The Application of International Risk Requirements for the Assessment of Investor Attractiveness of Russian Power-Generating Companies

A. Domnikov and G. Chebotareva

1 Introduction

The relevance of the study is due to the theoretical and practical significance of the international risk requirements to the evaluation of investment projects in the energy sector. The special role in modern conditions of economic growth and technological hazards requires the development of analytical tools and forecasting techniques of investment risks with the use of a system study tool. Furthermore, it contributes to the stimulation of growth of evaluation efficiency for power-generating companies' investor attractiveness.

Conducted by the authors, many years of research in this area showed that the assessment of emerging risks should accompany the development of specific mathematical apparatus that takes into account not only current requirements for risk management but also the features of the sector, and this is one of the main objectives of the present paper.

The result of the study is the authors' methodical approach in assessing the competitiveness of energy companies, which allows one to quickly identify industry risks and to assess their level of risk through the assessment of the value of these threats. The obtained results are of practical importance and are used in developing the strategy of development of power companies.

A. Domnikov · G. Chebotareva (✉)
Academic Department of Banking and Investment Management, Ural Federal University, Ekaterinburg, Russia

S. Syngellakis, C. Brebbia (eds.), *Challenges and Solutions in the Russian Energy Sector*, Innovation and Discovery in Russian Science and Engineering,
https://doi.org/10.1007/978-3-319-75702-5_15

2 International Risk Management Requirements

The desire to create uniform standards in the sphere of risk management began the process of developing international requirements to the system of risk management and implementing it worldwide. Prepared by the Basel Committee on Banking Supervision (BCBS), recommendations on risk assessment and management demonstrate the current trends in this sphere. Moreover, there is the basis for improvement of the risk management mechanisms, both credit institutions and the analogous departments of large industrial holdings.

Recommendations to risk assessment are presented in the framework agreement "International Convergence of Capital Measurement and Capital Standards" (Basel I 1988) and modified in the document Basel II (2004) and Basel III (2010) [1].

The main approaches to assessing investment risks BCBS proposes to introduce are [2]:

1. Standardized approach
2. The basic approach based on internal ratings (FIRB)
3. The advanced approach based on its own valuation models (AIRB)

The standardized approach is based on external credit ratings assigned by international rating agencies.

An improved version of the risk assessment is presented in basic and advanced IRB approaches where it is used for internal rating of the borrowers. And in the second case, BCBS offers to risk managers to measure the assessment components independently.

In turn, the need for the development and verification of the model under the AIRB stimulates the process of continuous development and improvement in this direction.

2.1 The Basic Components of a Risk Assessment in Accordance with International Requirements

International requirements proposed by the BCBS to the risk management system are associated with the use of basic risk components [1–4]:

- PD – probability of default. It characterizes the level of company risks in the implementation of the investment project.
- LGD – loss given default. It is the expected average cost of the company losses in the situation of default of the investment project.
- EAD – exposure at default. It characterizes the absolute value of the investment project sum and is determined by its full actual or forecasted cost of the investment, operating, and other expenses.
- M – maturity. This is the average duration of the investment phase of the project.

- ML_i – maximum losses of the i-th risk type.
- EL_i – the mathematical expectation of the i-th risk type losses.
- UL_i – unexpected losses of the i-th risk type.

3 Modified Approach to the Estimation of Investor Attractiveness of the Power-Generating Companies in the Implementation of the Investment Project

Proposed in the framework of the research approach to the assessment of investor attractiveness of a power-generating company is based on the well-known risk management theory of the economic capital and is the result of modification of a known Merton-Vasicek method [3, 4].

The economic capital is the amount of funds needed by the enterprise to cover the risks it faces in trying to maintain a certain standard solvency or in the event of default. In other words, economic capital allows maintaining by power-generating companies of the current level of their independence and stability and protection against economic losses as a result of implementation risks. Thus, economic capital determines the cost the company needs to have to provide a specified level of investment attractiveness and long-term sustainability.

A phased process of investor attractiveness assessment is presented in Fig. 1.

