



Catastrophic Business Risk: Data From the Russian Regions

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ABSTRACT

The purpose of the study is to analyze the regularities and trends of the existing levels of catastrophic business risk for sets of small and medium-sized enterprises located in each of the regions of Russia. The article discusses the methodological and empirical aspects of the assessment of catastrophic risk, as well as the calculation formula for determining its level. Research based on the official statistical data for Russian regions for the 2010-2017 period. Evaluation level of catastrophic risk was made on calculated functions density of normal distribution. Study revealed that for discussing years average value of catastrophic risk is 8.1%. The highest level of catastrophic business risk is due to the influence of crisis phenomena in the economy in 2016-2017. The article also identifies and observes the regions with respectively high and low levels of catastrophic business risk. The results obtained have a certain theoretical and applied value, in particular, in the analysis of patterns characteristic of the business sector of the economy, substantiation of proposals for its development, as well as business risk management. The results of the study would be of interest in the educational process of higher and secondary special educational institutions, as well as for researchers and state and municipal authorities.

INTRODUCTION

The Russian business sector has significantly developed in recent years. The problem of the substantial increase in the production of goods and services by small and medium-sized businesses in Russia requires understanding of the role that entrepreneurial risk has on their activities. A wide range of risk-related issues needs to be explored in order to predict the volume of this risk and its impact, as well as to develop measures to reduce this risk. Therefore, at the present stage

of business development it is important to analyze the patterns and trends characterizing the current level of risk in the business sector of the Russian economy, as well as the identification of territories and the total number of enterprises with high and low levels of these risks. The availability of such information is necessary for potential entrepreneurs to make informed decisions on starting a business. In addition, the federal, regional and municipal authorities need relevant data for planning, making programs and forecasts for economic development.

The modern concept of entrepreneurial risk is formulated in ISO 31000-09 (Risk management, 2009). It states that organizations of all types and sizes face internal and external factors and influences that make it impossible to determine how and when they achieve their goals. The last thesis is also fixed in the current legislation of the Russian Federation. According to the Civil Code of the Russian Federation (item 1 of art. 2), entrepreneurial activity is independent, carried out at its own risk, aimed at systematic profit from the sale of goods, performance of works or provision of services. The justification of consideration expediency of the three levels of enterprise risk as admissible, critical and catastrophic, which was presented in the article by Tapman (2002). A catastrophic business risk has the most negative impact on the activities of small and medium-sized enterprises, therefore the study of patterns and trends of its impact on the development of the modern economy is of substantial relevance.

The purpose of the study is to analyze the patterns and trends of existing levels of catastrophic business risk for the sets of small and medium-sized enterprises located in each of the regions of Russia for the 2010-2017 period.

The following tasks are fulfilled during the research:

- the suggestion of methodology and calculation formula for assessment of the level of catastrophic business risk in the regions;
- the presentation of description of the procedure for collecting and processing initial data to calculate the current level of catastrophic business risk on the basis of official statistics;
- the assessment of catastrophic risk levels on sets of the small and medium-sized enterprises formed in the regions of the country for the 2010-2017 period;
- the identification of regularities and tendencies characterizing the developed levels of catastrophic risks for the considered period;
- the observation of regions experienced high and low levels of catastrophic business risk from 2016 to 2017.

1. LITERATURE REVIEW

Originally, the issues of risk theory in business activity were considered in detail in the work of Knight (1921), where an important approach for the methodology was proposed, namely the indicator of statistical probability characterizing the existing level of risk. The study of Keins (1997) showed the relation of the entrepreneurial risk level to the achievement of the entrepreneur's goal, which is individually set. Some aspects of catastrophic business risk were mentioned in articles (Toma and Alexa, 2012; Veskovic, 2014; Nehrebecka, 2018; Spicas et al, 2018; Voda et al, 2019; Kozubíkova et al., 2017).

The problem of catastrophic business risk is also considered in the works of Russian researchers. The ones of great interest are the works presented in Table 1.

