

The use of the formed indexes' composition of assessment of the insurance companies' stress resistance involves the development of a scale measurement of these indicators for evaluation.

The purpose of the article is to construct microprudential indicators, which are the basis of the diagnostic tools for micronutrient supervision for its implementation, considering the indicators of assessment the stress resistance of insurance companies in Ukraine.

To achieve this goal, the following tasks need to be addressed:

1. To construct the scale of the micro-prudential indicators considering indicators of the assessment of the stress resistance of insurance companies.
2. Analyze the impact of the stress levels of insurance companies on the level of its risks.

The novelty of the study lays in the used methodology based on analysis of the scale of indicators for assessing the stress-resistance of insurers. The described approach is designed to provide retrospective and perspective assessments of insurance companies under the influence of risk factors, reducing time and resources, aimed at assessing the position of micro-prudential supervision over the activities of insurers (regardless of branch affiliation).

2. Literature overview

Such researchers as O. O. Nedosekin (2002, 2003), V. I. Lyametz (2004) and others have made the greatest contribution to the mathematical theory of measurement and scaling. Significant input is also made by S. Stevenson (1960) in the theory of measuring scales.

The Concept for introduction of prudential supervision of non-bank financial institutions for the purpose of prudential supervision is to protect the interests of consumers of financial services, prevent insolvency and ensure the stability of financial institutions through the identification of the risks of their activities; control over the level of solvency, liquidity and profitability; prevention of cases of systemic crisis; forecasting of financial results based on reports of the current period. That is why assessing the stress resistance of insurance companies has a significant potential for use in prudential supervision.

Stress testing assessment of insurance companies was examined in the papers of: Jobst (2014), Komarkova and Gronychova (2012), Ong and Pazarbasioglu (2013) and others.

The question of considering the peculiarities of the operation of insurance companies in crisis situations is also relevant. Ong and Pazarbasioglu (2013) studied the features of conducting crisis stress testing on the governmental level by a thorough examination of their banking system using scales, monitoring and taking action when valuations have fallen to certain levels.

Stress testing assessment in the banking and insurance sectors is similar. This thesis was justified by Komarkova and Gronychova (2012). The authors determined that both sectors face similar risks; however, there are some differences in the regulatory regimes based on the nature of insurance company's activity. Thus, stress testing methodology for bank

sector cannot be applied for insurance companies but can be transformed considering their special aspects.

The issue of ensuring the resistance of financial institutions was studied by authors: R. Blanchard (2012), Yu. L. Borko (2008), E. V. Boronina (2011), Bruder B. (2009), Gersl A. and Hermanek J. (2006), Rosch D. and Scheule H. (2008), R. Pukała (2017), IMF specialists (2012), EIOPA (2003; 2010) and others.

For example, according to Bruder B. (2009) risks are difficult to quantify in terms of probability distributions. Therefore, banks use a scenario-based approach (i.e. stress test scenarios), which can either be: repetition of a historical event, hypothetical crack scenario.

According to the publication of Gersl A. and Hermanek J. (2006) the methodology of selected financial soundness and financial stability indicators, including the attempts to construct an aggregate financial stability indicator are described. Rosch D. and Scheule H. (2008) considered that the stress of exposure at default and loss given default or exposure at default are modelled based on economic downturn conditions.

The theoretical and methodological support for assessing the stress resistance of insurance companies, as well as the methodical tools of prudential supervision for improving its efficiency, are not sufficiently developed. Apart from the issue of assessing the insurer's sensitivity to the risk factors, based on a prospective assessment of the financial situation, considering the adverse factors of risk, aimed at increasing the riskiness of the insurance company's performance during stress testing, remain questions. This necessitates the development of methodological approaches and practical recommendations for assessing the stress resistance of insurance companies, which proves the relevance of the study topic.

3. Methodology

The insurer's stress resistance is the ability of an insurance company to maintain a state of equilibrium under the influence of stress factors in the case of crisis situations. That is why assessment of the stress-resistance of insurance companies remains a relevant question, and requires a further research.

Stress resistance assessment of insurance companies is relevant as stress testing procedures are outlined by separate methodological recommendations from national regulators of countries and international practices for controlling the activities of insurers.

The foreign experience of state regulation of the insurance market involves the use of a wide range of instruments, which are conventionally divided into preventive, health and diagnostic.

Recreational instruments are aimed at correcting the negative states and trends in the activities of the insurance company and the insurance market in general.

Diagnostic tools are used by supervisors during field and off-site inspections of insurance organizations.

Preventive measures are used to prevent a particular type of risk or its reasons.

It is precisely the preventive instruments used by the state regulatory authorities to implement prudential supervision over the activities of insurance companies. The concept of stress resistance arose in physiology to denote a non-specific generalized reaction of the body in response to any adverse effect. The concept of "stress" was first introduced in science by the doctor of the Montreal University Hans Selye in 1946 to determine the impact of various nonspecific factors or "stressors" on the human body. Later, the concept of stress was expanded and became used to characterize the features of the states of financial institutions, insurers. To assess the willingness of insurers to deal with potential crisis situations, in particular, the Authorized Regulators, Insurers' Stress Testing, which is a tool for verifying their preparedness for probable crisis situations, the size of the required capital to cover possible losses in the event of a risk when using prospective impact assessment methods, are used on their financial state of stress factors.

The stress resistance of the insurer enriches the conceptual and terminological apparatus of prudential supervision over the activities of insurers, whose main objective is to protect the property interests of consumers of insurance services and to ensure confidence in the insurance market. The assessment of stress tolerance will confirm that the insurer is able to maintain a state of equilibrium under the influence of stress factors in the event of crisis situations. The presence of material financial losses of the insurer in the amount of not less than 10 percent of the amount of assets on the balance sheet indicates crisis situations.

Micro-prudential supervision of the activities of insurance companies involves the use of certain tools: microprudential indicators of insurance companies, stress testing, determining the adequacy of the capital of insurance companies.

Practical implementation of microprudential supervision is especially relevant as further diagnostic monitoring of macroprudential indicators is carried out based on aggregated microprudential factors, which determines the direct dependence of the insurance market indicators in general on the performance of individual insurance companies.

