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RISK ASSESSMENT OF USING INSURANCE COMPANIES IN SUSPICIOUS TRANSACTIONS

Abstract. The risk of using insurance companies in suspicious transactions is focused on optimizing the tax burden businesses and/or legalization (laundering) of criminally gained income increasing under conditions the world economy of globalization, capital flows between countries liberalization, financial innovation emergence and technology improvement. This problem cannot be considered as an isolated threat of each country's economic security. In this connection, universal scientific and methodical approach to the assessment of the risks of insurance companies' intake in suspicious transactions is proposed through application Bayes' theorem and fuzzy set method. In the proposed approach, the groups of indicators which characterize the risk of insurance companies intake in suspicious transactions are defined (country risk and its financial system, insurer's risk), insurer's risk, risk of regulatory standards violations). According to the results of risk assessment, a number of insurance companies with a «critical» and «high» level of insurance companies' intake in suspicious transactions indicator can be formed. This will serve as a basis for additional examination of financial condition for governmental supervisory and control authorities.
Keywords: risk; insurance company; suspicious transactions; Bayes' theorem.
JEL Classification: C11, C13, G22, H39

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ОЦІНЮВАННЯ РІВНЯ РИЗИКУ ВИКОРИСТАННЯ СТРАХОВИХ КОМПАНІЙ У СХЕМНИХ ОПЕРАЦІЯХ
Анотація. У статті проведено кількісну та якісну оцінку рівня ризику використання страхових компаній у схемних операціях на основі застосування методологічних положень теорії Байєса та нечіткої логіки. За результатами розрахунку оцінки ризику може бути сформована множина страхових компаній із «критичним» рівнем цього показника. Запропонований підхід має важливе практичне значення для здійснення адекватного регулювання і нагляду за діяльністю страхових компаній з метою протидії легалізації кримінальних доходів, оптимізації податкового навантаження суб'єктів господарювання.
Ключові слова: ризик; страхова компанія; схемні операції; теорія Байєса.

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ОЦЕНИВАНИЕ УРОВНЯ РИСКА ИСПОЛЬЗОВАНИЯ СТРАХОВЫХ КОМПАНИЙ В СХЕМНЫХ ОПЕРАЦИЯХ
Аннотация. В статье проведена количественная и качественная оценка уровня риска использования страховых компаний в схемных операциях на основе применения методологических положений теории Байеса и нечеткой логики. По результатам расчета оценки риска может быть сформировано множество страховых компаний с «критическим» уровнем данного показателя. Предложенный подход имеет важное практическое значение для осуществления адекватного регулирования и надзора за деятельностью страховых компаний с целью противодействия легализации криминальных доходов, оптимизации налоговой нагрузки субъектов хозяйствования.
Ключевые слова: риск; страховая компания; схемные операции; теория Байеса.

Introduction. Intense formation of the global financial system and liberalization of the capital movements led to a parallel activation and development of mechanism to intake financial institutions into the tax burden reduction, illegally gained incomes legalization and even terrorism financing. Insurance companies are one of the core financial institutions through which individuals and business entities can access the financial system. This access provides opportunities to misuse insurance and reinsurance industries in order to engage them in the tax burden optimizing businesses and legalization (laundering) of criminally gained income.

Based at above mentioned, must be stressed the topical character of a problem of an effective mechanism forming to evaluate the risk level of insurance companies using in suspicious transactions, as far as the only adequate means of risk identification will allow achieving high results in resistance to this process. Direct checks of financial intermediaries and detailed analysis of their activity transform their actions into a

long and unidirectional process, which will lose any chance of success without an integrated approach.

Brief Literature Review. A significant contribution to solving urgent problems of quantitative and qualitative risk analysis in insurance has been made in studies of domestic and foreign scholars, e.g. O. S. Dmytrov (2010) [1], O. V. Kuzmenko (2014) [2], A. D. Sanford (2012) [3], D. Kevin (2006) [4] and others. Using the operations of insurance companies in laundering illegally obtained money, and optimization of the tax burden are reflected in the analytical reviews of international organizations and national regulators, such as The Financial Action Task Force [5], International Actuarial Association [6], International Association of Insurance Supervisors [7], Committee of experts on the evaluation of anti-money laundering measures and the financing of terrorism [8], United Nations Office on Drugs and Crime [9]. However, the issues of quantitative risk assessment of insurance companies in suspicious transactions are poorly understood and insufficiently investigated.

