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RISK ASSESSMENT OF THE BANK'S INVOLVEMENT IN LEGALIZATION OF QUESTIONABLE INCOME CONSIDERING THE INFLUENCE OF FINTECH INNOVATIONS IMPLEMENTATION

The article is devoted to the formation of a methodical approach to the risk assessment of bank services use to legalize questionable income considering the influence the of FinTech innovations rapid development and their active implementation by banks. Microeconomic factors groups, which influence the bank clients' illegal incomes legalization processes are proposed. In the context of it, there were formed the measurement indicators regarding microeconomic interbank and microeconomic client factors. The assessment is proposed to be carried out in the following areas: firstly, integral assessment using questionnaires and taxonomy methods of the bank's system for prevention and counteraction of the income legalization as an environment, where money laundering appears potentially; secondly, statistic analysis regarding the dynamics of the existed indices of banking operations amounts, which have a higher risk of implementation for legalization; and thirdly, an assessment of the banks' activity in terms of FinTech innovations implementation. The results of the proposed methodological approach allow us to form a two-dimensional matrix structure, which divides banks into groups with a maximum, minimum and moderate risk of their use for money laundering. It was proved that the calculation regarding statistic features of cash turnovers dynamics and bank clients' funds on the current accounts enables to analyze the degree of unsystematic factors' influence, as one of the risk indicators to use banking services with purpose to legalize the illegal incomes, that is a base to improve the internal financial monitoring system in the Ukrainian banks. Next research will focus on the checking the hypothesis regarding the fact that more active banks from the viewpoint of FinTech innovations introduction are less vulnerable in relation to their involvement in the money laundering.

Keywords**:** the risk of questionable income legalization, money laundering, FinTech innovations, prevention and counteraction of the money laundering.

Problem statement. The problem of illegal incomes legalization and assessment of risks, related to this process, is very important for the monetary system stable functioning in any country in the world. The counteraction of the money laundering and active prevention from the questionable income legalization is

an important problem for Ukraine as a state, which requires financial support from international financial organizations and cooperations, to strengthen financial discipline and to increase image.

A special place among all initial financial monitoring subjects is taken by banks, because during 2011-2017 the specific weight of messages about risky and suspicious financial operations, sent by banks, makes 96-99 % of the total number of messages. At the same time, banks by number make only 0.9 % of the total number of initial financial monitoring subjects. Thus, the problem to assess the money laundering risk through this or that bank is urgent and has an essential practical significance. Despite the importance systematically to assess illegal incomes legalization risks through banks, which are key financial mediators, nowadays as in the international practice, in particular such organizations as FATF, Eurasian group of illegal incomes legalization counteraction and financial terrorism (EAG), Financial Crimes Enforcement Network of the Ministry of Finances of the UAS (FINCEN), Department of the Interpol General Secretary, which is engaged in the counteraction of the illegal income laundering. There is no officially approved or recommended technique to assess the risk of the bank's involvement in the money laundering in Ukraine. As a result, the formation of the methodical approach to assessing the risk of banking services implementation for the questionable income legalization taking into account the rapid development of the FinTech industry becomes greatly an urgent task.

Analysis of the recent researches and publications. There are different techniques to assess the risk of money laundering and terrorism financing at the banking institutions, in the scientific literature, but despite a great number of the scientific investigations, one has to mention that most of them are based on the data, that is the insider information for bank and is a banking secret for external users. In the article [27] one points out the absence of appropriate approaches to assess money laundering risks in the international practice and, respectively, a reliable evaluation of the system efficiency to counteract them. Besides, M. Levy with collective of authors (M. Levy, P. Reuter, T. Halliday, 2018) made a conclusion that "risks of money laundering and terrorism financing are hardly quantitatively measured" [27, p. 309], thus, most methodic approaches is based on scoring and expert evaluation.

I. M. Chmutova, I. O. Tkachova in the article [20] propose to use the reserved index as an operational risk and reliability rate to express operational and reputational risks, to assess money laundering and terrorism financing risk. Therefore, the operational risk reserve depends on the level of bank incomes. Thus, the relationship between the level of the bank's income and risk of its services use for the illegal money legalization, has not been proved.

In monograph [4] the authors propose to assess the risk of the banking services use for the illegal income legalization or terrorism financing through Bayes analysis. As the outgoing information to calculate the probability of risks to use banking operations for the questionable income legalization, authors suggest the ratio between number of indicators with deviation from the norm and 20 indicators, defined by authors for analysis of risk to use banking services for the illegal incomes legalization or terrorism financing, assessed by the binary method (0 – within the norm, 1 – with deviation from the norm). Therefore, there is a question regarding equivalency of the above indicators' influence on the risk of banking services for illegal incomes legalization, and adequacy of the normative' evaluation by every indicator.

