MSC 97M40 **DOI: 10.14529/jcem210202**

ANALYSIS OF SUSTAINABLE DEVELOPMENT LLC "COMPANY RBT"

V. G. Mokhov[1], mokhovvg@susu.ru,
T. S. Demyanenko[1], demianenkots@susu.ru,
R. S. Smirnov[1], vsc.littleuser@gmail.com
[1] South Ural State University, Chelyabinsk, Russian Federation

The article provides an analysis of the sustainable development of LLC "RBT Company", implemented by the company over the past six years. All three constituent segments of sustainability are considered: environmental, social and economic. Particular attention is paid to the latter, which is the only block feeding all the others. To assess the economic sustainability, an economic and mathematical model of operating activity was built on the basis of the production function, the parameters of which were calculated on the basis of computer support. The calculations of the model were carried out using the Java programming language. An analysis of the coefficients of elasticity of the production function showed that society needs to revise its personnel policy and optimize the means of labor used.

Keywords: sustainable development; economic and mathematical model; operational activity; production function; computer programming.

Introduction

In a turbulent economy and increasing economic crises, the question of assessing the economic sustainability of a corporation is quite relevant and in demand in scientific research [1, 2]. At the same time, with a certain degree of conditionality, all work in this direction can be divided into two clusters: based on traditional indicators of financial stability and work using original scientific approaches to determining the economic condition of an enterprise. This article relates to the work of the second cluster. The basis for assessing the economic sustainability of the enterprise is the economic and mathematical modeling of the operating activities of the enterprise based on the well-known Cobb-Douglas production function [3]. A methodology has been developed for constructing a mathematical model of the enterprise's activity, for determining elasticity indicators of output according to the resources used in the production process and elasticity of production, on the basis of the dynamics of which an approach to assessing economic stability. On the basis of the algorithm of mathematical modeling of the operating activity of the enterprise and the author's computer program, a model of the functioning of the limited liability company "RBT Company" is built, which is the basis for assessing its economic sustainability.

1. The Environmental Aspect of Sustainable Development

Currently, RBT does not apply any policy aimed at reducing the negative impact on the environment, preventing its pollution and complying with the requirements of regulatory documents and legislative acts in the field of environmental protection. This is primarily due to the non-publicity and relatively small scale of the company's activities, the

absence, in the opinion of the management, of a direct negative impact on the environment, as well as the small age of the trend for sustainable development in the retail segment of household appliances and electronics. At the same time, the company is an importer of household appliances and electronics, therefore, it pays an environmental fee, the amount of which is shown in Table 1.

Table 1

Environmental fee "RBT"

Year	Environmental fee, thousand rubles
2014	9
2015	8
2016	n/a
2017	28
2018	n/a
2019	n/a

One of the subsidiaries of RBT is engaged in the production of household appliances. Until 2020, all production was contractual, that is, the company transferred orders to factories in China and Russia, after which it placed its brand on finished products and was engaged in marketing and sales to consumers. In 2020, the company began construction of its own plant and in the future plans to engage in the production of household appliances on its own. Due to the fact that the production of electronics is subject to both national and international regulations on environmental impact, the company will be forced to build its work in accordance with international standards, including in the context of sustainable development. An important characteristic of an enterprise in the field of ecology is the consumption of energy resources necessary for the implementation of its activities. The importance is due to the fact that the production of some of these resources also has a negative impact on the environment. The RBT company uses the following energy resources: motor gasoline, electricity and thermal energy. It makes sense to compare the dynamics of the total consumption in rubles. The data are given in current prices for the period of consumption.

Table 2

Consumption of energy resources "RBT"

Year	Consumption volume, thousand rubles
2014	41 660
2015	27 685
2016	22 217
2017	20 472
2018	131 585
2019	30 725

In the period from 2014 to 2017, a trend towards a reduction in the volume of resource consumption is noticeable. The growth in costs by more than 6 times in 2018 is associated with the opening of new retail stores and increased costs for gasoline. If we compare the results of the economic activity of the enterprise with the consumption of natural resources, the following can be noted. During the period of reduction in consumption,

the company's revenue increased by 17%, while profit decreased by 42%. High resource consumption in 2018 was justified: profitability increased, profit increased more than 5 times, and revenue is a little more than 30% compared to 2017. In 2019, when the volume of resource consumption decreased significantly, the company's profit also decreased by 54%, while revenue increased by 3%. Hence, we can conclude that the company's profitability is highly dependent on the cost of energy resources.

2. Social Aspect of Sustainable Development

The main directions of the personnel policy of "RBT" are increasing the labor potential of employees, developing personnel by organizing their professional training, retraining and advanced training, managing their business career and professional growth and conducting trainings. The company also provides employees with an extended social package, organizes sports events, invests in improved working conditions and safety measures, and also does charity work.

