

DOI: 10.55643/fcaptp.4.63.2025.4921

Karolina Hałuszko

Junior Industrial Property Negotiator,
Querco Property Gdańsk, Zabrze,
Poland;
ORCID: [0009-0006-0026-0226](https://orcid.org/0009-0006-0026-0226)

Zuzana Kubaščíkova

PhD in Economics, Academician,
Professor of the Department of
Accounting and Auditing, University of
Economics in Bratislava, Bratislava,
Slovakia;
ORCID: [0000-0001-6739-1278](https://orcid.org/0000-0001-6739-1278)

Liudmyla Zakharkina

Candidate of Economic Sciences,
Associate Professor of the Department
of Financial Technologies and
Entrepreneurship, Sumy State
University, Sumy, Ukraine;
e-mail: l.zakharkina@biem.sumdu.edu.ua
ORCID: [0000-0003-1002-130X](https://orcid.org/0000-0003-1002-130X)
(Corresponding author)

Pavlo Halimon

PhD in Public Administration, Professor,
National Academy of Agrarian Sciences
of Ukraine, Kyiv, Ukraine;
ORCID: [0000-0003-3259-597X](https://orcid.org/0000-0003-3259-597X)

Sergey Selyutin

PhD in Economics, Associate Professor
of the Department of Management,
Higher Educational Institution
"University of Future Transformation",
Chernihiv, Ukraine;
ORCID: [0020-0003-8018-8539](https://orcid.org/0020-0003-8018-8539)

Tetiana Dotsenko

PhD in Economics, Department of
Economic Cybernetics, Sumy State
University, Sumy, Ukraine;
ORCID: [0000-0001-5713-2205](https://orcid.org/0000-0001-5713-2205)

Received: 18/07/2025

Accepted: 15/08/2025

Published: 31/08/2025

© Copyright

2025 by the author(s)



This is an Open Access article
distributed under the terms of the
[Creative Commons CC-BY 4.0](https://creativecommons.org/licenses/by/4.0/)

METHODOLOGICAL TOOLS FOR ANALYZING THE ACTIVITIES OF PRIMARY FINANCIAL MONITORING ENTITIES

ABSTRACT

The article addresses the pressing need to gauge how Ukraine's primary financial-monitoring entities (PFMEs) withstand simultaneous shocks from regulatory tightening, the COVID-19 pandemic, and full-scale war, circumstances that have magnified money-laundering and terrorism-financing risks. The study aims to develop and apply an integrated assessment toolkit that combines a transparent binary scoring grid with a Bayesian probability model to track PFME activity over 2011-2023. The empirical analysis, built on forty-five official indicators, shows a steady rise in compliance until 2019 with a historical peak in 2017-2019, a sharp contraction during 2020-2022, and an incipient rebound in 2023 as institutions adapt to remote supervision and digital workflows. Digital reporting channels prove the most resilient dimension, whereas court- and prosecution-related indicators suffer the deepest wartime setbacks, highlighting capacity gaps beyond the financial sector itself. The integrated methodology captures these nuances more effectively than static checklists and provides regulators with an evidence base for recalibrating risk-based supervision, prioritizing end-to-end digital infrastructure, and reallocating resources toward investigative and judicial bottlenecks. The findings confirm that adaptive, data-driven oversight can bolster the national anti-money-laundering framework even under extreme stress and suggest that the proposed toolkit is transferable to other transition or conflict-affected economies seeking to strengthen financial crime prevention during recovery.

Keywords: anti-money laundering, financial monitoring, Bayesian analysis, binary scoring, wartime impact, risk-based supervision, compliance resilience, Ukraine

JEL Classification: C11, G28, K42, O33, H56

INTRODUCTION

Primary financial monitoring entities (PFMEs) hold significant responsibility in detecting suspicious transactions potentially linked to illicit activities, including the concealment of illegal funds, support for extremist purposes, or other financial misconduct. In Ukraine, the role of these entities has become even more critical given the dual pressures of wartime conditions and economic instability. Despite regulatory frameworks and reporting mechanisms, the effectiveness and adaptability of PFMEs remain uneven, especially under challenging circumstances, such as the COVID-19 pandemic and full-scale war.

Traditional evaluation approaches often fail to capture the complexity and volatility of PFME operations, especially in environments where risks evolve rapidly and institutional capacity is strained. As such, there is an urgent need for analytical tools that not only assess formal compliance but also provide a dynamic understanding of monitoring intensity, institutional responsiveness, and systemic resilience.

This paper addresses this gap by proposing an integrated methodology for evaluating PFME performance using a combination of Ex-Ante and Ex-Post analysis, binary assessment models, and Bayesian probability estimation. By leveraging normalized statistical indicators and probabilistic modelling, the approach allows for a nuanced, multi-dimensional view of PFME activity levels over time. This framework enables regulatory bodies,

policymakers, and the institutions themselves to better identify risk patterns, measure performance, and implement targeted improvements within the financial monitoring system.

LITERATURE REVIEW

The development of methodological tools for analyzing the activities of primary financial monitoring entities has garnered significant academic attention, particularly against the backdrop of global initiatives aimed at countering illicit financial flows, including laundering practices and related financial crimes. Existing literature provides a multifaceted view of the challenges, trends, and technological advancements shaping the effectiveness of AML systems, underscoring the importance of comprehensive risk assessment, regulatory compliance, and institutional adaptation.

A recurring theme across the literature is the increasing complexity and adaptability of illicit financial behaviour. Pulungan et al. (2024) explore how personal predispositions and socio-economic vulnerabilities contribute to the risk of corruption and money laundering, highlighting the need for AML tools to account for behavioural as well as systemic factors. Complementing this, Burton and Moore (2024) examine the “pig butchering” scam as an emergent form of cyber-enabled financial crime, underscoring the dynamic interplay between digital manipulation techniques and regulatory weaknesses.

The ethical and regulatory frameworks within which AML entities operate are also a core focus. Ishwardat et al. (2024) provide a comprehensive review of mechanisms that stimulate ethical conduct and regulatory compliance, offering insights into organizational behaviour relevant to primary monitoring units. Similarly, Vyas-Doorgapersad (2024) critiques the shortcomings in anti-corruption systems, suggesting that institutional inefficiencies and a lack of coordination hinder effective monitoring.

Technological transformation emerges as both an enabler and a threat in AML operations. Dobrovolska and Rozhkova (2024) analyze how digitalization reshapes anti-corruption and cyber-fraud systems, advocating for the proactive integration of technological tools. This is reinforced by Lyeonov et al. (2024), who use bibliometric analysis to track the impact of artificial intelligence and machine learning in detecting illegal financial operations. Kuzior et al. (2022) further explore global digital convergence and its implications for AML efficiency, noting the crucial balance between technological integration and regulatory alignment.

Quantitative approaches to risk analysis are also represented in the literature. Lyeonov et al. (2020) utilize innovative modelling approaches for evaluating the risk of illicit fund circulation within the banking and finance sector, proposing advanced analytical frameworks adaptable for primary monitoring entities. Bozhenko et al. (2022) use a mar-spline approach to identify determinants of corruption in government systems, providing methodological parallels for AML assessment.

The institutional resilience of monitoring systems is scrutinized in multiple studies. Morin (2025) discusses enhanced oversight in banking to mitigate systemic failures, a concern echoed in the works of Brychko et al. (2021), who emphasize the erosion of trust caused by illegal intermediary activities. Meanwhile, Yarovenko et al. (2024b) assess the maturity of judicial systems in addressing financial fraud during wartime, highlighting jurisdictional capacity as a critical variable.

Cybersecurity, a closely linked domain, is thoroughly addressed. Wright (2023) and Dobrovolska et al. (2024) assess cybersecurity risks across sectors, identifying systemic vulnerabilities that complicate AML enforcement. Similarly, Yarovenko et al. (2023) model insider fraud behaviour in banks, a key concern for primary monitoring functions, while Yarovenko et al. (2024a) further consider societal perceptions of artificial intelligence in financial contexts, a factor relevant to the public acceptance of AML technologies.

Broader governance concerns are discussed by Mazurenko et al. (2023), who investigate the relationship between tax competition, shadow economies, and governance structures, suggesting that AML effectiveness is inherently tied to state policy coherence. Vasilyeva et al. (2021) conduct a data-mining analysis of the pandemic’s impact on AML systems, illustrating how crisis conditions exacerbate structural weaknesses. Similarly, Patel et al. (2023) present a global overview of financial typologies used to mitigate risks, providing comparative perspectives that inform the strategic focus of monitoring institutions. Zhuk et al. (2023) also consider digital tools for ensuring financial monitoring at the public finance level.

Public health and national security perspectives, while less traditionally associated with AML, offer additional dimensions. Firstová and Vysochyna (2024) argue for optimizing socio-economic and public health determinants in national recovery

frameworks, while Dobrovolska et al. (2024) examine how health-related safety and cybersecurity increasingly converge — an increasingly relevant topic as AML intersects with other domains of critical infrastructure protection.

Collectively, the literature illustrates the dynamic and interdisciplinary nature of modern AML practices. From behavioural insights and ethical compliance to AI-driven detection systems and geopolitical stressors, the landscape of primary financial monitoring is rapidly evolving. It is evident that any methodological framework designed to assess these entities must be both integrative and adaptive, capable of responding to a spectrum of internal and external pressures.

AIMS AND OBJECTIVES

The aim of this study is to develop an integrated methodological toolkit for analyzing the activities of primary financial monitoring entities (PFMEs), enabling a quantitative assessment of their activity levels and compliance with regulatory expectations during both peacetime and wartime periods.

To achieve this aim, the study sets the following objectives:

1. To construct a statistical database of indicators reflecting the activity of PFMEs based on official sources.
2. To normalise the selected indicators, taking into account their stimulating or inhibiting influence on monitoring performance.
3. To build binary characteristics of activity for each indicator and calculate an integral activity assessment across different periods.
4. To conduct a Bayesian analysis to determine the probability of pfmes achieving an acceptable level of activity.
5. To analyse the dynamics of activity levels in pre-war (Ex-Ante) and wartime (Ex-Post) periods.
6. To develop actionable suggestions for improving primary financial monitoring performance, drawing on the research findings.