O. O. Hlushchenko and I.B. Semegen (O. O. Hluschenko, I. B. Semegen, 2014) propose an approach, based on the statistic analysis of the messages, registered by banks as dubious ones with respect to the money legalization (laundering) [3, p. 226-237], and a qualitative approach – an expert assessment of risk by the bank worker through implementation of the legalization risks matrix [3, p. 281-283]. Therefore, the impact of dubious operations number, registered by the bank, on the total level of risk to carry out such operations, has not been defined.

O. V. Smahlo (O. V. Smahlo, 2015) [18] suggests an approach to assess the illegal incomes legalization risk, based on the risks scoring, with the help of 15 indicators, which take into account some aspects of the dubious financial operations and staff participation in the money laundering. However, the

approach of O. V. Smahlo does not take into account such important factors of risk as an availability and quality of the internal control, results of external audit inspections, the staff competence.

In S. O. Dmytrov's opinion (S. O. Dmytrov, 2010) the risk to involve the bank in the illegal money laundering, has two main components [4, p. 51]: risk of dubious transactions; risk of the requirements violation of the relevant legislation. Such risk factors as staff (conscious or unconscious participation), bank administration, informational systems of the bank and their setup are not observed.

According to legislation [15-17], the risk level to use a bank with the purpose of money laundering is defined individually by the bank. Besides, high risk to use banking services for the illegal incomes legalization may be a reason to include the bank to the plan of on-site inspections by NBU, so that is why banks may develop such methods of risk assessment, which will not give effective results, and, thus, will not be enough adequate.

In the monograph [11, p. 194] one affirms that in Ukraine it is much easier and more beneficial to launder money via small banks (with assets up to 5 billion UAH), than via large banks. In fact, according to the NBU data [12], during December 2017 - July 2018 62.5% of remarks regarding violation of the financing monitoring legislation relate to the small banks. Moreover, one should mention that 37.5% of such remarks relate to large banks, 18.75% of them to banks with assets over 20 billion UAH, and thus, operations of such banks may absolutely exceed operations of small banks.

Unsolved aspects of the general problem. Analysis of the recent practices shows that the current methodic approaches to assess the risk of the bank's involvement in the money laundering do not consider such factors as the staff competence, setup and control of the informational systems, the role of corporate governance bodies and the internal financial monitoring and reporting about operations. None of the analyzed techniques distinguishes such factor as a rapid development of the financial technologies and their influence on the counteraction processes to the illegal incomes legalization.

The aim of the article is to form the methodical approach to assess the risk of bank's involvement in its clients' questionable incomes legalization taking into account the influence, caused by rapid development of the financial technologies and their introduction activity by the bank.

In order to achieve this aim, it is necessary to solve the following **tasks**:

1. to distinguish factors, which greatly influence the risk to use banking services for illegal incomes legalization;

2. to measure and to evaluate the above factors taking into account the specific nature of the bank work;

3. to carry out retrospective statistic analysis of bank operations, which are potentially vulnerable from the viewpoint of money laundering;

4. to group banks by the level of risk to involve them in the illegal incomes legalization processes.

The object of the study is the process to assess the risk of the bank's involvement in the illegal incomes legalization processes.

The subject of the study includes factors of the illegal incomes legalization, indicators, which measure them, bank operations, which are potentially vulnerable from the viewpoint of legalization, the role and impact of FinTech innovations on the processes to prevent and to counteract the money laundering.

The methodology of the research. In order to solve the set tasks, the following methods of the research are used: generalization, logical analysis and structuring – to form a group of factors of bank clients' illegal incomes legalization; questionnaire, expert assessment, taxonomic analysis – to create the integral indicator of intrabank factors influence on the incomes legalization processes; method of the time series statistic features analysis to calculate risk indicators of the banking services use for the illegal incomes legalization; matrix method – to group banks by the level of risk to involve in the money laundering processes.

Main material. 1. Formation of the factors to legalize bank clients' illegal incomes, their

measurement and assessment.

The risk to be involved in the money laundering process is inherent for any bank. Factors, which influence the bank's activity and the illegal money laundering processes should be subdivided into three big groups: macroeconomic factors, which cannot be influenced by the bank; microeconomic intrabank and microeconomic client factors. The macroeconomic factors are the same for the Ukrainian banks. They are described in more detail in the work [2]. That is why it is not reasonable to take into account the macroeconomic factors in the risk assessment process to involve the bank in the money laundering process. More detail information regarding microeconomic intrabank and microeconomic client factors, and also indicators and features, through which these factors may be measured, is shown in table 1.

