"Search for statistically approved criteria for identifying money laundering risk"

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BUSINESS PERSPECTIVES

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SEARCH FOR STATISTICALLY APPROVED CRITERIA FOR IDENTIFYING MONEY LAUNDERING RISK

Abstract

The paper focuses on the theoretical justification and theoretical foundations of using statistical criteria for identifying money laundering risk as a tool to prevent and counteract the legalization of bank clients' proceeds.

The hypothesis is that the coefficient of variation can be appropriately used as an identifier for money laundering risk. To prove this hypothesis, a special methodology was used: generalization, grouping, statistical analysis of time series, and correlation analysis – to identify and analyze the hidden signs of the customer income legalization in the financial activities of a bank; mathematical statistics and scaling – to determine the quantitative values of risk levels for the use of bank services for legalizing customer income. The analysis of financial activities of 32 Ukrainian banks aimed at identifying money-laundering risks showed that banks in which the National Bank of Ukraine revealed suspicious transactions with money-laundering features (16 operating banks) had much higher coefficients of variation in the volume of cash flows, in cash flows for on-demand accounts of economic entities, in cash flows of on-demand accounts for individuals, compared with banks in which violations of legislation in the field of financial monitoring were revealed (eight banks), and with banks where violations were not found (eight banks). This proves that sudden changes in customer transaction volume can be a sign of money laundering risk.

Keywords	money laundering, risk, risk-oriented approach, coefficient of variation, criteria of money laundering risk

JEL Classification	G21, O17

INTRODUCTION

Legalization of proceeds of crime is a serious threat to the stability of any country's economy; it significantly reduces the financial security of the state and increases the risk of global socio-economic and political instability. Awareness of this fact prompts the international community to develop and take appropriate measures to limit and prevent money laundering. In Ukraine, such aspirations are enshrined in the "Strategy for the Development of the System of Prevention and Counteraction to Legalization (Laundering) of the Proceeds of Crime, Financing of Terrorism and Financing of Proliferation of Weapons of Mass Destruction until 2020" (Kordik & Kurilovska, 2017) and in the terms of measures to implement this strategy (JSC CB "PRIVATBANK", 2018). However, the rapid development of information technology, increased mobility of financial resources, virtualization of certain types of business activities require constant improvement of processes and tools to prevent and combat money laundering. Leading professionals, specialists and experts in money laundering realize that most counteraction mechanisms are performed ex post facto, that is, after the identification and definition of typological schemes and methods of legalization, and often after a series of specially conducted investiga-

tions and relevant court decisions. In this regard, it is almost impossible to talk about the existence of effective and well-functioning precautionary or preventive measures: when the public becomes aware of an improved or new scheme or method of money laundering, criminals find new ways to withdraw funds from the shadow economy. The process of combating money laundering is further complicated by the fact that criminal money laundering schemes usually involve a significant number of participants subordinate to various agencies, ministries, and often states. Therefore, the state system of financial monitoring, which is designed to combat money laundering and coordinate the activities of various entities, includes public authorities of various branches and a wide range of primary level entities.

1. LITERATURE REVIEW

Banking institutions play one of the leading roles among the subjects of primary financial monitoring. They carry out the vast majority of cash transactions in Ukraine and provide 96% or more of information about suspicious financial transactions. In 2017–2018 alone, UAH 33.26 billion was legalized with the help of bank services. For these reasons, the issue of preventing and counteracting the legalization of income of bank customers is constantly relevant, and for the proper implementation of the functions of internal financial monitoring, it is necessary to create effective systems for preventing and combating money laundering. Risk assessment is one of the important functions of such systems. For its proper implementation, it is necessary to collect and process a large array of information, turn it into data that is the basis for identifying and measuring the level of money laundering risk. The set of initial data for analysis also depends on what the analyst or employee of the internal banking system of financial monitoring wants to receive after completion of the identification and measurement of risk.

Levi et al. (2018, p. 310) noted that in terms of evaluation, the ideal result would be the amount of money laundered over a period of time. However, no official document, either internationally or nationally, contains such information. In this regard, a risk-oriented approach is used to counter money laundering, that is, to determine a certain probability that funds received as a result of illegal activities will be legalized in a certain way.