METHODS

Analyzing how primary monitoring entities operate through integrated Bayesian, Ex-Ante, and Ex-Post approaches involves examining statistical reports reflecting their performance in Ukraine. Data are collected from reports of the State Financial Monitoring Service of Ukraine, the National Bank of Ukraine, the National Securities and Stock Market Commission of Ukraine, the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine), Court report (State Judicial Administration of Ukraine), and other sources Boiko (2019), Dotsenko (2021). The analysis is implemented in the following stages.

At **the first stage** of the study, the input statistical base is collected and formed. The following 45 statistical indicators were selected as input indicators, describing certain characteristics of the activities of primary financial monitoring entities (Table 1).

Table 1. Input statistical indicators of the study.

Indicator	Source	Marking
Number of notifications by financial monitoring characteristics: threshold financial transactions / with characteristics of mandatory financial monitoring (until 28.04.2020)	Report of the State Financial Monitoring Service of Ukraine	SFM1
Number of reports by financial monitoring signs: suspicious financial transactions (activity) / with signs of internal financial monitoring (until 04/28/2020)	Report of the State Financial Monitoring Service of Ukraine	SFM2
Number of reports by financial monitoring characteristics: threshold and suspicious financial transactions (activities) / with characteristics of mandatory and internal financial monitoring (until 28.04.2020)	Report of the State Financial Monitoring Service of Ukraine	SFM3
Number of reports by financial monitoring features: tracking (monitoring) of financial transactions	Report of the State Financial Monitoring Service of Ukraine	SFM4
Number of messages selected for dossier formation	Report of the State Financial Monitoring Service of Ukraine	SFM5
Number of summarized materials transferred to law enforcement agencies	Report of the State Financial Monitoring Service of Ukraine	SFM6
Number of request files sent to banking institutions	Report of the State Financial Monitoring Service of Ukraine	SFM7

(continued on next page)

Table 1. Continued.

Indicator	Source	Marking
Number of additional summarized materials transferred to law enforcement agencies	Report of the State Financial Monitoring Service of Ukraine	SFM8
Number of requests to foreign financial intelligence units	Report of the State Financial Monitoring Service of Ukraine	SFM9
Number of dossiers generated	Report of the State Financial Monitoring Service of Ukraine	SFM10
Number of summarized materials used in criminal proceedings	Report of the State Financial Monitoring Service of Ukraine	SFM11
Number of responses to foreign financial intelligence units	Report of the State Financial Monitoring Service of Ukraine	SFM12
Number of decisions and instructions of the State Financial Monitoring Service to suspend financial transactions	Report of the State Financial Monitoring Service of Ukraine	SFM13
Number of financial transactions submitted by banks to the FMS	Report of the National Bank of Ukraine	SFM14
Number of scheduled bank inspections / scheduled on-site and on-site inspections (since 2020)	Report of the National Bank of Ukraine	SFM15
Number of unscheduled inspections of banks	Report of the National Bank of Ukraine	SFM16
Number of impact measures	Report of the National Bank of Ukraine	SFM17
Number of entities found to have violated legislative requirements in the field of preventing and combating the legalization (laundering) of proceeds from crime, financing of terrorism, and financing of the proliferation of weapons of mass destruction	Report of the National Securities and Stock Market Commission of Ukraine	SFM18
Number of inspections of primary financial monitoring entities / Number of requests for information (since 2022)	Report of the National Securities and Stock Market Commission of Ukraine	SFM19
Number of penalties for violation of legislative requirements on prevention and counteraction to the legalization (laundering) of proceeds from crime or the financing of terrorism	Report of the National Securities and Stock Market Commission of Ukraine	SFM20
Number of considered cases of violation of legislative requirements on prevention and counteraction to the legalization (laundering) of proceeds from crime or the financing of terrorism	Report of the National Securities and Stock Market Commission of Ukraine	SFM21
Number of criminal offenses for which a pre-trial investigation was conducted in the reporting period	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM22
Number of outstanding criminal cases/prosecutions at the beginning of the reporting period (until 2019) / at the end of the reporting period (2022-2023)	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM23
Number of criminal cases/trials sent to court with indictment/act	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM24
Number of criminal cases/trials referred to court for release from criminal liability	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM25
Number of criminal cases/investigations referred to other authorities	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM26
Number of closed cases/proceedings	Report of the Prosecutor General's Office of Ukraine (Office of the Prosecutor General of Ukraine)	SFM27
Number of criminal cases pending	Court report	SFM28
Number of cases reviewed, with the case returned for additional investigation	Court report	SFM29
Number of referrals by jurisdiction	Court report	SFM30
Number of indictments returned to the prosecutor	Court report	SFM31
Number of outstanding cases	Court report	SFM32
Number of cases in which charges were changed	Court report	SFM33
Number of consolidated cases	Court report	SFM34
Number of cases considered with the release of persons from criminal liability	Court report	SFM35
Number of reports received by primary financial monitoring entities: non-banking institutions	Report of the State Financial Monitoring Service of Ukraine	SFM36
Number of reports received from the non-banking sector: insurance institutions	Report of the State Financial Monitoring Service of Ukraine	SFM37
Number of notifications received from the non-banking sector: Other entities providing financial services / Financial companies (since 2022)	Report of the State Financial Monitoring Service of Ukraine	SFM38
Number of reports received from the non-banking sector: Securities traders, Asset management companies, Custodian traders, Other professional securities market participants (2011-2012) / Professional stock market participants (2013-2021) / Participants in capital markets and organized commodity markets (from 2022)	Report of the State Financial Monitoring Service of Ukraine	SFM39
Number of notifications received from the non-banking sector: Business entities conducting lotteries / Business entities conducting lotteries, and Business entities conducting gambling, including casinos, electronic (virtual) casinos (since 2022)	Report of the State Financial Monitoring Service of Ukraine	SFM40
Number of messages received from the non-banking sector: Notaries	Report of the State Financial Monitoring Service of Ukraine	SFM41
Number of messages received from the non-banking sector: Other SPFM	Report of the State Financial Monitoring Service of Ukraine	SFM42
Number of received and processed reports on financial transactions subject to financial monitoring	Report of the State Financial Monitoring Service of Ukraine	SFM43
Number of financial transaction reports recorded	Report of the State Financial Monitoring Service of Ukraine	SFM44
Number of registered SPFM	Report of the State Financial Monitoring Service of Ukraine	SFM45

For further research, the indicators are divided into stimulants, with the increase of which the overall level of activity of the subjects of primary financial monitoring increases, and disincentives, with the increase of which, on the contrary, the activity decreases.

At **the second stage** of the study, to ensure indicator comparability, normalization is applied, since absolute values reflecting different characteristics are not directly comparable. Normalization is performed using the minimax normalization method, taking into account the nature of the impact of the indicators (stimulators/disincentives) according to the following formulas (formulas 1 and 2) (Kuzmenko et al, 2011):

$$SFM_{ins} = \frac{SFM_i - \min SFM_i}{\max SFM_i - \min SFM_i}, \quad SFM_i \geq \min SFM_i \quad (1)$$

$$SFM_{ind} = \frac{\max SFM_i - SFM_i}{\max SFM_i - \min SFM_i}, \quad SFM_i \leq \max SFM_i \quad (2)$$

where SFM_{ins} – normalized values of indicators for stimulants; SFM_{ind} – normalized values of indicators for destimulators; SFM_i – input values of indicators; $\max SFM_i$ – maximum values of indicators for each of the indicators; $\min SFM_i$ – minimum values of indicators for each of the indicators.

At **the third stage** of the study, the limit (permissible) values for the selected characteristics are determined. The corridor of permissible standards is calculated by determining the average values of the normalized indicators of the activities of the subjects of primary financial monitoring using the arithmetic mean formula (formula 3) (Kuzmenko et al, 2011):

$$SFM_{ia} = \frac{\sum SFM_{in}}{N}, \quad (3)$$

where SFM_{ia} – average values of normalized indicators for each indicator; $\sum SFM_{in}$ – sum of normalized values of indicators for each indicator; N – the number of periods under study.

Where values falling in the interval $(0; SFM_{ia})$ indicate unacceptable values, i.e., insufficient activity of subjects, and values in the interval $(SFM_{ia}; 1)$ indicate acceptable values, i.e., sufficient activity.

At **the fourth stage** of the study, binary characteristics are calculated for each of the selected indicators, the sum of which is used to perform an express assessment of the activity of primary financial monitoring entities, with visualization of the results.

The values of binary characteristics are determined by formula 4 (Kuzmenko et al, 2011), taking into account the normalized (Table A2) and limit (Table A3) indicators of the activities of primary financial monitoring entities.

$$SFM_{ib} = \begin{cases} 0, & SFM_{in} < SFM_{ia} \\ 1, & SFM_{in} > SFM_{ia} \end{cases} \quad (4)$$

where SFM_{ib} – binary characteristics for each indicator by year; SFM_{in} – normalized values of indicators by year; SFM_{ia} – average values of normalized indicators for each indicator.

If a given indicator's adjusted value falls within an unacceptable range, the binary variable is assigned "0". Conversely, when this adjusted value lies within the acceptable range, the binary variable takes the value "1".

Within this stage, the sum of binary characteristics is calculated for each year, which acts as an express assessment of the activity of the subjects of primary financial monitoring, with the definition of activity groups. That is, each period will have a set of binary characteristics from 1 to 45, where the sum of binary indicators for each studied period represents coded information on the level of activity of the subjects of primary financial monitoring. In this case, it is advisable to divide the activity levels into groups (Kuzmenko et al, 2011):

1. Group 1 – low activity in the interval [0;9).
2. Group 2 – activity below average in the interval [9;18).
3. Group 3 – average activity in the interval [18;27).
4. Group 4 – activity above average in the interval [27;36).
5. Group 5 – high activity in the interval [38;45].

At the fifth stage of the study, an assessment of the activity of the subjects of primary financial monitoring is implemented based on Bayesian analysis. This type of analysis is a probabilistic approach to assessing the processes under study, which involves obtaining information on the compliance of certain indicators with regulatory characteristics, adequate to current realities, as well as calculating the probability of their fulfillment or non-fulfillment based on this information. That is, according to the current study, the probability of subjects achieving the level of activity in their activities related to conducting primary financial monitoring.