Table 1 – **Microeconomic factors groups, which influence the bank clients' illegal incomes legalization processes** (it is investigated by authors)

Title of the factors group	Title of the factors subgroup	Title of the factor	Measurement indicators
1	2	3	4
Client	Factors of legal entities	Type of activity	The qualitative indicator: legal entities, which work in the sphere of property privatization, state procurement, large-scale infrastructure projects, mining, health care, assistance for the development of security sectors, defence and military operations
		Beneficiary owners	Qualitative indicator: legal entities, owners of which consist of politicians, officials, close relatives of the mentioned clients' categories, their trustees (representatives of interests, companies which manage wealth, relatives, who are residents of other countries)
	Factors of individuals	Sphere of the main activity	Qualitative indicator: public and political figures, including foreign states, officials, their close relatives; the number of officials in the state; the number of bank clients with a special status
Intrabank	Work with clients	Order to identify and to study the client	Qualitative indicators of the order to identify and to study clients, processes of clients' risks classification during the study of clients, monitoring of clients' payments, fixing of the financial operations aim and character, in the bank.
	Financial monitoring	Monitoring and reporting about financial operations	Qualitative indicators of requirements regarding the client's financial operations monitoring, analysis of the client's behaviour as for suspicious actions, requirements of the intensive monitoring of the clients' financial operations with high risk etc
		Risks management	Qualitative indicators of the risk management function in the internal documents on money laundering counteraction in the bank; the order to analyze the illegal incomes legalization risk in the bank, the frequency of such analysis conduct
	Risks management	Compliance	Qualitative indicator, which shows the complex of measures and a mechanism to monitor changes in legislation regarding anti-money laundering and terrorist financing standards and their introduction in the internal documents; the program on compliance-risk management on financial monitoring has been approved.

Table 1

Title of the factors group	Title of the factors subgroup	Title of the factor	Measurement indicators
Intrabank	Management	The staff competence	Frequency to carry out studies on the problem of money laundering, percentage of the bank workers, who participate in the study, special education programs regarding the counteraction of illegal incomes legalization etc
		Corporate management and the role of the bank administration	Internal documents on financial monitoring, which are approved in a proper manner in the bank; frequency of internal documents review on the financial monitoring; availability and frequency to organize meetings by bank administration with proper workers or bank units whether programs of the illegal incomes legalization counteraction are effectively introduced
	Control and audit	Internal control, internal and external audit	The frequency of the internal audit inspections regarding legislation demands fulfilment in the bank; drawbacks, revealed by NBU in the work of the bank internal audit subdivision during the last three years; the internal audit functions considering the existed risks
Intrabank	Informational systems and technologies	Saving of documents and information	Qualitative indicators of existence (or absence) of procedures regarding fixation of documents receiving and information saving; terms and forms to save information; the procedure to receive 5-years old information and/or documents as for the concrete client
		Control of informational systems, including the FinTech innovations introduction	Number of automated (built in the ABS of the bank) elements, which fix: situations, when the relationship with the client has not been established or has been broken, inspection of clients by the database of the bank, determination of situations when there is no information regarding identification and study of the clients; The frequency of FinTech innovations introduction, expenses for FinTech innovations introduction in the total sum of bank expenses

If one observes intrabank factors as some components (table 1), they together form the system to prevent and counteract the bank clients' questionable incomes legalization, assessed with the help of a questionnaire, involving experts from active Ukrainian banks and taxonomic analysis of the questionnaire results.

The banks for analysis are selected, based on the results of their grouping by the financial activity features, which are described in more detail in [9]. The grouping results clearly define the group of banks, the activity of which is oriented to the cash operations service and current accounts: PJSC "OTPBank", PJSC "Rayffayzen Bank Aval", PJSC "Ukssibbank", PJSC «MTB Bank» (PJSC "Marfin" Bank"), PJSC "Praveks-Bank". As of 01.07.2018 the share of money on the individuals' and legal entities' bank accounts of the mentioned group of banks makes on average 72.5% of obligations [9]. Such a great amount of money on the bank accounts additionally increases the risk of the bank financial state worsening as a result of risk realization to use banking services for the illegal incomes legalization. Thus, the above banks are chosen for the further research. Hereinafter in the article, the banks' titles are hidden because the information sources for assessment have banking secrecy, and the assessment results may indirectly hurt the image and stability of the bank.

In order to assess the intrabank factors, which show the state of the system to prevent and to counteract the illegal incomes legalization, there was a questionnaire among experts from the above banks, the results are generalized. The total number of scores, received after questionnaire evaluation regarding the system to prevent and counteract the bank clients' illegal incomes by the constituents (subgroups of factors, shown in table1) is demonstrated in table 2.