Table 3

Expenditures on social policy "RBT"

Year	Expenses, thousand rubles
2014	4 217
2015	3 260
2016	3 062
2017	5 486
2018	20 352
2019	1 669

The main share of expenses is occupied by personnel training and sports events. The notable increase in social spending in 2018 is associated with higher training costs for employees, in particular salespeople. As a result of high costs for personnel training, employees not only improve their qualifications in their main direction, but also acquire new knowledge and skills that make it possible to move not only vertically, but also horizontally, radically changing their field of activity. Traditionally for the enterprise, the main areas of social support for employees are: vaccinations and medical examinations; organization of recreation; material assistance and bonuses to employees. The company annually organizes corporate sports events for employees and their families. Charity plays a small part in the development of social responsibility. A generalizing indicator of the degree of achievement of the stability of the enterprise is the level of social protection of the personnel of the enterprise, which is determined by the formula (the assessment methodology developed by Professor Chistov LM is taken as a basis) [4]

$$Us.z. = (Dav.year.)/(Prats.potr.korz),$$

where $Us.z.$ is the level of social protection of personnel; $Dav.year.$ is the average annual labor income of the average employee of the enterprise; $Prats.potr.korz$ is the price of a rational consumer basket.

The average monthly salary in 2019 at RBT (excluding the heads of areas and departments) was 39.065 rubles. There are three types of consumer baskets: for able-bodied citizens; for minor children and non-working citizens; for citizens who have reached

retirement age. Due to the fact that the level of social protection of personnel is calculated, it is rational to calculate it based on the cost of the consumer basket for adults. In 2020, the cost of the required minimum for adults was 11.200 rubles per month. Thus, the cost of the consumer basket per year is 134.400 rubles. Then the assessment of the level of social protection of personnel is

$$Ys.z. = 468780/134400 = 3.49.$$

The obtained result suggests that the average employee of the RBT company receives a salary sufficient to cover the minimum costs by 3.49 times.

3. The Economic Aspect of Sustainable Development

Assessment of economic sustainability is one of the most important sections of the strategic management of a corporation, since economic sustainability not only meets the objectives of the activity, but is also the main source of funding for the social and economic well-being of society. The method used to assess the financial stability of "RBT" is based on comparing the amount of reserves with its own working capital, net working capital and the main sources of the formation of reserves. Calculation of indicators of financial stability of the company "RBT" allows us to draw the following conclusions.

1. The corporation is unable to cover the amount of its inventory from its own funds.
2. The corporation needs long-term credits and loans to carry out its financial and economic activities.
3. The corporation is exposed to the risk of default on its obligations to creditors.
4. The corporation is exposed to the risk of non-payment of receivables.

Based on the results obtained during the analysis of the financial and economic activities of the enterprise, it can be concluded that at the micro level of the enterprise there is a high risk of non-repayment of receivables, in this regard, the corporation will have even less of its own working capital, it will require a large amount of long-term and short-term borrowed funds. Risks in the corporation's mesosphere are associated with supply disruptions, as well as with changes in regional electricity tariffs, higher prices for gasoline and other energy resources consumed by the corporation. At the level of the macro environment, the corporation bears the risks of fluctuations in tax rates and fluctuations in the refinancing rate and exchange rates. Due to the fact that the corporation's operating activities depend on long-term and short-term funds, an increase in the refinancing rate will lead to an increase in the cost of a loan, an increase in prime cost and a decrease in net profit. At the maxi-sphere level, the enterprise bears risks associated with changes in the legislation on foreign companies (the owner of 100% of "RBT" is a Cypriot joint-stock company). The company receives all its income in Russia and has no foreign counterparties. Thus, we can say that in order to increase financial stability in the context of sustainable development, an enterprise needs:

- increase in the value of own circulating assets;
- decrease in financing of operating activities at the expense of credit funds through work with counterparties on prepayment;
- reduction of the period of accounts receivable turnover.

The assessment of the economic sustainability of the RBT company was carried out on the basis of an economic and mathematical model of the corporation, built on data for 6 years (2013–2019) according to the following algorithm.

The algorithm for constructing mathematical models of the enterprise's operating activities is based on the use of the production function (1).

$$CP = A \cdot N^{\alpha} \cdot FA^{\beta} \cdot CA^{\gamma} \cdot e^{\lambda t}, \tag{1}$$

where CP means commercial products, thousand rubles / year; N is a number of personnel, people; FA is the volume of fixed assets, thousand rubles; CA means working capital, thousand rubles / year; A is an empirically determined coefficient that ensures the conjugation of the dimensions of the left and right sides of equation (1) and simultaneously plays the role of a scale conversion factor between all components of the formula (1); α, β, γ are coefficients of elasticity of production for the corresponding resource, indiscriminate; e is a base of the natural logarithm; λ is a coefficient of elasticity, showing the influence of "autonomous"/ technical progress on the results of production, no size; t is the time normalized relative to the base year, years, $(t_i = T_i - T_b)$.