Purpose of this article is mathematical formalization of the risk assessment process of insurance companies usage in suspicious transactions based at fuzzy logic and Bayes' analysis.

Results. Financial crises, impact of external shocks and shadowing financial flows led the search for new approaches to the risk assessment of using suspicious transactions by insurance companies and their active practical application in government regulation, supervisory and control authorities. Taking into account the internationalization of insurance relations and increase in the volume of the capital flow between countries, there is a need to develop a universal scientific and methodical approach to the risk assessment of insurance companies intake in suspicious transactions that can be adapted to the national regulator in any country of the world. Thus, we propose to consider the gradual formalization of the proposed technique.

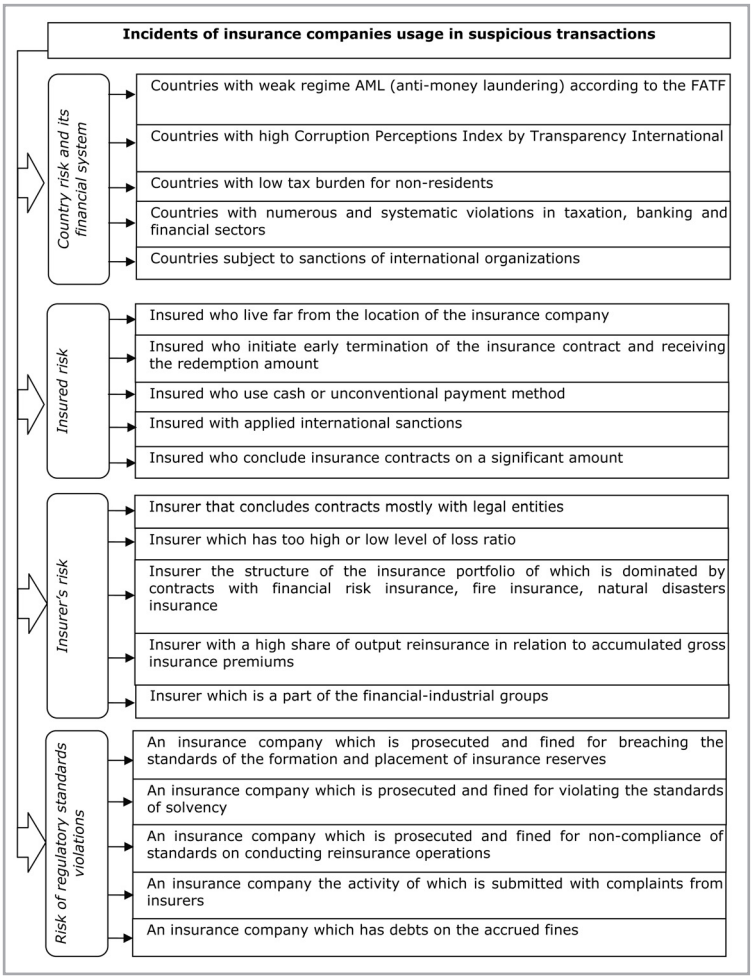

Figure: **The group of indicators (incidents), describing the risk of using insurance companies in suspicious transactions**

Source: Composed by the authors on the base of [1; 5; 9]

Exploring each stage more detailed, we have noted that in the formation of the input data (the first stage) four groups of indicators (incidents) of risk characteristics are singled out (see Figure). This grading is due to the use of multivector insurance companies in the suspicious transactions and it is used to further identify the strength of influence of each incident on the overall level of risk. It should be also mentioned that the accumulation of statistical information within specified risk assessment takes place in the context of each insurance company, i.e. the data for all insurance companies of the country fall into the sample under the condition of national financial system research.