Constituent	Scores of answers to the questions by banks					
	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Maximum value
1	26.8	25.4	27.5	29	22.4	32
2	6.1	2.5	6.1	5.2	5.2	7
3	7.3	5.4	7.2	6.4	5.5	10
4	7.3	7.9	6.8	6.4	6.9	10
5	4.1	2.2	4.1	4.1	3.2	6
6	5.3	7.4	3.4	6.8	5.6	10
7	5.2	4.1	2.3	7	4.2	8
8	10.6	9.6	9.8	9.3	8.9	12
9	4.6	1	3.7	3.1	3.2	7

In order to obtain the integral indicator by the questionnaire constituents and integral evaluation of the system to prevent and to counteract the bank clients' illegal incomes legalization, the formula 1 is used, that is a result of previous studies with authors' participation:

$$
\begin{aligned}
Iumls = {}& 0{,}15 \times F(id) + 0{,}15 \times F(m) + 0{,}13 \times F(r) + 0{,}12 \times F(p) + \\
& +0{,}105 \times F(in) + 0{,}105 \times F\left(\frac{c}{a}\right) + 0{,}09 \times F(c) + \\
& +0{,}075 \times F(is) + 0{,}075 \times F(cm)
\end{aligned}
\tag{1}
$$

where *Iumls* – integral evaluation of the system to prevent and to counteract the bank clients' incomes legalization;

$F(id)$– integral evaluation of the constituent "Identification and study of the client";

$F(m)$ – integral evaluation of the constituent "Monitoring and reporting of the financial operations"

$F(r)$ – integral evaluation of the constituent "Risk management"

$F(p)$ – integral evaluation of the constituent "The staff competence"

$F(in)$ – integral evaluation of the constituent "Saving of documents and information"

$F\left(\frac{c}{a}\right)$ – integral evaluation of the constituent "Internal control, internal and external audits"

$F(c)$ – integral evaluation of the constituent "Compliance"

$F(is)$ – integral evaluation of the constituent "Control of the informational systems"

$F(cm)$ – integral evaluation of the constituent "Corporate management and role of the bank administration".

The generalized results of the integral evaluation are demonstrated in table 3.

The results, shown in table 3, demonstrate the condition of the system to prevent and to counteract the legalization of each bank's illegal incomes. The higher integral indicator, the more qualitatively financial monitoring is carried out in the bank, the lower risk is to involve the bank in the money laundering processes. However, the main drawback of this approach is the fact that the data are obtained on the basis of bank workers' questionnaire, i.e. data are given by insiders, who may consciously give information, that differs from the real situation. In this regard, in order to increase the results objectivity, it is necessary to use public data regarding banking operations and to measure their risk level regarding involvement in the questionable incomes legalization.

Table 3 – **Integral indicator of the system assessment to prevent and to counteract the clients' illegal incomes legalization**

Indicator	Integral indicator by banks				
	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5
F(id)	0.49	0.36	0.56	0.71	0.06
F(m)	0.81	0.03	0.81	0.61	0.61
F(r)	0.49	0.12	0.47	0.31	0.14
F(p)	0.32	0.47	0.19	0.09	0.22
F(in)	0.52	0.04	0.52	0.52	0.29
F(c/a)	0.33	0.63	0.07	0.55	0.38
F(c)	0.57	0.40	0.12	0.85	0.42
F(is)	0.60	0.31	0.37	0.23	0.11
F(cm)	0.62	0.04	0.47	0.38	0.39
Iumls	0.53	0.26	0.42	0.48	0.29

2. Retrospective statistic analysis of banking operations, which are potentially vulnerable from the viewpoint of money laundering. In order to assess the risk of the illegal incomes legalization, with the banking services implementation, particularly operations related to cash, it is reasonable to analyze volumes to credit and to withdraw cash in the Ukrainian banks. According to the data of Report to carry out National assessment of risks in the sphere to prevent and to counteract illegal incomes legalization (laundering), and terrorist financing [7, 8] in the total number of messages, registered by Ukrainian State Service of Financial Monitoring from banks during the operation period of the Law № 2258 editor (from 21.08.2010 to 05.02.2015), the largest specific weight is made by the financial operations with cash (67 %), during the period of Law № 1702 operation editor (from 06.02.2015 to 31.12.2015) – financial operations with cash (41 %) and financial operations, carried out by persons, regarding which high risk is set (public figures) (41 %). The financial operations, related to the obtaining or providing the financial help and cash transactions are the riskiest from the viewpoint of money laundering due to the Report. Thus, analyzing the risk of money laundering through banks in Ukraine, it is reasonable to pay attention to the cash operations.

The first stage to analyze the dynamics of the cash flows volumes and funds on the accounts upon the request of the studied banks is the analysis of statistic features of some data. The National bank of Ukraine gives extended data regarding the activity of banks only since August 2017, so the existed data volume is limited. The standardized degree of risk is the variation coefficient of the random value. It is considered that risk is low, if the variation coefficient does not exceed 0.1, medium – from 0.1 to 0.25 and high – over 0.25 [14, p. 305]. Besides, one may judge the cash flows amounts prediction by the correspondence of time series distinguish to the normal one. It is thought that the normal distribution points to the fact that the random value depends on the systematic acts of some factors, which may be revealed and evaluated, also statistic procedures are mostly developed for normal distribution of the random value.