Table 1. Criteria for catastrophic level of business risk

<i>Authors</i>	<i>Criteria</i>
1	2
Raizberg (1991)	losses exceed the critical level and can reach the value of the property of the entrepreneur
Patlasov (1996)	losses exceed the critical level and can reach the value of the property of the entrepreneur
Granaturov (2002)	losses of more than expected income and the property status of the firm
Shapkin (2003)	risk that exceeds the maximum limit of risk prevailing in this economic system
Pelikh et al. (2004)	losses exceeding the critical level and able to reach the value of the property status of the entrepreneur
Kabakov (2012)	losses exceeding the critical level
Kibitkin et al. (2013)	losses leading to a partial loss of equity or debt capital

Source: Compiled by authors based on the literature analysis

The information given in column 2 of Table 1 shows that the authors propose the assessment of the level of catastrophic business risk on the basis of various criteria. Moreover, most of the proposed criteria are not specific and difficult to calculate. The relationship between the criterion and the property status of the entrepreneur is not logical, since the size of the state significantly varies among different enterprises. In addition, such a proposal contradicts the current legislation, which determines that the owners of small and medium-sized enterprises are financially responsible for the debts of their enterprises only within the authorized capital. In the works of Kabakov (2012) and Shapkin (2003), some limit values are proposed as criteria, which, however, are not specifically defined. The criterion proposed in the monograph Kibitkin et al. (2013), in our opinion, refers to the critical risk, because it does not necessarily have a direct impact on the strategic goal of the enterprise. It should be noted that the criteria proposed by the majority of authors can be used only to assess the performance of a particular enterprise, but their application to assess the current level of a set of enterprises proves to be difficult.

In general, the analysis of literature shows that the issues of comprehensive assessment of catastrophic business risk, in our opinion, have not been properly studied.

2. RESEARCH METHODS AND DESIGN

As stated in ISO 31000-09 (Risk management, 2009), risk affects the main objectives of small and medium-sized enterprises. The accumulated experience shows that the main strategic goal of any enterprise is to continue its operational activities. This approach uses the continuation of the enterprise as a criterion for attributing the performance of specific small and medium-sized enterprises to a catastrophic risk. Therefore, this article considers the termination of activity and subsequent liquidation of the enterprise as a result of the catastrophic risk. It is logical to assess whether the strategic goal of the enterprise has been achieved based on the results for a relatively long period. Given that the financial statements for small businesses (which reflect the balance sheet financial results) are compiled at the end of the year, this period can be chosen to assess the level of risk. The proposed criterion for assessing catastrophic business risk is objective, easy to apply and clearly describes the impact of this type of risk on the enterprise.

The values of the existing levels of catastrophic business risk can be calculated within the sets of small and medium-sized enterprises formed on the territorial principle, on the basis of official

statistics on the proportion of discontinued and liquidated enterprises number in the totality of enterprises in a particular region. It is advisable to use such indicators as the total number of enterprises at the end of the year (N_1) and the number of officially liquidated enterprises within this year (N_2) as the initial data for calculations. The current level of catastrophic risk (U , %) was determined by the following formula:

$$U_{kam} = \frac{N_2}{N_1} \times 100\% . \quad (1)$$

The above indicators were calculated for the sets of small and medium-sized enterprises located in each of the regions of the country, since the research (process) took into account the fact that the aggregates of small and medium-sized enterprises were developed in all regions of Russia.

The research tested two main hypotheses:

- hypothesis 1 states that the existing levels of catastrophic business risk are determined by the presence or absence of crisis phenomena in the country's economy;
- hypothesis 2 states that the existing levels of catastrophic business risk significantly varies among regions of the country.

The official statistical information of the Federal State Statistics Service on small and medium-sized businesses was used as initial data for assessing the existing levels of entrepreneurial risk (Federal State Statistics Service, 2019). In particular, we considered the demographic indicators of small and medium-sized enterprises, namely the data characterizing the share of liquidated small and medium-sized enterprises in the regions of Russia within the total number of such enterprises in the relevant region.

