for paying insurance claims. At

the same time, the authors claimed that shadow insurance operations create significant financial risks and are a significant threat to the country's economy as a whole. The implementation of shadow insurance mechanisms is based on the authors' significant tax savings: an increase in the volume of shadow insurance by one position would decrease the effective tax rate by 3.72 (2.67) percentage points.

In evaluating the impact of individual components of state policy on the indicators of the shadow sector, there is a need to study the specifics of the formation and implementation of the policy of combating shadow financial transactions by the state.

Methodology and research methods. Through scenario modeling, the formalization of innovative strategies to counter the shadow withdrawal of capital with the participation of financial intermediaries would be done. The World Bank and the Organization for Economic Cooperation and Development data, the Group for the Development of Financial Measures to Combat Money Laundering (FATF), Transparency International, and the World Economic Forum serve as the information base of the study. The period of the study is 2003-2021. The object of the study is the EU countries and Ukraine, Moldova, and Montenegro, as candidate countries for EU membership. The methodological tools of the research are Stata and Statista software packages.

In the first stage of modeling the innovative scenarios of reforming the state policy of combating the participation of financial intermediaries in shadow transactions, the indicators that most fully characterize individual components of this policy would be formalized.Thus, the following groups of indicators were included in the statistical input base of the study: 1) indicators characterizing state policy's effectiveness in counteracting the shadow withdrawal of capital in terms of its institutional and financial components, the coherence of the country's interests, and economic entities (Boyko et al., 2021; Kuzior et al., 2021). This group of indicators includes: the rate of change in the level of the shadow economy (SE), the rate of change in costs for financing measures to de-shadow the economy (FIN), the rate of change in the effectiveness of the financial monitoring process (FM), the rate of change in the amount of accrued and paid fines (PS); 2) indicators reflecting the effectiveness of the state anti-money laundering policy. As indicators characterizing this component, the value of the Basel AML Index Score will be used to assess the risks of money laundering and terrorist financing. The calculation of this index is based on the consideration of 17 sub-indices divided into five categories according to five key factors: Quality of AML/CTF Framework (65%); 3) Corruption and Bribery Risk (10%); 4) Financial Transparency and Standards (10%); 5) Public Transparency and Accountability (5%); 5) Political and Legal Risks (10%). The information base is based on data from 17 sources, including the Financial Action Task Force (FATF), Transparency International, the World Bank, and the World Economic Forum (FATF, 2013; 2022).

At the next stage of the study, an assessment of the impact of indicators characterizing individual components of state policy on the effectiveness of strategies to combat shadow withdrawal of funds was carried out: corruption index, time spent on paying taxes, level of digitalization of the economy, index of tax progressivity, level of the tax burden. The basis of modeling the strategy of countering the shadowing economy is the selection of country clusters based on the proximity of their policies and their ability to achieve the desired result. With the help of agglomerative methods of minimum dispersion, the optimal number of country clusters was determined. The application of this method involves several stages:

- normalization of initial data;
- calculation of distance matrix or matrix of similarity measures;
- each object is considered as a separate cluster, after which a pair of nearest clusters was sequentially merged. The new cluster is assigned the smaller number of the connecting clusters;
- the steps are repeated until all objects are combined into one cluster or until a given similarity «threshold» is reached.

At the next stage of the clustering procedure, the entire set of objects is organized into relatively homogeneous groups using the k-means method. The basis of using this method is the minimization of the total quadratic deviation of cluster points from their centers:

$$V = \sum_{i=1}^{k} \sum_{x \epsilon S_i} (x - \mu_i)^2 \quad (1)$$

where k is the number of clusters S_i are the obtained clusters, = 1, 2, …, k and μ_i are the centers of mass of all vectors x from the cluster S_i.