In order to check the data correspondence of cash flows and funds on the clients' accounts to the normal law, coefficients of excess, asymmetry and Shapiro-Wilk statistics value are analyzed. All calculations are carried out in the program complex Statistica. The results of the above indicators are shown in table 4.

Table 4 – **Statistic properties of dynamics regarding cash flows and money on accounts on the request of the analyzed banks during 01.09.2017 - 01.07.2018**

Indicator	Values of statistic indicators of Bank 1 turnovers dynamics by directions					
	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC*	FC**	NC	FC	NC	FC
μ	36084255	7939656	36129163	7936817	128933574	37426589
Me	35869197	8124928	36112997	7735151	132343142	36510831
σ	2075388	874896	2097499	900946	12925496	2662453
V	0.06	**0.11**	0.06	**0.11**	0.10	0.07
Ex	1.92	0.56	1.56	1.31	-1.33	1.44
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	1.08	-0.25	1.00	0.32	-0.10	**1.48**
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.91	0.98	0.91	0.96	0.93	**0.81**
P	0.24	0.97	0.22	0.79	0.39	**0.01**
R			1.00	0.92		
Indicator	Money withdraw upon the request of the economic entities		Money transfer on the request of individuals		Money withdraw on the request of individuals	
	NC	FC	NC	FC	NC	FC
μ	128927983	37535558	8423217	1867689	8554724	1925314
Me	133167045	36612273	8148557	1958919	8432904	1907373
σ	13487509	2749861	896370	250039	1055208	222639
V	0.10	0.07	**0.11**	**0,13**	**0,12**	**0,12**
Ex	-1.31	1.59	-1.39	-1.54	-1.68	-0.96
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	-0.20	**1.61**	0.11	-0.26	0.16	0.19
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.92	**0.77**	0.94	0.92	0.91	0.96
P	0.34	**0.00**	0.53	031	0.22	0.79
R	1.00	0.97			0.92	0.84
Indicator	Values of the statistic indicators of the turnover dynamics of the Bank 2 by directions					
	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC	FC	NC	FC	NC	FC
μ	2147319	1255848	2142854	1249707	7627542	1652845
Me	2121556	1235998	2120768	1204181	7430940	1705870
σ	107006	174272	111822	170991	945798	234940
V	005	**0.14**	0.05	**0.14**	**0.12**	**0.14**
Ex	-0.45	-1.27	-0.14	-0.69	-0.45	-0,29
S_E	1.28	1.28	1.28	1.28	1.28	1,28

Table 4

Value of statistic indicators of turnover dynamics of the Bank 2 by directions						
Indicator	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC	FC	NC	FC	NC	FC
γ_1	0.28	0.33	0.55	0.44	0.10	-0.62
S_γ	0.66	0.66	0.66	0.66	0.66	0.66
W	0.91	0.93	0.96	0.95	0.96	0.95
P	0.25	0.44	0.75	0.65	0.73	0.67
R			0.98	0.99		
Indicator	Cash withdraw upon the request of the economic entity		The credit of money upon the request of the individual		Cash withdraw upon the request of the individuals	
	NC	FC	NC	FC	NC	FC
μ	7642020	1650758	501148	542164	510081	553912
Me	7576426	1665926	495312	516096	503076	533881
σ	986257	233555	47251	80632	51981	81388
V	**0.13**	**0.14**	0.09	**0.15**	0.10	**0.15**
Ex	-0.95	0.57	0.71	-1.25	-0.72	-0.96
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	-0.02	-0.70	0.63	0.42	0.33	0.61
S_γ	0.66	0.66	0.66	0.66	0.66	0.66
W	0.95	0.96	0.95	0.93	0.94	0.89
P	0.68	0.78	0.64	0.38	0.55	0.13
R	0.99	0.98			0.94	0.94
Value of statistic indicators of turnover dynamics of the Bank 3 by directions						
Indicator	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC	FC	NC	FC	NC	FC
μ	7372782	2337756	7359163	2342178	84095467	18515635
Me	7259690	2441867	7266488	2393531	82648986	18172320
σ	432170	350565	474342	300328	8565664	1880545
V	0.06	**0.15**	0.06	**0.13**	0.10	0.10
Ex	1.32	0.10	0.72	1.31	-0.04	-0.64
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	1.20	-0.02	0.94	-0.11	0.72	0.66
S_γ	0.66	0.66	0.66	0.66	0.66	0.66
W	0.90	0.93	0.92	0.96	0.94	0.92
P	0.20	0.43	0.33	0.80	0.57	0.35
R			0.99	0.97		
Indicator	Cash withdraw upon the request of the economic entity		The credit of money upon the request of the individual		Cash withdraw upon the request of the individuals	
	NC	FC	NC	FC	NC	FC
μ	84030035	18587513	5170721	1348528	5257447	1407841
Me	82646228	18482954	5066792	1319858	5127021	1391568
σ	8997669	1796460	564266	180211	669044	187387
V	**0.11**	0.10	**0.11**	**0.13**	**0.13**	**0.13**
Ex	0.16	-0.57	-0.58	-0.27	-0.56	-1.28

