

## Economic And Mathematical Modeling And Forecasting Of Key Performance Indicators Of Pjsc "Sberbank"\*

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**Abstract.** *This article explored the theoretical foundations of efficiency, describes methods of influencing bank performance. Today is becoming increasingly relevant in the transition to more modern forms of assessing the effectiveness not only of individual banks but of the banking system as a whole. Also predicted KPI of Russian commercial bank PJSC "Sberbank" is based on correlation and regression unit in the short term in terms of return on assets, market share by assets, transaction costs and turnover of staff. In the analysis it becomes evident that the unfavorable external economic situation continue to function systemically-important banks.*

**Key words:** key performance indicator, return on assets, market share from the contribution of the population, operating costs, staff stability index.

### Introduction

Commercial banks are the most important element of a market economy.<sup>1</sup> In the process of their activity is mediated by a large part of the money circulation in the state, is the formation of sources of capital for expanded reproduction through the reallocation of temporarily free funds of all participants in the reproductive process – the state, economic entities and population. The commercial banks facilitate the flow of capital from the least efficient industries and enterprises of the national economy in the most competitive.<sup>2</sup> From their clear and competent activities depends on the efficient functioning of the banking system and the Russian economy generally. Therefore, the development of KPI (key performance indicators) is not only the results but also the ability of the earlier stages to identify problems in activities of a commercial Bank, vital for financial and social stability of our state.<sup>3</sup>

KPI (Key Performance Indicators) came to us along with the American and West European companies, where it has been successfully used for several decades. KPI is a tool that helps to analyze the effectiveness of certain activities and the level of achievement of goals.

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<sup>1</sup> J. A. Klaas, A.A. Daryakin, "The indicative model of financial stability management of the banking sector," *Academy of Strategic Management Journal*, XV (2016), no. 2, p. 43-49.

<sup>2</sup> A. A. Daryakin, J. A. Klaas, "Identification of the regional banking systems sustainability as a key factor in the effectiveness of their integration," in *Journal of Economics and Economic Education Research*, XVII (2016), no. 2, p. 15-26.

<sup>3</sup> S. G. Partiw, P. Suwignjo, P. Eriyatno, A. M. Fauzi, K. Setyowati, "Design of key performance indicators for a comprehensive performance in marine agro-industrial clusters: A case study in Indonesi," in *International Journal of Business Performance Management*, XV (2014), no. 1, p. 72-86.

In Russia, KPI commonly translated as key performance indicator, a measure of success in certain activities or achieve certain goals. We can say that KPI is a quantifiable indicator of the achieved results.<sup>4</sup>

### Method

There is no single generally accepted methodological development of key performance indicators. Various authors suggest using their own development methods, they are recommended to follow any rules and principles. To study the efficiency of a commercial bank, the methodology for developing KPI based on the interpretations of modern authors is systematized and supplemented with a new classification group of KPI indicators - «Assumptions KPI»:

- economic;
- management;
- organizational.

This is the characteristic of the indicator (indicator), by which the assumption of belonging

Table 1

| Assumptions KPI Direction | Economic | Management | Organizational |
|---------------------------|----------|------------|----------------|
| <i>Finance:</i>           |          |            |                |
| Return on assets          | +        |            |                |
| Profitability of capital  | +        |            |                |
| Liquidity rates           | +        |            |                |
| Operating profitability   | +        |            |                |
| Net% margin               | +        |            |                |
| Assumptions KPI Direction | Economic | Management | Organizational |
| Quality Score of Loans    | +        |            |                |
| <i>Clients:</i>           |          |            |                |
| Share of new customers    |          | +          | +              |

<sup>4</sup> A. A. Daryakin, S. G. Andriashina, "Problems Of Evaluation And Management Of Operational Risks In Banks," in *INTERNATIONAL CONFERENCE ON APPLIED ECONOMICS (ICOAE) 2015, XXIV (2015)*, p. 156-165.