The Bayesian approach to data analysis is based on the application of Bayes' theorem, which allows you to calculate with high accuracy the probability of the validity of the formulated hypothesis. Bayes' formula (formulas 5 and 6) (Kuzmenko et al, 2011), according to which a posteriori (experimental) expected phenomena are defined as the product of a priori (independent of experience) predictions (characterizes the degree of expert confidence in the truth of the hypothesis) and the Bayesian criterion (characterizes the observation data of the event, relative chances, weight of evidence).

$$P_{po} = P_{pr} * P_B$$

$$P_B = P_0/P_a \quad (5)$$

where P_{po} is the posterior probability of the null hypothesis being true; P_{pr} – a priori probability of the null hypothesis being true; P_B – Bayes criterion; P_0 – the probability of obtaining information when the null hypothesis is true; P_a – the probability of obtaining information when the alternative hypothesis is true.

$$P_{SFM}(A) = \frac{P(A) * P_A(SFN)}{P(SFN)} = \frac{P(A) * P_A(SFN)}{P(A) * P_A(SFN) + P(N) * P_N(SFN)} = 1 / \left(1 + \frac{P(N) * P_N(SFN)}{P(A) * P_A(SFN)} \right) =$$

$$= 1 / \left(1 + \frac{P(N)}{P(A)} \prod \left(\frac{b_N}{b_A} \right)^{SFM_i} * \left(\frac{1-b_N}{1-b_A} \right)^{1-SFM_i} \right) = 1 / (1 + e^{\{w_0 + W\}}) \quad (6)$$

where A are the periods of activity; N – periods of inactivity; SFM_b – binary characteristics by year; $P_{SFM}(A)$ – the probability that during this period the activities of business entities in conducting primary financial monitoring will be active if information on the indicator is available, SFM ; $P(A)$ – is the probability of activity of subjects in the studied period in the absence of a posteriori information on it; $P(N)$ – this is the probability of inactivity of subjects in the studied period in the absence of a posteriori information on it; $P_A(SFN)$ – is the probability that information on SFN indicators will be available for the a priori period of activity of subjects; $P_N(SFN)$ is the probability that information on SFN indicators will be available for the a priori period of inactivity of subjects. b_N – probability of inactivity (events with binary value 0); b_A – probability of activity (events with binary value 1); w_0, w_i – parameters; W – integral indicator of binary characteristics SFN, i.e., their weighted sum.

The values of the indicators b_N , b_A , w_0, w_i , and W were calculated using the corresponding formulas (formula 7) (Kuzmenko et al, 2011).

$$b_A = (\sum SFM_i) / n$$

$$b_N = 1 - b_A$$

$$w_0 = \ln (P(N)/P(A)) + \sum \ln ((1 - b_N)/(1 - b_A))$$

$$w_i = \ln ((b_N(1 - b_A))/(b_A(1 - b_N)))$$

$$W = \sum w_i * b_N \quad (7)$$

The activity probability indicator of primary financial monitoring entities serves as a quantitative metric used to evaluate or predict the likelihood that these entities are meeting their responsibilities in preventing illicit financial flows and terrorism-related transactions. This measure is shaped by multiple factors, including adherence to regulatory and legal standards, the extent of identifying high-risk activities, frequency of suspicious transaction reporting, availability and functionality of internal control mechanisms, level of automation in monitoring processes, consistency in conducting reviews, and how

effective those reviews are. This indicator plays a crucial role in evaluating the overall performance of the financial monitoring framework and may assist regulators in identifying high-risk entities, conducting compliance audits, and helping primary financial monitoring bodies enhance their internal oversight mechanisms.

After calculating the probabilistic assessment of the activity of primary financial monitoring subjects for each studied period, within this stage, activity levels are determined with the following limits:

1. Group 1 – low activity in the interval $[0;0.3)$.
2. Group 2 – reduced activity in the interval $[0.3;0.5)$.
3. Group 3 – increased activity in the interval $[0.5;0.7)$.
4. Group 4 – high activity in the interval $[0.7;1.0]$.

RESULTS

The results of the first stage of the study on the formed input base of indicators are presented in Table A1. Including, within this stage, the distribution of indicators into stimulants and disincentives is presented as follows:

1. Stimulants: SFM1 – SFM14, SFM17 – SFM26, SFM28, SFM30, SFM34, SFM36 – SFM45.
2. Disincentives: SFM15, SFM16, SFM27, SFM29, SFM31 – SFM33, SFM35.

Table A2 displays the outcomes of the study's second phase, during which indicators related to the activity level of primary financial monitoring entities were normalized. This step enabled the subsequent implementation of comparative analysis.

The third stage of the study allowed the formation of the limit (permissible) values for the selected characteristics of the activities of primary financial monitoring entities (Table A3). Table 2 contains preliminary computed values intended for use in subsequent stages of the analysis.

Table 2 outlines the outcomes of the fourth research stage, which involved computing binary parameters for the chosen indicators and aggregating them to obtain a rapid evaluation of the activity levels of primary financial monitoring entities.

Table 2. Estimated binary indicators of the activity of primary financial monitoring entities and their amounts.										
	SFM1	SFM2	SFM3	SFM4	SFM5	SFM6	SFM7	SFM8	SFM9	SFM10
2011	0	0	0	1	0	0	0	0	0	0
2012	0	1	0	1	0	1	0	0	0	0
2013	0	1	0	0	0	1	0	0	0	0
2014	0	1	0	0	0	0	1	0	0	0
2015	1	1	1	0	0	0	1	0	0	0
2016	1	1	1	0	0	0	0	0	1	0
2017	1	1	1	0	1	0	1	0	0	0
2018	1	0	1	0	1	0	0	1	0	0
2019	1	1	1	0	1	1	0	1	0	0
2020	1	0	0	0	1	1	0	1	0	0
2021	0	0	0	0	1	1	0	1	1	1
2022	0	0	0	0	0	1	1	1	1	1
2023	0	0	0	0	0	1	1	1	1	1
	SFM11	SFM12	SFM13	SFM14	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20
2011	0	0	0	0	0	1	0	1	1	1
2012	0	0	0	0	0	1	1	1	1	1
2013	1	0	0	0	0	1	1	1	1	1
2014	1	0	1	0	0	0	1	0	0	1
2015	0	0	1	1	1	1	1	1	0	0
2016	0	0	1	1	1	1	0	0	0	1
2017	0	0	0	1	1	1	0	1	1	1

(continued on next page)

Table 2. Continued.

	SFM11	SFM12	SFM13	SFM14	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20
2018	1	0	0	1	1	1	0	1	0	1
2019	1	1	0	1	1	1	0	0	0	0
2020	0	1	0	1	1	1	0	0	0	0
2021	1	1	0	0	0	1	0	0	0	0
2022	1	0	0	0	0	0	1	0	0	0
2023	1	1	0	0	0	0	1	0	0	0
	SFM21	SFM22	SFM23	SFM24	SFM25	SFM26	SFM27	SFM28	SFM29	SFM30
2011	1	0	0	0	1	0	1	1	0	1
2012	1	0	0	0	1	0	1	1	0	0
2013	1	0	0	0	0	0	1	1	0	0
2014	1	0	0	0	0	0	1	0	0	1
2015	0	0	0	0	0	0	1	0	1	0
2016	0	0	0	0	0	0	1	0	0	0
2017	1	0	0	0	0	0	1	0	1	1
2018	1	0	0	0	0	0	1	0	1	0
2019	0	0	0	0	0	0	1	0	1	1
2020	0	0	0	0	0	0	1	0	1	0
2021	0	0	0	0	0	0	1	1	1	1
2022	0	1	1	1	1	1	0	1	1	0
2023	0	1	1	1	1	1	0	1	1	0
	SFM31	SFM32	SFM33	SFM34	SFM35	SFM36	SFM37	SFM38	SFM39	SFM40
2011	1	0	0	1	0	0	0	0	0	0
2012	1	1	0	1	0	0	0	0	0	0
2013	0	1	0	1	0	0	1	0	0	0
2014	0	1	0	0	1	0	1	0	0	0
2015	0	1	1	1	1	0	1	0	0	0
2016	0	1	1	0	1	1	1	0	1	0
2017	1	1	1	0	0	1	1	1	1	1
2018	0	1	1	0	0	1	1	1	1	1
2019	1	0	1	0	1	1	1	1	1	1
2020	1	0	1	0	1	1	0	1	1	1
2021	1	0	1	0	1	0	0	0	1	1
2022	1	0	1	0	1	0	0	0	0	0
2023	1	0	1	0	1	0	0	0	0	1
	SFM41	SFM42	SFM43	SFM44	SFM45	SUM	GROUP			
2011	1	1	0	0	0	14	2			
2012	1	1	0	0	1	18	3			
2013	0	0	0	0	1	15	2			
2014	0	0	0	0	1	13	2			
2015	0	0	1	1	1	20	3			
2016	0	0	1	1	1	19	3			
2017	0	1	1	1	1	27	4			
2018	0	1	1	1	1	24	3			
2019	0	0	1	1	1	25	3			
2020	0	0	1	1	1	20	3			
2021	0	0	0	0	0	17	2			
2022	0	0	0	0	0	17	2			
2023	0	0	0	0	0	19	3			

Figure 1 illustrates the express evaluation of primary financial monitoring entities' activity through binary metrics during the pre-war (Ex-Ante) and wartime (Ex-Post) phases, which highlights the characteristics of activity by year by the number of analytical indicators performed, and in Figure 2, which depicts activity levels in the form of formed activity groups of primary financial monitoring entities.