Indicator	Value of statistic indicators of turnover dynamics of the Bank 3 by directions					
	Cash withdraw upon the request of the economic entity		The credit of money upon the request of the individual		Cash withdraw upon the request of the individuals	
	NC	FC	NC	FC	NC	FC
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	0.74	0.64	0.28	0.45	0.44	0.47
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.95	0.92	0.98	0.96	0.97	0.91
P	0.69	0.32	0.93	0.82	0.88	0.24
R	1.00	0.99			0.97	0.90
Value of statistic indicators of turnover dynamics of the Bank 4 by directions						
Indicator	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC	FC	NC	FC	NC	FC
μ	63498195	12507793	63340166	12554295	187872361	22333394
Me	63188366	12974153	63102683	13186431	190090072	22088460
σ	4513182	2230028	4297631	2153236	12731490	1628166
V	0.07	**0.18**	0.07	**0.17**	0.07	0.07
Ex	-0.84	-1.39	-1.13	-1.31	-0.81	-0.99
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	0.11	0.24	-0.11	0.20	-0.44	-0.51
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.97	0.92	0.95	0.91	0.92	0.90
P	0.93	0.31	0.67	0.25	0.36	0.21
R			0.98	1.00		
Indicator	Cash withdraw upon the request of the economic entity		The credit of money upon the request of the individual		Cash withdraw upon the request of the individuals	
	NC	FC	NC	FC	NC	FC
μ	187574441	22341465	14004826	1343611	14321532	1396779
Me	191002026	22178529	13426968	1270587	13611240	1269359
σ	13348628	1759531	1379943	198919	1790597	265700
V	0.07	0.08	0.10	**0.15**	**0.13**	**0.19**
Ex	-0.64	-0.33	-1.39	0.91	-0.94	-0.36
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	-0.43	-0.67	0.24	1.25	0.48	0.92
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.94	0.92	0.92	0.86	0.92	0.87
P	0.48	0.29	0.31	**0.06**	0.29	0.09
R	1.00	0.96			0.92	0.61
Value of statistic indicators of turnover dynamics of the Bank 5 by directions						
Indicator	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	HB	IB	HB	HB	IB	HB
μ	63498195	12507793	63340166	12554295	187872361	22333394
Me	63188366	12974153	63102683	13186431	190090072	22088460

Table 4

Indicator	Cash adding to the bank's cash desk		Cash withdraw from the bank's cash desk		Admission of funds on the request of economic entities	
	NC	FC	NC	FC	NC	FC
σ	4513182	2230028	4297631	2153236	12731490	1628166
V	0.07	**0.18**	0.07	**0.17**	0.07	0.07
Ex	-0.84	-1.39	-1.13	-1.31	-0.81	-0.99
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	0.11	0.24	-0.11	0.20	-0.44	-0.51
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	0.97	0.92	0.95	0.91	0.92	0.90
P	0.93	0.31	0.67	0.25	0.36	0.21
R			0.98	1.00		
Indicator	Cash withdraw upon the request of the economic entity		The credit of money upon the request of the individual		Cash withdraw upon the request of the individuals	
	NC	FC	NC	FC	NC	FC
μ	3672006	607870	501964	178980	504947	182609
Me	3582667	582657	496463	174718	495670	187452
σ	486335	127983	33424	26893	42488	29493
V	**0.13**	**0.21**	0.07	**0.15**	0.08	**0.16**
Ex	**4.83**	-0.18	-0.64	2.70	0.22	-1.02
S_E	1.28	1.28	1.28	1.28	1.28	1.28
γ_1	**1.82**	0.47	0.50	0.81	0.05	0.00
$S\gamma$	0.66	0.66	0.66	0.66	0.66	0.66
W	**0.83**	0.97	0.96	0.91	0.96	0.97
P	**0.02**	0.92	0.75	0.23	0.81	0.83
R	0.97	0.98			0.87	0.57

Value of statistic indicators of turnover dynamics of the Bank 5 by directions

*NC – national currency; ** FC – foreign currency

The variation coefficients are calculated to analyze the turnovers by operations of cash and clients' funds withdraw and admission. The results of calculations show that for most banks fluctuations regarding volumes of cash crediting and withdraw and funds on the current accounts of the legal entities are absolutely correlated, i.e. it is reasonable to carry out the analysis only by one of the mentioned directions. The coefficients of turnovers correlation on individuals' funds crediting and withdraw upon the request are lower, this index is 0.57 in the Bank 5 for funds in foreign currency on the individuals' current accounts, that indicates the difference in time of receipts and debits by these accounts.