In the study of risk assessment and management of the use of services for legalizing criminal proceeds or financing of terrorism in a bank, it was found that the risk of using the bank's services to legalize proceeds of crime included two main components (Dmytrov et al., 2011, p. 51): the risk of suspicious transactions and the risk of violating the requirements of relevant legislation.

According to the Ukrainian law (Ministry of Finance of Ukraine, 2016), the level of risk of using a bank for money laundering is determined by the bank itself. In accordance with these components of the methodology for assessing such risk, banks can focus on the risk of violating the law more than on the risk of suspicious transactions. In addition, the high level of risk of using the bank's services to legalize proceeds of crime may be grounds for including the bank in the plan of on-site inspections of the NBU, so banks may consciously develop risk assessment techniques that will not work well, and, therefore, may be inadequate. Consequently, there is a need to develop methods for objective assessment and analysis of the risks of using banking services for money laundering.

According to the Report on the National Risk Assessment in the Field of Prevention and Counteraction to Legalization (Laundering) of the Proceeds of Crime and Financing of Terrorism (Academy of Financial Monitoring, 2019), in the total number of notifications registered by the SFSMU from banks during the period of validity of the Law No. 2258 (from August 21, 2010 to February 5, 2015), the largest share was created by financial transactions with cash (67%), during the period of validity of the Law No. 1702 (from February 6, 2015 to December 31, 2015) – financial transactions with cash (41%) and financial transactions conducted by persons at high risk (politically exposed persons) (41%). According to the Report, in terms of money laundering, the most risky are financial transactions

related to the receipt or provision of financial assistance and cash financial transactions. In April 2019, Priazhentseva, Head of the Compliance Department of the Financial Monitoring Department of the NBU (NBU, 2019) noted in her presentation that, firstly, among the main national risks of money laundering is the high cash flow in Ukraine, and, secondly, the focus of the risk-oriented approach is: cash and scheme operations, fictitious entrepreneurship, politically exposed persons, identification of ultimate beneficial owners and terrorism financing. Thus, when analyzing the risk of money laundering through banking institutions in Ukraine, it is advisable to pay attention to the banks' cash transactions.

2. DATA AND METHODOLOGY

To assess the risk of money laundering using the bank's services, in particular transactions related to cash and non-cash movement of funds through customer accounts, the following hypothesis was put forward and tested:

H1: *Sharp changes in the amount of crediting and debiting funds at the request of bank customers can serve as an indicator that the bank's services are used in money laundering schemes.*

To test the hypothesis, the coefficient of variation of the amounts of crediting and writing off the funds of the bank's clients was chosen as a statistical indicator of money laundering risk. It is well known that the coefficient of variation of a random variable is a standardized measure of risk. Statistics show that the risk is low if the coefficient of variation does not exceed 0.1, moderate – from 0.1 to 0.25 and high if it is more than 0.25.

In addition, a certain predictability of the turnover, and, accordingly, the controllability of this process can be determined by the correspondence of the distribution of the time series to normal. It is believed that the normal distribution indicates that the random variable depends on the systematic action of certain factors that can be detected and evaluated, and statistical procedures are the most developed for the normal distribution of the random variable.

To verify the compliance of data on cash turnover and funds on current accounts of customers with the normal law of data distribution, the kurtosis coefficients, asymmetry and the value of the Shapiro-Wilk test were analyzed. The Shapiro-Wilk criterion was chosen due to the fact that the sample size of each indicator does not exceed 20. All calculations were performed in the software package Statistica.

The initial data for testing the hypothesis were the volumes of turnover on cash accounts and demand accounts of existing Ukrainian banks. The choice of banks for further analysis is due to the presence of proven involvement in money laundering processes based on the results of inspections carried out by the National Bank of Ukraine. Detailed information on the results of such inspections is given in Table 1.