The main objectives of exercising microprudential supervision: protecting the interests of financial services consumers, preventing insolvency and ensuring financial stability of financial institutions through the application of appropriate corrective measures by: identifying increased risks in the activities of financial institutions; control over solvency, liquidity and profitability of a financial institution; minimizing bankruptcy and systemic crisis of financial institutions; forecasting of future financial results based on reports of the current period.

Taking into account the presence of a significant number of risks to the insurance companies: accounting risk, business risk, credit risk, operational risk, underwriting risk, loss risk, reinsurance risk, reputational risk, market risk, insurance risk, technological risk, and the risk factors that determine their onset, the current risk management system will not be fully effective, since the introduction of stress testing (the ability to identify key risk factors and assess their impact on the financial condition of the insurer) is at an early stage and its practice application is insignificant.

The rational use of information, namely, the importance of indicators for assessing the stress resistance of insurance companies, may be conditional on its transformation into a

form suitable for further analysis, aimed at making decisions by the heads of insurance companies, the national regulator and consumers of insurance services. In this regard, before moving on to the description of the mathematical and statistical methods used to process this information, it is necessary to consider the main possibilities and limitations of its formalization. Depending on the nature of the indicator, it can be measured according to the appropriate type of scale (V. I. Lyametz, 2004): the nominal scale is a simple type of measurement in which numbers or symbols are used only for the classification of objects. The scale does not allow any operations with numbers.

The order scale of objects of one class is in some respects with the objects of another class (more than; preferable; stronger, etc.); If $[A] > [B]$ for some (but not all) objects of classes A and B, then we have a partially arranged scale. The rank order allows you to calculate the scale, the median, the percentage, and the ratios of the rank correlation.

The interval scale is a sequence plus the known distances between two any numbers on a scale (zero point of the scale and the unit of measurement are chosen arbitrarily). Known relation of any two intervals. The indicator of variation (Gromyko, 2002) can not be determined.

Scale ratio (absolute) - interval plus real zero point (the ratio of any two points of the scale does not depend on the unit of measurement) of any two intervals. The relationship between any two points is determined. For this scale, all statistical and arithmetic operations are admissible (Gromyko, 2002).

Rational use of information involves the need for formalization of information. Indicators used in assessing the stress resistance levels of insurance companies are metric.

Metric scales include the scale of the intervals and the scale of the ratio. Scale ratio is used when an absolute reference point exists. For scoring indicators, it is advisable to apply an interval scale, since this scale allows measuring the values of the indicators at the appropriate intervals, in addition, it allows to determine the magnitude of the difference between the intensities by the indicators and the zero point of the reference is set arbitrarily.

Methods of constructing interval scales are based on the axiom of normality. Estimates are distributed in the economy according to Gauss's normal law, when the extreme intensity of the index occurs less frequently than the intensity close to the average. For the most part, the indicators are not distributed according to normal law (Gromyko, 2002).

The symbolic designation and formulas for calculation of the indicators presented in table 1.

Table 1

Indicator	Symbolic designation	Formula of calculation	Economic content
Receivables ratio	I ₁	Receivables / Capital	Shows the specific weight of receivables in the insurer's capital, the ability to repay debts in the short term
Risk factor of assets	I ₂	Accounts receivable: (Insurance premiums + Amount of reimbursement received from reinsurers)	Characterizes the credit policy of an insurance company and its potential ability to risk the deterioration of asset quality
Insurance risk factor	I ₃	Net Awards / Capital	Shows how many net bonuses per unit of capital
Loss ratio of insurance operations	I ₄	Insurance indemnity / Insurance premium	Characterizes the level of payments and makes it possible to compare the costs of repayment of the insurer with the assumed liability insurance
The level of capital in total assets	I ₅	Capital / Assets	Indicates the ability to absorb the risk of loss
Risk factor Independence indicator from reinsurance	I ₆	Net insurance premiums / Insurance premiums	It serves as a feature of insurance risk management policies
Indicator of insurance reserves adequacy	I ₇	Net insurance reserves / Average amount of insurance premiums received over the past 3 years	Evidence of the adequacy of the existing insurance reserves in view of the receipt of insurance payments
The indicator of independence	I ₈	Equity / Equity capital	Characterizes the independence of the insurance company from external sources
Actual solvency margin		Assets – intangible assets liabilities, including insurance	-
Statutory margin of solvency	-	(Insurance premiums - 0,5 × Insurance premiums transferred to reinsurance) × 0,18	-
Statutory solvency margin	-	(Insurance indemnities - 0,5 × Insurance indemnities received from reinsurers) × 0,26	-
Stability factor	I ₉	Statutory margin of solvency/Statutory solvency margin	Characterizes a financial condition in which an insurance company is able to fulfill its obligations
The indicator of profitability of the insurance activity	I ₁₀	Net profit (loss) / Insurance premiums	Displays the effectiveness of insurance activity in relation to turnover, or the profitability of sales
Management stability factor	I ₁₁	Administrative expenses / Insurance premiums	Characterizes the level of expenses in the total insurance receipts

In Table 2 are the quantitative characteristics of indicators of assessing the stress resistance of insurance companies, and in Figures 1-3, the frequency distribution of stress-rating indicators for insurance companies with direct normal distribution calculated on the data of annual financial statements of 80 insurance companies and with the elimination of non-typical or rare values (cases) that significantly deviate from the distribution of other values indicators.

Figure 1

Histogram of the 4 indicators' distribution for assessing the stress resistance of insurance companies