At the same time, the center of each of the formed clusters would be determined using the distance sorting method and the selection of observations at constant intervals:

$$\mu_i = \frac{1}{S_i}\sum_{x^{(j)}es_i} x^{(j)} \quad (2)$$

An important component of the country clustering procedure is determining the optimal number of clusters that meet the criterion of maximum approximation of countries' policies within one cluster. When determining the number of clusters into which countries would be divided, the following components must be taken into account: the maximum value of Fisher's criterion; approximation of the probability of rejection of the null hypothesis to the zero value; the minimum index of intragroup variance and the maximum value of intergroup variance. The description of the portraits of the formed clusters was carried out using the method of one-dimensional branching CART, the use of which involves the following procedures:

1. Determination of criteria for assessing the accuracy of the received forecast (equal a priori probability method).
2. Construction of a classification tree and selection of its branching options.
3. Determination of the criteria by which the branching procedure is terminated (FACT method).
4. Determination of the required size of the classification tree (global cross-checking method).

Results. At the initial stage of modeling innovative scenarios for countering income shadowing, the study clustered countries according to the most similar scenarios of state policy reform. A comparative analysis of the values of intergroup and intragroup characteristics of dispersion allowed us to conclude the expediency of grouping countries into 3 clusters (Table 2).

Table 2. Fragment of the results of dispersion analysis of country clustering

Variable	BetweenSS	df	WithinSS	df	F	signif.p
SE	0.398221	2	0.856782	28	4.904813	0.00010
FIN	0.694106	2	0.403938	28	18.13343	0.00000
FM	0.318027	2	0.19294	28	17.39451	0.00000
PS	0.232173	2	0.384803	28	6.367069	0.00001
AML1	0.242997	2	0.517342	28	4.956684	0.00009
AML2	0.555260	2	0.714014	28	8.206428	0.00000
AML3	0.184289	2	0.497909	28	3.905927	0.00054
AML4	40.12782	2	6.887821	28	61.47981	0.00000
AML5	1.001882	2	0.633383	28	16.69237	0.00000
AML6	1.189501	2	0.751566	28	16.70186	0.00000
AML7	0.894863	2	0.600525	28	15.72501	0.00000
AML8	1.059731	2	0.712675	28	15.69177	0.00000
AML9	1.518639	2	0.654016	28	24.50397	0.00000
AML10	1.691994	2	0.713667	28	25.01922	0.00000
AML11	1.664311	2	0.742154	28	23.66514	0.00000
AML12	0.465974	2	1.002553	28	5.739308	0.00012
AML13	0.812200	2	0.472663	28	21.21862	0.00000
AML14	0.372136	2	0.225767	28	20.35398	0.00000
AML15	0.271674	2	0.450272	28	7.450350	0.00001
AML16	0.284340	2	0.605362	28	5.800005	0.00011
AML17	0.649730	2	0.835496	28	9.602653	0.00000

Note: AML1 – FATF Mutual Evaluation Reports; AML2 –Tax Justice Network Financial Secrecy Index; AML3 – US State Department International Narcotics Control Strategy Report; AML4 – US State Department Trafficking in Persons (TIP) Report; AML5 – Transparency International Corruption Perceptions Index; AML6 – TRACE Bribery Risk Matrix; AML7 – World Bank Extent of Corporate Transparency Index; AML8 – WEF Global Competitiveness Report – Strength of auditing and reporting standards; AML9 – World Bank IDA Resource Allocation Index – Financial sector regulations; AML10 – International Budget Partnership Open Budget Index – Budget transparency score; AML11 - International IDEA Political Finance Database – Political disclosure; AML12 – World Bank IDA Resource Allocation Index – Transparency, accountability and corruption in the public sector; AML13 – WEF Global Competitiveness Report – Institutional pillar; AML14 – World Justice Project Rule of Law Index; AML15 - Freedom House: Freedom in the World – political rights and civil liberties; AML16 – WEF Global Competitiveness Report – Judicial independence; AML17 – Reporters Without Borders: Press Freedom Index

Sources: developed by authors based on Basel Institute on Governance (2022) and International Monetary Fund (2022) data.