|                                                            |          |            |                |
|------------------------------------------------------------|----------|------------|----------------|
| Cost of customer service                                   | +        |            |                |
| Customer Satisfaction Index                                |          | +          | +              |
| Share of the market (assets)                               | +        |            |                |
| Average sales per customer                                 |          | +          | +              |
| <i>Processes:</i>                                          |          |            |                |
| Number of automated processes                              |          | +          | +              |
| Average customer service time per customer                 |          | +          | +              |
| The average complexity of performing individual operations |          | +          | +              |
| <i>Staff:</i>                                              |          |            |                |
| Staff turnover                                             |          | +          | +              |
| Profit per employee                                        |          | +          | +              |
| Administrative costs per employee                          |          | +          | +              |
| Percentage of employees with higher education              |          | +          | +              |
| <del>Assumptions KPI Direction</del>                       | Economic | Management | Organizational |
| Productivity of personnel                                  |          | +          | +              |

### Results And Discussion

The key performance indicators of banking activity and their forecasting based on correlation-regression analysis were evaluated. The analysis used 4 directions of KPI indicators.

In order to study the prospects for the development of PJSC Sberbank, we will build a correlation-regression model for the following indicators: return on assets, market share from the contribution of the population, operating costs, stability index staff. The bank's data were selected according to the system-importance category. The following factors were used as independent variables for the assessment:

- lending volume (x1);

- attracted cash (x2);
- key rate (x3);
- level of administrative and management expenses (x4);
- profit per employee (x5).

When constructing multifactor models, the requirement of the least possible correlation of the factors included in the model must be observed. PJSC "Sberbank" has the following initial data on the factors and the resulting indicator, given in appendix 1.

As a result of the analysis, data were obtained on the tightness of the relationship between the factors and the resulting indicator of return on assets. From these data, we can conclude that the tightness of the connection between the "key rate" and "lending volume" is weak, so these factors are excluded from the analysis of the profitability of assets. The remaining factors have a moderate relationship with the resulting indicator.

The next stage in the analysis of the profitability of assets of PJSC "Sberbank" is the construction of a regression, which includes three factors. It is necessary to check the parameters for significance and model significance. Traditionally, such a check assumes the use of the F-criterion of Fisher and the Student criterion. The table value of Fisher's F-test is 3,59. With the value  $F_{\text{frac}} = 2,32$  the model is insignificant. The following results were obtained for T table = 2,1. The calculation of the actual values of the criteria is presented in table 2.

Table 2. Student criterion

| Factor                                          | Ttable | t statistics | Relevance   |
|-------------------------------------------------|--------|--------------|-------------|
| Attracted cash                                  | 2,10   | 0,06         | Significant |
| Level of administrative and management expenses | 2,10   | 1,22         | Significant |
| Profit per employee                             | 2,10   | 0,03         | Significant |

The quantity R - a square, also called a measure of certainty, characterizes the quality of the regression model. According to the analysis, the value of R-square of 0,59. This means that the model constructed explains the influence of the corresponding variables by 59%.

Multiple R - coefficient of multiple correlation R - expresses the degree of dependence of independent variables (x) and the dependent variable (y). Based on the results of calculations, the multiple R is 0,77, that is, the relationship between the variables is high. The regression equation was obtained, which has the following form:

$$Y = -0,54 - 0,33x_2 + 0,56x_4 + 0,49x_5$$

Was calculated prognostic values, starting from 3rd quarter 2017 to 2020, presented in figure 1.