The relevant information was considered during the 2010-2017 period for small and medium-sized enterprises operating in 80 regions. Table 2 shows a fragment of the initial empirical data describing the demographics of small and medium-sized enterprises (in terms of liquidation of enterprises) in 2017 based on the example of 6 regions of Russia.

Table 2. Fragment of data on the number of liquidated small and medium-sized enterprises

<i>Area</i>	<i>Number of liquidated small and medium-sized enterprises per 1000 such enterprises in the region</i>
Belgorod region	116.4
Bryansk region	97.8
Vladimir region	91.4
Voronezh region	90.7
Ivanovo region	143.9
Kaluga region	84.7
...	...

Source: Compiled by authors based on official statistic data

The computational experiment was based on statistical and probabilistic methods of the quantitative assessment of the existing business risks levels. Analyzing regularities and tendencies of differentiation of catastrophic business risk on the sets of the enterprises operating in different regions of the country, we introduced the functions of density of normal distribution. As shown in the work by (Pinkovetskaia, 2015; Pinkovetskaia et al., 2019; Denisenko and Varshavskaya, 2018), they appropriately approximate the initial data on the sets of small and medium-sized enterprises located in each of the regions of Russia. Software Statistica and Microsoft Excel were used for solving tasks and processing information.

3. ASSESSMENT OF CATASTROPHIC RISK LEVELS

The calculation of the levels of catastrophic risk was carried out on the basis of the sets of small and medium-sized enterprises located in each of the regions of the Russian Federation taking into account the empirical data for the 2010-2017 period. As mentioned above, the assessment of the existing levels of catastrophic risk in the regions of Russia was executed using the density functions of the normal distribution. The distribution of the values of catastrophic risk in the activities of small and medium-sized enterprises in the regions of the country developed in the 2010-2017 time period is described by the following equations:

- for 2010

$$y_1(x_1) = \frac{80}{1,3 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_1 - 4,7)^2}{2 \cdot 1,3 \cdot 1,3}} ; \quad (2)$$

- for 2011

$$y_2(x_2) = \frac{229}{3,3 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_2 - 9,4)^2}{2 \cdot 3,3 \cdot 3,3}} ; \quad (3)$$

- for 2012

$$y_3(x_3) = \frac{213}{3,5 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_3 - 8,6)^2}{2 \cdot 3,5 \cdot 3,5}} ; \quad (4)$$

- for 2013

$$y_4(x_4) = \frac{120}{1,9 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_4 - 6,6)^2}{2 \cdot 1,9 \cdot 1,9}} ; \quad (5)$$

- for 2014

$$y_5(x_5) = \frac{96}{2,1 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_5 - 7,2)^2}{2 \cdot 2,1 \cdot 2,1}} ; \quad (6)$$

- for 2015

$$y_6(x_6) = \frac{96}{1,7 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_6 - 6,2)^2}{2 \cdot 1,7 \cdot 1,7}} ; \quad (7)$$

- for 2016

$$y_7(x_7) = \frac{213}{3,3 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_7 - 9,9)^2}{2 \cdot 3,3 \cdot 3,3}} ; \quad (8)$$

- for 2017

$$y_8(x_8) = \frac{213}{3,7 \cdot \sqrt{2\pi}} \cdot e^{-\frac{(x_8 - 12,4)^2}{2 \cdot 3,7 \cdot 3,7}} \quad (9)$$

The quality control of the initial data approximation based on the density function of the normal distribution was carried out using the criteria arising from the methodology of mathematical statistics. These criteria allowed us to compare the empirical distribution of statistical information of the considered indicator with the theoretical one described by the model. The quality analysis was carried out using well-known and well-established criteria of consent by Pearson, Kolmogorov, Shapiro-Wilk. The results of the analysis are given in Table 3.