It ensured the high quality of the grouping of countries and exceeded the critical value of the p-level (0.05) over the calculated one. Thus, when dividing countries into 4 clusters for indicators SE, AML1, AML4, AML5, AML8, AML11, AML12, AML13, AML15, and AML17, the estimated values exceed the critical (0.05), while for the rest of the indicators, the values obtained were marginal to critical. At the same time,

when selecting 5 clusters, the values of the FIN, PS, AML2, AML3, AML5, AML9, AML10, and AML14 indicators exceed critical values.

The results of grouping countries using the iterative divisive method of k-means and tree-like clustering according to the most relevant scenarios of state policy reform allow forming the following structure of countries: 1 cluster – 9 countries; cluster 2 – 14 countries; Cluster 3 – 7 countries.

- Cluster 1: Cyprus, Czech Republic, Denmark, Finland, Greece, Ireland, Italy, Luxembourg, Portugal.
- Cluster 2: Bulgaria, Croatia, Estonia, France, Malta, Netherlands, Spain, Sweden, Belgium, Greece, Austria, Hungary, Slovak Republic, Slovenia.
- Cluster 3: Lithuania, Latvia, Romania, Poland, Moldova, Montenegro, Ukraine.

Figure 7 visualizes the results of the grouping of EU countries and EU candidate countries.

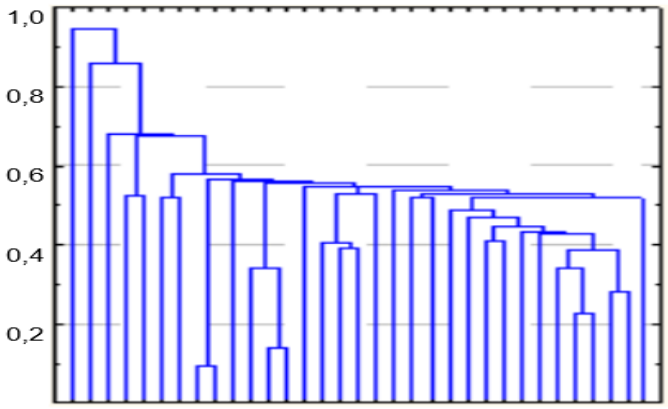

Figure 7. Tree of the hierarchical structure of clusters of countries according to the scenarios of the implementation of the policy of countering the shadowing economy with the participation of financial intermediaries

Sources: developed by authors.

At the next stage of clustering countries, the main criteria for implementing the state policy of combating income shadowing were determined. The basis of this process is the determination, using agglomerative methods, of the limit values of the analyzed indicators. This contributes to the formalization of the key vectors of formatting and implementing the policy of the de-shadow economy within each of the formed clusters (Table 3), in particular:

1) within the indicators characterizing the institutional and financial components of the effectiveness of the state policy of combating shadow withdrawal of capital, the coherence of the interests of the country and economic entities, the average values of the rates of change in costs for financing measures to combat the shadowing of the economy, the effectiveness of the financial monitoring process, the amounts of accrued and paid of fines in the countries of the 1st cluster are the lowest and increases when moving from the 1st to the 3rd cluster. At the same time, the average values of the rates of change in the level of shadowing of the economy are the highest in the countries of the 1st cluster;

2) within the indicators reflecting the effectiveness of the state anti-money laundering policy, the average values of indicators AML4, AML5, AML6 for countries belonging to cluster 1 are the highest. The rest of the indicators are characterized by downward dynamics – the average values gradually decrease when moving from the 1st to the 3rd cluster.