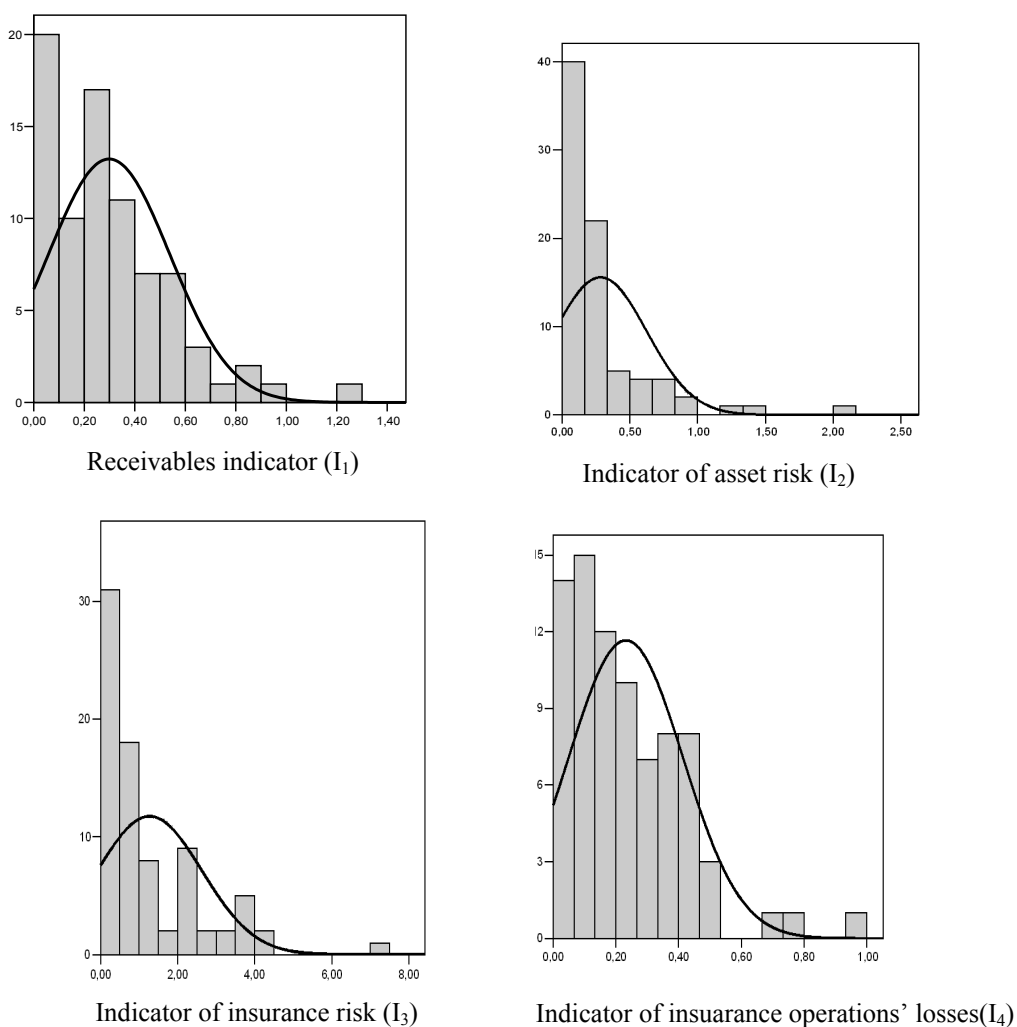
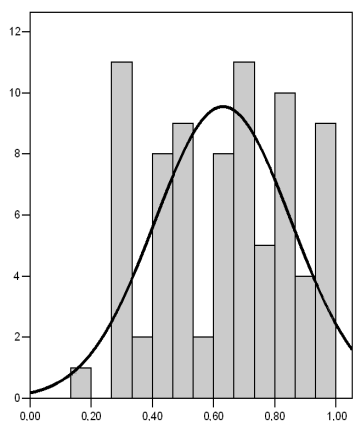
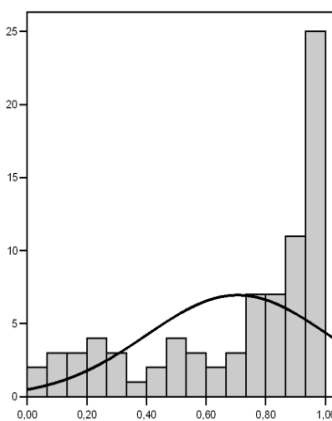


Figure 2

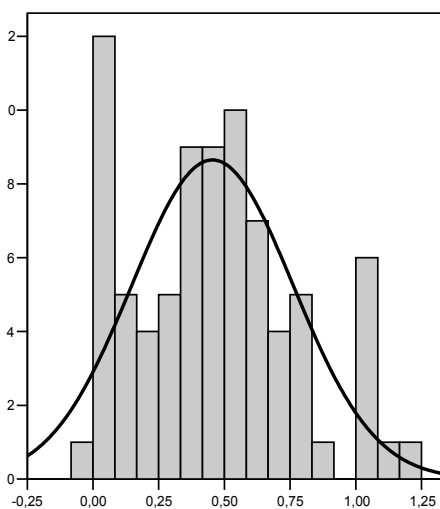
Histogram of the next 4 indicators distribution for assessing the stress resistance of insurance companies



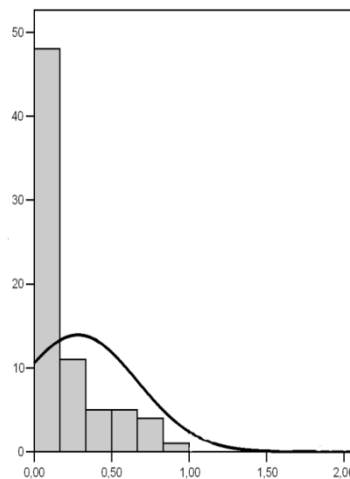
The specific weight of capital in total assets (I_5)



Indicator of riskretention (I_6)



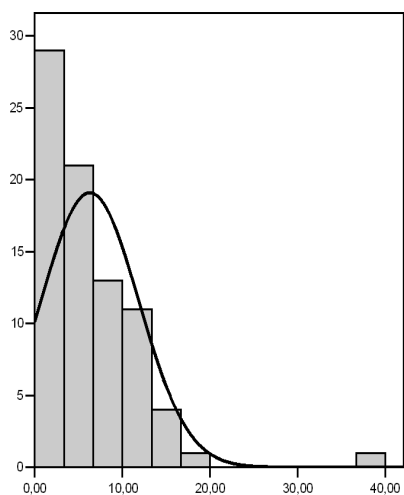
Indicator of insurance reserves' adequacy (I_7)



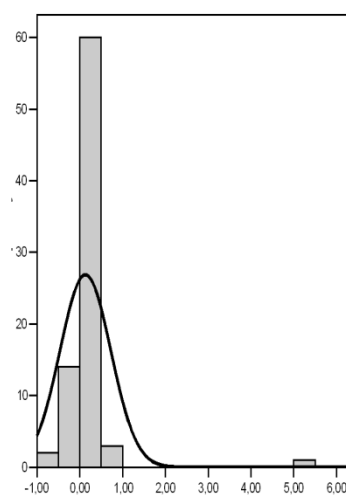
Indicator of independence (I_8)

