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CONSTRUCTION OF CORRELATION-REGREGIONAL MODEL FOR MANAGING THE TOTAL RISK

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A correlation-regression model was constructed to manage total bank risk. The model is applicable both to a single commercial bank and to the whole bank sector of the Republic of Belarus.

Management of bank risks is a holistic concept of bank management based on an understanding of the nature of risk as an economic category, knowledge of types of bank risks, risk management methods and development of a risk management strategy. Consequently, the improvement of the system of assessment and management of bank risks is a strategically important area for increasing the efficiency of bank activities in the conditions of accrescent uncertainty in the external environment.

We'll construct a correlation-regression model for organizing a comprehensive effective management of bank risks, the dependent variable of which is the total risk. The model will be constructed according to the data of JSC "Belgazprombank". We investigated various factors that can affect the total bank risk, in our opinion, in order to determine the dependent variables, namely:

1. The refinancing rate;
2. The amount of loans granted to legal entities;
3. The amount of profit;
4. Special reserve for covering losses on assets susceptible to credit risk;
5. Customer accounts in the bank;
6. The bank's equity;
7. The amount of the bank's assets;
8. Total expenses of the bank;
9. Profitability of assets;
10. Profitability of bank services;
11. The amount of the bank's obligations;
12. The amount of assets susceptible to credit risk;
13. Share of distressed assets in assets susceptible to credit risk;
14. The amount of credit risk;
15. The amount of the operational risk.

Since we determined 15 influencing factors, the model would initially take the following form:

$$Y = F(X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, X12, X13, X14, X15), \quad (1)$$

where Y – the calculated value of the total risk; X1 – X15 – our accepted factors.

To construct an econometric model of the total risk, we will observe the following principles of its construction:

– adduction of factors to an acceptable form for the formulation of a future equation;

– each of the factors should moderately or strongly affect the total risk, that is, the correlation coefficient > 0.75;

– elimination of factors that are strongly influence each other (correlation coefficient > 0.85), so-called multicollinear factors;

– formulation of the final regression equation and verification for adequacy by the calculated value of the Fisher coefficient and the tabulated value of the Student's coefficient (Fcal > Ftable).

We bring all of our indicators to the coefficient form by the following transformation to make the model easier to interpret the results:

1. The refinancing rate, the amount of loans granted to legal entities, the profitability of assets, the profitability of bank services, share of distressed assets in assets susceptible to credit risk are put to a general form by dividing the values of the corresponding indicator by 100.

2. The remaining indicators are calculated as a growth factor compared to the previous period.

According to the described above transformations, we obtain the following data (Table 1).

Table 1 – Transformed data for construction of the regression equation for JSC "Belgazprombank"

Index	Date					
	01.12	01.13	01.14	01.15	01.16	01.17
X1	0.45	0.30	0.23	0.20	0.25	0.18
X2	0.80	0.84	0.83	0.87	0.92	0.89
X3	1.32	1.34	0.92	1.31	1.13	0.93
X4	1.78	0.60	0.84	1.75	1.07	0.94
X5	2.71	1.34	0.87	1.00	1.10	0.81
X6	1.25	1.57	0.76	1.09	1.05	1.03
X7	2.55	0.90	0.91	1.23	1.14	0.92
X8	1.94	1.19	0.78	1.13	1.34	0.89
X9	0.02	0.03	0.03	0.03	0.03	0.03
X10	0.20	0.31	0.37	0.42	0.36	0.38
X11	2.91	0.82	0.94	1.25	1.15	0.90
X12	4.62	2.06	1.19	1.34	3.24	1.29
X13	0.02	0.05	0.08	0.04	0.09	0.08
X14	3.00	1.02	1.68	1.12	0.98	0.81
X15	1.03	1.19	1.64	1.19	1.31	1.14
Y	2.88	1.23	1.15	1.12	0.98	0.99

Source: own development based on [1–3].

Now we'll consider the correlation links between the dependent variables (X1-X15) and the actual values of the total risk in Table 2.

Table 2 – Correlation links between total risk and variables X1 – X15

Index	Correlation coefficient to У
The refinancing rate (X1)	0,931
The amount of loans granted to legal entities (X2)	-0,759
The amount of profit (X3)	0,463
Special reserve for covering losses on assets susceptible to credit risk (X4)	0,584
Customer accounts in the bank (X5)	0,975
The bank's equity (X6)	0,285
The amount of the bank's assets (X7)	0,959
Total expenses of the bank (X8)	0,855
Profitability of assets (X9)	- 0,993
Profitability of bank services (X10)	-0,902
The amount of the bank's obligations (X11)	0,960
The amount of assets susceptible to credit risk (X12)	0,800
Share of distressed assets in assets susceptible to credit risk (X13)	-0,767
The amount of credit risk (X14)	0,947
The amount of the operational risk (X15)	-0,477

Source: own development based on table 1.

The correlation coefficient as described above, shows how closely the two factors are related quantitatively. The sign (–) means that there is an inverse link, the sign (+) is a direct link.