According to the data of Bank 1, analysis of results in the calculation of the variation, excess, asymmetry, Shapiro-Wilk criterion coefficients show small excess 10% of the variation coefficient, other indicators point at inessential deviation from the normal distribution. Only by the legal entities' accounts in foreign currency, the Shapiro-Wilk criterion denotes inconsistency with the normal distribution law, and the asymmetry coefficient shows the strong right-side asymmetry. One should mention that from the viewpoint of risks analysis, «right tail» distribution analysis is significant, as features of the risk growth. Thus, despite the small variation coefficient (0.7), high positive asymmetry coefficient may point at the unsystematic factors' influence on the bank's turnovers amounts, among which there is a factor of the clients' illegal incomes legalization.

Statistic features, calculated due to the data of Bank 2 during 01.09.2017 - 01.07.2018 do not find

great deviations of turnovers fluctuations from the normal distribution. The variation coefficients exceed 10% by turnovers on the economic entities' accounts, and by turnovers of funds in the foreign currency in the cash desk and on the individuals' current accounts. The asymmetry coefficient is positive by most directions.

According to the data of Bank 3 and 4 calculations do not show essential deviations of the funds turnover dynamics in cash desk and on the clients' current accounts from the normal distribution law, that proves the low risk of unsystematic factors' influence on the bank's work. The variation coefficient excess of 10% in some directions is not essential.

Analysis of results from calculation of statistic features due to the data of Bank 5 demonstrates higher turnover variation indicators than those in the other studied banks, particular in directions of cash withdraw in foreign currency, credit and withdraw of funds in the foreign currency to the economic entities' accounts, the variation coefficient is 21%, that is close to the risk level. Besides, the Shapiro-Wilk criterion and indicators of excess and asymmetry denote the great deviation from the normal distribution law of the turnovers dynamics to credit and to withdraw legal entities' funds upon the request, that claims attention from the financial monitoring departments in the bank in this direction.

3. Banks' grouping by the level of risk to use them for money laundering. In order to present visually the results regarding the level of system quality to prevent and counteract the illegal income legalization in banks and risk of unsystematic factors' influence, the diagram is built (fig. 1). The risk of unsystematic factors' influence is calculated as a share of indicators number, which exceeds the normative in a total number of the calculated indicators in the bank.
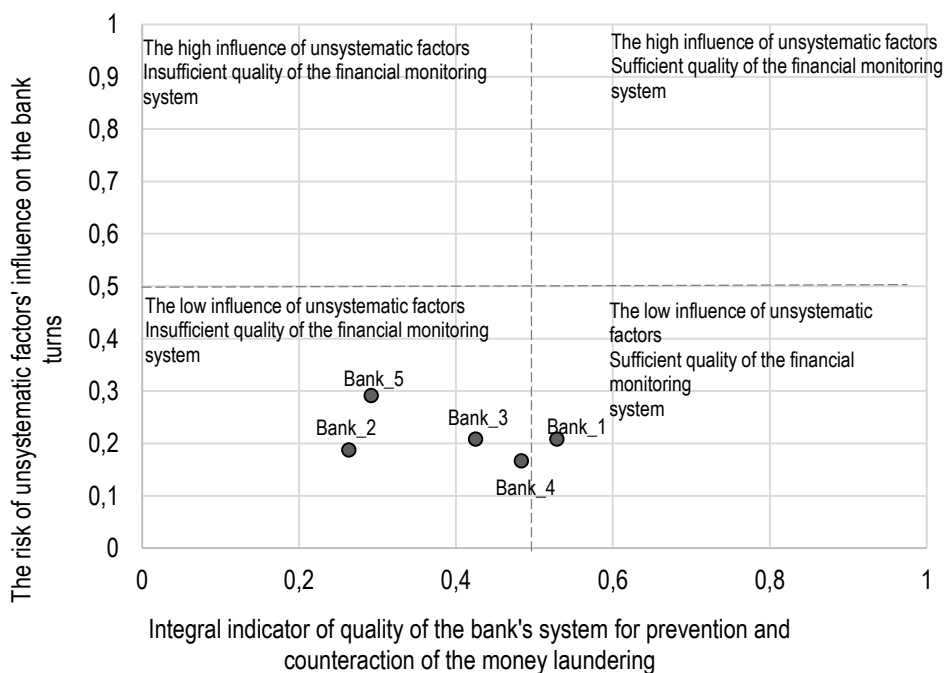