Figure 3

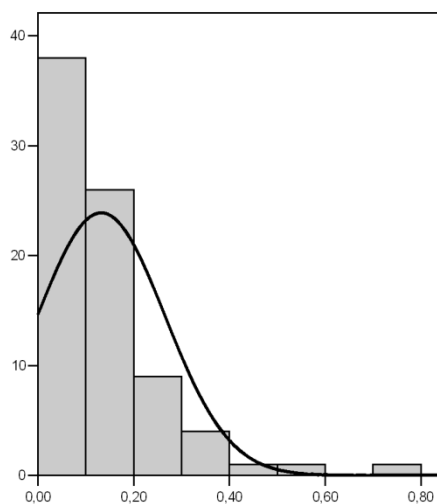
Histogram of the next 3 indicators distribution for assessing the stress resistance of insurance companies



Indicator of solvency margin (I_9)



Indicator of insurance activity's profitability (I_{10})



Management stability indicator (I_{11})

Table 2

Quantitative characteristics of indicators for assessing the stress resistance of insurance companies

Indicator	Symbols	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇	I ₈	I ₉	I ₁₀	I ₁₁
Medium	x	0.298	0.283	1.194	0.232	0.631	0.706	0.4546	0.284	6.29	0.130	0.132
Median	M	0.253	0.164	0.715	0.195	0.66	0.8	0.4485	0.13	4.75	0.036	0.106
Mode	Mo	0.07	0.1	0.4	0.03	0.72	1.0	0	0.1	1	0.02	0.00
Standard deviation	δ	0.241	0.341	1.411	0.182	0.223	0.306	0.307	0.381	5.573	0.593	0.132
Asymmetry	A	1.370	2.9	1.278	1.408	-1.138	-0.854	0.363	2.204	2.644	7.359	2.176
Average square deviation of asymmetry	δ_a	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269
Assessment of asymmetry	$\frac{ A }{\sigma_a}$	5.093	10.78 1	4.751	5.234	4.227	3.175	1.3494	8.193	9.83	27.357	8.0855
Value of probability by Kolmagorova-Smirnovacriterion	p	0.019	0.000	0.000	0.041	0.044	0.000	0.000	0.000	0.000	0.000	0.000

As shown in Figures 1 and 2, some indicators are not distributed according to the normal distribution law. The histogram gives an opportunity to evaluate qualitatively the various characteristics of the distribution, but the obtained distribution of indicators must be confirmed by the quantitative characteristics of the indicators, which are given in Table 1.

As can be seen from Table 1, under the normal distribution law, the value of the mod, median and mean coincide (Zhuravka, 2010). However, some indicators for assessing the stress resistance of insurance companies are not distributed according to the normal distribution law, that is, there is a discrepancy between the values of the mod, the median and the mean value, indicating the asymmetry of the distribution of indicators.

The asymmetric distribution is characterized by the fact that most of the values of the indicators are on the one hand from the mean value, and the other part is located on a large distance from the other side (Prytula, 2008).

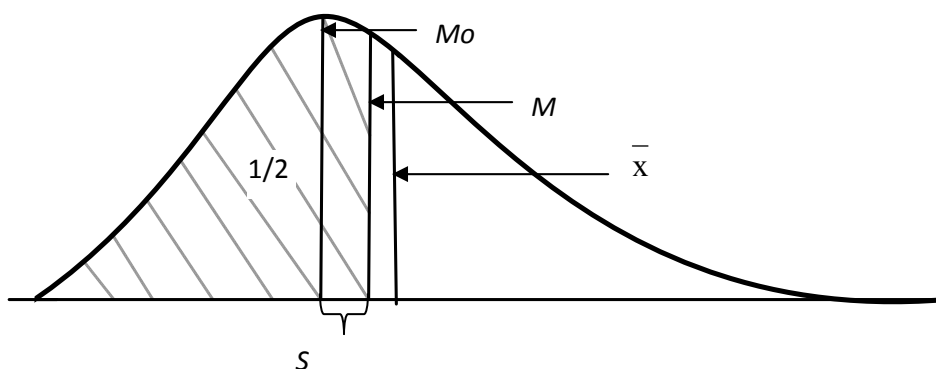
Based on the data of Table 1 it is possible to further scale the indicators, taking into account the right-hand and left-hand side asymmetry, if the indicators are not distributed according to the normal law.

With the asymmetric distribution of the intensity of the indicators, the most informant is the median represented in Figure 4 (Prytula, 2008).

As can be seen from Figure 4, based on the discrepancy between the values of the mode, the median and the mean value in the presence of asymmetry in the distribution of the intensity of the indicator when constructing the interval scale, it is more appropriate to use the median instead of the mean value (Prytula, 2008).

Figure 4

Right-hand distribution asymmetry with fashion, median and average values



In the rightmost asymmetry the intensity to the left of the median are denser than each other to the value S, and to the right – the distance between them increases (Fig. 4). In the left-hand side of the asymmetry there is a reverse.

In order to determine how far the distance between the intensities in the asymmetric distribution changes with respect to the values in normal distribution, it is proposed to introduce a correction factor equal to S, reduced in proportion to the number of divisions of the scale lying to the right and left of the median ($n = 5/2 = 2,5$) (N.I. Prytula, 2008):

$$k = \frac{S}{n}, \quad (1)$$

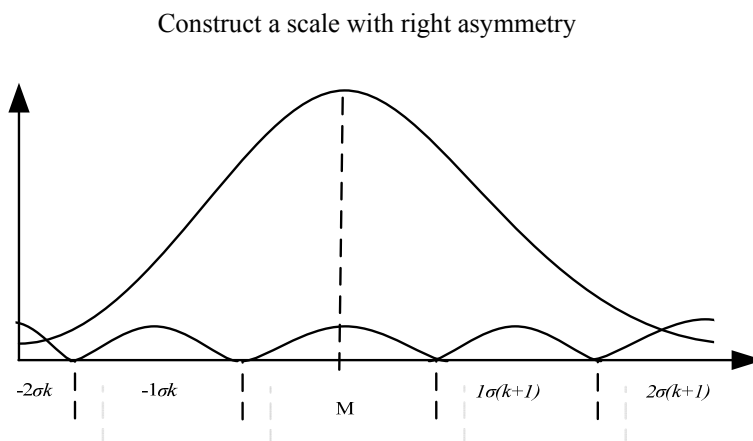
$$S = \frac{M - Mo}{M} \text{ — in case of right-sided asymmetry;} \quad (2)$$

$$S = \frac{Mo - M}{Mo} \text{ — in case of left-sided asymmetry} \quad (3)$$

When constructing an interval scale according to the rule of "three sigma" with the right asymmetry, the scale has a range of values ($M - 2\sigma k, M + 2\sigma (k + 1)$), with the left-hand side asymmetry - ($M - 2\sigma (k + 1), M + 2\sigma k$). In fig. 5 a scale with right asymmetry is depicted.