Table 3. The calculated and table values according to the criteria of consent

Criteria	Calculated values by function								Table values
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Pearson	1.46	3.24	4.06	4.56	3.69	4.84	1.95	1.52	9.49
Kolmogorov	0.05	0.09	0.08	0.09	0.05	0.06	0.04	0.05	0.15
Shapiro-Wilk	0.98	0.95	0.95	0.96	0.96	0.97	0.97	0.96	0.93

Source: Compiled by authors based on calculated economic-mathematical models

Comparison of tabular and calculated values shows that according to Pearson and Kolmogorov criteria, tabular values are significantly higher than calculated values (9.49 and 0.15 respectively) and according to the Shapiro-Wilk criterion, the calculated values of the criterion exceed the table value (0.93). Thus, the developed density functions of the normal distribution (2)-(9) are of high quality, and appropriately approximate the empirical data.

4. DISCUSSION OF RESULTS

The density functions of the normal distribution (2)-(9) make it possible to identify a number of significant patterns characterizing the level of catastrophic business risk in the economies of the regions of the country in current conditions. The main indicators of functions (2)-(9), namely, the average values and standard (mean square) deviations are given in columns 2 and 3 of Table 4. Column 4 of this table shows the intervals of changes in the values of catastrophic business risk for most (68%) regions of our country. It is evident that the boundaries of these intervals are calculated as follows: the mean square deviations (column 3) are respectively added and subtracted from the mean values given in column 2.

As seen from the data given in column 2 of Table 4 for the period under review, the regional average values of catastrophic business risk ranged from 4.7% to 12.4%. At the same time, in general, for the whole period the average value of this indicator for small and medium-sized enterprises activity amounted to 8.1%. That is, on average every twelfth company ceased its operations within a year.

Table 4. The values of catastrophic business risk prevailing in Russia, %

<i>Years</i>	<i>Average</i>	<i>Standard deviation</i>	<i>Interval</i>
1	2	3	4
2010	4.7	1.3	3.4-6.0
2011	9.4	3.3	6.1-12.7
2012	8.6	3.6	5.1-12.2
2013	6.6	1.9	4.7-8.5
2014	7.2	2.1	5.1-9.3
2015	6.2	1.7	4.5-7.9
2016	9.9	3.3	6.6-13.2
2017	12.4	3.7	8.7-16.1
Average for 8 years	8.1	2.6	-

Source: Compiled by authors based on calculated economic-mathematical models

During the period under review, Russia experienced two economic crises. 2010 was the last year of the 2008-2010 crisis, which resulted from the global financial decline. The second crisis of 2014-2015 occurred only in Russia. The growth of regional averages of catastrophic business risk, as shown in Table 4, was due to economic crises in the country. At the same time, the growth of business risk values in the first and second cases was observed with 2-3 years delay in relation to the beginning of the crisis. Thus, in our opinion, the crisis of 2008-2010 had an impact on the growth of average values of catastrophic business risk in 2011 and 2012, and the crisis of 2014-2015 influenced the growth of values in 2016 and 2017. This delay seems logical for the following reasons:

- the impact of the crisis on the activities of small and medium-sized enterprises is gradual. In the beginning profitability of the enterprises decreases, and then their activity becomes inefficient and unprofitable, and it is necessary to cease it;
- the current procedure of enterprises liquidation under the current country`s legislation is quite complex and lengthy.

Thus, it can be concluded that hypothesis 1 has been confirmed.

As it is known, the presence of differentiation of values is determined by the standard (mean square) deviation taken as an indicator. Analysis of the ratios between standard deviations (column 3) and averages (column 2) showed that these ratios ranged from 0.27 to 0.42 for each period of time. This indicates that there is a significant differentiation of the existing levels of catastrophic business risk in the regions of the country. A similar conclusion follows from the interval values given in the column 4 of Table 4. These intervals show the levels of catastrophic risk for the majority (68%) of regions, their minimum and maximum limits of values. The presence of a significant differentiation of the existing levels of catastrophic business risk in the regions of the country allows us to conclude that the hypothesis 2 we put forward has also been confirmed.

It is of significant interest to rank the values of catastrophic business risk in the regions of Russia. In the course of the research, regions with the maximum and minimum values of such risk were noted, respectively, according to empirical data for 2017 and 2016.