Initially, the study of the company investor attractiveness is preceded by identifying industry risks arising in the course of the project and describing its parameters. Source statistical data for each of the risk indicators are the basis for some of the parameters of risk calculation.

3.1 The Estimation Features of Risk Parameters Under the Modified Approach

The basic risk components used in the valuation include:

1. Average probability of default (PD)

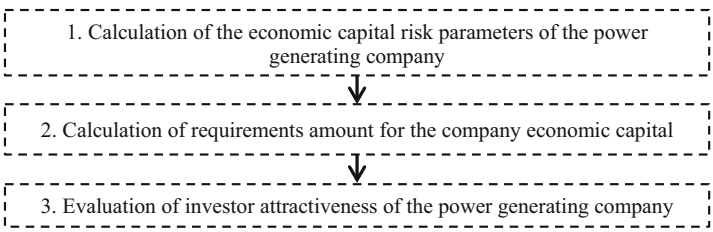

Fig. 1 Scheme of evaluation of the power-generating company investor attractiveness

2. Exposure at default (EAD)
3. Average loss given default (LGD)
4. Maturity (M)
5. Company's confidence level (α)
6. The level of correlation of company's condition with the region economy (r)

The average annual probability of default takes into account the totality of all financial and nonfinancial, including exogenous factors that influence to the project. In this study the probability of default is based on the standard form of a weighted arithmetic average given by the Eq. (1)

$$PD = \sum_{j=1}^{n} \left(P_j^m \cdot \gamma_j^s \right), \tag{1}$$

where PD is the investment project probability of default, P_j^m is the average probability of j-th risk realization, and γ_j^s is the j-th risk significance.

Exposure at risk is calculated as the full actual (or forecast) value of the investment project with the rate of return minus the value of highly liquid collaterals.

Assessment of LGD is based on analysis of statistical data for similar investment projects published in the area of default [5].

The maturity characterizes the effective period during which a stored position on the risk is determined by the duration of the investment phase of the project [4]. The maturity is evaluated using Eq. (2)

$$M = \frac{1 + T - 2.5 \cdot b(PD)}{1 - 1.5 \cdot b(PD)}, \tag{2}$$

where M is the maturity, T is the duration of the project investment phase, and parameter $b(PD) = (0.00852 - 0.05489 \cdot \ln(PD))^2$ is the investment project probability of default.

The company's confidence level is determined based on the assigned credit rating. The concordance between the expected probability of default (years) and rating is developed by international rating agencies and banking groups based on the statistics data.

The level of correlation of company's condition with the region economy status in this study is calculated based on the Pearson correlation coefficient given by Eq. (3) [6]

$$r = \frac{\operatorname{cov}\left(P_{jex}^{av}; P_{jen}^{av} \right)}{\sigma P_{jex}^{av} \cdot \sigma P_{jen}^{av}}, \tag{3}$$

where r is the correlation coefficient, $\operatorname{cov}\left(P_{jex}^{av}; P_{jen}^{av} \right)$ is the covariance value of the variables P_{jex}^{av} and P_{jen}^{av}, σP_{jex}^{av} is the standard deviation of the variable P_{jex}^{av}, σP_{jen}^{av} is the standard deviation of the variable P_{jen}^{av}, P_{jex}^{av} is the average probability of j-th

exogenous risk realization, and P_{jen}^{av} is the average probability of j-th endogenous risk realization.

3.2 The Economic Capital Requirements for the Power-Generating Company

Under the modified approach to the estimation of the power-generating company investor attractiveness, the calculation of the initial values of the requirements for economic capital is carried out according to Eq. (4) [1, 7]

$$CaR = EAD \cdot LGD \cdot \left| N \cdot \left(\frac{N^{-1} \cdot (1 - PD) + N^{-1} \cdot (1 - \alpha) \cdot \sqrt{r}}{\sqrt{1 - r}} \right) - PD, \right| \quad (4)$$

where CaR is the requirements for power-generating company economic capital, N is the standard normal distribution, and N^{-1} is the inverse of the standard normal distribution.