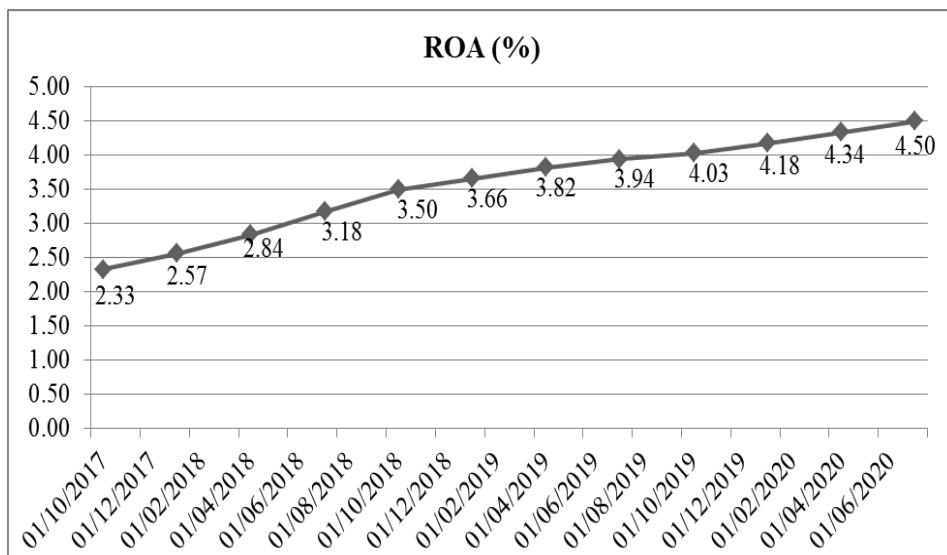


Fig.1 Forecast values of return on assets of PJSC "Sberbank", %

On the basis of these data, we can conclude that the positive dynamics of return on assets is forecasted and by the end of 2018 the forecast of return of assets should be 4,5%. Therefore, we can conclude that, with other stable conditions, the bank's return will continue to grow.

Next, consider the data obtained on the tightness of the relationship between the factors and the resulting indicator of market share from the contribution of the population. From these data, we can conclude that the tightness of the connection between the "attracted cash" and " key rate" is weak, so these factors are excluded from the analysis of the market share from the contribution of the population. The remaining factors have a moderate relationship with the resulting indicator.

The next stage of the analysis of market share from the contribution of the population, of PJSC "Sberbank" is the construction of a regression, which includes three factors. It is necessary to check the parameters for significance and model significance. Traditionally, such a check assumes the use of the F-criterion of Fisher and the Student criterion. The table value of Fisher's F-test is 3,59. With the value  $F_{calc} = 7,39$  the model is insignificant. The following results were obtained for  $T_{table} = 2,1$ . The calculation of the actual values of the criteria is presented in table 3.

Table 3. Student criterion

| Factor                      | $T_{table}$ | t statistics | Relevance   |
|-----------------------------|-------------|--------------|-------------|
| Lending volume              | 2,10        | 1,88         | Significant |
| Level of administrative and | 2,10        | 1,04         | Significant |

|                     |      |      |             |
|---------------------|------|------|-------------|
| management expenses |      |      |             |
| Profit per employee | 2,10 | 0,77 | Significant |

The quantity R - a square, also called a measure of certainty, characterizes the quality of the regression model. According to the analysis, the value of R-square of 0,82. This means that the model constructed explains the influence of the corresponding variables by 82%.

Multiple R - coefficient of multiple correlation R - expresses the degree of dependence of independent variables (x) and the dependent variable (y). Based on the results of calculations, the multiple R is 0,91, that is, the relationship between the variables is high. The regression equation was obtained, which has the following form:

$$Y=42,62-0,02x1+0,48x4+0,54x5$$

Was calculated prognostic values, starting from 3rd quarter 2017 to 2020, presented in figure 2.

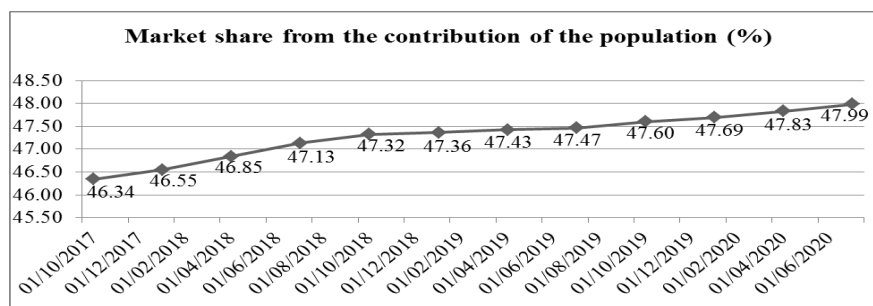


Fig.2 Forecast values of market share from the contribution of the population, of PJSC "Sberbank", %

On the basis of these data, we can conclude that the positive dynamics of the market share from the contribution of the population is forecasted and by the end of 2018 the forecast of the market share from the contribution of the population should be 47,99%. Therefore, we can conclude that, with other stable conditions, the bank's of the market share from the contribution of the population will continue to grow.