Table 1. Generalized information on inspections of banks by the NBU and enforcement measures applied to them for violation of legal requirements on financial monitoring

Parameter	Parameter values by years			
	2016	2017	2018	2019[2]
Number of violating banks	21[1]	40	24	11
Number of cautions	28	37	23	11
Number of penalties	28	15	13	9
Amount of penalties, UAH million	9.3	67.6	114.9	27.9
Number of restrictions on certain types of bank transactions	1	0	0	0
Number of shutdowns of a certain bank's transactions	1	1	0	0
Number of persons suspended from office	2	0	3	0
Number of decisions to revoke banking license and liquidate banks	4	0	0	0
Number of violations of legal requirements by types, pcs.				
Failure to comply with legal requirements for public figures, including improper identification of politically exposed persons	3	15	19	6
Violation of the procedure for analysis, detection, registration of financial transactions subject to financial monitoring	2	12	16	5
Violation of certain requirements for customer identification, verification and study	2	9	16	3
Failure to refuse to serve customers in cases provided by the legislation on financial monitoring	No data	No data	1	1

Table 1 (cont.). Generalized information on inspections of banks by the NBU and enforcement measures applied to them for violation of legal requirements on financial monitoring

Parameter	Parameter values by years			
	2016	2017	2018	2019[2]
Violation of the procedure for suspension of financial transactions	No data	2	5	1
Violation of the procedure for submitting information/documents to a specially authorized body and at the request of the NBU, including the submission of unreliable statistical reporting on financial monitoring	No data	9	8	4
Implementation of risky activities in the field of financial monitoring	No data	8	12	5
Lack of proper functioning of the risk management system, including improper fulfillment of the obligation to ensure risk management and reassessment of customer risks	No data	7	8	3
Use of software that does not provide automatic detection and stopping in cases of a financial transaction established by law before its implementation	No data	3	1	0

Note: 1 – Data starting from August 2016; 2 – data as of May 2019.

To assess the money laundering risk using the bank's services, in particular cash transactions, the amounts of depositing and withdrawing cash, as well as the volume of transactions with the on-demand accounts (with the meaning of demand accounts of individuals and accounts of funds at the request of business entities) in the Ukrainian banks, which at the time of the NBU inspection had significant deficiencies, were analyzed. Inspections carried out by the NBU during 2016–2019 revealed banks violating the legislation on financial monitoring (see Table 1), as well as identified the most vulnerable components operating in banks with systems of preventing and countering money laundering.

By summarizing (Table 1), it was found that the total number of banks with problems in the field of preventing and combating money laundering of their clients during 2016–2019 is 39 banks. However, after an in-depth analysis of the activities of each of the 39 banks, the most significant violations in the field of financial monitoring were revealed. On this basis, the final sample of banks was reduced.

Out of 39 banks, 16 were selected, which identified and documented by the National Bank of Ukraine schemes of money laundering operations or significant violations in the field of financial monitoring, for which they paid significant fines, and therefore are priority in terms of minimizing the risk of money laundering. For further analysis, the data of these 16 banks were used, which is 20.78% of the total number of banks operating in Ukraine. This sample is statistically representative.

The source of statistical data was the website of the National Bank of Ukraine, which, since August 2017, has been publishing data on the amounts of withdrawals and credits to various accounts of banks in Ukraine (NBU, 2017b). Thus, the amount of data available for analysis as of May 2019 was 20 periods (monthly data).

3. RESULTS

The analysis of the obtained statistical characteristics of the time series on the amounts of deposits and withdrawals of cash and non-cash funds from the accounts of bank customers allows identifying an increased risk of money laundering.

Necessary static characteristics of the time series were obtained after performing the calculations of cash deposits to the bank's cash desk, volumes of cash withdrawals from the bank's cash desk, amounts of crediting and debiting funds at the request of individuals, volumes of crediting and debiting funds at the request of business entities of 32 operating banks of Ukraine. Table 2 gives detailed information on statistical indicators of crediting and writing off funds of PJSC "JSCB "CONCORD".