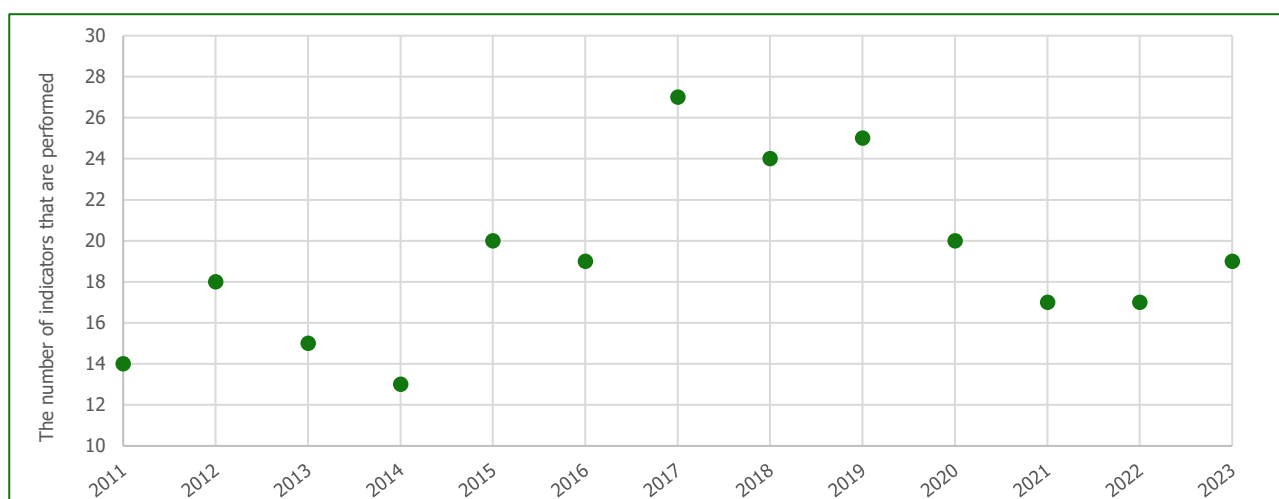


Figure 1. Characteristics of the activity of primary financial monitoring entities by year, by the number of analytical indicators performed.

According to the results of Table 2 and Figure 1, according to the number of indicators being implemented, the following trends are observed. Given the Ex-Ante characteristics, in the period from 2011 to 2015, activity gradually increases, with the lowest activity in 2011 (14 indicators) and in 2014 (13 indicators), which indicates insufficient activity of primary financial monitoring entities. From 2016 to 2019, activity increased significantly, with the highest activity in 2017 (27 indicators), 2018 (24 indicators), and 2019 (25 indicators). Since 2020, activity has stabilized at an average level. At the same time, in the war years (Ex-Post characteristics), no sharp jumps are observed; that is, in 2022 and 2023, the sum of the indicators is 17 and 19, respectively. This indicates a certain adaptation in 2022 to the difficult conditions of martial law, despite possible difficulties in the work of institutions. A slight improvement in 2023 indicates a certain restoration of the activities of primary financial monitoring entities, and indicates their greater attention to financial flows during the war. Trends and visually interpreted classifications of activity levels for primary financial monitoring entities are reflected in Table 2 and Figure 2. None of the analyzed periods fell into the first and fifth groups, which indicates the absence of low and high activity. According to the Ex-Ante analysis, one year (2017) activity reaches a level above average (group 4); most periods (2012, 2015, 2016, 2018-2020) showed average activity (group 3); the second group with activity below average included 2011, 2013, 2014, 2021. According to the Ex-Post analysis, 2022 fell into the second group of activity below average, and 2023 into the third group of average activity.

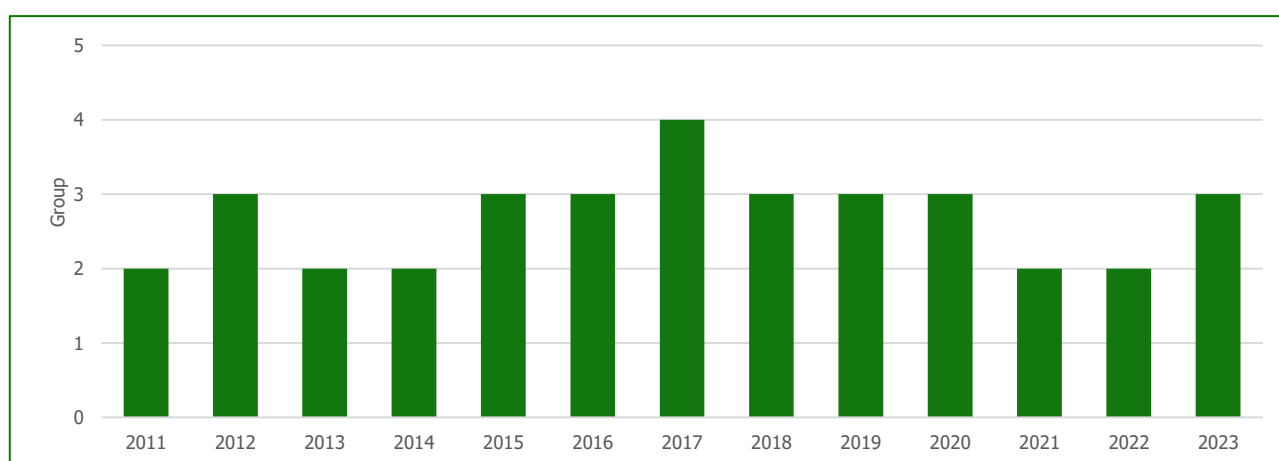


Figure 2. Express assessment of activity levels (groups) of primary financial monitoring entities.

The fifth stage focused on evaluating the activity levels of primary financial monitoring entities through the Bayesian method. During this step, probabilities of activity/inactivity were estimated for each period using all indicators. Additionally, intermediate values and composite binary metrics were derived, which enabled determining probabilistic activity estimates for each year and grouping entities accordingly (Table 3 and Figures 3 and 4).

Table 3. Estimated characteristics of the activity of primary financial monitoring entities using the Bayesian approach. (Source: compiled by the authors)

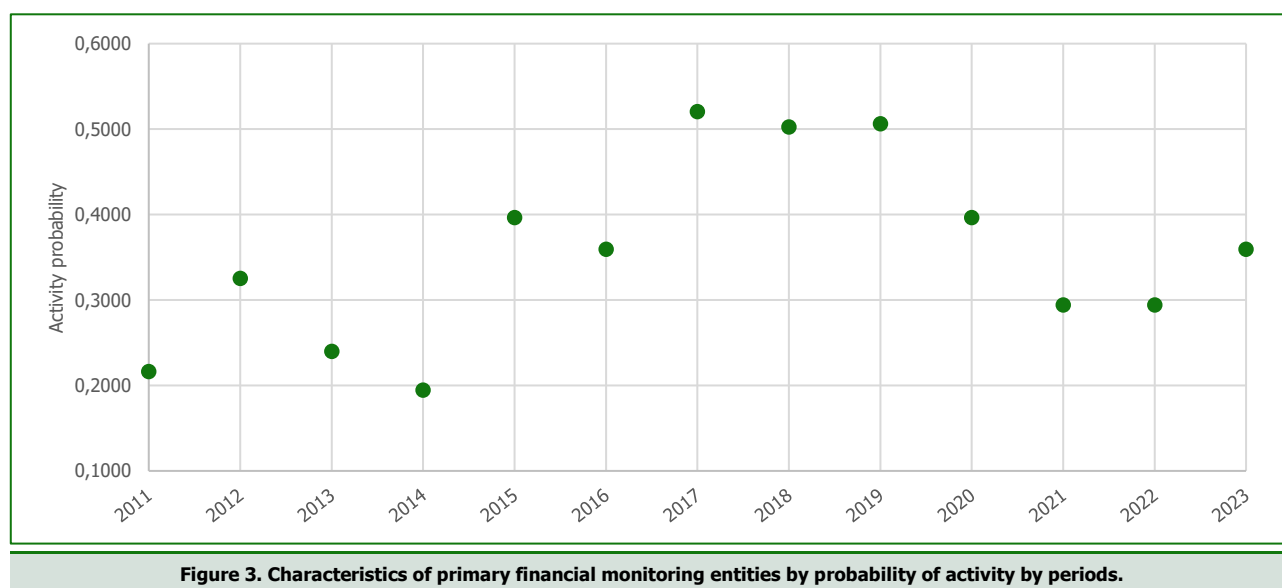
		Event probabilities						Wi	
year	bN	bA	$\ln(1-bN)/(1-bA)$	with	SFM1	SFM2	SFM3	SFM4	SFM5
2011	0.689	0.311	-0.795	1,590	0.000	0.000	0.000	1,590	0.000
2012	0.600	0.400	-0.405	0.811	0.000	0.811	0.000	0.811	0.000
2013	0.667	0.333	-0.693	1,386	0.000	1,386	0.000	0.000	0.000
2014	0.711	0.289	-0.901	1,802	0.000	1,802	0.000	0.000	0.000
2015	0.556	0.444	-0.223	0.446	0.446	0.446	0.446	0.000	0.000
2016	0.578	0.422	-0.314	0.627	0.627	0.627	0.627	0.000	0.000
2017	0.400	0.600	0.405	-0.811	-0.811	-0.811	-0.811	0.000	-0.811
2018	0.467	0.533	0.134	-0.267	-0.267	0.000	-0.267	0.000	-0.267
2019	0.444	0.556	0.223	-0.446	-0.446	-0.446	-0.446	0.000	-0.446
2020	0.556	0.444	-0.223	0.446	0.446	0.000	0.000	0.000	0.446
2021	0.622	0.378	-0.499	0.998	0.000	0.000	0.000	0.000	0.998
2022	0.622	0.378	-0.499	0.998	0.000	0.000	0.000	0.000	0.000
2023	0.578	0.422	-0.314	0.627	0.000	0.000	0.000	0.000	0.000
year	SFM6	SFM7	SFM8	SFM9	SFM10	SFM11	SFM12	SFM13	SFM14
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.811	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	1,386	0.000	0.000	0.000	0.000	1,386	0.000	0.000	0.000
2014	0.000	1,802	0.000	0.000	0.000	1,802	0.000	1,802	0.000
2015	0.000	0.446	0.000	0.000	0.000	0.000	0.000	0.446	0.446
2016	0.000	0.000	0.000	0.627	0.000	0.000	0.000	0.627	0.627
2017	0.000	-0.811	0.000	0.000	0.000	0.000	0.000	0.000	-0.811
2018	0.000	0.000	-0.267	0.000	0.000	-0.267	0.000	0.000	-0.267
2019	-0.446	0.000	-0.446	0.000	0.000	-0.446	-0.446	0.000	-0.446
2020	0.446	0.000	0.446	0.000	0.000	0.000	0.446	0.000	0.446
2021	0.998	0.000	0.998	0.998	0.998	0.998	0.998	0.000	0.000
2022	0.998	0.998	0.998	0.998	0.998	0.998	0.000	0.000	0.000
2023	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.000	0.000
year	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20	SFM21	SFM22	SFM23
2011	0.000	1,590	0.000	1,590	1,590	1,590	1,590	0.000	0.000
2012	0.000	0.811	0.811	0.811	0.811	0.811	0.811	0.000	0.000
2013	0.000	1,386	1,386	1,386	1,386	1,386	1,386	0.000	0.000
2014	0.000	0.000	1,802	0.000	0.000	1,802	1,802	0.000	0.000
2015	0.446	0.446	0.446	0.446	0.000	0.000	0.000	0.000	0.000
2016	0.627	0.627	0.000	0.000	0.000	0.627	0.000	0.000	0.000
2017	-0.811	-0.811	0.000	-0.811	-0.811	-0.811	-0.811	0.000	0.000
2018	-0.267	-0.267	0.000	-0.267	0.000	-0.267	-0.267	0.000	0.000
2019	-0.446	-0.446	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020	0.446	0.446	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2021	0.000	0.998	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2022	0.000	0.000	0.998	0.000	0.000	0.000	0.000	0.998	0.998
2023	0.000	0.000	0.627	0.000	0.000	0.000	0.000	0.627	0.627
year	SFM24	SFM25	SFM26	SFM27	SFM28	SFM29	SFM30	SFM31	SFM32
2011	0.000	1,590	0.000	1,590	1,590	0.000	1,590	1,590	0.000
2012	0.000	0.811	0.000	0.811	0.811	0.000	0.000	0.811	0.811
2013	0.000	0.000	0.000	1,386	1,386	0.000	0.000	0.000	1,386
2014	0.000	0.000	0.000	1,802	0.000	0.000	1,802	0.000	1,802
2015	0.000	0.000	0.000	0.446	0.000	0.446	0.000	0.000	0.446
2016	0.000	0.000	0.000	0.627	0.000	0.000	0.000	0.000	0.627
2017	0.000	0.000	0.000	-0.811	0.000	-0.811	-0.811	-0.811	-0.811
2018	0.000	0.000	0.000	-0.267	0.000	-0.267	0.000	0.000	-0.267
2019	0.000	0.000	0.000	-0.446	0.000	-0.446	-0.446	-0.446	0.000
2020	0.000	0.000	0.000	0.446	0.000	0.446	0.000	0.446	0.000
2021	0.000	0.000	0.000	0.998	0.998	0.998	0.998	0.998	0.000
2022	0.998	0.998	0.998	0.000	0.998	0.998	0.000	0.998	0.000
2023	0.627	0.627	0.627	0.000	0.627	0.627	0.000	0.627	0.000