Next, consider the data obtained on the tightness of the relationship between the factors and the resulting indicator of operating costs. From these data, we can conclude that the tightness of the connection between the "lending volume" and "key rate" is weak, so these factors are excluded from the analysis of operating costs. The remaining factors have a moderate relationship with the resulting indicator.

The next stage of the analysis of operating costs, of PJSC "Sberbank" is the construction of a regression, which includes three factors. It is necessary to check the parameters for significance and model significance. Traditionally, such a check assumes the use of the F-criterion of Fisher and the Student criterion. The table value of Fisher's F-test is 3,59. With the value  $F_{calc} = 5,87$  the model is insignificant. The following results were obtained for  $T$  table =2,1. The calculation of the actual values of the criteria is presented in table 4.

Table 4. Student criterion

| Factor                                          | Ttable | t statistics | Relevance   |
|-------------------------------------------------|--------|--------------|-------------|
| Attracted cash                                  | 2,10   | 0,39         | Significant |
| Level of administrative and management expenses | 2,10   | 0,13         | Significant |
| Profit per employee                             | 2,10   | 2,19         | Significant |

The quantity R - a square, also called a measure of certainty, characterizes the quality of the regression model. According to the analysis, the value of R-square of 0,79. This means that the model constructed explains the influence of the corresponding variables by 79%.

Multiple R - coefficient of multiple correlation R - expresses the degree of dependence of independent variables (x) and the dependent variable (y). Based on the results of calculations, the multiple R is 0,89, that is, the relationship between the variables is high. The regression equation was obtained, which has the following form:

$$Y = -134\,698\,705 + 0,54x_2 + 0,58x_4 + 0,72x_5$$

Was calculated prognostic values, starting from 3rd quarter 2017 to 2020, presented in figure 3.

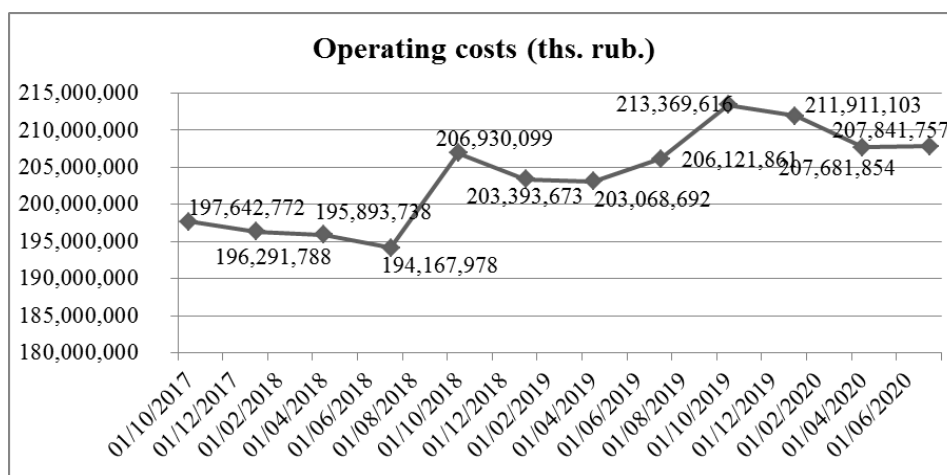


Fig.3 Forecast values of operating costs, of PJSC "Sberbank", ths. rub.

On the basis of these data, one can conclude that the fluctuation of operating costs and by the end of 2018 according to the forecast of operating costs should be 207 841 757 thousand. Therefore, we can conclude that, ceteris stable conditions costs the Bank will continue fluctuating.