In the case of exceeding the project investment phase duration by more than 1 year, there is a need for adjustment to CaR on the amount of the risk horizon as shown in Eq. (5):

$$CR = CaR \cdot M, \quad (5)$$

where CR is the requirements for economic capital subject to the penalty for the duration of the project investment phase.

4 Application of the Modified Approach to the Estimation of the Power-Generating Company Investor Attractiveness

Consider the actual case of use of the modified approach described on the example of Russian power-generating company JSC "TGC-9" in the implementation of the investment project "Construction of thermal power plant."

4.1 Scenario Approach to the Estimation of Investor Attractiveness

The framework of the studies considered two possible scenarios of development of the power-generating company investor attractiveness: "optimistic" and "pessimistic" [8].

Table 1 Scenarios for the development of the power-generating company investor attractiveness

№	Parameter's name	Scenarios	
		"Optimistic"	"Pessimistic"
1	Value of the investment project, bln rub	5	8
2	Investment project duration, years	2	3
3	Investor's income, billion rubles	2.2	3
4	Value of highly liquid collaterals, bln rub	2	1
5	*LGD* value, %	10	12
6	Cutoff risk horizon (G_s), %	1	50
7	The level of correlation (r)	0.5587	0.6879
8	Confidence level (credit ranking) (α)	0.9995 (*A*)	0.9964 (*BBB*)

Table 2 Probability of industry risk realization of JSC "TGC-9"

№	Risks names	Probability of risk realization				
		Maximum	Minimum		Average	
			$G_1 = 1\%$	$G_2 = 50\%$	$G_1 = 1\%$	$G_2 = 50\%$
Exogenous risks						
1	Risk of a slowdown in the development of the region industry	0.6364	0.1225	0.3130	0.3795	0.4747
2	Risk of reduction of the region investor attractiveness	0.2727	0.0125	0.1478	0.1426	0.2103
3	Risk of currency exchange	0.5455	0.1478	0.3215	0.3467	0.4335
Endogenous risks						
4	Risk of increase of the direct financial losses	0.8182	0.3625	0.5971	0.5904	0.7077
5	Risk of dependence on imported equipment	0.9091	0.2529	0.6799	0.5810	0.7945
6	Risk of wear of BPA	0.6364	0.1419	0.3418	0.3892	0.4891

The features of each of them are presented in Table 1: a direct impact on the assessment of the company investor attractiveness. Moreover, it plays an important role in the development of future scenarios for the company's investment policy.

4.2 JSC "TGC-9" Industry Risks in the Implementation of the Investment Project

As an example of assessment, the following exogenous and endogenous risks of the power-generating company considered are presented (Table 2) [8].

These are the results of the evaluation of the realization probability of exogenous and endogenous industry risks in the example of Russian power-generating company JSC "TGC-9."

The calculation of the maximum and minimum probabilities for each industry risk is based on the study of the dynamics of statistical data on their performance using the method of historical simulation. Estimation of the minimum probability also involves the use of scenario analysis when it changes the value of the cutoff risk horizon.

The results are shown in Table 2.

4.3 Evaluation of JSC "TGC-9" Investor Attractiveness

The final evaluation of investor attractiveness of the power-generating company considered is preceded by a calculation of risk parameters, as well as the requirements for economic capital.

Table 3 shows the values of risk components and requirements for economic capital of the company for each of the scenarios. The source data for their calculation are presented in Tables 1 and 2.

The results of calculations (Table 3) showed that the final requirements for economic capital of JSC "TGC-9" differ significantly from the proposed scenarios. So the requirements of the "pessimistic" scenario are higher than the analogous parameter by 4.4 times.

The main reason for the resulting differentiation is a "pessimistic" scenario's significant deterioration in terms of the economy functioning as a whole and the efficiency of the industry. This, ultimately, influenced the rise in the cost of the project, increasing the duration of its implementation, the requirements of investors to risk, etc.