Table 3. Clustering of countries according to key vectors of the formation and implementation of the policy of de-shadow economy

Variable	Cluster 1	Cluster 2	Cluster 3
1	2	3	4
SE	0.371485	0.252728	0.124314
FIN	6.109604	6.183632	7.023473
FM	0.260176	0.405958	0.543175
PS	0.24677	0.26669	0.30732
AML1	0.22263	0.35620	0.41557
AML2	0.23747	0.41906	0.50462
AML3	0.17810	0.32477	0.32652

Continued Table 3

1	2	3	4
AML4	0.32652	0.30382	0.19294
AML5	0.33510	0.23048	0.17810
AML6	0.44525	0.33525	0.23747
AML7	0.19294	0.27239	0.26715
AML8	0.19764	0.31622	0.36893
AML9	0.21082	0.37203	0.44798
AML10	0.15811	0.28832	0.29125
AML11	0.17129	0.26972	0.31254
AML12	0.18452	0.20461	0.22432
AML13	0.22947	0.29762	0.39528
AML14	0.16973	0.24182	0.23717
AML15	0.19452	0.31123	0.36310
AML16	0.20749	0.36615	0.44091
AML17	0.15561	0.28377	0.28529

Sources: developed by authors

An equally important stage of country clustering is constructing a classification tree, which allows formalizing the portraits of each selected cluster. For this purpose, using the construction of classification trees, this study evaluated the parameters of the classification tree of countries considering the most relevant indicators of the effectiveness of the policy of countering the shadowing of the economy of the EU member countries and countries-candidate for joining the EU (table 4).

Table 4. Classification tree structure according to the scenarios of implementation of the policy of countering shadowing of the economy

Node	Left Branch	Right Branch	N in cls Cluster1	N in cls Cluster2	N in cls Cluster3	Predict. Class	Split constant	Split variable
1	2	3	24	34	30	Cluster1	0.2254	AML5
2	4	5	24	6	0	Cluster3	0.2254	AML3
3	6	7	0	28	30	Cluster2	0.3477	AML3
4			16	0	0	Cluster2		
5	8	9	8	6	0	Cluster3	0.2254	AML1
6	10	11	0	16	6	Cluster1	0.2254	AML2
7	12	13	0	12	24	Cluster2	0.2254	AML6
8	14	15	4	6	0	Cluster1	0.2254	AML7
9	16	17	4	0	0	Cluster2	0.2254	AML2
10			0	10	0	Cluster3		
11	18	19	0	6	6	Cluster3	0.3477	AML1
12	20	21	0	6	2	Cluster2	0.2254	AML1
13	22	23	0	6	22	Cluster6	0.2254	AML3
14			2	6	0	Cluster2		
15			2	0	0	Cluster1		
16			4	0	0	Cluster1		
17			0	0	0	Cluster2		
18	24	25	0	6	4	Cluster1	0.3477	AML1
19	26	27	0	0	2	Cluster3	0.2254	AML6
20			0	0	2	Cluster3		

Sources: developed by authors.

Table 4 shows the parameters for building a classification tree according to the scenarios of the implementation of the policy of countering the shadowing economy, allowing conclude that the left and right branches of the tree should contain thirteen nodes each (the numbers of the left branch: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26; numbers of the right: 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27). Based on the results of the calculations, it could be concluded that the first cluster includes 9 countries, the second – 7, and the third – 15. The distribution of countries by vertices 2 and 3 should be based on the values of the AML1 variable. For countries in cluster 1, its value should not exceed 0.2254, while for cluster 4 the obtained value should exceed 0.2254. Further assignment of the country to cluster 1 is based on taking into account the values of the AML2 variable, which should not exceed 0.2254. In the next stage, the AML8 indicator was

analyzed. Thus, if this indicator exceeds the value of 0.2254, the country could be assigned to cluster 1. Otherwise, it should be assigned to cluster 2. The value of the variable AML5 is used to divide countries into the first and third clusters, which, similarly to the previous indicators, should not exceed 0.2254 for cluster 1, and be greater than the given value for cluster 3.