(continued on next page)

Table 3. Continued.

year	SFM33	SFM34	SFM35	SFM36	SFM37	SFM38	SFM39	SFM40	SFM41
2011	0.000	1,590	0.000	0.000	0.000	0.000	0.000	0.000	1,590
2012	0.000	0.811	0.000	0.000	0.000	0.000	0.000	0.000	0.811
2013	0.000	1,386	0.000	0.000	1,386	0.000	0.000	0.000	0.000
2014	0.000	0.000	1,802	0.000	1,802	0.000	0.000	0.000	0.000
2015	0.446	0.446	0.446	0.000	0.446	0.000	0.000	0.000	0.000
2016	0.627	0.000	0.627	0.627	0.627	0.000	0.627	0.000	0.000
2017	-0.811	0.000	0.000	-0.811	-0.811	-0.811	-0.811	-0.811	0.000
2018	-0.267	0.000	0.000	-0.267	-0.267	-0.267	-0.267	-0.267	0.000
2019	-0.446	0.000	-0.446	-0.446	-0.446	-0.446	-0.446	-0.446	0.000
2020	0.446	0.000	0.446	0.446	0.000	0.446	0.446	0.446	0.000
2021	0.998	0.000	0.998	0.000	0.000	0.000	0.998	0.998	0.000
2022	0.998	0.000	0.998	0.000	0.000	0.000	0.000	0.000	0.000
2023	0.627	0.000	0.627	0.000	0.000	0.000	0.000	0.627	0.000
Wi									
year	SFM42	SFM43	SFM44	SFM45	W	P_ SFM(A)	Probabilistic assessment (groups)		
2011	1,590	0.000	0.000	0.000	0.495	0.216	1		
2012	0.811	0.000	0.000	0.811	0.324	0.325	2		
2013	0.000	0.000	0.000	1,386	0.462	0.240	1		
2014	0.000	0.000	0.000	1,802	0.520	0.194	1		
2015	0.000	0.446	0.446	0.446	0.198	0.396	2		
2016	0.000	0.627	0.627	0.627	0.265	0.359	2		
2017	-0.811	-0.811	-0.811	-0.811	-0.487	0.520	3		
2018	-0.267	-0.267	-0.267	-0.267	-0.142	0.502	3		
2019	0.000	-0.446	-0.446	-0.446	-0.248	0.506	3		
2020	0.000	0.446	0.446	0.446	0.198	0.396	2		
2021	0.000	0.000	0.000	0.000	0.377	0.294	1		
2022	0.000	0.000	0.000	0.000	0.377	0.294	1		
2023	0.000	0.000	0.000	0.000	0.265	0.359	2		

Visualization of the characteristics of the pre-war years (Ex-Ante) and war years (Ex-Post) by the probability of activity of primary financial monitoring entities is presented in Figure 3, as well as the probabilistic assessment of activity, divided into groups, in Figure 4.



The results shown in Figure 3 indicate different trends in the pre-war period. The Ex-Ante analysis highlights a gradual increase in the activity of subjects since 2014, peaking in 2017–2019 (0.520, 0.502, 0.506, respectively), indicating a stabilization of the economic situation and stricter control during this period of time; since 2020, there has been a decline in activity, which could be related to COVID-19 and its consequences. The Ex-Post analysis demonstrates a decline in

activity in 2022–2023 (0.294 and 0.359, respectively), related to economic, financial, and physical constraints, and risks of war conditions in the country; although in 2023, there are some improvements, indicating adaptation to war conditions.

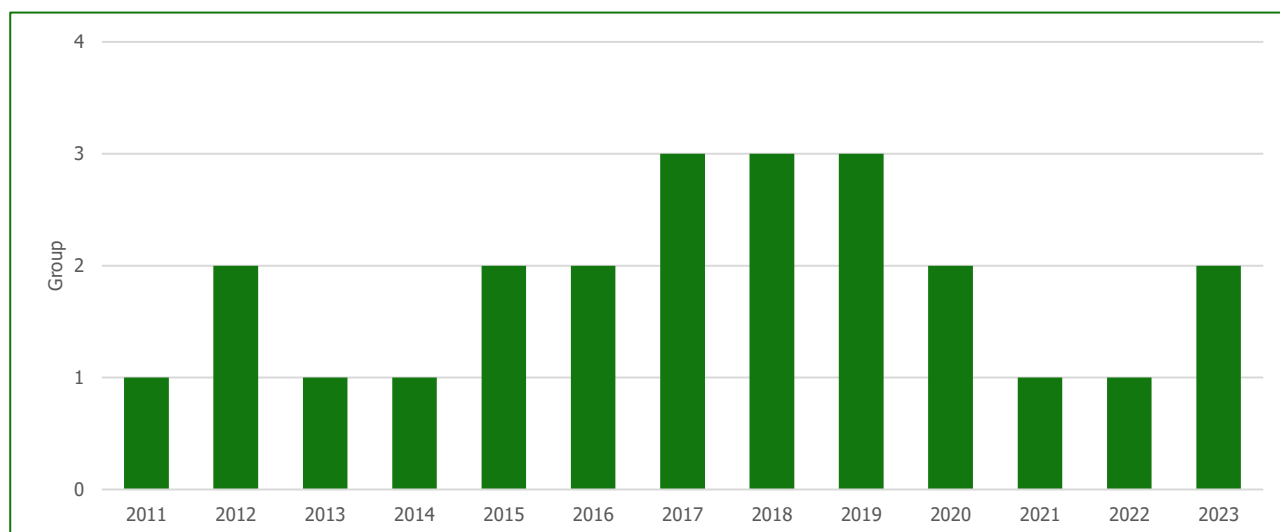


Figure 4. Probabilistic assessment of the activity of primary financial monitoring entities by groups by periods.

The results presented in Figure 4 lead to the following conclusions. Ex-Ante analysis shows that in the pre-war period, activity assessments in 2011–2014 remained mainly at the level of the first group, characterized by low levels and existing difficulties; in 2015–2016, there was a transition to the second group, which compared to previous years means some improvement, but this group is characterized by reduced activity; in the period 2017–2019, the activity level reaches a peak value and falls into the third group, which means increased activity of entities and may indicate regulatory activity; in 2020–2021, activity levels decreased to the second, and then to the first groups, which could be influenced by a number of factors, including the COVID-19 pandemic, as well as the nature of risky operations. According to the Ex-Post analysis, during wartime in 2022, there is low activity of the first group, associated with the difficulties of the emergence of military risks; but in 2023, there is a certain, albeit not significant, improvement with the transition of activity to the second group, reflecting the adaptive characteristic of this period with a tendency to stabilization.

DISCUSSION

The results confirm that the activity level of primary financial monitoring entities (PFMEs) in Ukraine is highly variable and sensitive to external shocks, most notably the COVID-19 pandemic and the ongoing war. A rapid assessment based on binary indicators showed a steady rise in PFME activity during 2011–2019, peaking in 2017 (27 satisfied indicators, activity Group IV). This dynamic coincides with stricter oversight by the National Bank of Ukraine and the National Securities and Stock Market Commission. The Bayesian probability model reinforced this pattern, revealing the highest posterior probabilities of compliant activity in 2017–2019 (0.502–0.520). After 2019, both approaches register a decline, first during the pandemic (2020–2021) and then under martial law (2022). Only in 2023 is a partial recovery observed (from Group I to Group II and a probability rise to 0.359), suggesting that PFMEs have begun adapting to new risks and to remote interaction with regulators.