On the second stage, there is a formalization of each incident within the indicators describing it. The relevance of this stage is due to the fact that one indicator can characterize several incidents with different strength and influence on them. This pattern is described by binary indicators, on condition that the indicator corresponds to the certain incident «1» is put, otherwise – «0». If the indicator shows two or more incidents, the «1» is put several times (e. g. an index insurers, who initiate early termination of the insurance contract and receiving the redemption amount, characterizes such incidents as the risk associated with the actions of the insurer and risk associated with the insurance company activities, in parallel with this indicator – insurers who use cash or non-traditional payment method and describe such incidents as the risk associated with the actions of the insurer and the risk associated with the country and its financial system).

Based on that factor, the indicators selected for characteristics of effective signs are different. It is necessary to conduct normalization on the third stage of the scientific and methodical approach to the assessment of the risks of insurance companies in suspicious transactions. For qualitative indicators normalization, it is to establish the «1» provided the risk availability or «0» respectively otherwise. For quantitative indicators it is proposed to use the normalization method based on weighing the absolute value of i-th indicator of the quantitative assessment of the degree of investigated risk on its average value of the defined statistical information, or for the analyzed time period.

On the fourth stage of the proposed methodology is performed the assessment of the degree of dummy variables influence (binary characteristics of the incidents) on values of parameters which are the risk indicators. The implementation of these tasks takes place on two stages. The first stage constructs the linear equation of multiple regression of determined dependence (the linear equation of determined dependence multiple regression). However, it should be noted that the coefficients of this equation describe only conditionality general of quantitative risk assessment to appropriate incidents without reflecting proportion of each incident's impact. This problem is solved on the second step of the fourth stage, based on the construction of standardized equation (Equation 1):

$$K_i = \alpha_1 F_{1i} + \alpha_2 F_{2i} + \alpha_3 F_{3i} + \alpha_4 F_{4i} + \varepsilon\,, \quad (1)$$

where K_i is an absolute value of the i-th index of quantitative risk assessment of using insurance companies in suspicious transactions;

F_{ji}, $j = 1/4$ is a dummy variable of i-th incident rate risk of insurance companies in suspicious transactions;

$\alpha_m, m = 1 \div 4$ is a fixed values that reflect the values of the characteristics of the degree influence of a certain incident on

the level indicator risk of using insurance companies in suspicious transactions;

ε is an error (deviation of actual and theoretical levels of the appropriate i-th indicator of quantitative risk assessment of using insurance companies in suspicious transactions).

Having calculated the proportion of each of the four incidents of risk characteristics of insurance companies intake in suspicious transactions within the fifth stage of investigated scientific and methodological approach, it is necessary to conduct weighing of each normalized indicator value on weighting coefficients of operational risk incidents. This will take into account the strength of influence of each indicator on the effective feature.

Then, the process of formalization of the risk level of insurance companies using in suspicious transactions (the sixth stage) is to calculate the second array of binary indicators, which is based on comparison of the normalized index weighed by the characteristic of certain incident impact, with an average level of normalized weighed indicators. The binary characteristic takes the value «1», if it exceeds each normalized weighed index of its maximum allowable (average) level, and «0» otherwise (Equation 2).

$$NKbin_i \begin{cases} = 1; \alpha_m^* \overline{NK_m} \geq \alpha_m^* NK_i, \\ = 0; \alpha_m^* NK_i > \alpha_m^* \overline{NK_m} \end{cases}, \quad (2)$$

where $NKbin_i$ is a binary characteristic for each indicator of a quantitative risk assessment of using insurance companies in suspicious transactions in accordance with incidents of this risk;

$NKi,\ i = 1/n$ is a normalized index value of the i-th indicator of quantitative assessment of the investigated risk;

$\alpha_m^*, m = 1 \div 4$ is an adjusted characteristic of a degree of the certain incident influence on the level of risk of using insurance companies in suspicious transactions;

$\overline{NK_m}$ is an average value of all normalized indicators of the m-th risk incident.