Table 2 indicates a high risk of money laundering by customers of JSC "JSCB "CONCORD", as the value of the coefficient of variation for the entire analyzed period in all respects was not less than 0.28, and variation was more than 0.75 on the accounts of individuals in foreign currency. The asymmetry is positive for all values, which indi-

Table 2. Statistical characteristics of the dynamics of cash turnover and funds on on-demand accounts from September 1, 2017 to April 1, 2019 for JSC "JSCB "CONCORD"

Parameter	Cash				Funds on demand of economic entities	
	Cash deposit		Cash withdrawal		Depositing of funds	
	NC	FC	NC	FC	NC	FC
Average value	386,271	133,077	382,655	128,806	18,43766	449,892
Median	357,635	96,336	356,903	94,313	1,728,895	343,768
Minimum value	245,716.5	20,529.0	255,489.0	21,681.3	955,925.1	237,911.7
Maximum value	743,074	485,005	677,605	428,716	2,967,277	1,276,587
Standard deviation	123,292.0	125,477.2	110,547.1	117,684.9	624,436.6	257,171.8
Coefficient of variation	0.3192	0.9429	0.2889	0.9137	0.3387	**0.5716**
Coefficient of asymmetry	2.08	1.70	1.94	1.50	0.39	1.98
Standard asymmetric error	0.51	0.51	0.51	0.51	0.51	0.51
Kurtosis	4.35	2.48	3.76	1.50	−1.16	4.70
Standard error of kurtosis	0.99	0.99	0.99	0.99	0.99	0.99
Shapiro-Wilk test	0.74995	0.79438	0.76486	0.80685	0.93057	0.78332
P-value of the Shapiro-Wilk test	0.00017	0.00071	0.00027	0.0011	0.15835	0.00049

Parameter	Funds on demand of economic entities		Funds on demand of individuals			
	Withdrawal		Withdrawal		Deposition	
	NC	FC	NC	FC	NC	FC
Average value	1,849,656	451,068	136,572	55,410	138,458	58,249
Median	1,709,254	345,769	128,810	43,129	129,269	47,689
Minimum value	978,754.6	220,542.9	68,190.2	7,051.1	67,401.2	8,037.5
Maximum value	2,934,153	1,287,751	242,675	169,643	242,746	185,532
Standard deviation	622486.7	257,164.0	47,929.4	41,669.2	48,603.7	45,571.5
Coefficient of variation	0.3365	0.5701	0.3509	0.7520	0.3510	**0.7824**
Coefficient of asymmetry	0.41	2.05	0.47	1.44	0.41	1.66
Standard asymmetric error	0.51	0.51	0.51	0.51	0.51	0.51
Kurtosis	−1.17	5.08	−0.25	1.97	−0.20	2.69
Standard error of kurtosis	0.99	0.99	0.99	0.99	0.99	0.99
Shapiro-Wilk test	0.92551	0.78482	0.96059	0.86482	0.96072	0.8294
P-value of the Shapiro-Wilk test	0.12654	0.00052	0.55573	0.00954	0.55831	0.00245

Note: NC – national currency, FC – foreign currency.

cates the location of most of the data to the right of the mathematical expectation. According to the statistics (Bashina et al., 2003; Husarov, 2002), phenomena for which kurtosis is maximum are burdened with minimal risk. For JSC "JSCB "CONCORD" (Table 2), this means that the lowest risk of money laundering has transactions related to withdrawal (or write-off) and crediting funds in foreign currency to the accounts of economic entities.

To compare the calculated values (Table 2) of the Shapiro-Wilk test with the tabular ones, the appropriate calculations have been performed, the results of which are shown in Table 3.

Table 3. Shapiro-Wilk test value for 20 observations

Parameter	Test significance		
	0.01	0.05	0.1
Shapiro-Wilk test for 20 observations	0.2167	0.4230	0.5422

If the calculated value of the criterion is greater than the value from the table (see Table 3), it is considered that the analyzed value is normally distributed.

Thus, according to the Shapiro-Wilk test, the values of cash and non-cash turnover of clients of JSC "JSCB "CONCORD" are normally distributed, which allows applying parametric methods for analyzing bank data.