These findings align with earlier studies. Vasylieva et al. (2021) demonstrated that digitalization and pandemic restrictions exerted mixed effects on AML effectiveness: cyber-risks and workloads rose, yet automation accelerated. Similarly, Dobrovolska & Rozhkova (2024) reported that digital transformation is a “double-edged sword,” enhancing suspicious-transaction detection while complicating control over new abuse channels. Our analysis refines those observations by showing that, in 2020–2021, even rapid digitalization could not offset the loss of face-to-face interaction and personnel shortages; binary activity fell to 17 indicators (Group II) and Bayesian estimates to 0.294 (Group I).

The military dimension is also consistent with Yarovenko et al. (2024b), who forecast heavier burdens on courts and law-enforcement agencies amid wartime cyber- and financial crime. In our data, indicators reflecting prosecutorial and judicial action (SFM22-34) systematically dropped below acceptable thresholds in 2022, driving the lowest overall score. Conversely, indicators tied to remote PFME reporting to the State Financial Monitoring Service (SFM36-45) remained relatively stable, supporting Lyeonov et al. (2024) on the positive impact of IT solutions.

From an applied perspective, the integrated binary-Bayesian toolkit allows practitioners to:

- quickly flag weak spots (e.g., supervision of gambling businesses and notaries in 2022-2023);
- rank periods by risk level and adjust inspection plans, in line with FATF risk-based supervision guidance;
- prioritise digital investment - automated channels (SFM14, SFM43) recover fastest aftershocks, so their development should be central to strategic programmes of the State Tax Service and financial institutions.

Limitations

1. Data representativeness. Official statistics may under-report certain indicators (SFM28–34) owing to wartime disruptions, affecting both binary and Bayesian estimates.
2. Exclusion of qualitative dimensions. The method relies on quantitative indicators; internal PFME procedures and the substantive quality of suspicious-activity reports remain outside the analysis.
3. Temporal and geographic scope. Conclusions apply only to Ukraine for 2011-2023; applying the model elsewhere requires adjustments to normative thresholds.
4. Assumed indicator independence. The Bayesian framework treats indicators as independent, omitting possible correlations, for example, between inspection counts and imposed fines.
5. No predictive back-testing. The study did not conduct ex post or ex ante tests to evaluate the model's forecasting accuracy.

Despite these constraints, the proposed approach offers a comprehensive view of PFME performance and provides a foundation for further research that combines quantitative and qualitative analytics and develops scenario projections for the post-war period.

CONCLUSIONS

This study offers the first long-run, data-driven assessment of how Ukraine's primary financial monitoring entities (PFMEs) have coped with successive systemic shocks – from the tightening of supervisory rules, through the COVID-19 pandemic, to full-scale war. By combining a transparent binary scoring grid with a Bayesian-probability model, we were able to (i) quantify the intensity of PFME activity over 2011-2023, (ii) pinpoint the 2017-2019 window as the historical apex of compliance, and (iii) document a sharp, though uneven, contraction during 2020-2022 followed by an incipient rebound in 2023. The dual-method approach also illuminated which functional areas proved most resilient (digital reporting to the FIU) and which persistently underperformed (court- and prosecution-related indicators).

Three policy-relevant insights emerge:

1. Risk-based supervision should be recalibrated to focus on those PFME sectors – e.g., gambling services, notarial practices, and high-cash businesses – that systematically slipped below normative thresholds during the pandemic and the war.
2. Digital channels accelerate post-shock recovery. Automated submission lines (SFM14, SFM43) recovered activity levels substantially faster than traditional paper-based or face-to-face procedures, underscoring the need to prioritise end-to-end digital AML/CTF workflows.
3. Adaptive resource allocation is critical. The steep wartime decline in court- and prosecution-centric indicators suggests that reinforcing investigative and judicial capacity is as important as upgrading PFME technology.

Directions for further research.

Broader data architecture. Future studies should integrate qualitative metrics – such as the depth of internal PFME controls or the accuracy of suspicious-transaction narratives – to complement the quantitative indicator set deployed here.

Predictive validation. Conducting systematic back-testing and stress-testing would allow researchers to gauge the model's forecasting power and refine its input weights.

Cross-jurisdictional comparison. Applying the binary-Bayesian framework to other transition or conflict-affected economies could reveal whether Ukraine's recovery trajectory is unique or part of a wider regional pattern.

Causal analysis of digitalization. Employing quasi-experimental designs (e.g., difference-in-differences on staggered IT roll-outs) could verify whether digital adoption is an exogenous driver of AML effectiveness or merely correlated with broader institutional quality.

Integrated scenario modelling. Combining our compliance scores with macro-financial variables and war-risk indicators would facilitate forward-looking scenarios for AML/CTF system resilience in the post-war reconstruction phase.

By addressing these avenues, scholars and practitioners can build on the present findings to craft more granular, evidence-based strategies that strengthen Ukraine's – and other countries' – financial crime prevention architectures under conditions of heightened uncertainty.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

ACKNOWLEDGMENT

This research was supported by the Ministry of Education and Science of Ukraine (project No. 0123U101945 – National security of Ukraine through prevention of financial fraud and money laundering: war and post-war challenges) and by the VEGA Agency (project No. 1/0638/23 – Reputational risk of an auditing company as a reflection of the sentiment on Twitter).

FUNDING

The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

REFERENCES

1. Boiko, A. O. (2019). *The system of countering money laundering in ensuring the economic security of the national economy* [Doctoral dissertation, Sumy State University]. ESSUIR. https://essuir.sumdu.edu.ua/bitstream-download/123456789/75303/3/diss_Boiko_Anton.pdf
2. Bozhenko, V. V., Lyeonov, S. V., Polishchuk, E. A., Boyko, A. O., & Artyukhova, N. O. (2022). Identification of determinants of corruption in government: a mar-spline approach. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*, (6), 176–180. <https://doi.org/10.33271/nvngu/2022-6/176>
3. Burton, S. L., & Moore, P. D. V. M. (2024). Pig Butchering in Cybersecurity: A Modern Social Engineering Threat. *SocioEconomic Challenges*, 8(3), 46-60. [https://doi.org/10.61093/sec.8\(3\).46-60.2024](https://doi.org/10.61093/sec.8(3).46-60.2024)
4. Brychko, M., Savchenko, T., Vasylieva, T., & Piotrowski, P. (2021). Illegal activities of financial intermediaries: A burden of trust crisis. *Journal of International Studies*, 14(1), 172–189. <https://doi.org/10.14254/2071-8330.2021/14-1/12>
5. Dobrovolska, O., Ortmanns, W., Dotsenko, T., Lustenko, V., & Savchenko, D. (2024). Health Security and Cybersecurity: Analysis of Interdependencies. *Health Economics and Management Review*, 5(2), 84-103. <https://doi.org/10.61093/hem.2024.2-06>
6. Dobrovolska, O., & Rozhkova, M. (2024). The Impact of Digital Transformation on the Anti-Corruption and Cyber-Fraud System. *Business Ethics and Leadership*, 8(3), 231-252. [https://doi.org/10.61093/bel.8\(3\).231-252.2024](https://doi.org/10.61093/bel.8(3).231-252.2024)
7. Dotsenko, T. V. (2021). *Improving the system of financial monitoring as a tool to ensure the economic security of the national economy* [PhD dissertation, Sumy State University]. ESSUIR. <https://essuir.sumdu.edu.ua/handle/123456789/81697>
8. Firstová, J., & Vysochyna, A. (2024). Optimisation of socio-economic, environmental and public health determinants of national security for post-pandemic recovery. *Health Economics and Management Review*, 5(1), 67-79. <https://doi.org/10.61093/hem.2024.1-05>
9. Ishwardat, S., van Steenbergen, E., Coffeng, T., & Ellemers, N. (2024). Stimulating Regulatory Compliance and Ethical Behavior of Organizations: A Review. *Business Ethics and Leadership*, 8(3), 151-172. [https://doi.org/10.61093/bel.8\(3\).151-172.2024](https://doi.org/10.61093/bel.8(3).151-172.2024)
10. Kuzior, A., Vasylieva, T., Kuzmenko, O., Koibichuk, V., & Brožek, P. (2022). Global Digital Convergence: Impact of Cybersecurity, Business Transparency, Economic Transformation, and AML Efficiency. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(4), 195. <https://doi.org/10.3390/joitmc8040195>

