A statistical approach to the analysis of merger and acquisition efficiency in the Russian industry

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Abstract. At present, the success of economic institution transformations, as well as creating an efficient economic system with a fundamental new nature of corporate relationships are impossible without the statistical recording of factors contributing to the efficiency of merger and acquisition transactions in the Russian industry. The paper proposes a method for analyzing the efficiency of merger and acquisition transactions of enterprises in the industrial sector of the Russian economy, based on simulation methods. The methodical approach developed to analyze the efficiency of the integration transactions of Russian industrial companies allows one to consider individual preferences of investors, as well as to give a complex statistical evaluation of the strategic economic benefits from M&A transactions. This method enables to evaluate the probability and stability of the synergistic effect values within the increase of competitiveness of Russian industrial enterprises on the domestic and foreign markets.

1 Introduction

The current economic environment creates quite strict operating conditions for enterprises in the industrial sector in the economy of the Russian Federation. Only those companies can maintain and strengthen their competitive positions whose management is always concerned with the qualitative and quantitative growth; that develops effective business strategies for realization of which there may not be enough internal capacity. When internal reserves of increasing efficiency in activity have been exhausted, external development that is realized by means of mergers and acquisitions (M&A) becomes an indispensable condition to ensure the continuity of the enterprise life cycle [1,2].


Employees of such international consulting and auditing companies as Deloitte, Ernst and Young, KPMG, McKinsey, PricewaterhouseCoopers significantly contributed to the study of the merger and acquisition practice, to the investigation of their effects, the causes of failure and the development of methods and techniques for analysis of the expected results of the integration transactions.

Despite the presence of a large number of works devoted to the analysis of individual issues relating to merger and acquisition efficiency, a study of investigations in the field of M&A showed that the greatest attention has been paid to the integration processes taking place in the banking sector. Transactions that are carried out in the industrial sector of the economy and have serious specificity remain insufficiently studied.

Mergers and acquisitions are a high-risk, expensive, and, at the same time, highly profitable kind of investment project whose potential can be realized only by transaction careful preparation, planning, analysis, and its efficiency justification [3]. All this causes the necessity for the development of a statistical approach to the analysis of merger and acquisition efficiency in the Russian industry.

2 A systematic approach to the analysis of integration transaction efficiency of enterprises in the industrial sector in the economy of the russian federation

In this work we determined the synergistic effect as a key parameter that affects the decision making process on integration within the framework of the justification of the merger and acquisition efficiency [4].

There are a number of approaches to the formation of an information base for analysis of the integration activity efficiency; for example, you can use the accumulated statistical information on the industrial enterprises, as well as promising data. For the solution of
5) a statistical analysis of simulation results and interpretation of the results obtained.

In this article, we examined the purchase of one of the coal companies by a Russian steel company, incorporated in 2008 in a government list of strategic companies in Russia, as the example of the merger and acquisition transaction. This should allow the creation of a highly efficient vertically integrated structure possible and result in increased cost of the metallurgical company.

Forecasting and carrying out calculations resulted in a value that evaluates the synergistic effect based on generated incomes of the two business segments of the merged company (SE = 348,80 million U.S. dollars). Since the forecast was created in the form of an algorithm, it is possible to re-count the results of the forecast for the different set of input data values. This makes possible to implement the Monte Carlo method for statistical tests [8-11].

Sensitivity analysis found that the most critical parameters in evaluation of the synergistic effect are:
- cost value of a ton of metal production (each 1% decrease under otherwise equal conditions results in increased SE by 16.75%);
- cost value of a ton of coke concentrate (each 1% decrease under otherwise equal conditions results in increased SE by 8.22%);
- coke concentrate production (each 1% decrease under otherwise equal conditions results in increased SE by 3.68%).

In practice, normal and uniform distribution laws are more common in the generation of the input parameters of the projects. In this study, we used the normal distribution law to generate the input parameters. Table 1 presents the values of parameters required for generation of random numbers for the most sensitive factors for synergy valuation.

Table 1. The values of parameters required for generation of random numbers according to the normal distribution law.

