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# USE OF ECONOMETRIC ANALYSIS METHODS IN RICE SCIENCE

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*In the article it is considered the peculiarities of application of econometric methods to the research of risk factors and forecasting of economic risk on the basis of the risk curve. It is established the connection between the objectivity of risk and economic activity of economic entities. It is concluded that the use of econometric analysis methods in risk science allows assessing the closeness of the relationship between the influence of economic risk factors on its value, conducting scientifically sound risk forecasting by selecting an appropriate regression of the economic risk curve. And the use of IT technologies (in particular, the capabilities of the MS EXCEL spreadsheet processor) makes this process easy, convenient and time-efficient.*

***Keywords:*** *econometric analysis, econometrics, economic risk, risk curve, riskology, spreadsheet processor MS EXCE.*

## Problem statement.

Nowadays, risk is an integral part of any economic activity. One of the characteristics of risk is its objectivity: risk exists regardless of whether business entities recognise its presence or deny it. And the more this phenomenon is studied and predicted, the better the results of economic activity can be expected.

Risk is a very complex and multifaceted phenomenon that must be taken into account in any area of activity. The development of a regulatory framework, guidelines and other documentation for effective risk management requires, first and foremost, a clear, logical and consistent interpretation of the concept of risk, identification of the main factors of influence and formation of a classification for a business entity. There are certain types of risks to which all organisations, including banks, are exposed, but there are also specific types of risk alongside the general ones: the risk associated with the personality of the entrepreneur, the risk associated with insufficient information about the state of the external environment. It is the multidimensional nature of this phenomenon that determines the complexity of risk classification [6].

The existence of risk has been ignored for a long time in our country: research on risk theory began to receive attention in the 90s of the XX century in connection with the transition of the economy to market rails, the crisis phenomena that arose in the economic situation during this period.

## Recent research and publications analysis.

Currently, there are quite a few works devoted to the theory of economic risks,

in particular, the essence of the concept of «economic risk» (O.S. Borodina, M.P. Koyuda, O.P. Koyuda, Semenyutina T.V.) [2], [8], [10], types of risks (O.S. Dmytrova, O.I. Karintseva) [7], [8], analysis of economic risks (M.L. Vdovin M.O., Voloshyna-Sidei V.V., Shurda K.E., etc.) [3], [4], [10].

**The object of the article** is to consider the peculiarities of applying econometric analysis methods to the study of risk factors and forecasting of economic risk.

**Statement of basic materials.**

Methods of econometrics and econometric modelling are nowadays quite often used not only in human economic activity, but also in many other sciences: sociology, psychology, military affairs, etc. We will offer our vision of the use of econometric methods in risk science.

It is worth noting that quantitative risk analysis is possible only if an initial set of statistical data is available. Econometric studies also require initial data. For example, the impact of various risk factors on the process under study is of great importance in risk science. Usually, the significance of risk factors (in the absence of statistical data) is determined through expert surveys: experts assign ranks to the factors, then the most significant factor (the one with the highest rank) is determined, however, the procedure for assessing the consistency of expert opinions using appropriate coefficients (Spearman's in the case of two experts or two groups of experts and concordance in the case of three or more experts) is mandatory. It is also necessary to prove the significance of the results obtained using statistical criteria (Pearson, Student).

We propose to use correlation analysis as an econometric tool to assess the closeness of the influence of the relevant risk factor on its value.

It should be noted that riskology still does not have a single universal definition of risk. Risk is usually associated with uncertainty, probability, losses, etc. However, when it comes to economic risk, it is most often measured as the amount of profit loss compared to the forecasted variant.

Thus, having statistical data on the amount of profit loss for a certain period of time (month, quarter, year) and the corresponding values of risk factors (number of low-quality products delivered, losses from delays in raw material supplies, etc.), it is possible to use correlation analysis tools to assess the closeness of the relationship between the impact of each risk factor and the resulting indicator.

In particular, it is reasonable to calculate pairwise correlation coefficients. The main task of correlation analysis is to identify the relationship between random variables by estimating pairwise (partial) correlation coefficients, calculating and checking the significance of multiple correlation and determination coefficients. Correlation does not directly reveal causal relationships between parameters, but establishes the numerical value of these relationships [1].