Table 4. Coefficients of pairwise correlation between indicators of cash and non-cash flows of clients of JSC "JSCB "CONCORD"

Parameter	Cash deposit	Cash withdrawal	Depositing funds to accounts on demand of economic entities	Withdrawal of funds from accounts on demand of economic entities	Depositing funds to accounts on demand of individuals	Withdrawal of funds from accounts on demand of individuals
Cash deposit	1.0000	0.9940	0.5756	0.5769	0.7983	**0.8368**
Cash withdrawal	0.9940	1.0000	0.5910	0.5944	0.7887	**0.8278**
Depositing funds to accounts on demand of economic entities	0.5756	0.5910	1.0000	0.9980	0.4793	0.4881
Withdrawal of funds from accounts on demand of economic entities	0.5769	0.5944	0.9980	1.0000	0.4823	0.4922
Depositing funds to accounts on demand of individuals	0.7983	**0.7887**	0.4793	0.4823	1.0000	0.9900
Withdrawal of funds from accounts on demand of individuals	0.8368	**0.8278**	0.4881	0.4922	0.9900	1.0000

To check the closeness of the relationship between depositing funds to accounts and withdrawals, the coefficient of pairwise correlation between the amounts of depositing funds to the respective accounts and the amounts of withdrawals from the accounts of clients of JSC "JSCB "CONCORD" is used. Table 4 shows the results of calculations.

Table 4 shows that depositing and withdrawing funds are closely related, because the pairwise correlation coefficients between the indicators of one group are 0.99 or more. In addition, the data from Table 4 show that the cash flow in JSC "JSCB "CONCORD" is linked with the accounts of individuals much more closely than with the cash flow of enterprises and organizations.

The calculations of statistical characteristics of the series of dynamics of cash turnover and funds in the accounts of bank customers – economic entities and individuals – showed that banks in which the scheme operations are detected have mostly high values of the coefficient of variation (average 25%).

To confirm the hypothesis that banks with a higher risk of money laundering have higher values of the coefficient of data variation, the statistical characteristics of the series of dynamics of cash flows in bank accounts are calculated, which in their activities have shortcomings in the system of prevention and counteraction to legalization cli-

ents' proceeds, which, however, is not observed in scheme operations.

The second group of banks is the banks to which the NBU applied enforcement measures for non-compliance with the requirements in the field of financial monitoring, except for those in the activities of which scheme operations were identified; it starts with JSC "ASVIO BANK" (Table 5).

Table 5 confirms that for all analyzed accounts, JSC "ASVIO BANK" has a high or moderate level of risk of exposure to non-systemic factors, including money laundering. The highest values of the coefficients of variation are withdrawals in foreign currency and withdrawals from accounts on demand of individuals. All deposits and withdrawals in foreign currency have a right-wing asymmetry in the distribution of data, therefore, the most likely will be deviations of further revenues in the direction of increase from the mathematical expectation. Interestingly, the asymmetry of data on the deposit and withdrawal of cash and accounts on demand of economic entities is negative. This indicates a more likely decrease in the inflow of funds on these accounts. The Shapiro-Wilk test shows that the data on the accounts of JSC "ASVIO BANK" are distributed according to the normal law. This is also evidenced by the values of the kurtosis, which, under conditions of normal distribution or close to it, have values in the range from 2 to 4. Although the asymmetry

Table 5. Statistical characteristics of the dynamics of cash turnover and funds on the on-demand accounts from September 1, 2017 to April 1, 2019 for JSC "ASVIO BANK"

Parameter	Cash				Funds on demand of economic entities	
	Cash deposit		Cash withdrawal		Fund deposit	
	NC	FC	NC	FC	NC	FC
Average value	232,140.45	17,681.96	231,539.90	17,306.83	1,558,490.31	101,542.07
Median	223,377.82	16,394.74	226,386.22	14,409.18	1,550,831.67	92,828.88
Minimum value	132,207.42	4,411.97	131,745.85	6,619.59	1,104,658.53	67,382.77
Maximum value	307,204.14	46,196.55	304,301.92	38,761.60	1,938,814.81	202,916.94
Standard deviation	41,497.45	10,214.76	41,455.32	9,691.99	222,117.19	32,045.35
Coefficient of variation	0.1788	0.5777	0.1790	0.5600	0.1425	**0.3156**
Coefficient of asymmetry	−0.1821	1.3010	−0.2036	0.8837	−0.1009	2.1317
Standard asymmetric error	0.5121	0.5121	0.5121	0.5121	0.5121	0.5121
Kurtosis	0.5067	2.1187	0.6235	−0.3497	−0.2279	5.1622
Standard error of kurtosis	0.9924	0.9924	0.9924	0.9924	0.9924	0.9924
Shapiro-Wilk test	0.9507	0.9006	0.9702	0.8875	0.9812	0.7692
P-value of the Shapiro-Wilk test	0.3780	0.0424	0.7580	0.0242	0.9481	0.0003