Forming binary value assessment of the risk level of using insurance companies in suspicious transactions allows to conduct rapid assessment on the seventh stage and to make a preliminary conclusion about the overall risk level.

$$EO = \sum_{j=1}^{4} \sum_{i=1}^{n} NKbin_{ij}, \quad (3)$$

where EO – a rapid risk assessment of insurance companies in suspicious transactions;

$NKbin_{ij}$ – a binary characteristic for each indicator quantitative evaluation of the degree of investigated risk of the insurer in accordance with the incidents of this risk.

The qualitative assessment of the risk level is determined by the obtained amounts of binary indicators (EO), which act as quantitative rapid assessment of the risk degree of using insurance operations in the suspicious transactions:

– if $0 \leq EO < n/4$ it is the normal risk level;

– if $n/4 \leq EO < n/2$, it is the acceptable risk level;

– if $n/2 \leq EO < 3n/4$, it is the high risk level;

– if $3n/4 \leq EO \leq n$, it is the critical risk level.

Formalization of the risk using Bayes' approach takes place on the eighth stage to conduct more detailed analysis of the risk level of using insurance companies in suspicious transactions. This approach allows determining the probable of occurrence the investigated risk in general for the insurance system, and in the context of each of the incidents. Applying Bayes' approach provides an opportunity to increase the effectiveness of management decisions in the future, while solving the problem of risk assessment of insurance companies using in suspicious transactions by taking into account its value of the previous period and clarifying indicators of the current period

Thus, a quantitative description of the degree of risk of insurance companies intake in suspicious transactions is proposed to determine as the probability of occurrence this risk type, i. e. the probability $(p_{SR}(H1))$ of risk occurrence (event $H1$) if there is available information $SR=(SR_1, SR_2)$ in the context of 4 incidents, where $ORk,\ k=1/4$ accept the value 0 if the relevant standard is performed (probability of occurrence of relevant risk factors is within acceptable limits), and 1 is otherwise. The basis for determining the components $SR=(SR_1, SR_2)$ is the probabilities $(p_K(H1_j))$ of occurrence the j-th incident of the risk of using insurance companies in the suspicious transactions (event $H1_j$) if there is available information $K=(K_1, K_2, ..., K_n)$, where $K_k,\ k=1/n$ is the 0 value if the relevant standard is performed, and 1 otherwise.

Let us consider the sequence of determining probability $(p_{OR}(H1))$ of occurrence of the risk of using insurance companies in suspicious transactions (event $H1$) if there is available information $SR=(SR_1, SR_2)$.

Based on the binary indicators for each j-th incident of risk according to Bayes' formula (the basis of the probable approach), we define the probability $(p_K(H1_j))$ of occurrence of the j-th incident of risk of using insurance operations in suspicious transactions (event $H1_j$) if there is available information $K=(K_1, K_2, ..., K_n)$ (Equation (4):

$$p_K(H1j) = \frac{1}{1 + e^{\{\lambda_{0j} + L\}}} \quad (4)$$

$$L = \sum_{i=1}^{n} \lambda_i NKbin_{ij} \quad (5)$$

$$\lambda_{ij} = \ln\left(\frac{b_{ij}(1-g_{ij})}{g_{ij}(1-b_{ij})}\right), i = 1,...,n$$

$$\lambda_{0j} = \ln\left(\frac{p(H2j)}{p(H1j)}\right) + \sum_{i=1}^{n} \ln\left(\frac{1-b_{ij}}{1-g_{ij}}\right)$$

where $(p_K(H1_j))$ – probability of the j-th risk incident occurrence for using insurance companies in suspicious transactions if there is available information $K=(K_1, K_2, ..., K_n)$;

L – an integral index (weighed sum) of binary characteristic $NK\acute{o}K\acute{o}_{ij}$ (available information about the state of the insurance company based on the values of analytical indicators);

$P(H1_j)$ – probability of the hypothesis $H1_j$;

$H1_j$ – formed a hypothesis: there will occur the j-th risk incident for using insurance companies in suspicious transactions;

$P(H2_j)$ – probability of the opposite hypothesis;

$NK=\{NKbin_{ij}\}$ – a binary component of characteristics' number of insurer's activity;

b_{ij} – probable event $NK=\{NKbin_{ij}\}$ for an insurance company in context of the j-th risk incident for using insurance companies in suspicious transactions;

g_{ij} – probability of the opposite event.