Thus, by determining the values of the pairwise correlation coefficients between the value of risk and risk factors, it appears not only the closeness of the respective relationship: the closer the values found are to 1 by absolute value, the stronger the relationship. This also helps to identify the factors that have the greatest impact on the risk.

However, in our case, the construction of a correlation table is not limited to the construction of a correlation table. A more complete, detailed study is possible by calculating a multiple correlation coefficient. If we put the value of the calculated coefficient into the square, we will get the value of the sample multiple coefficient of determination. Then this indicator (preferably measured as a percentage) will show how much of the variation in risk is due to the variation in the factors we have taken into account. For example, if the ratio is 85 per cent, this means that the risk is influenced by the factors we have taken into account for the specified number of per cent, and the remaining 15 per cent is due to other (unaccounted for) factors.

It is also possible to calculate the closeness of the relationship between two risk factors when the influence of other factors is fixed or excluded. In this case, sample partial correlation coefficients are calculated. All relevant formulas are available in any econometrics textbook.

For example, the sample partial correlation coefficient is calculated by the formula:

$$r_{jk(1,2....,m)} = -\frac{R_{jk}}{\sqrt{R_{jj}R_{kk}}} \quad (1)$$

де $R_{jk}$, $R_{jj}$, $R_{kk}$ – is an algebraic addition to the corresponding elements of the correlation matrix R. The partial correlation coefficient, as well as the paired correlation coefficient, varies from -1 to +1 [1].

In the case where certain risk factors are assumed to be interrelated, the three-part Farrar-Glober criterion can be applied to determine multicollinearity in an array of risk factors.

However, econometric methods can still be used quite effectively to forecast economic risk. This is usually done by building a risk curve. The economic risk curve is classically understood as the relationship between the magnitude of profit losses and their corresponding probabilities.

As it is well known, the economic risk curve can be constructed using the statistical method (if statistical data is available) and the method of expert estimates if it is not. However, in both cases, it is possible to make a forecast based on a properly selected regression equation.

We suggest selecting the dependence equation using information technology, namely, the capabilities of the MS EXCEL spreadsheet processor.

We will consider a specific example. Suppose that the statistical data on the work of an enterprise in one of its areas of activity are presented in Table 1. Using the statistical method, you need to calculate the expected level of risk (risk ratio) and the spread of its values. Draw a graph of the change in the risk curve over time. In risk areas, the risk factor takes on the following values: minimal risk - 0-25%; acceptable risk - 25-50%; critical risk - 50-75%; catastrophic risk - 75-100%. Select the regression relationship that most accurately describes the statistical data and make a forecast of the risk ratio for the next year. Take the average values of the risk ratio in each region as x.

Then $x_1$=0,125; $x_2$=0,375; $x_3$=0,625; $x_4$=0,875.

We will find the expected value of the risk ratio and the spread of its values for the first month.

$$M(X) = 0{,}33 \cdot 0{,}125 + 0{,}32 \cdot 0{,}375 + 0{,}05 \cdot 0{,}625 + 0{,}05 \cdot 0{,}875 = 0{,}236;$$

$$D(X) = 0{,}33 \cdot (0{,}125 - 0{,}236)^2 + 0{,}32 \cdot (0{,}375 - 0{,}236)^2 + 0{,}05 \cdot (0{,}625 - 0{,}236)^2 + 0{,}05 \cdot (0{,}875 - 0{,}236)^2 = 0{,}038$$

$$\sigma = \sqrt{0{,}038} \approx 0{,}198.$$

**Table 1 - Relative frequency of losses**

| Month | Minimal risk | Acceptable risk | Critical risk | Catastrophic risk |
|---|---|---|---|---|
| 1 | 0,33 | 0,32 | 0,05 | 0,05 |
| 2 | 0,3 | 0,3 | 0,04 | 0,06 |
| 3 | 0,34 | 0,28 | 0,06 | 0,05 |
| 4 | 0,38 | 0,32 | 0,05 | 0,07 |
| 5 | 0,4 | 0,3 | 0,1 | 0.07 |
| 6 | 0,35 | 0,3 | 0,09 | 0.06 |
| 7 | 0,45 | 0,34 | 0,08 | 0,06 |
| 8 | 0,4 | 0,3 | 0,07 | 0,06 |
| 9 | 0,48 | 0,35 | 0,1 | 0,08 |
| 10 | 0,4 | 0,4 | 0,1 | 0,1 |
| 11 | 0,5 | 0,35 | 0,09 | 0,08 |
| 12 | 0,52 | 0,4 | 0.13 | 0,1 |