Application of Fig.5, when constructing scales with the correction indicator (k) and the median, it is possible to obtain the values of scales intervals for indicators $I_1, I_2, I_3, I_4, I_7, I_8, I_9, I_{10}, I_{11}$ with right asymmetry (Table 2) and for indicators I_5, I_6 with a left-sided asymmetry (Table 3).

Figure 5



The determination of the intervals of the values of indicators took place in the following sequence:

1. The calculation of the distance between the mode and the median by the formula (2) for the indicators $I_1, I_2, I_3, I_4, I_7, I_8, I_9, I_{10}, I_{11}$ and by the formula (3) for indicators I_5, I_6 is made, adding the corresponding values for this from Table 1.
2. The value of the correction factor (k) by the formula (1) for each of the indicators is calculated.
3. Based on Fig. 5 intervals of values of indicators are calculated.

The intervals of values of the scale of indicators for right-hand asymmetry are given in Table 3.

Results data in Table 3 indicate the use of these intervals separately for each indicator, as well as for an integrated assessment of the financial condition of insurance companies.

Scale measurement of stress resistance of insurance companies was conducted by using methods of mathematical statistics (Pukala, 2017).

The intervals of values of the scale of indicators for the left-hand side of the asymmetry are given in Table 4.

Table 3

Intervals of values of the scale of indicators with right-sided asymmetry

Calculation procedure	Interval value								
	I ₁	I ₂	I ₃	I ₄	I ₇	I ₈	I ₉	I ₁₀	I ₁₁
$[-\infty; M - 2\sigma k)$	[0; 0,114)	[0;0,058)	[0; 0,240)	[0; 0,072)	[0;0,203)	[0; 0,059)	[0; 1,23)	$[-\infty; -0,175)$	[0;0,0004)
$[M-2\sigma k; M - 1\sigma k)$	[0,114; 0,183)	[0,058; 0,111)	[0,240; 0,487)	[0,072; 0,170)	[0,203; 0,325)	[0,059; 0,095)	[1,23; 2,99)	$[-0,175; -0,069)$	[0,0004; 0,053)
$[M - 1\sigma k; M + 1\sigma(k+1)$	[0,183; 0,564)	[0,111; 0,558)	[0,487; 2,341)	[0,170; 0,439)	[0,325; 0,878)	[0,095; 0,546)	[2,99; 12,083)	$[-0,069; 0,734)$	[0,053; 0,291)
$[M + 1\sigma(k+1); M + 2\sigma(k+1)$	[0,564; 0,874)	[0,558; 0,952)	[2,341; 3,946)	[0,439; 0,682)	[0,878; 1,308)	[0,546; 0,962)	[12,083; 19,416)	[0,734; 1,432)	[0,291; 0,476)
$[M + 2\sigma(k+1); +\infty)$	[0,874; 1)	[0,952; 1)	[3,946; +\infty)	[0,682; 1)	[1,308; 1)	[0,962; 1)	$[19,416; +\infty)$	[1,432; +\infty)	[0,476; 1)

Table 4

Intervals of the scale of indicators for left-sided asymmetry

Calculation procedure	Interval value	
	I ₅	I ₆
$[0; M - 2\sigma(k+1)$	[0;0,139)	[0;0,199)
$[M - 2\sigma(k+1); M - 1\sigma(k+1)$	[0,139; 0,470)	[0,199; 0,429)
$[M - 1\sigma(k+1); M + 1\sigma k)$	[0,470; 0,824)	[0,429; 0,667)
$[M + 1\sigma k; M+2\sigma k)$	[0,824; 0,849)	[0,667; 0,675)
$[M+2\sigma k; +\infty);$	[0,849; 1)	[0,675; 1)

So, in Tables 3-4 is shown the intervals of the values of the indicators of the assessment of the stress resistance of insurance companies. The urgency of this study led to the need for identifying the main indicator indicators, which are related to the stability of insurance companies. The use of selected estimates of the stress resistance levels of insurance companies, based on the calculation of insurers' financial statements, can reveal trends in cumulative and increased risks of insurers. The technique of analysis is based on quantitative indicators, their limits and a qualitative interpretation of the information obtained in the process of assessing the stressors of insurers.

Investigating the conditions for micro-prudential supervision over the activities of insurance companies, it became clear that the approach to assessing the problems of insurance companies in the early stages, the definition of risk-based diagnostic risk-based tools and a thorough analysis of the impact of risk factors have not been adequately developed. This made it possible to conclude that it is necessary to construct scales of microprudential indicators, which will help to improve the national regime of prudential supervision, reduce its fragmentation.

To solve the problem of the scale measurement of microprudential indicators, which form the composition of the indicators for assessing the stress resistance of insurance companies, the main indicators of their activities have been derived from data from 80 insurance companies. Representativeness of this sample has been checked (the concentration indicator and the sample share in insurance premiums and insurance indemnities in the market is more than 70%).

According to the results of calculations of the indicators of stress resistance assessment, it is established: these indicators are not distributed by Gauss law, which indicates the asymmetry of their division, that is, there is a discrepancy between the values of the mode, the median and the mean value. Their scale measurement is taken into account, taking into account the correction factor for right and left-hand side asymmetry of the distribution of the values of the indicators, since the methods of constructing interval scales are based on the axiom of normality. The determination of the intervals of the values of the indicators of the assessment of the stress resistance of the insurance companies is carried out in the following order: the calculation of the distance between the mode and the median with the right-hand asymmetry for the indicators I₁, I₂, I₃, I₄, I₇, I₈, I₉, I₁₀, I₁₁ and for indicators I₅, I₆ in the left-hand side asymmetry. The value of the adjustment indicator for each of the indicators is calculated.