Parameter	Funds on demand of economic entities		Funds on demand of individuals			
	Withdrawal		Fund deposit		Withdrawal	
	NC	FC	NC	FC	NC	FC
Average value	1,559,145.58	102,204.58	212,894.56	12,114.80	209,448.65	12,453.98
Median	1,527,437.72	93,191.15	169,512.92	9,052.87	168,520.84	10,400.32
Minimum value	1,082,025.79	66,650.62	119,268.16	3,515.87	109,443.71	3,661.16
Maximum value	1,906,785.16	206,787.91	502,074.21	29,864.90	544,904.63	29,204.32
Standard deviation	210277.53	33334.49	107106.70	8225.95	108694.06	7855.12
Coefficient of variation	0.1349	0.3262	0.5031	0.6790	0.5190	**0.6307**
Coefficient of asymmetry	−0.1625	2.0775	1.4937	1.0719	1.7346	**1.0929**
Standard asymmetric error	0.5121	0.5121	0.5121	0.5121	0.5121	0.5121
Kurtosis	0.0754	4.9145	1.6275	0.0203	3.5824	0.1870
Standard error of kurtosis	0.9924	0.9924	0.9924	0.9924	0.9924	0.9924
Shapiro-Wilk test	0.9711	0.7766	0.8104	0.8567	0.8165	0.8637
P-value of the Shapiro-Wilk test	0.7782	0.0004	0.0012	0.0069	0.0015	0.0091

coefficients for all foreign currency accounts are above 0.5, which indicates a significant asymmetry that cannot be ignored in further calculations.

If one compares the results of calculations of JSC "JSCB "CONCORD" (Table 4), as a representative of a group of banks in the activities of which scheme operations have been identified, and JSC "ASVIO BANK" (Table 5), as a representative of a group of banks with shortcomings in the system of prevention and counteraction to legalization clients' proceeds without scheme operations, it becomes clear that the risk of money laundering in terms of data variation is much higher in the first group.

To validate the conclusions, similar calculations of statistical characteristics of time series were performed for all analyzed banks – 32 banks for 20

periods, from August 2017 to April 2019. The summarized data are presented in Table 6.

Table 6 summarizes the results of the analysis of the statistical characteristics of data on cash flows through cash registers and accounts on demand of bank customers. It can be seen from Table 6 that the average values of the coefficient of variation are much higher among the banks in the activities of which the scheme operations are detected. Thus, according to the cash flow in the national currency (Table 6), the coefficient of variation averages 24.68%, the movement of funds of economic entities is 27, 69%, and the movement of funds on accounts on demand of individuals in the national currency is 38.63%. Regarding the movement of funds in foreign currency, the value of the coefficient of variation is slightly higher – 33.00% for cash transactions, 22.44% for transactions of

Table 6. Generalized results of calculating the coefficient of variation of cash flow by cash registers and accounts on demand of bank customers for the period August 2017 – May 2019