Similarly, we calculate the corresponding indicators for other months and build a risk curve based on the data obtained. To build an economic risk curve and further forecasting, it is advisable to use the capabilities of the MS EXCEL spreadsheet processor.

The MS EXCEL spreadsheet allows to make calculations using formulas, present data in the form of diagrams, structure data, make a selection from large tables, create consolidated tables, etc. Word processing, database management - the program is so powerful that in many cases it surpasses specialised word processing or database programs. MS EXCEL provides both ease of data handling and data storage. This programme can calculate sums by rows and columns of tables, calculate the arithmetic mean, bank interest or variance, and it can use many standard functions: financial, mathematical, logical, statistical [9]. The study [5] emphasises that the development of digital competences of higher education students is an integral characteristic of a modern specialist in the economic field.

Having calculated the corresponding mathematical expectations of the risk factor, we build the corresponding curve (Fig. 1).

The main purpose of building a risk curve is to predict future risk. The most optimal forecast will be made when the fitting curve is chosen econometrically correctly. Typically, econometrics uses statistical criteria (in particular, Fisher's criterion) to assess the adequacy of the model, calculate the average approximation error, the coefficient of determination, and compare the variations of the residuals (sums of squared deviations of theoretical values from empirical values). We suggest taking advantage of the capabilities of the MS EXCEL spreadsheet processor,

namely, using the tools for building a trend line.

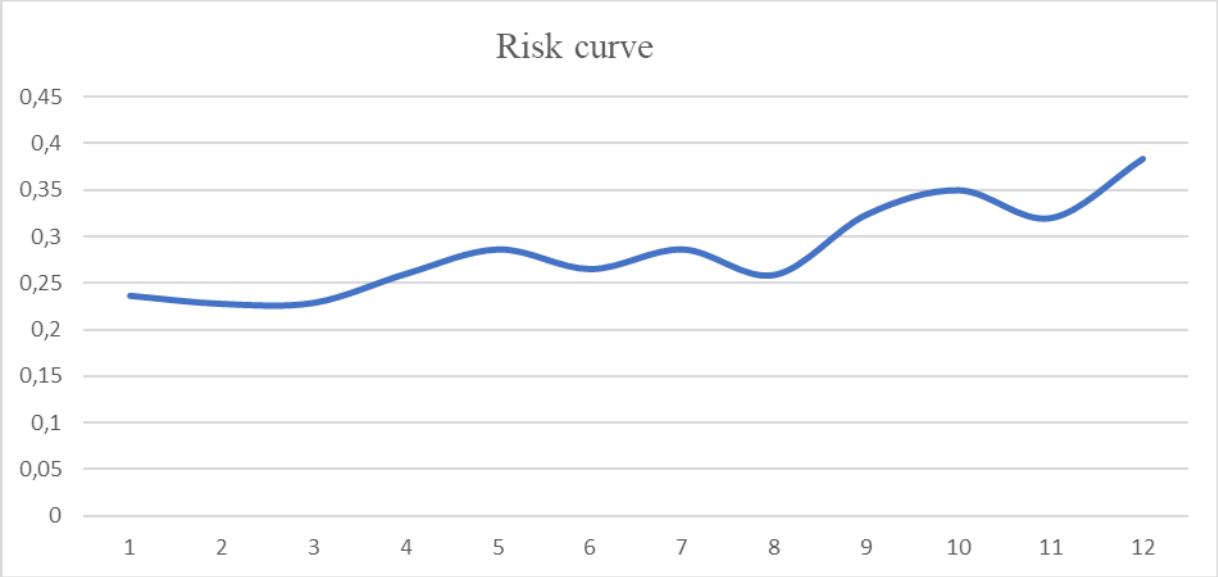


**Figure 1 - Economic risk curve**

To do this, you need to show the value of the approximation reliability (coefficient of determination) on the diagram, and among the proposed basic regressions (exponential, linear, logarithmic, polynomial, power), choose the one with the highest value of the specified coefficient for the forecast.