Next, consider the data obtained on the tightness of the relationship between the factors and the resulting indicator of the stability index staff. From these data, we can conclude that the tightness of the connection between the "attracted cash", "lending volume", "level of administrative and management expenses" and "profit per employee" is weak, so these factors are excluded from the analysis of the stability index staff. The remaining factors have a moderate relationship with the resulting indicator.

The next stage of the analysis of the stability index staff, of PJSC "Sberbank" is the construction of a regression, which includes three factors. It is necessary to check the parameters for significance and model significance. Traditionally, such a check assumes the use of the F-criterion of Fisher and the Student criterion. The table value of Fisher's F-test is 3,59. With the value  $F_{\text{frac}} = 1,96$ , the model is insignificant. The following results were obtained for T table = 2,1. The calculation of the actual values of the criteria is presented in table 5.

Table5. Student criterion

| Factor   | Ttable | t statistics | Relevance       |
|----------|--------|--------------|-----------------|
| Key rate | 2,10   | 2,28         | Significan<br>t |

The quantity R - a square, also called a measure of certainty, characterizes the quality of the regression model. According to the analysis, the value of R-square of 0,55. This means that the model constructed explains the influence of the corresponding variables by 55%.

Multiple R - coefficient of multiple correlation R - expresses the degree of dependence of independent variables (x) and the dependent variable (y). Based on the results of calculations, the multiple R is 0,74, that is, the relationship between the variables is high. The regression equation was obtained, which has the following form:

$$Y=1,23+0,34x^3$$

Was calculated prognostic values, starting from 3rd quarter 2017 to 2020, is presented in figure 4.



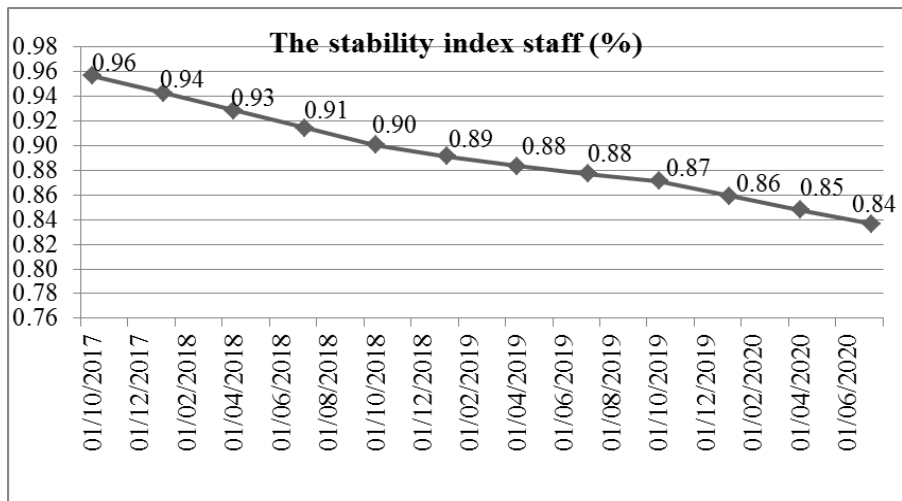


Fig.4 Forecast values of the stability index staff of PJSC "Sberbank", %

On the basis of these data, we can conclude that the projected decline in the index of stability of the staff and by the end of 2018 according to the forecast index of stability of personnel must be of 0,84%. Therefore, we can conclude that, ceteris stable conditions, the stability index Bank staff will continue to decline.