The last stage of formalizing the scenarios for implementing the state policy of countering the shadowing of the economy should be the assessment of the degree of importance of each of the analyzed indicators for the process of clustering countries. Figure 8 shows the results of the ranking of indicators depending on their weight in this process, allowing conclude that the greatest impact on the clustering processes of countries is exerted by AML5 (100 points), AML11 (97 points), AML15 (95 points), AML11 (94 points). At the same time, the level of shadowing economy (26 points) and AML2 (23 points) exert the least influence on these processes.

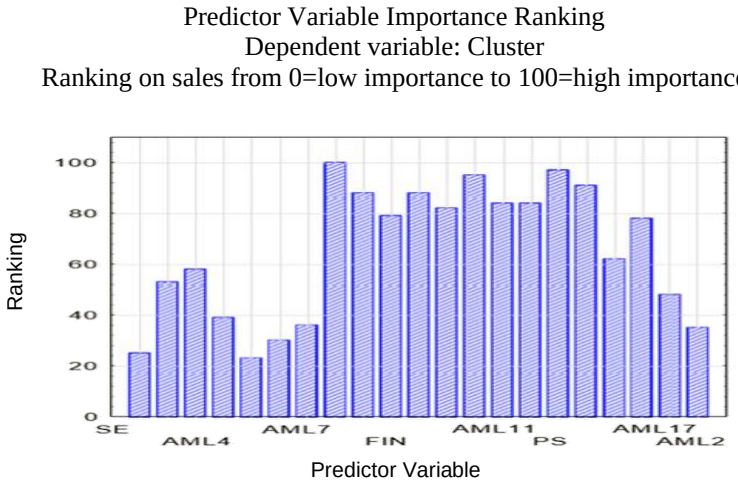

Figure 8. Ranking indicators according to the degree of influence on the clustering countries according to scenarios of shadowing economy

Sources: developed by authors.

Thus, the obtained results form the basis for the formalization of the key vectors of the implementing state policy of countering the shadowing economy, depending on the country's belonging to the corresponding cluster and its ability to move, based on the results of the implemented measures, to another (with improved characteristics). At the same time, the entire set of innovative scenarios for the implementation of the policy of de-shadow economy could be divided into the following categories

- evolutionary scenario – a scenario in which there is no significant change in the values of policy effectiveness indicators and, accordingly, a transition to another cluster;
- the scenario of sequential transformation – a scenario based on the results of which the country changes its position by 1 cluster;
- the forced scenario – a scenario in which the change in indicators of state policy effectiveness occurs fairly fast, and the country itself (according to its indicators) can immediately move from the first to the third cluster.

Conclusions. This study is devoted to the analysis of the problem of a high level of the shadow economy and the active involvement of financial intermediaries in these operations. The bibliographic analysis of scientific works on these issues proved the relevance of revising and formalizing a set of tools for implementing the policy of countering the shadowing economy, considering the indicators of its effectiveness and financial indicators of developing economy and indicators of the quality of the functioning of the institutional environment in the country.

Based on the analysis of scientific works, a list of indicators characterizing individual components of the state policy of countering shadowing was formed. Thus, the information base of the study was served by indicators of the effectiveness of the institutional and financial components of the state policy of combating shadow capital withdrawal (the rate of change in the level of shadowing of the economy, the rate of change in costs for financing measures to combat the shadowing of the economy, the level of change in the effectiveness of the financial monitoring process, the rate of change in the amount of accrued and paid fines sanctions, and 17 performance indicators of the state anti-money laundering policy.

Based on the results of the analysis of the impact of these indicators on the vectors of the implementation of the policy of the de-shadow economy, a clustering of the EU countries and 4 candidate countries for EU membership was carried out. That made it possible to form three clusters of countries based on scenarios of the de-shadow economy (Cluster 1 – Cyprus, Czech Republic, Denmark, Finland, Greece, Ireland, Italy, Luxembourg, Portugal; Cluster 2 – Bulgaria, Croatia, Estonia, France, Malta, Netherlands, Spain, Sweden, Belgium, Greece, Austria, Hungary, Slovak Republic, Slovenia; Cluster 3 – Lithuania, Latvia, Romania, Poland, Moldova, Montenegro, Ukraine).