In our case, the value for the exponential is 0.882, for the linear is 0.81, for the logarithmic is 0.64, for the polynomial is 0.64, and for the power law is 0.68. Thus, the most optimal is the polynomial fitting curve, for which the coefficient of determination is the highest and close to 1. Having selected the fitting curve, using the MS EXCEL capabilities again, in the trend line formatting window, we select the number of periods for the future forecast (in our case, we took 4) and build a forecast risk curve for 4 months ahead (Fig. 2). With the help of the forecast, you can scientifically state what the risk ratio will be for the specified period.

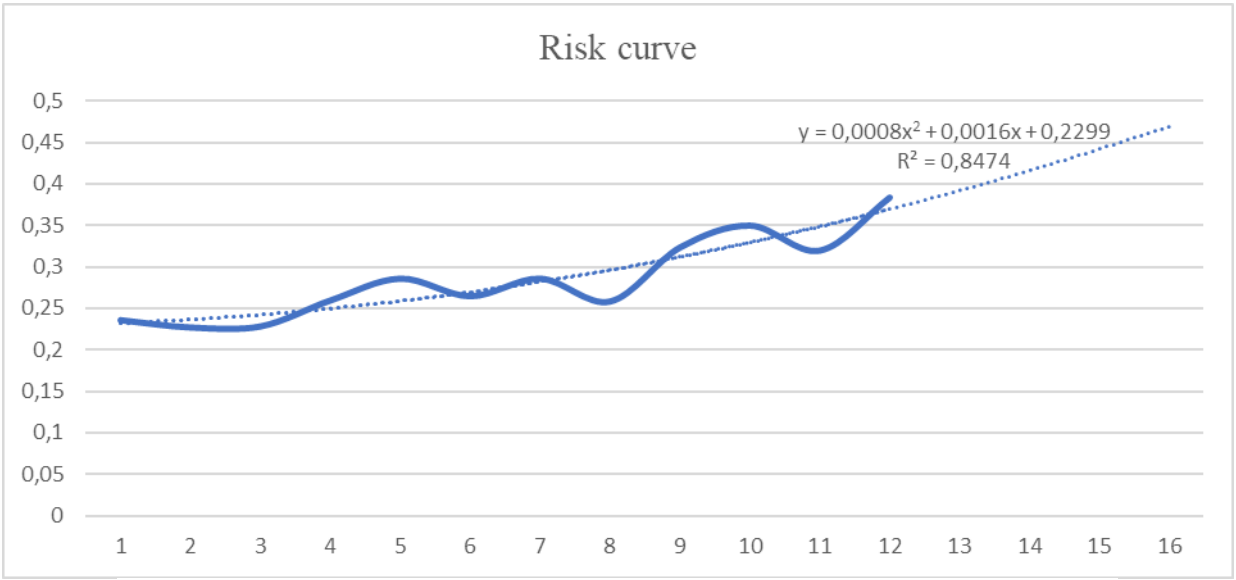


**Figure 2 - Prediction of the risk ratio based on the fitting curve**

It should be noted that this method is not cumbersome, takes a minimal amount of time and allows to make forecasts based on the construction of the risk curve. It is also worth noting that it can be used not only in the case of the statistical method of building a risk curve, but also in cases where the risk curve is built using the method of expert estimates.

**Summary and conclusions**. Thus, the use of econometric analysis methods in risk management allows assessing the closeness of the relationship between the influence of economic risk factors on its value, and conducting scientifically sound risk forecasting by selecting the appropriate regression of the economic risk curve. And the use of IT technologies (in particular, the capabilities of the MS EXCEL spreadsheet processor) makes this process easy, convenient and time-saving.

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