Figure 1 – **Dot diagram of the integral indicator of the system quality for prevention and counteraction of the bank clients' questionable incomes legalization and level of risk regarding the unsystematic factors' influence of the bank turnovers**

As it is shown in fig. 1 almost all studied banks are in the right lower quadrant with unsystematic factors' low-influence level on the cash turnovers and on the clients' funds on the accounts upon the request, but also with the low level of the system quality to prevent and to counteract the illegal incomes legalization. Among the investigated banks, only Bank 1 is in the quadrant of the unsystematic factors' low-risk influence and sufficient system quality to prevent and counteract the illegal incomes legalization. Taking into account the bank's size and its significance for the banking system in Ukraine on the whole, it is necessary to improve the internal financial monitoring system in the bank by the defined directions. The weakest position from the viewpoint of risk to use the bank's service with purpose to legalize the illegal incomes, according to data of fig. 1 is in Bank 5. The integral indicator of the system quality to prevent and to counteract the illegal incomes legalization in this bank is only 29%, and at the same time, the indicator of unsystematic factors' influence risk on the bank's activity is the highest among studied banks – 29%.

Thus, the calculation regarding statistic features of cash turnovers dynamics and bank clients' funds on the current accounts enables to analyze the degree of unsystematic factors' influence, as one of the risk indicators to use banking services with purpose to legalize the illegal incomes, that is a base to improve the internal financial monitoring system in the Ukrainian banks.

Conclusions and perspectives for further research. Formation of the qualitative system to prevent and counteract the clients' illegal incomes legalization is an important and difficult task for the financial monitoring system development. The risk assessment to use banking services for illegal income legalization takes a central place to provide the prevention and counteraction for money laundering. The proposed methodic approach to determine the risk of the bank's involvement in legalization has many advantages, in particular:

− it considers external and internal microeconomic factors, which help or prevent the bank clients' questionable incomes legalization;

− it has two main components – evaluation of the system to prevent and counteract the bank's legalization, which does not lose the subjective constituent, since the experts from banks are insiders and answers the questions from questionnaires about their own activity and condition of the financial monitoring, risks management etc. The second component is objective because it is based on the number of bank's operations and cash flows on its accounts;

− it is a convenient tool to identify banks, which are potentially engaged in the money laundering processes, that provides economically grounded reasons, for example, to send National Bank of Ukraine for inspection of these banks.

In future studies, authors will focus on the checking the hypothesis regarding the fact that more active banks from the viewpoint of FinTech innovations introduction are less vulnerable in relation to their involvement in the money laundering. For this reason, the technique of the bank's innovative activity deep assessment (in the context of technology) regarding the financial technologies introduction is being developed.

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Оцінка ризику залучення банку до легалізації сумнівних доходів з урахуванням впливу впровадження FinTech інновацій

Стаття присвячена питанням формування методичного підходу до оцінювання ризику використання банківських послуг для легалізації сумнівних доходів з урахуванням стрімкого розвитку FinTech інновацій та активності їх впровадження банками. В статті представлено групи мікроекономічних факторів, які впливають на процеси легалізації незаконних доходів клієнтів банків. Було сформовано систему індикаторів за кожною групою мікроекономічних внутрішньобанківських та мікроекономічних (клієнтських) факторів. Запропонований підхід реалізується за наступними напрямками: по-перше, інтегральне оцінювання методів опитування та таксономії системи запобігання та протидії легалізації доходів банку як середовища, в якому потенційно може здійснюватися відмивання коштів; по-друге, статистичний аналіз динаміки фактичних показників обсягів операцій банків, що мають підвищений ризик використання для легалізації; по-третє, оцінка активності банків по впровадженню FinTech інновацій. Результати використання запропонованого методичного підходу дозволяють сформувати двомірну матричну структуру, яка розподіляє банки на групи з максимальним, мінімальним та середнім ризиком їх використання для зняття коштів. Було доведено, що розрахунок статистичних характеристик динаміки грошових оборотів та коштів банківських клієнтів на поточних рахунках дозволяє проаналізувати ступінь впливу несистематичних факторів, оскільки це один з показників ризику використання банківських послуг з метою легалізації незаконних доходів, що є базою для вдосконалення системи внутрішнього фінансового моніторингу в українських банках. Наступні дослідження будуть спрямовані на перевірку гіпотези, що більш активні банки з точки зору впровадження інновацій FinTech є менш уразливими щодо їх участі у відмиванні коштів.

Ключові слова: ризик, легалізація, сумнівний дохід, FinTech інновації, протидія, відмивання коштів.