11. Lyeonov, S., Draskovic, V., Kubaščíková, Z., & Fenyves, V. (2024). Artificial intelligence and machine learning in combating illegal financial operations: Bibliometric analysis. *Human Technology*, 20(2), 325–360. <https://doi.org/10.14254/1795-6889.2024.20-2.5>
12. Lyeonov, S., Żurakowska-Sawa, J., Kuzmenko, O., & Koibichuk, V. (2020). Gravitational and intellectual data analysis to assess the money laundering risk of financial institutions. *Journal of International Studies*, 13(4), 259–272. <https://doi.org/10.14254/2071-8330.2020/13-4/18>
13. Mazurenko, O., Tiutiunyk, I., Grytsyshen, D., Daňo, F., Artyukhov, A., & Rehak, R. (2023). Good governance: Role in the coherence of tax competition and shadow economy. *Problems and Perspectives in Management*, 21(4), 757–770. [https://doi.org/10.21511/ppm.21\(4\).2023.56](https://doi.org/10.21511/ppm.21(4).2023.56)
14. Morin, S. L. (2025). Regulating for Resilience: Addressing Bank Failures Through Enhanced Oversight. *Financial Markets, Institutions and Risks*, 9(1), 43–58. [https://doi.org/10.61093/fmir.9\(1\).43-58.2025](https://doi.org/10.61093/fmir.9(1).43-58.2025)
15. National Bank of Ukraine. (n.d.). *Annual reports for 2011–2023*. https://bank.gov.ua/ua/publications?page=1&perPage=5&search=&document=&pubCategory=1&keywords=&created_from=&created_to=
16. National Securities and Stock Market Commission of Ukraine. (n.d.). *Annual reports for 2011–2021*. <https://www.nssmc.gov.ua/about-us/annual-reports/#tab:1>
17. Patel, S., Kasztelnik, K., & Zelihic, M. (2023). Global overview of modern financing typologies to mitigate financial risks in developed countries. *SocioEconomic Challenges*, 7(2), 54–66. [https://doi.org/10.21272/sec.7\(2\).54-66.2023](https://doi.org/10.21272/sec.7(2).54-66.2023)
18. Prosecutor General's Office of Ukraine. (n.d.). *Statistical and analytical reports for 2011–2023*. https://old.gp.gov.ua/ua/stst2011.html?dir_id=113896&libid=100820
19. Prosecutor General's Office of Ukraine. (n.d.). On the results of investigations into criminal offenses related to money laundering, terrorist financing, and the proliferation of weapons of mass destruction. <https://www.gp.gov.ua/ua/posts/pro-rezultati-rozsliduvannya-kriminalnih-provazhen-pro-kriminalni-pravoporushennya-shodo-legalizaciyi-vidmivannya-majna-oderzhanogo-zlochinnim-shlyahom-finansuvannya-terorizmu-rozposvyudzhennya-zbroyi-masovogo-znishennya>
20. Pulungan, A. H., Setiawan, S., & Windiarti, F. (2024). The Risk of Corruption and Money Laundering: An Analysis of Personal Predispositions and Socio-Economic Challenges. *SocioEconomic Challenges*, 8(4), 121–136. [https://doi.org/10.61093/sec.8\(4\).121-136.2024](https://doi.org/10.61093/sec.8(4).121-136.2024)
21. State Financial Monitoring Service of Ukraine. (2024). *Report of the State Financial Monitoring Service of Ukraine for 2011–2023*. <https://fmu.gov.ua/en/>
22. State Judicial Administration of Ukraine. (n.d.). *Judicial statistics for 2011–2023*. https://court.gov.ua/inshe/sudova_statystyka/
23. Vasylieva, T., Ziółko, A., Kuzmenko, O., Kapinos, A., & Humenna, Y. (2021). Impact of digitalization and the COVID-19 pandemic on the AML scenario: Data mining analysis for good governance. *Economics and Sociology*, 14(4), 326–354. <https://doi.org/10.14254/2071-789X.2021/14-4/19>
24. Vyas-Doorgapersad, S. (2024). Assessment of the Shortcomings on Fight Against Corruption. *Business Ethics and Leadership*, 8(3), 219–230. [https://doi.org/10.61093/bel.8\(3\).219-230.2024](https://doi.org/10.61093/bel.8(3).219-230.2024)
25. Wright, J. (2023). Healthcare cybersecurity and cybercrime supply chain risk management. *Health Economics and Management Review*, 4(4), 17–27. <https://doi.org/10.61093/hem.2023.4-02>
26. Yarovenko, H., Kuzior, A., & Raputa, A. (2023). The Modeling of the Probable Behaviour of Insider Cyber Fraudsters in Banks. *Financial Markets, Institutions and Risks*, 7(4), 155–167. [https://doi.org/10.61093/fmir.7\(4\).155-167.2023](https://doi.org/10.61093/fmir.7(4).155-167.2023)
27. Yarovenko, H., Kuzior, A., Norek, T., & Lopatka, A. (2024a). The future of artificial intelligence: Fear, hope or indifference? *Human Technology*, 20(3), 611–639. <https://doi.org/10.14254/1795-6889.2024.20-3.10>
28. Yarovenko, H., Pozovna, I., & Bylbas, R. (2024b). The Risk of Escalating Cyberattacks and Financial Fraud During Wartime: The Maturity of The County's Judicial System in Combating Cyber and Financial Crimes. *Financial Markets, Institutions and Risks*, 8(4), 126–147. [https://doi.org/10.61093/fmir.8\(4\).126-147.2024](https://doi.org/10.61093/fmir.8(4).126-147.2024)
29. Zhuk, I., Zakharkin, O., Vishka, I., Sharova, S., & Nabatova, I. (2023). Mechanisms of public finance digitalization and methods of implementing in the public administration system in Ukraine: European experience. *Economic Affairs*, 68(3), 1701–1712. <https://doi.org/10.46852/0424-2513.3.2023.35>

Галушко К., Кубащикова З., Захаркіна Л., Халімон П., Селютін С., Доценко Т.

МЕТОДИЧНИЙ ІНСТРУМЕНТАРІЙ АНАЛІЗУ ДІЯЛЬНОСТІ СУБ'ЄКТІВ ПЕРВИННОГО ФІНАНСОВОГО МОНІТОРИНГУ

У статті розглянута нагальна потреба оцінити, як основні суб'єкти фінансового моніторингу (ОСФМ) України витримують одночасні потрясіння від посилення регуляторних вимог, пандемії COVID-19 і повномасштабної війни – обставин, що посилили ризики відмивання грошей і фінансування тероризму. Метою дослідження є розробка та застосування інтегрованого інструментарію оцінки, який поєднає прозору бінарну сітку оцінювання з байєсівською

моделлю ймовірностей для відстеження діяльності ОСФМ протягом 2011-2023 років. Емпіричний аналіз, побудований на сорока п'яти офіційних показниках, демонструє стабільне зростання дотримання вимог до 2019 року з історичним піком 2017-2019 років, різким скороченням протягом 2020-2022 років і початковим відновленням 2023 року, оскільки установи адаптуються до дистанційного нагляду та цифрових робочих процесів. Цифрові канали звітності виявляються найбільш стійким виміром, водночас показники, пов'язані з судом і прокуратурою, зазнають найбільших невдач воєнного часу, що висвітлює прогалини в потужностях поза межами самого фінансового сектора. Інтегрована методологія враховує ці нюанси ефективніше, ніж статичні контрольні списки, та надає регуляторам базу доказів для перекалібрування ризик-орієнтованого нагляду, пріоритезації комплексної цифрової інфраструктури та перерозподілу ресурсів на вузькі місця в слідчих і судових органах. Результати підтверджують, що адаптивний, заснований на даних нагляд може зміцнити національну систему боротьби з відмиванням грошей навіть за надзвичайних стресових ситуацій, і свідчать про те, що запропонований інструментарій можна застосовувати до інших країн із перехідною економікою або країн, що постраждали від конфліктів, які прагнуть посилити запобігання фінансовим злочинам під час відновлення.

Ключові слова: боротьба з відмиванням грошей, фінансовий моніторинг, баєсівський аналіз, бінарний скоринг, вплив воєнного часу, ризик-орієнтований нагляд, стійкість до дотримання вимог, Україна

JEL Класифікація: C11, G28, K42, O33, H56

Table A1. Input statistical base of the study.

	SFM1	SFM2	SFM3	SFM4	SFM5	SFM6	SFM7	SFM8	SFM9	SFM10
2011	581213	241155	5050	252033	205543	323	0	257	467	1841
2012	620974	277795	6780	62272	100912	588	12931	131	433	1896
2013	653645	312898	12075	3523	117976	588	14747	234	439	1999
2014	780234	490617	12167	4478	200824	476	47940	298	458	1970
2015	3873967	407462	67888	7800	280525	364	22745	322	421	1951
2016	5925372	315262	76728	2414	288614	269	16942	322	668	2278
2017	7631690	298394	298394	10116	397902	382	17876	330	367	2757
2018	9663903	253913	51638	338	526372	466	15070	468	418	2999
2019	11092670	288317	55964	423	530393	503	12981	390	356	2861
2020	4562082	146484	16435	536	1229660	607	13070	429	328	2859
2021	1582370	76501	421	585	488088	767	14679	403	591	5575
2022	1117829	52123	194	9246	38121	550	21430	384	1242	5016
2023	1260269	155369	178	13778	98535	608	21505	514	824	6785
	SFM11	SFM12	SFM13	SFM14	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20
2011	191	189	91	1062215	194	12	90	100	287	84
2012	161	172	126	943862	218	8	185	212	178	81
2013	294	173	471	954380	188	5	194	116	190	77
2014	293	251	2406	1260508	184	72	260	9	70	74
2015	233	245	3313	4312637	59	59	262	70	35	30
2016	183	229	757	6260727	34	50	158	23	30	57
2017	265	253	399	7940799	35	29	154	99	118	125
2018	296	241	161	9871608	25	21	169	66	67	91
2019	284	287	171	11327040	50	12	152	27	34	34
2020	250	338	184	4675432	63	3	94	7	13	18
2021	391	373	151	1638483	326	8	80	13	21	5
2022	294	245	475	1174044	337	205	219	1	8	0
2023	382	298	232	1423311	214	347	251	14	35	8
	SFM21	SFM22	SFM23	SFM24	SFM25	SFM26	SFM27	SFM28	SFM29	SFM30
2011	150	215	35	131	2	13	7	987	87	40
2012	127	133	36	80	1	17	13	978	80	25
2013	105	18	2	4	0	0	2	798	96	20
2014	82	37	7	6	0	5	2	566	42	39
2015	34	58	10	3	0	8	2	428	17	19
2016	58	148	24	2	0	43	2	369	42	13
2017	134	185	40	11	0	28	2	448	13	35
2018	102	175	66	18	0	46	1	552	7	25
2019	35	149	61	13	0	71	0	650	5	48
2020	21	0	0	0	0	0	0	683	2	12
2021	8	0	0	0	0	0	0	816	3	28
2022	0	4933	2714	608	3	1104	574	777	1	15
2023	13	7832	3728	1934	2	1389	803	1010	1	17
	SFM31	SFM32	SFM33	SFM34	SFM35	SFM36	SFM37	SFM38	SFM39	SFM40
2011	13	487	75	15	12	33668	23138	0	5764	0

2012	7	466	81	13	24	31537	22907	0	5997	0
2013	34	347	63	5	15	35957	27612	1492	4875	392
2014	34	284	30	0	3	36816	28831	1680	5357	258
2015	32	264	22	3	4	44480	29991	2632	11315	300
2016	32	251	22	2	0	59049	36782	2583	18987	399
2017	19	317	10	0	11	72701	36451	4747	29181	603
2018	26	431	6	0	11	98184	40021	6810	45805	600
2019	20	507	6	0	0	110334	44577	12783	51318	648
2020	17	600	0	0	0	50105	15882	6489	26730	511
2021	17	688	0	0	0	21394	1385	843	18202	612
2022	12	689	0	0	0	5348	339	1492	2874	266
2023	11	854	0	0	0	6283	388	1535	2788	1413
	SFM41	SFM42	SFM43	SFM44	SFM45					
2011	1172	2297	1095883	1079451	11701					
2012	637	1996	975399	967821	21863					
2013	89	40	990337	982141	22947					
2014	29	30	1297324	1287496	23172					
2015	31	211	4391834	4357117	24327					
2016	20	278	6381728	6319776	23656					
2017	21	1698	8044703	8013500	23831					
2018	21	4927	10006093	9969792	24603					
2019	11	997	11462494	11437374	23055					
2020	14	479	4744115	4725537	22451					
2021	6	346	1664173	1659877	14557					
2022	0	377	1181675	1179392	13030					
2023	0	125	1432684	1429594	11445					

Table A2. Normalized values of activity indicators of primary financial monitoring entities.