Bank category	Bank	Coefficient of variation, %												Correspondence of the data distribution to the normal law according to the Shapiro-Wilk test
		Cash				Funds on demand of economic entities				Funds on demand of individuals				
		Deposition		Withdrawal		Crediting		Withdrawal		Crediting		Withdrawal		
		NC	FC	NC	FC	NC	FC	NC	FC	NC	FC	NC	FC	
Banks in the activities of which the NBU found scheme operations with signs of money laundering	ALPARI BANK	341.66	104.21	342.42	117.45	61.74	126.85	61.30	128.77	198.75	306.64	197.18	211,49	Partially
	BANK FOR INVESTMENT AND SAVINGS	33.76	27.28	33.84	25.55	26.24	47.10	26.30	47.27	17.41	29.73	17.80	30,42	Compliant
	BANK SICH	22.54	41.52	22.22	41.67	27.21	96.13	27.04	97.17	26.63	59.21	26.15	76,09	Compliant
	GLOBUS	15.18	31.56	15.22	31.39	13.60	16.26	14.40	15.99	27.99	55.92	28.37	52,45	Compliant
	CONCORD	31.92	94.29	28.89	91.37	33.87	57.16	33.65	57.01	35.09	75.20	35.10	78,24	Compliant
	MEGABANK	17.04	13.26	17.02	12.27	24.09	23.38	23.77	22.72	14.91	22.93	15.98	19,23	Compliant
	MISTO BANK	89.22	60.44	88.99	64.67	55.76	87.66	56.64	85.95	83.35	119.99	84.51	124,53	Compliant
	МТБ BANKV	7.45	19.99	7.85	20.03	20.18	21.66	20.25	21.52	19.26	25.79	19.16	23,01	Compliant
	ОТП BANK	10.33	18.53	10.67	17.47	11.06	14.29	11.35	13.67	20.90	23.57	21.13	21,44	Compliant
	PIVDENNYI	11.47	9.82	11.36	9.68	14.00	16.44	14.27	16.98	23.46	28.56	22.54	25,50	Compliant
	RWS BANK	53.28	65.75	52.41	65.91	53.77	70.42	52.90	70.80	96.12	95.54	95.77	100,28	Compliant
	SBERBANK	7.78	21.84	7.79	19.89	12.85	21.55	12.96	20.48	16.98	32.98	17.58	30,72	Compliant
	TASCOMBANK	16.29	41.53	16.50	41.76	11.03	25.29	11.13	25.57	26.02	41.68	27.89	39,52	Compliant
	UKRAINIAN CAPITAL	17.85	17.26	17.75	17.70	41.74	42.72	41.64	41.88	31.02	64.58	30.11	70,99	Compliant
	UKRSOTSBANK	15.95	32.58	15.83	32.50	50.66	56.41	51.15	57.70	61.87	58.60	63.92	65,16	Compliant
	UNIVERSAL BANK	21.85	29.24	22.01	30.03	18.30	20.04	18.99	19.26	75.45	40.09	76.29	46,22	Compliant
Average values by group (excluding data from Alpari Bank)		24.79	34.99	24.56	34.79	27.62	41.10	27.76	40.93	38.43	51.62	38.82	**53.59**	–

Table 6 (cont.). Generalized results of calculating the coefficient of variation of cash flow by cash registers and accounts on demand of bank customers for the period August 2017 – May 2019