The scales and criteria of the indicators of the assessment of the stress resistance of insurance companies by scaling method based on the rule of "three sigma" with the right and left-hand distribution asymmetry were obtained (Table 5).

Table 5
Scales and criteria for assessing the stress resistance levels of insurance companies

Symbol of the indicator	Criteria for assessing the stress resistance levels of insurance companies by levels:				
	very low	low	medium	high	very high
I ₁	[0,874; +∞)	[0,564; 0,874)	[0,183; 0,564)	[0,114; 0,183)	[0; 0,114)
I ₂	[3,946; +∞)	[2,341; 3,946)	[0,487; 2,341)	[0,24; 0,487)	(0,0; 0,24)
I ₃	[0; 0,139)	[0,139; 0,470)	[0,470; 0,824)	[0,824; 0,849)	[0,849; 1)
I ₄	[0,962; 1)	[0,546; 0,962)	[0,095; 0,546)	[0,059; 0,095)	[0; 0,059)
I ₅	[0; 1,23)	[1,23; 2,99)	[2,99; 12,083)	[12,083; 19,416)	[19,416; +∞)
I ₆	[-∞; -0,175)	[-0,175; 0,069)	[0,069; 0,734)	[0,734; 1,432)	[1,432; +∞)
I ₇	[0; 0,072); [0,682; +∞)	[0,072; 0,170)	[0,170; 0,439)	[0,439; 0,682)	-
I ₈	[0; 0,199)	[0,199; 0,429)	[0,429; 0,667)	[0,667; 0,675)	[0,675; +∞)
I ₉	[0,952; +∞)	[0,558; 0,952)	[0,111; 0,558)	[0,058; 0,111)	[0; 0,058)
I ₁₀	[0; 0,203)	[0,203; 0,325)	[0,325; 0,878)	[0,878; 1,308)	[1,308; +∞)
I ₁₁	[0; 0,0004)	[0,0004; 0,053)	[0,053; 0,291)	[0,291; 0,467)	[0,467; +∞)

The developed scales and criteria of indicators of stress resistance of insurance companies as microprudential indicators are an integral part of the diagnostic tools of microprudential supervision.

Based on the classification of risks, the author substantiates the trends of changes in indicators and individual components of these indicators. The economic components according to the proposed classification of risks coincide with the components of the indicators in the formulas for calculating the indicators of stress resistance assessment.

The determination of the conformity of economic components to the proposed classification of risks and component indicators in the formulas for calculating the stress indexes of insurance companies is given in Table 6.

Table 6
Influence of negative tendency of change of indicators' components on risks of insurers

Risk group	Indicator	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇	I ₈	I ₉	I ₁₀	I ₁₁
Risks related to responsibility and insurance activities	Insurance payments ↓	-	-	+	-	+	+	+	-	+	+	+
	Insurance payments due to reinsurers Unbalanced ↑	-	-	-	-	+	-	-	-	+	-	-
	Net insurance premiums (insurance premiums less bonuses belonging to reinsurers)	-	+	+	-	-	-	-	-	-	-	-
	Insurance indemnity	-	-	-	-	+	-	+	-	-	-	-
	Insurance payments received from reinsurers	-	-	-	-	+	-	-	-	-	-	-
	Net insurance indemnity (insurance compensation reduced by the amount of insurance reinsurance from reinsurers) Unbalanced ↑	-	-	-	-	-	-	-	-	-	-	-
	Operating Expenses Unbalanced ↑	-	-	-	-	-	-	-	-	-	+	-
	Insurance reserves Unbalanced ↓	-	-	-	-	-	-	-	-	-	-	+
	Risks related	Investment Income Unbalanced ↓	-	-	-	-	-	+	-	-	-	-

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with assets and investment activities	Assets ↓	+	+	-	+	-	-	-	+	-	-	-
	The share of a reinsurer in insurance reserves ↓	-	-	-	-	-	-	-	-	-	-	+
	Receivables ↑	+	-	-	-	-	-	-	+	-	-	-
Supplemented by the formulas of indicators	Responsibilities	+	+	-	-	+	-	-	+	-	-	-
	Equity	-	-	-	+	-	-	-	-	-	-	-
Negative trend of indicator change		↑	↓	↓	↑	↓	↓	↓	↓	↑	↓	↑
Symbols :												
Used in numerator formula -	+	Supplemented by the formulas of indicators -		Indicator of independence -	I ₄	The specific weight of capital in total assets -	I ₈					
Used in the denominator formula -	+	Indicator of receivables -	I ₁	Indicator of solvency margin -	I ₅	Indicator of assets' risk -	I ₉					
Magnification -	↑	Indicator of insurance risk -	I ₂	Indicator of insurance activity profitability -	I ₆	Management stability indicator -	I ₁₀					
Reduction -	↓	Indicator of risk retention	I ₃	Indicator of insurance operations' losses -	I ₇	Indicator of insurance reserves' adequacy	I ₁₁					

As can be seen from Table 6, for the insurance companies, there are the following significant risk factors: reducing the amount of insurance premiums and increasing the amount of insurance indemnities. However, this list is not exhaustive.

To determine the expert opinion about the possibility of using individual indicators characterizing the financial condition of insurance companies to determine the risk exposure of insurance companies, a questionnaire was conducted. The expert opinions received are considered in determining the correspondence between risks and indicators of manifestation. Indicators for assessing the stress resistance of insurance companies form a system of indicators of the risk exposure of insurance companies. Generalized information on risks and manifestations is given in Table 7.