The level of catastrophic risk in 2017 is higher than the upper limit of the interval specified in Table 4, was noted for the aggregates of small and medium-sized enterprises located in the Orel, Ulyanovsk, Nizhny Novgorod, Tomsk, Chelyabinsk, Vologda regions, the republics of North Ossetia-Alania, Kalmykia, Udmurtia, Mari El, Tatarstan and Khakassia. This should be taken into account when starting a business in these regions.

The level of catastrophic risk in 2017 is less than the lower limit of the interval specified in Table 4, occurred in the aggregates of small and medium-sized enterprises located in the republics of Tyva, Adygea, Karachay-Cherkessia, Kabardino-Balkaria, as well as Pskov, Leningrad, Kaluga regions. In these regions, doing business is more comfortable than in the regions mentioned above.

The level of catastrophic risk higher than the upper limit of the interval specified in Table 4, in 2016, was noted for the aggregates of small and medium-sized enterprises located in the Ivanovo, Tyumen, Kursk, Kirov, Novosibirsk, Murmansk regions, the cities of Moscow and St. Petersburg, the republics of North Ossetia-Alania, Altai, Kalmykia.

The level of catastrophic risk less than the lower limit of the interval specified in Table 4 occurred in 2016 for the aggregates of small and medium-sized enterprises located in the Kaliningrad region, the republics of Khakassia, Dagestan, Tyva, Karelia, Chechnya.

The reasons for high risk values can be regarded as both insufficient attention of the authorities to the issues of support and assistance to small and medium-sized enterprises, and the presence of administrative barriers. Low values of catastrophic business risk indicate a good business climate, the availability of the necessary infrastructure and the active work of the authorities for the development of small and medium-sized enterprises. In these regions, doing business is more comfortable than in regions with a high level of risk. Information on the existing levels of catastrophic risk should be taken into account when starting a business in specific regions.

CONCLUSIONS

The results of the study, demonstrating scientific novelty and originality, include the following:

- the formula estimating the developed levels of catastrophic risk on sets of the small and average enterprises located in specific regions is offered;
- the possibility of using official statistics on the number of liquidated enterprises for the analysis of the existing levels of catastrophic business risk for aggregates of small and medium-sized enterprises formed on a territorial basis is shown;
- the expediency of using the density functions of the normal distribution describing the distribution of the values of catastrophic risks on the aggregates of enterprises located in different regions of Russia is demonstrated;
- it is proved that the average value of catastrophic business risk for the period from 2010 to 2017 was 8.1%;
- it is shown that the highest level of catastrophic business risk occurred due to the influence of crisis phenomena in the economy;
- regions with respectively high and low levels of catastrophic business risk were identified and observed.

The results obtained have a certain theoretical and applied value, in particular, in the analysis of patterns characteristic of the business sector of the economy, substantiation of proposals for its development, as well as business risk management. The proposed methods and tools of catastrophic business risk assessment can be used in subsequent research of the business sector in the regions of Russia. The results of the study would be of interest in the educational process of higher and secondary special educational institutions, as well as for researchers and state and municipal authorities.

As a result of the study, the following proposals and recommendations can be formulated:

- the use of the assessment of existing levels of business risk in monitoring the number of small and medium-sized enterprises in the regions seems to be appropriate;

- the proposed methodology and procedures for calculations can be used for assessment of the existing levels of risk on the totality of small and medium-sized enterprises located in municipalities;

- it is necessary to inform entrepreneurs (including beginners in business) on the expected levels of risk in specific regions, as well as the impact on the level of catastrophic business risk caused by crisis phenomena in the economy;

- when establishing programs and long-term plans for the development of small and medium-sized enterprises, the existing levels of entrepreneurial risk should be taken into account, drawing attention to territorial characteristics.

The government and regional authorities can use the results of research in the practice of formation and implementation of projects and programs for the development of entrepreneurship, including information on the estimated number of enterprises that may cease their operational activities in each of the regions. In addition, the results of the work can be used in the current functioning of financial and credit, insurance, leasing and other organizations related to the operation and support of small and medium-sized enterprises.

Further studies of catastrophic business risk can be associated with the assessment of differentiation of its level for small and medium-sized enterprises located in municipalities of certain regions of Russia.

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