Using the construction of a classification tree, the indicators were ranked within the indicators characterizing individual components of the state policy of countering shadowing and indicators that determine the effectiveness of the institutional and financial components of the state policy of countering shadow withdrawal of capital, their components according to the degree of their influence on the grouping of countries. Based on the results of the analysis, it was concluded that the indicators AML5 (100 points), AML11 (97 points), AML15 (95 points), and AML11 (94 points) exert the greatest influence on the processes of clustering countries. At the same time, the level of shadowing of the economy (26 points) and AML2 (23 points) exert the least influence on these processes.

In general, the obtained results made it possible to distinguish 3 types of innovative scenarios for implementing the policy of the de-shadowing economy (evolutionary scenario, sequential transformation scenario, forced scenario), the nature of which determines the rate of change in the main indicators of the development of the shadow sector of the economy and their sensitivity to the measures implemented in the country.

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Менеджмент інновацій в сфері державного управління: стратегії запобігання участі фінансових посередників у тіньових схемах

Ця стаття узагальнює аргументи та контраргументи в межах наукової дискусії з питань удосконалення інструментарію державного управління в контексті застосування інноваційних механізмів протидії тіньовим фінансовим операціям. Основною метою проведеного дослідження є формалізація інноваційних стратегій протидії тіньовому виведенню капіталу за участю фінансових посередників. Систематизація літературних джерел та підходів до проблеми детінізації економіки засвідчила, що характерною особливістю функціонування тіньового ринку є активна участь фінансових посередників у тіньових операціях. Інформаційною базою дослідження є дані Світового банку та Організації економічного співробітництва та розвитку, Групи з розробки фінансових заходів для боротьби з відмиванням грошей, Міжнародного транспарентного а Всесвітнього економічного форумів. Періодом дослідження є 2003-2021 рр. Об'єктом дослідження є обрані країни ЄС, Україна, Молдова та Чорногорія, як країни-кандидати на членство в ЄС. Методичним інструментарієм проведеного дослідження стали методи бібліометричного аналізу для узагальнення наявного наукового доробку з даної проблематики, аналізу зміни кількості пошукових запитів з проблем тінізації економіки, кластеризації регіонів за кількістю пошукових запитів з питань тіньової економіки. Методи інтелектуального аналізу даних (метод одновимірного розгалуження CART та методи агломерації) застосовано для кластеризації країн залежно від характеру політики детінізації економіки. За результатами бібліометричного аналізу узагальнено теорії, що описують тіньову економіку, зокрема: теорія інновацій, теорія централізації, інституційна теорія. У статті представлені результати кластерного аналізу, який засвідчив доцільність виділення трьох кластерів країн: кластер 1 – Кіпр, Чехія, Данія, Фінляндія, Греція, Ірландія, Італія, Люксембург, Португалія; кластер 2 – Болгарія, Хорватія, Естонія, Франція, Мальта, Нідерланди, Іспанія, Швеція, Бельгія, Греція, Австрія, Угорщина, Словаччина, Словенія; кластер 3 – Литва, Латвія, Румунія, Польща, Молдова, Чорногорія, Україна. Дослідження емпірично підтверджує та теоретично доводить, що всю сукупність інноваційних сценаріїв реалізації політики детінізації економіки можна розділити на три типи (еволюційний сценарій, сценарій послідовної трансформації, форсований сценарій), залежно від швидкості зміни показників розвитку тіньового сектору економіки та їх чутливості до заходів, що реалізуються.

Ключові слова: тіньова економіка, фінансові посередники, інноваційні стратегії, інновації в державному управлінні, моделювання, інноваційний розвиток.