<table>
<thead>
<tr>
<th>No</th>
<th>Indicator</th>
<th>Expected value μ</th>
<th>Standard deviation σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cost value of metal production, million USD</td>
<td>16915.37</td>
<td>6121.02</td>
</tr>
<tr>
<td>2</td>
<td>Cost value of 1 ton of coke concentrate, USD</td>
<td>117.87</td>
<td>16.82</td>
</tr>
<tr>
<td>3</td>
<td>Coke concentrate production, kt</td>
<td>4284.07</td>
<td>544.25</td>
</tr>
</tbody>
</table>

The most effective methods for determining the number of tests are methods for reducing dispersion [12-14], such as:
- use of Chebyshev's Theorem;
- use of Spalding formulas;
- estimation of set standard deviation as a measure of dispersion of sample values.

Chebyshev's inequality says that at a given number k and a random sample \( x_1, x_2, ..., x_n \) of size n at least 1-\( 1/k^2 \) measurements are close to the average value of \( \mu \) at a distance of no more than k of standard deviations. This
inequality is valid for any distributions of sets, and you can use Chebyshev’s inequality to determine sample size, which has the form

$$\mu_g(w, i) = \min_{\text{conf}} \left(1 - \mu_g(v) + \mu_g(i)\right)$$  \hspace{1cm} (1)$$

If we want to estimate the parameter of a simulation model into the interval $A\in D, B\in D, v\in A, i\in B$, with a probability of 0.95, then $n$ is 320. If we want to estimate the parameter of a simulation model into the interval with a probability of 0.05, then $n$ is 720.

Table 2 shows the sample size obtained by using Spalding formulas.

**Table 2.** The sample size corresponding to the desired precision in calculations and significance value.

<table>
<thead>
<tr>
<th>Desired precision</th>
<th>Significance value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.10</td>
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<tr>
<td>0.10</td>
<td>149</td>
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<tr>
<td>0.05</td>
<td>596</td>
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<td>0.02</td>
<td>3723</td>
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<tr>
<td>0.01</td>
<td>14884</td>
</tr>
<tr>
<td>0.001</td>
<td>1488400</td>
</tr>
</tbody>
</table>

Among dispersion reduction techniques for finding the sample size $n$ evaluating set fluctuation is the most effective. The problem of estimating dispersion of a set can be put as a task to find such $s^2$ evaluation that

$$P\left\{(1-d)\sigma^2 \leq s^2 \leq (1+d)\sigma^2\right\} = 1-\alpha,$$  \hspace{1cm} (2)$$

where $0 \leq d \leq 1$ is a number characterizing the similarity degree of estimation $s^2$ to true dispersion $\sigma^2$.

Maze and Cox demonstrated that it is more convenient to use in this equation $\chi^2$ - the statistic (n-1)s2/\sigma2 with (n-1) degrees of freedom, which allows you to find the confidence probability independent of $s^2$ [17-18]. If $n$ is large enough then $\chi^2$ distribution can be approximated by a normal distribution, then

$$i_j \in C_\alpha,$$  \hspace{1cm} (3)$$

where $F(C) = \int_0^{\alpha_{\text{max}}} \frac{1}{\alpha_{\text{max}}} M(C, \alpha) d\alpha$ is the standard normal statistic for the original probability.

If we want $s^2$ to be different from $\sigma^2$ no more than in 5% with the probability of 0.95 then $n = 3075$; if we want $s^2$ to be different from $\sigma^2$ no more than in 10% with a probability of 0.95 then $n = 770$.

The next stage of the simulation was the stage of statistical tests implemented by using the Monte Carlo method [19-20]. The values of the input parameters were generated according to the normal distribution, the sample size was 3075. Simulation experiment was carried out in the AP Excel environment with the help of a random number generator.

In this integration project the level of risk assessment of the synergistic effect is estimated as strong (37.49%). But since the metallurgical company gives the priority to the target company and the possibility of implementing an integration project in order to create a vertically integrated holding company in the industry of Russia is expedient at a cost of no more than $V_{\text{max}} \approx 463.99$ million USD.

**3 Conclusion**

Thus, the statistical approach proposed to the analysis of the efficiency of merger and acquisition transactions in the industry of the Russian Federation makes it possible...
to predict the synergistic effect in the integration transactions. The values obtained allow systematically exploring the factors of the change in the performance of the integrated company in the real sector of the economy; to estimate risk assessment of the synergistic effect; to give grounds for management decisions relating to a particular integration project which should be accepted or rejected within the framework of improving the competitiveness of the industry of the Russian Federation.

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References

2. M. Polikarpova, *Risk analysis and the effectiveness of mergers and acquisitions of Russian companies* (NPO MAX Group, Moscow, 2012)