## Appendix 1

The original data of PJSC "Sberbank"

| Period     | ROA (%) (Y) | Market share from the contribution of the population (%) (Y) | Operating costs (ths. rub.) (Y) | Stability index staff (%) (Y) | Lending volume (ths. rub.) (X1) | Attracted cash (ths. rub.) (X2) | Key rate (%) (X3) | Level of administrative and management expenses (%) (X4) | Profit per employee (rub.) (X5) |
|------------|-------------|--------------------------------------------------------------|---------------------------------|-------------------------------|---------------------------------|---------------------------------|-------------------|----------------------------------------------------------|---------------------------------|
| 01.04.2014 | 2,40        | 46,10                                                        | 103 531 000                     | 1,03                          | 12 636 593 000                  | 14 858 725 908                  | 7,00              | 1,97                                                     | 96 204                          |
| 01.07.2014 | 2,20        | 46,30                                                        | 129 211 000                     | 1,03                          | 13 029 912 000                  | 15 018 051 976                  | 7,50              | 2,20                                                     | 39 373                          |
| 01.10.2014 | 2,20        | 45,80                                                        | 134 568 000                     | 1,04                          | 13 705 155 000                  | 15 782 752 630                  | 8,00              | 2,27                                                     | 127 223                         |
| 01.01.2015 | 1,70        | 45,00                                                        | 231 356 000                     | 1,05                          | 15 718 147 000                  | 19 468 744 822                  | 17,00             | 2,43                                                     | 208 650                         |
| 01.04.2015 | 0,50        | 44,20                                                        | 110 807 000                     | 1,07                          | 15 385 692 000                  | 18 214 794 433                  | 14,00             | 1,74                                                     | 8 160                           |
| 01.07.2015 | 0,80        | 44,90                                                        | 153 146 000                     | 1,06                          | 14 927 651 000                  | 17 541 907 053                  | 11,50             | 1,95                                                     | 05 579                          |
| 01.10.2015 | 0,90        | 45,10                                                        | 182 096 000                     | 1,05                          | 16 500 000 000                  | 19 170 787 947                  | 11,00             | 2,00                                                     | 41 106                          |
| 01.01.2016 | 1,00        | 46,00                                                        | 204 782 000                     | 1,03                          | 16 383 534 000                  | 19 985 638 348                  | 11,00             | 2,18                                                     | 21 382                          |
| 01.04.2016 | 1,80        | 45,80                                                        | 143 800 000                     | 0,98                          | 16 200 000 000                  | 19 488 364 099                  | 11,00             | 1,79                                                     | 84 017                          |
| 01.07.2016 | 2,00        | 46,30                                                        | 143 678 000                     | 0,98                          | 15 979 845 000                  | 18 874 400 883                  | 10,50             | 2,06                                                     | 77 325                          |

|                |      |       |             |      |                   |                   |       |          |            |
|----------------|------|-------|-------------|------|-------------------|-------------------|-------|----------|------------|
| 01.10.20<br>16 | 2,20 | 46,40 | 188 188 000 | 0,98 | 15 895 578<br>000 | 18 646 790<br>443 | 10,00 | 2,1<br>7 | 443<br>113 |
| 01.01.20<br>17 | 2,20 | 46,60 | 289 110 000 | 0,98 | 15 664 837<br>000 | 18 546 167<br>659 | 10,00 | 2,3<br>8 | 916<br>159 |
| 01.04.20<br>17 | 2,90 | 46,60 | 147 300 000 | 0,96 | 18 043 000<br>000 | 17 838 997<br>475 | 9,75  | 2,2<br>4 |            |
| 01.07.20<br>17 | 3,00 | 46,00 | 145 200 000 | 0,96 | 11 067 994<br>367 | 18 447 542<br>471 | 9,00  | 2,3<br>4 | 268<br>053 |

### Conclusion

Feature of KPI is that they all focused on strategic goals and objectives of the Bank, as well as interrelated and grouped according to certain criteria, and only the achievement of the totality of the criteria will allow to speak about efficiency of activity of commercial bank.

Correlation and regression analysis based on expert opinion, showed that the banking sector will grow at a moderate pace, sustained positions will be taken systemically-important banks in the banking sector of the Russian Federation. Therefore, the effectiveness of the commercial bank is not only the results of its operations, but the control system, based on the formation of evidence-based of the bank's strategy and monitoring its implementation.

*Economic and mathematical modeling and forecasting of key performance indicators of pjsc  
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