Bank category	Bank	Coefficient of variation, %												Correspondence of the data distribution to the normal law according to the Shapiro-Wilk test
		Cash				Funds on demand of economic entities				Funds on demand of individuals				
		Deposition		Withdrawal		Crediting		Withdrawal		Crediting		Withdrawal		
		NC	FC	NC	FC	NC	FC	NC	FC	NC	FC	NC	FC	
Banks to which the NBU applied enforcement measures for non-compliance with the requirements in the field of financial monitoring, except for those, in whose activities the scheme operations have been revealed	ASVIO BANK	17.88	57.77	17.90	56.00	14.25	31.56	13.49	32.62	50.31	67.90	51.90	63.07	Compliant
	BANK 3/4	41.23	59.56	41.23	59.65	19.22	57.29	19.25	57.73	64.49	110.52	65.65	103.25	Compliant
	OSCHADBANK	10.01	9.55	9.97	9.16	13.95	13.59	14.01	11.31	18.45	32.13	18.62	32.93	Compliant
	CREDOBANK	7.18	16.82	7.40	16.84	9.69	11.57	10.08	11.51	23.04	34.15	22.30	32.45	Compliant
	PROMINVEST-BANK	10.75	23.26	10.65	22.92	28.37	34.24	27.07	37.89	27.22	35.31	28.12	35.93	Compliant
	SEB BANK	102.02	204.91	165.86	163.28	22.14	19.40	24.62	19.44	27.65	0.00	32.18	0.00	Partially
	UKRCONSINVESTBANK	32.33	52.08	32.38	53.51	23.47	47.28	25.23	43.94	35.08	103.83	35.21	112.92	Compliant
	UKRSIBBANK	7.02	12.32	7.01	12.50	9.22	10.48	9.55	11.08	20.08	23.61	20.01	23.55	Compliant
	Average values by group (excluding data from SEB Bank)	18.06	33.05	18.08	32.94	16.88	29.43	16.95	29.44	34.10	58.21	34.54	**57.73**	–
Banks to which the NBU did not apply enforcement measures for non-compliance with financial monitoring requirements	BANK AALLIANCE	26.76	82.89	26.88	83.14	74.51	56.73	75.45	54.83	74.89	62.15	74.33	63.47	Compliant
	GRANT	18.68	65.86	19.14	69.32	12.07	13.38	12.38	13.05	26.96	128.47	25.83	114.77	Compliant
	CREDIT AGRICOLE BANK	8.30	18.74	8.67	17.79	14.81	23.08	14.80	22.80	19.95	30.15	19.72	23.05	Compliant
	POLICOMBANK	13.38	21.08	13.77	20.93	15.37	39.97	15.46	40.81	27.18	62.92	30.02	55.83	Compliant
	PRAVEX BANK	10.46	18.29	10.20	20.24	11.88	26.25	12.90	26.95	13.46	26.84	14.12	28.64	Compliant
	RAIFFEISEN BANK AVAL	7.18	22.31	6.91	20.53	9.01	16.00	9.25	16.47	16.78	23.62	16.55	27.22	Compliant
	UKRGASBANK	21.84	20.24	22.00	19.76	26.42	18.78	26.63	15.69	19.25	20.51	20.84	20.95	Compliant
	UKREXIMBANK	6.37	17.96	6.23	15.87	12.63	15.23	12.93	13.22	15.28	29.67	15.58	27.33	Compliant
	Average values by group	14.12	33.42	14.23	33.45	22.09	26.18	22.48	25.48	26.72	48.04	27.12	**45.16**	–

economic entities, and 57.97% for transactions on accounts of individuals.

Thus, for a group of banks with identified scheme operations, the coefficient of variation indicates the presence of a high risk of exposure to non-systemic factors, including money laundering using the operations of these banks.

The group of banks with shortcomings in the financial monitoring system identified by the NBU has a coefficient of variation, which indicates the average risk of money laundering: in most cases in the range from 16.00% to 35.00% for cash flows in UAH and within 29-58% for cash flows in foreign currency.

The third group of banks includes banks that did not have comments from the NBU on the functioning of their systems to prevent and combat money laundering. The calculated values of the coefficients of variation of cash flows on the accounts of these banks confirm this in most cases, and the average values for this group are the lowest: 14.18% in cash flows in national currency and 33.43% in foreign currency; coefficient of variation of 22.29% on the movement of funds on the accounts of economic entities in the national currency, and 25.83% in foreign currency; the coefficient of variation is 26.92% for the movement of funds on the accounts of individuals in national currency and 46.60% in foreign currency.

The analysis showed that the coefficient of variation of cash flows in bank accounts and cash can be used as an indicator of the money laundering risk.

CONCLUSION

An important group of factors of legalization of income and processes of prevention and counteraction to this are transactions of bank customers with cash and non-cash funds. Analysis of the turnover of 32 banks on cash accounts and on demand accounts of individuals and businesses showed that the coefficient of variation of these indicators could be used to identify an increased risk of legalization of customers' incomes. Banks are divided into three groups to reduce the risk of using their services for money laundering:

- the first group includes banks in which the NBU has identified scheme operations with signs of legalization (16 banks);

- the second group includes banks to which the NBU has applied enforcement measures in the field of financial monitoring, except for those in which scheme operations are detected (8 banks);

- the third group includes banks to which the NBU did not apply enforcement measures for non-compliance with financial monitoring requirements, i.e. banks with the lowest risk of legalization (8 banks).

The study has proven that the first group of banks with the highest (actually detected) risk of legalization has the highest values of variation coefficients – up to 120%; the second group of banks with an average risk of using their services for money laundering has significantly lower values of variation coefficients – on average 18-58%. The third group of banks without NBU remarks has the lowest values of the variation coefficients of the turnover of cash and non-cash clients' funds.

AUTHOR CONTRIBUTIONS

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