	SFM1	SFM2	SFM3	SFM4	SFM5	SFM6	SFM7	SFM8	SFM9	SFM10
2011	0.0000	0.4311	0.0163	1.0000	0.1405	0.1084	0.0000	0.3290	0.1521	0.0000
2012	0.0038	0.5147	0.0221	0.2461	0.0527	0.6406	0.2697	0.0000	0.1149	0.0111
2013	0.0069	0.5947	0.0399	0.0127	0.0670	0.6406	0.3076	0.2689	0.1214	0.0320
2014	0.0189	1.0000	0.0402	0.0164	0.1365	0.4157	1.0000	0.4360	0.1422	0.0261
2015	0.3133	0.8104	0.2271	0.0296	0.2034	0.1908	0.4744	0.4987	0.1018	0.0222
2016	0.5084	0.6001	0.2567	0.0082	0.2102	0.0000	0.3534	0.4987	0.3720	0.0884
2017	0.6707	0.5616	1.0000	0.0388	0.3019	0.2269	0.3729	0.5196	0.0427	0.1853
2018	0.8641	0.4602	0.1726	0.0000	0.4098	0.3956	0.3144	0.8799	0.0985	0.2342
2019	1.0000	0.5386	0.1871	0.0003	0.4131	0.4699	0.2708	0.6762	0.0306	0.2063
2020	0.3787	0.2152	0.0545	0.0008	1.0000	0.6787	0.2726	0.7781	0.0000	0.2059
2021	0.0952	0.0556	0.0008	0.0010	0.3776	1.0000	0.3062	0.7102	0.2877	0.7553
2022	0.0511	0.0000	0.0001	0.0354	0.0000	0.5643	0.4470	0.6606	1.0000	0.6422
2023	0.0646	0.2355	0.0000	0.0534	0.0507	0.6807	0.4486	1.0000	0.5427	1.0000
	SFM11	SFM12	SFM13	SFM14	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20
2011	0.1304	0.0846	0.0000	0.0114	0.4583	0.9738	0.0549	0.4692	1.0000	0.6720
2012	0.0000	0.0000	0.0109	0.0000	0.3814	0.9855	0.5769	1.0000	0.6093	0.6454
2013	0.5783	0.0050	0.1179	0.0010	0.4776	0.9942	0.6264	0.5450	0.6523	0.6186

2014	0.5739	0.3930	0.7185	0.0305	0.4904	0.7994	0.9890	0.0379	0.2222	0.5920
2015	0.3130	0.3632	1.0000	0.3244	0.8910	0.8372	1.0000	0.3270	0.0968	0.2400
2016	0.0957	0.2836	0.2067	0.5121	0.9712	0.8634	0.4286	0.1043	0.0789	0.4560
2017	0.4522	0.4030	0.0956	0.6739	0.9679	0.9244	0.4066	0.4645	0.3943	1.0000
2018	0.5870	0.3433	0.0217	0.8598	1.0000	0.9477	0.4890	0.3081	0.2115	0.7280
2019	0.5348	0.5721	0.0248	1.0000	0.9199	0.9738	0.3956	0.1232	0.0932	0.2720
2020	0.3870	0.8259	0.0289	0.3594	0.8782	1.0000	0.0769	0.0284	0.0179	0.1440
2021	1.0000	1.0000	0.0186	0.0669	0.0353	0.9855	0.0000	0.0569	0.0466	0.0400
2022	0.5783	0.3632	0.1192	0.0222	0.0000	0.4128	0.7637	0.0000	0.0000	0.0000
2023	0.9609	0.6269	0.0438	0.0462	0.3942	0.0000	0.9396	0.0616	0.0968	0.0640
	SFM21	SFM22	SFM23	SFM24	SFM25	SFM26	SFM27	SFM28	SFM29	SFM30
2011	1.0000	0.0275	0.0094	0.0677	0.6667	0.0094	0.9913	0.9641	0.0947	0.7778
2012	0.8489	0.0170	0.0097	0.0414	0.3333	0.0122	0.9838	0.9501	0.1684	0.3611
2013	0.6978	0.0023	0.0005	0.0021	0.0000	0.0000	0.9975	0.6693	0.0000	0.2222
2014	0.5467	0.0047	0.0019	0.0031	0.0000	0.0036	0.9975	0.3073	0.5684	0.7500
2015	0.2267	0.0074	0.0027	0.0016	0.0000	0.0058	0.9975	0.0920	0.8316	0.1944
2016	0.3867	0.0189	0.0064	0.0010	0.0000	0.0310	0.9975	0.0000	0.5684	0.0278
2017	0.8933	0.0236	0.0107	0.0057	0.0000	0.0202	0.9975	0.1232	0.8737	0.6389
2018	0.6800	0.0223	0.0177	0.0093	0.0000	0.0331	0.9988	0.2855	0.9368	0.3611
2019	0.2333	0.0190	0.0164	0.0067	0.0000	0.0511	1.0000	0.4384	0.9579	1.0000
2020	0.1400	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.4899	0.9895	0.0000
2021	0.0533	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.6973	0.9789	0.4444
2022	0.0000	0.6299	0.7280	0.3144	1.0000	0.7948	0.2852	0.6365	1.0000	0.0833
2023	0.0867	1.0000	1.0000	1.0000	0.6667	1.0000	0.0000	1.0000	1.0000	0.1389
	SFM31	SFM32	SFM33	SFM34	SFM35	SFM36	SFM37	SFM38	SFM39	SFM40
2011	0.7778	0.6086	0.0741	1.0000	0.5000	0.2698	0.5154	0.0000	0.0613	0.0000
2012	1.0000	0.6434	0.0000	0.8667	0.0000	0.2495	0.5101	0.0000	0.0661	0.0000
2013	0.0000	0.8408	0.2222	0.3333	0.3750	0.2916	0.6165	0.1167	0.0430	0.2774
2014	0.0000	0.9453	0.6296	0.0000	0.8750	0.2997	0.6441	0.1314	0.0529	0.1826
2015	0.0741	0.9784	0.7284	0.2000	0.8333	0.3727	0.6703	0.2059	0.1757	0.2123
2016	0.0741	1.0000	0.7284	0.1333	1.0000	0.5115	0.8238	0.2021	0.3338	0.2824
2017	0.5556	0.8905	0.8765	0.0000	0.5417	0.6415	0.8163	0.3714	0.5438	0.4268
2018	0.2963	0.7015	0.9259	0.0000	0.5417	0.8843	0.8970	0.5327	0.8864	0.4246
2019	0.5185	0.5755	0.9259	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.4586
2020	0.6296	0.4212	1.0000	0.0000	1.0000	0.4263	0.3513	0.5076	0.4933	0.3616
2021	0.6296	0.2753	1.0000	0.0000	1.0000	0.1528	0.0236	0.0659	0.3176	0.4331
2022	0.8148	0.2736	1.0000	0.0000	1.0000	0.0000	0.0000	0.1167	0.0018	0.1883
2023	0.8519	0.0000	1.0000	0.0000	1.0000	0.0089	0.0011	0.1201	0.0000	1.0000
	SFM41	SFM42	SFM43	SFM44	SFM45					
2011	1.0000	0.4629	0.0115	0.0107	0.0195					
2012	0.5435	0.4015	0.0000	0.0000	0.7918					
2013	0.0759	0.0020	0.0014	0.0014	0.8741					
2014	0.0247	0.0000	0.0307	0.0305	0.8912					
2015	0.0265	0.0370	0.3258	0.3237	0.9790					
2016	0.0171	0.0506	0.5155	0.5112	0.9280					
2017	0.0179	0.3406	0.6741	0.6730	0.9413					

2018	0.0179	1.0000	0.8611	0.8598	1.0000	
2019	0.0094	0.1975	1.0000	1.0000	0.8824	
2020	0.0119	0.0917	0.3594	0.3589	0.8364	
2021	0.0051	0.0645	0.0657	0.0661	0.2365	
2022	0.0000	0.0709	0.0197	0.0202	0.1205	
2023	0.0000	0.0194	0.0436	0.0441	0.0000	

Table A3. Limit (average) values of normalized indicators for each indicator characterizing the activities of primary financial monitoring entities.

SFM1	SFM2	SFM3	SFM4	SFM5	SFM6	SFM7	SFM8	SFM9	SFM10
0.30582	0.46289	0.15518	0.11099	0.25874	0.46247	0.37213	0.55814	0.23127	0.26223
SFM11	SFM12	SFM13	SFM14	SFM15	SFM16	SFM17	SFM18	SFM19	SFM20
0.47625	0.4049	0.18512	0.3006	0.60503	0.8229	0.51902	0.27124	0.27075	0.42092
SFM21	SFM22	SFM23	SFM24	SFM25	SFM26	SFM27	SFM28	SFM29	SFM30
0.44564	0.13635	0.13872	0.11177	0.20513	0.15086	0.86512	0.51182	0.68988	0.38462
SFM31	SFM32	SFM33	SFM34	SFM35	SFM36	SFM37	SFM38	SFM39	SFM40
0.47863	0.62725	0.70085	0.19487	0.74359	0.39297	0.52843	0.25927	0.30584	0.32675
SFM41	SFM42	SFM43	SFM44	SFM45					
0.13462	0.21066	0.30065	0.29997	0.6539					