Thus, by analyzing Table 2 it can be seen that 1,2,5,7,8,9,10,11,12,13 and 14 indicators strongly correlate, the others correlate poorly.

We'll calculate the coefficients of determination (Table 3). The coefficient of determination shows how much the variation in the values of factor Y is due to the variation of the values of the factor X.

Analyzing Table 3 we see that the highest error rates are observed with the indicators X3, X4, X6, X15. Accordingly, we exclude them from the future model.

Table 3 – Values of the determination coefficient

Index	Determination coefficient to Y
The refinancing rate (X1)	0,868
The amount of loans granted to legal entities (X2)	0,546
The amount of profit (X3)	0,214
Special reserve for covering losses on assets susceptible to credit risk (X4)	0,341
Customer accounts in the bank (X5)	0,952
The bank's equity (X6)	0,081
The amount of the bank's assets (X7)	0,920
Total expenses of the bank (X8)	0,731
Profitability of assets (X9)	0,947
Profitability of bank services (X10)	0,988
The amount of the bank's obligations (X11)	0,813
The amount of assets susceptible to credit risk (X12)	0,921
Share of distressed assets in assets susceptible to credit risk (X13)	0,638
The amount of credit risk (X14)	0,898
The amount of the operational risk (X15)	0,227

Source: own development based on table 1.

Thus, the model (1) takes the form:

$$Y = F(X1, X2, X5, X7, X8, X9, X10, X11, X12, X13, X14). \quad (2)$$

Next, following the methodology for constructing this model, we'll consider the interdependencies between the selected indicators to exclude the multicollinearity of the indicators. Let's construct the table on correlation coefficients between the left dependent variables (Table 4).

Table 4 – Correlation coefficients between dependent variables that affect the result indicator (total risk of JSC Belgazprombank)

	Y	X1	X2	X5	X7	X8	X9	X10	X11	X12	X13	X14
Y		0,935	-0,808	0,964	0,930	0,82	-0,99	-0,89	0,930	0,75	-0,81	0,95
X1			-0,709	0,971	0,857	0,88	-0,94	-0,97	0,85	0,87	-0,69	0,86
X2				-0,656	-0,55	-0,37	0,78	0,68	-0,56	-0,29	0,67	-0,81
X5					0,944	0,93	-0,96	-0,93	0,94	0,88	-0,77	0,88
X7						0,91	-0,92	-0,80	0,99	0,84	-0,73	0,90
X8							-0,82	-0,81	0,89	0,95	-0,69	0,72
X9								0,93	-0,93	-0,79	0,72	-0,96
X10									-0,79	-0,83	0,58	-0,82
X11										0,83	-0,71	0,91
X12											-0,46	0,70
X13												-0,65
X14												

Source: own development based on table 1.

Analyzing Table 4, we conclude that the indicators X1, X5, X7, X8, X9, X14 duplicate each other and, consequently, we will not take into account these factors in our model.

After excluding these factors from the model, the table will take the following form (Table 5).

Table 5 – The transformed table of correlation coefficients

	Y	X2	X10	X11	X12	X13
Y		-0,808	-0,89	0,93	0,75	-0,81
X2			0,68	-0,56	-0,29	0,67
X10				-0,79	-0,83	0,58
X11					0,83	-0,71
X12						-0,46
X13						

Source: own development based on table 4.

The next stage is the construction of a multifactor model. By using the Microsoft Office Excel 2016 program, the following equation was obtained:

$$y = 3{,}125 - X2 * 1{,}328 - X10 * 3{,}641 + X11 * 0{,}693 - X12 * 0{,}101 - X13 * 0{,}932. \quad (3)$$

Let's check the constructed model for adequacy.

To do this, let's calculate the calculated value of the Fisher coefficient. For this we use the formula (4):

$$F_{cal} = \frac{\sum(y_{i,cal} - y_{av,cal})^2}{m} * \frac{n - m - 1}{\sum(y_i - y_{i,cal})^2}. \quad (4)$$

where $y_{i,cal}$ – the calculated value of the refinancing rate according to the model; y_{av} – average estimated value of the refinancing rate; m – number of factors (only exogenous), n – number of observations.

Compare this indicator with the Student's coefficient Ftable, which is determined depending on the degrees of freedom (number of observations - 1) and the probability with which we can guarantee the reliability of the calculated values to be actual.

Thus, with a probability of reliability of 95%, this indicator is 2.0395.

The calculated value of the Fisher coefficient is 2.7155.

Proceeding from the fact that Fcal> Ftable, the model (3) is adequate.

So, with a probabilistic error of 5%, it can be applied to the practice of the bank under investigation. Note that the specified error rate of 5% is quite low according to modern theoretical studies in the financial sphere. With the help of this model, measures can be developed to minimize total bank risk, namely, indicators that are most appropriate in specific conditions and their impact parameters for changing the dependent indicator (total risk).

A similar model can be built for each bank, and in conjunction with the above studies on groups of banks and the identified relationships within groups, it is possible to develop practical recommendations for reduction of the risks of the whole bank sector of the Republic of Belarus.

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