On the basis of obtained probability (quantitative) risk assessment of using insurance operations in the suspicious transactions $(p_K(H1_j))$ for each j-th incidents qualitative characteristics of risk level is defined:

– if $0 \leq p_K(H1j) < fsr\{\min_s\{p_B(H1)_s\}\} \div fsr\{p_B(H1)_s\}\}$, the normal level of the risk (where $fsr\{\}$ - is the average value of these indicators for a number s of insurance companies);

– if $fsr\{\min_s\{p_B(H1)_s\}\} \div fsr\{p_B(H1)_s\}\} \leq p_K(H1j) < fsr\{p_B(H1)_s\}$, higher risk level;

– if $fsr\{p_B(H1)_s\} \leq p_K(H1j) < fsr\left\{fsr\{p_B(H1)_s\} \div \max_s\{p_B(H1)_s\}\right\}$, high risk level;

– if $fsr\left\{fsr\{p_B(H1)_s\} \div \max_s\{p_B(H1)_s\}\right\} \leq p_K(H1j) \leq 1$, critical risk level.

Conclusions. Implementation of mathematical models of risk assessment of insurance companies using in the suspicious transactions solves such problems as:

– identification of indicators, characterizing the investigated risk within different groups (incidents) that allows you to create universal requirements for risk assessment of insurance companies using in suspicious transactions at the macro and meso levels;

– timely and simple definition of the risk of insurance companies intake in suspicious transactions (rapid approach);

– a detailed analysis of the impact (specific gravity) forming the risks of insurance companies usage in suspicious transactions incidents and indicators;

– accumulation within integrated assessment of the risks of insurance companies intake in suspicious transactions of historical data and risk factor characteristics nowadays.

In terms of government regulation, supervisory and control authorities, developed scientific and methodical approach allows distinguishing a number of insurance companies with «high» and «critical» risk levels of suspicious transactions using and to form a system of management measures in financial monitoring concerning them.

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OPTIMIZATION OF THE RISK LEVEL OF NET RETENTION IN THE INSURANCE MARKET

Abstract. *Introduction.* In this paper, the authors discuss key optimization aspects of net retention ratio in the risk transfer process for reinsurance as a factor of financial stability and security in the insurance company. For this purpose, an algorithm was developed, which estimated a net retention ratio in the context of the insurance company responsibility for ensuring the minimum required level of the insurer's financial security. Implementation of suggested approach has been performed based at economic and mathematical model («linear programming»), subject to the insurance market performance.

Purpose of this research is to develop an estimation algorithm of a net retention ratio which should be the responsibility of the insurance company for ensuring the minimum required level of the insurer's financial security.

Methods. The methodological basis of the paper lies in identifying main trends of financial and insurance theory, development of domestic and foreign science in insurance and reinsurance activities and optimal financial security by determining the net retention ratio.
Results. The practical application of this model allows calculating the minimum required level of net retention risk among insurance market participants. On the bases of the insurance market analysis in Ukraine, it must be noted that only 50 companies accumulate more than 50% of all insurance premiums, which is the reason why the practical implementation of the model is conducted using these companies. Having executed settlements according with a developed technique, a ranking of insurance companies in the context of their net retention level has been made. Achieved results allow stating that all analyzed market participants for ensuring the minimum required level of financial security should cede a significant proportion of earned premiums.

Conclusion. The scientific novelty of this study is development of the model for retention risk ratio estimation by the insurance market participants, considering the minimum required level of financial security. The importance of this work is in potential for this model usage from a perspective of loss reduction by the insurance companies. Findings obtained under practical application of suggested approach allow valuing the net retention ratio of each insurance company, needed for ensuring the minimum required level of financial security.

Keywords: insurance market; financial security of the insurance market; net retention; net retention risk; reinsurance; economic and mathematical model.
JEL Classification: G22, B41, C60, C61