Table 7

Correspondence between the risks of insurance companies and indicators of manifestation

Indicators	Risk						
	Insurance	Market	Credit	Liquidity	Operation	Group	System
Indicator of receivables (I ₁)	-	-	+	-	-	-	-
Indicator of insurance risk (I ₂)	-	-	-	+	-	-	-
Indicator of risk retention (I ₃) (Indicator of independence from reinsurance)	-	-	+	-	-	-	-
Indicator of independence (I ₄)	-	-	-	-	-	+	-
Indicator of solvency margin (I ₅)	+	-	-	-	-	-	-
Indicator of insurance activity profitability (I ₆)	+	-	-	-	-	-	-
Indicator of insurance operations' losses (I ₇)	+	-	-	-	-	-	-
The specific weight of capital in total assets (I ₈)	-	-	-	-	-	-	+
Indicator of assets' risk (I ₉)	-	-	+	-	-	-	-
Management stability indicator (I ₁₀)	-	-	+	-	-	-	-
Indicator of insurance reserves' adequacy (I ₁₁)	+	-	-	-	-	-	-

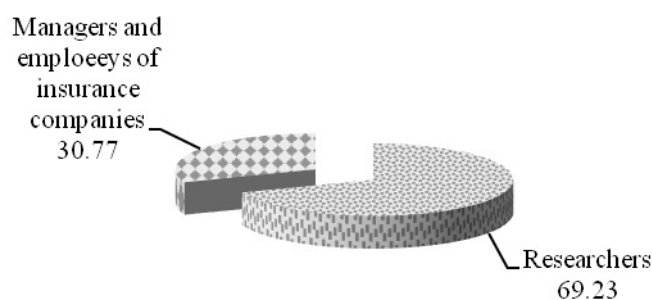
Results, at Table 7, indicate the uneven distribution of indicators for assessing the stress resistance of insurance companies and the risks proposed in accordance with the Methodological recommendations on the use of stress tests by insurers, in particular, market and operational risks are difficult to determine through the indicators of manifestation.

The expert group included executives and employees of insurance companies, as well as researchers investigating the problems of insurance companies and the organization of risk management of insurers (Figure 6).

As can be seen from Figure 6, all experts were grouped into two groups; the largest share in the structure of respondents was made by researchers (69.23%). It should be noted that to more accurate and qualitative determination of the indicators of the insurance company's risks, it is necessary to increase the number of interviewed experts, since the results of the methodological recommendations depend on the subjective opinion of the experts, their experience and knowledge, that is, they have a subjective character (Achkasova, 2013).

Figure 6

The composition of the expert group to determine the correspondence between risk and indicator of manifestation



E. V. Boronina (2011) proposed issues of stress testing of the insurance company, which most fully characterized the groups of risks and were accompanied by economic indicators – numerical indicators of shock situations:

Market risk: How does an insurer's asset devalue when a national currency is devalued? How will the effectiveness of investment operations change if interest rate growth depends on the refinancing rate of the Central Bank?

Credit risk: What will be the proportion of risks with reinsurance cover in the overall risks taken for insurance? How will the insurance company fulfill its obligations in case of default by the reinsurer, which is its partner for the three biggest risks?

Liquidity risk: How will the insurance company operate at the simultaneous occurrence of such events: the reduction of cash flows from insurance premiums and the occurrence of insurance incidents for the three largest portfolio risks?

Operational Risk: How will an insurance company work, if problems arise in interactions with intermediaries (brokers and agents – legal entities) and their share in the provision of contractual insurance contracts, will decrease sharply? How will change the proportion of company losses with increasing fraud: a) in the middle of the company; b) intermediaries; c) insured persons?

Risks of the group: What are the insurer's actions in the event of a financial support from the parent company? What are the insurer's actions in case of the return of financial support to the parent company?

Systemic risk: What are the insurer's actions in the event of deterioration in the position of the main banks servicing its operations associated with the placement of insurance reserves?

Considering the E.V. Boronina (2011) and the author's proposed test questions, the information on the correspondence between the insurer's risk and the possible indicator of estimation is presented (Table 8).

Table 8

The correspondence between the insurer's risk and possible assessment indicator

Risk	Test questions	Indicators of stress resistance assessment
Insurance	How will the insurance company operate at the simultaneous occurrence of such events: reduction of cash flows from insurance premiums and occurrence of insurance events of the largest portfolio risks?	Indicator of solvency margin (I_5), Indicator of insurance activity profitability (I_6), Indicator of insurance operations' losses (I_7), Management stability indicator (I_{11}).
Credit	How will the insurance company fulfill its responsibilities in case of default by the reinsurer, which is its partners at the three highest risks?	Indicator of receivables (I_1), Indicator of risk retention (Indicator of independence from reinsurance) (I_3), Indicator of assets' risk (I_9), Indicator of insurance reserves' adequacy (I_{11}).
Liquidity	What are the insurance company's actions in reducing investment income and lack of fast liquid assets and increasing insurer expenses?	Indicator of insurance risk (I_2)
Group	What are the insurer's actions in case of a financial support from the parent company?	Indicator of independence (I_4)
System	What are the insurer's actions in the event of deterioration in the position of the main banks serving its operations related to the placement of insurance reserves?	The specific weight of capital in total assets (I_8)