The final decision about the current state of investor attractiveness is based on a comparison made to the company's requirements to cover risk (economic capital)

Table 3 Values of indicators of the investor attractiveness evaluation in accordance with the scenarios

№	Parameter's name	Scenarios	
		"Optimistic"	"Pessimistic"
1	Probability of default	0.4619	0.5881
2	EAD, bln rub	5.2	10
3	LGD, %	10	12
4	Maturity	2.0014	3.0091
5	Confidence level (credit ranking) (α)	0.9995	0.9964
6	The level of correlation (r)	0.5587	0.6879
7	Requirements for economic capital, bln rub	**0.4807**	**2.1236**

and the actual amount of funds that can be used in the event of a default of the investment project.

Study data of the financial statements of JSC "TGC-9" [9] showed that the actual amount of economic capital is 1.8 billion rubles.

Therefore, at this stage of research, it is difficult to draw a definitive conclusion regarding the attractiveness of a power company to investors. This is due to the fact that "optimistic" scenarios for the power-generating company are absolutely investor attractive: the actual amount of the funds exceeds requirements with a factor of safety of 1.3 billion roubles. This, in turn, can be used to cover other latent industry risks.

However, in case of execution of a "pessimistic" scenario, the company is recognized as investor unattractive: its own funds will not be sufficient to redress the full default of the investment project.

Thus, for the purpose of increasing the investor attractiveness and receipt of funds for the project of power-generating company, developing an appropriate program is required. Its activities usually involve two main areas [10–12]. In the first case, the acquisition of the required level of investor attractiveness is achieved through the attraction of additional funds to the amount not less than the deficit of the coating (in the studied case, 0.32 billion rubles).

5 Conclusion

The competitiveness of power companies in the investment market is largely dependent on compliance with international requirements for the risk management system. The special importance of these requirements is in their aim to implement capital-intensive projects that will improve the efficiency and reliability of power-generating companies.

The proposed modified approach to the estimation of investor attractiveness of power-generating companies based on the model of Merton–Vasicek has shown its effectiveness. In particular, the final requirements for economic capital of JSC "TGC-9" are significantly differentiated depending on the scenarios. This, in turn, improves the accuracy of evaluation of its investor attractiveness.

However, in terms of improving the methodological apparatus, it should be noted the necessity of considering the correlation of investment projects with the level of development and the trends in the economy.

Acknowledgment The work was supported by Act 211 Government of the Russian Federation, contract № 02.A03.21.0006.

References

1. Basel ommittee on Banking Supervision. International regulatory framework for banks, www.bis.org
2. Basel Committee on Banking Supervision. Proposed enhancements to the Basel II framework, www.bis.org
3. Domnikov, A., Khomenko, P., Chebotareva, G.: A risk-oriented approach to capital management at a power generation company in Russia. WIT Trans. Ecol. Environ. **186**, 13–24 (2014)
4. Domnikov, A., Chebotareva, G., Khomenko, P., Khodorovsky, M.: Risk-oriented approach to long-term sustainability management for oil and gas companies in the course of implementation of investment projects. WIT Trans. Ecol. Environ. **192**, 275–284 (2015)
5. Peter, C.: Estimating loss given default – experiences from banking practise. Springerlink. **2**, 143–175 (2006)
6. Gmurman, V.: Probability theory and mathematical statistics [in Russian]. High. Sch. **1**, 479 p (1997)
7. Gorby, M.B.: A risk-factor model foundation for rating-based bank capital rules. J. Financ. Intermed. **25**, 199–232 (2003)
8. Domnikov, A., Chebotareva, G., Khodorovsky, M.: Evaluation of investor attractiveness of power-generating companies, given the specificity of the development risks of electric power industry [in Russian]. Vestnik UrFU. **3**, 15–25 (2013)
9. Financial statements of JSC "TGC-9" for 2005–2014
10. Merton, R.C.: On the pricing of corporate debt: the risk structure of interest rates. J. Financ. **29**, 449–470 (1974)
11. Vasicek, O.: Loan portfolio value. Credit Portfolio Models. **15**, 160–162 (2002)
12. Ohlson, J.A.: Financial ratios and the probabilistic prediction of bankruptcy. J. Account. Res. **18** (1), 109–131 (2012)