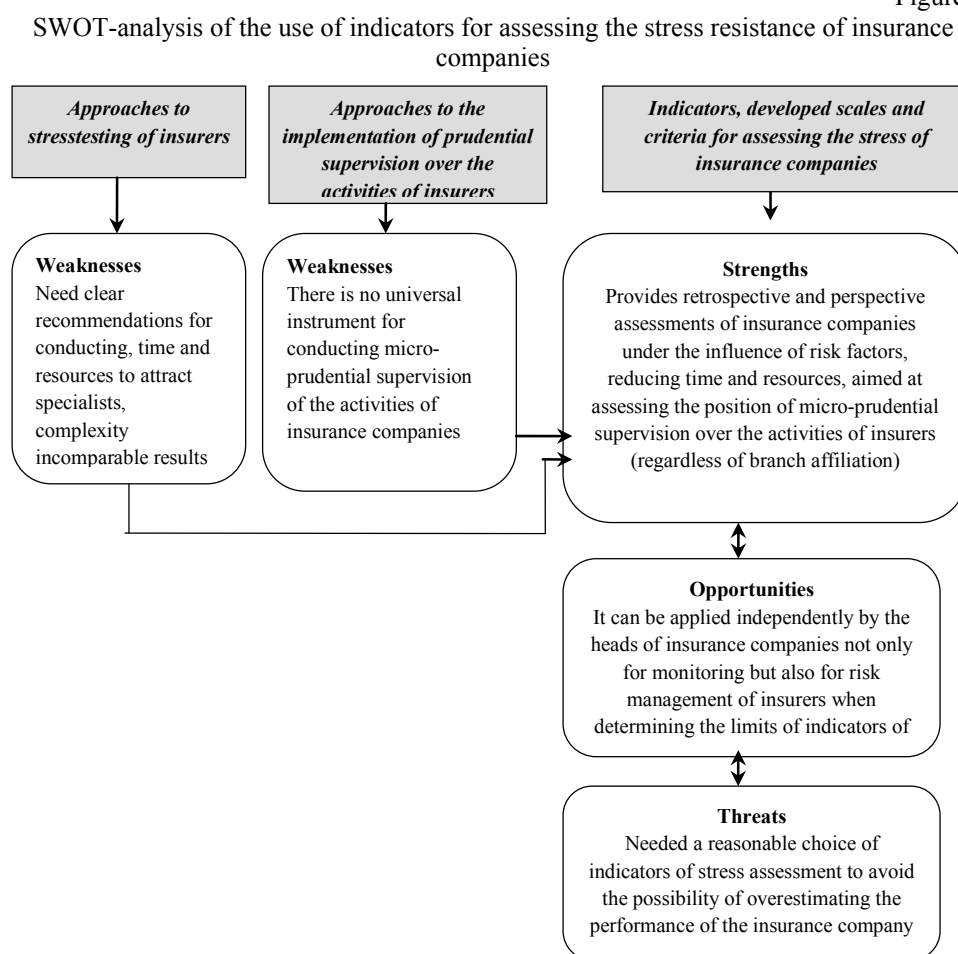
Applying the results of Table 8 provides for the use of marginal intervals for indicators of stress resistance. Table data results testify to the possibility of using separate indicators for assessing the stress of insurance companies depending on the target approach of its use, that is, to determine the impact risk factors for a separate group of risks, and not for all together. It is advisable to carry out the actuaries, since under current conditions the actuaries are an integral part of the system of prudential supervision, their activities must be certified and should include the compilation and submission of a mandatory annual actuarial report on the assessment of the insurance portfolio, tariff policy and policy formation of reserves, capital adequacy and solvency, investment policy, risk analysis and management mechanisms, stress testing results, etc.

To justify the effectiveness of the offered approach its preferences and difficulties need to be determined (Figure 7). Jobst (2014) highlights three main issues of existing stress testing practices such as: the risk factors may change over time and therefore disfigure the results of stress testing; the usefulness of quantitative measures may be limited by non-recurring

shocks that can not be considered by the valuation model; there are difficulties in early interpretation of signals and providing early warnings without hindsight bias.

By considering the mentioned and adding more difficulties of assessment of stress resistance of insurance companies the justification of its effectiveness by the proposed scales and criteria is shown in Figure 7.

Figure 7



As can be seen from Figure 7, the author's approach to assessing the stress resistance of insurance companies makes it possible to determine the assessment of the stress of insurance companies under the influence of risk factors, reduce the time and resources for attracting specialists, is acceptable for self-application by managers of insurance companies, in contrast to the approaches to stress testing and the exercise of prudential supervision is universal, since it is aimed at assessing the position of micro-prudential

supervision over the activities of insurers and can be applied independently supervise insurance companies not only for monitoring, but also for risk management of insurers in determining the limits of the indicators of assessment of stress resistance.

Research materials can be used to build a stress assessment index for insurance companies, which is the subject of further research.

4. Empirical results

The empirical results of the use of indicators for assessing the stress of insurance companies are given by the example of PJSC "European Insurance Alliance" according to the data of 2011 (Table 9).

Table 9
Conducting an assessment of the stress resistance of insurance companies

Indicator	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇	I ₈	I ₉	I ₁₀	I ₁₁
Value	0,502	1,057	0,835	0,587	4,783	0,001	0,340	0,584	0,397	0,207	0,571
The level of a scale	Average	Average	High	Low	Average	Low	Average	Low	Average	Low	Very high

As can be seen from Table 9, the indicators of the assessment of the stress resistance of insurance companies and their symbols:

with the average level of the following: the indicator of accounts receivable (I₁), the insurance risk factor (I₂), the factor of the solvency margin (I₅), the indicator of losses of insurance operations (I₇), the risk factor of assets (I₉), indicator of stability management (I₁₁);

with a high level: the risk factor (I₃),

with low and very low: indicator of independence (I₄), indicator of profitability of insurance activity (I₆), level of capital in total assets (I₈), adequacy of insurance reserves (I₁₀).

For the latter group of indicators, it is advisable to develop a program of tactical, operational and strategic measures to improve these indicators.

To standardize the information required for conducting micro-prudential supervision over the activities of insurance companies, it is proposed:

- to define a retrospective assessment for summing up the results of previous years and determining the trends of the insurer;
- to determine the perspective assessment of stress resistance to determine the key risk factors and risk profile of the insurer to level these factors;

- identify the most significant risk factors for determining capital adequacy to cover losses from exposure to risks;
- determine the planned measures to increase the level of stress (content, timing) to achieve the limit values of indicators of stress assessment in accordance with the manifestation of risks;
- identify responsible executors, as the risk monitoring carried out by the risk management unit includes monitoring of changes in the values of risk indicators and the maximum allowable limits.

5. Concluding remarks

Improved diagnostic tools for microprudential supervision, the basis of which are built scales and defined criteria for microprudential indicators, their margins for their scales at very low, low, medium, high and very high levels depending on the risks insurers used in assessing the stress resistance of insurance companies. The use of established scales and criteria allows us to assess changes in indicators and to improve micro-prudential supervision.

Micro-prudential supervision of the activities of insurance companies involves the use of certain tools: microprudential indicators of insurance companies, stress testing, determining the adequacy of the capital of insurance companies.

Practical implementation of microprudential supervision is especially relevant as further diagnostic monitoring of macroprudential indicators is carried out based on aggregated microprudential factors, which determines the direct dependence of the insurance market indicators in general on the performance of individual insurance companies.

The necessity of assessing the stress resistance for raising the level of risks (insurance, credit, liquidity, group, system) is substantiated. It can be used independently by managers of insurance companies not only for monitoring but also for risk management of insurers when determining the limits of indicators of assessment of stress resistance.

Research materials can be used to build a stress assessment index for insurance companies, which is the subject of further research.

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