The parameters of the production function (1) $A, \alpha, \beta, \gamma, \lambda$ in the most general form, are found on the basis of retrospective data on CP, N, FA, CA, t, as a solution to a system of linear equations. In the system of equations, m is the number of years for which retrospective data were collected $(m > 4)$

$$\begin{cases} \sum\limits_{i=1}^{m} \ln CP_i = m \cdot \ln A + \alpha \cdot \sum\limits_{i=1}^{m} \ln N_i + \beta \cdot \sum\limits_{i=1}^{m} FA_i + \gamma \cdot \sum\limits_{i=1}^{m} \ln CA_i + \lambda \cdot \sum\limits_{i=1}^{m} t_i, \\ \sum\limits_{i=1}^{m} (\ln CP_i \cdot \ln N_i) = \ln A \cdot \sum\limits_{i=1}^{m} \ln N_i + \alpha \cdot \sum\limits_{i=1}^{m} (\ln N_i)^2 + \\ \qquad + \beta \cdot \sum\limits_{i=1}^{m} (\ln FA_i \cdot \ln N_i) + \gamma \cdot \sum\limits_{i=1}^{m} (\ln CA_i \cdot \ln N_i) + \lambda \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln N_i), \\ \sum\limits_{i=1}^{m} (\ln CP_i \cdot \ln FA_i) = \ln A \cdot \sum\limits_{i=1}^{m} \ln FA_i + \alpha \cdot \sum\limits_{i=1}^{m} (\ln FA_i \cdot \ln N_i) + \\ \qquad + \beta \cdot \sum\limits_{i=1}^{m} (\ln FA_i)^2 + \gamma \cdot \sum\limits_{i=1}^{m} (\ln FA_i \cdot \ln CA_i) + \lambda \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln FA_i), \\ \sum\limits_{i=1}^{m} (\ln CP_i \cdot \ln CA_i) = \ln A \cdot \sum\limits_{i=1}^{m} \ln CA_i + \alpha \cdot \sum\limits_{i=1}^{m} (\ln CA_i \cdot \ln N_i) + \\ \qquad + \beta \cdot \sum\limits_{i=1}^{m} (\ln CA_i \cdot \ln FA_i) + \gamma \cdot \sum\limits_{i=1}^{m} (\ln CA_i)^2 + \lambda \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln CA_i), \\ \sum\limits_{i=1}^{m} (\ln CP_i \cdot t_i) = \ln A \cdot \sum\limits_{i=1}^{m} t_i + \alpha \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln N_i) + \\ \qquad + \beta \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln FA_i) + \gamma \cdot \sum\limits_{i=1}^{m} (t_i \cdot \ln CA_i) + \lambda \cdot \sum\limits_{i=1}^{m} (t_i)^2. \end{cases}$$

The use of the method of power-law production functions to analyze the economics of production is often complicated by the fact that the system of equations (1) may not have a solution. This is explained by the fact that there may be a relationship between statistical data, due not so much to their functional relationship, but to the proximity in time of the sets of exogenous variables, when all values change proportionally. This gives rise to a phenomenon called by Mendershausen the effect of multicollinearity between independent variables. To overcome this barrier, it is necessary to make the following transformations.

Let us divide the total differential of function (1) by the function itself. We get

$$dCP/CP = \alpha \cdot dN/N + \beta \cdot dFA/FA + \gamma \cdot dCA/CA + \lambda \cdot dt. \tag{2}$$

Let's introduce the notation $\dfrac{dCP}{CP} = 2 \cdot \dfrac{CP_{i+1} - CP_i}{CP_{i+1} + CP_i} = z$, $\dfrac{dN}{N} = 2 \cdot \dfrac{N_{i+1} - N_i}{N_{i+1} + N_i} = x$,

$\dfrac{dFA}{FA} = 2 \cdot \dfrac{FA_{i+1} - FA_i}{FA_{i+1} + FA_i} = y$, $\dfrac{dCA}{CA} = 2 \cdot \dfrac{CA_{i+1} - CA_i}{CA_{i+1} + CA_i} = w$, $dt = t_{i+1} - t_i = 1$.

Then expression (2) is transformed into the equation

$$z = \alpha \cdot x + \beta \cdot y + \gamma \cdot w + \lambda.$$

Based on the transformed initial data from the system of equations

$$\begin{cases} \sum\limits_{i=1}^{m} z_i = \lambda \cdot m + \alpha \cdot \sum\limits_{i=1}^{m} x_i + \beta \cdot \sum\limits_{i=1}^{m} y_i + \gamma \cdot \sum\limits_{i=1}^{m} w_i, \\ \sum\limits_{i=1}^{m} (x_i \cdot z_i) = \lambda \cdot \sum\limits_{i=1}^{m} x_i + \alpha \cdot \sum\limits_{i=1}^{m} (x_i)^2 + \beta \cdot \sum\limits_{i=1}^{m} (x_i \cdot y_i) + \gamma \cdot \sum\limits_{i=1}^{m} (x_i \cdot w_i), \\ \sum\limits_{i=1}^{m} (y_i \cdot z_i) = \lambda \cdot \sum\limits_{i=1}^{m} (t_i \cdot y_i) + \alpha \cdot \sum\limits_{i=1}^{m} (x_i \cdot y_i) + \beta \cdot \sum\limits_{i=1}^{m} (y_i)^2 + \gamma \cdot \sum\limits_{i=1}^{m} (y_i \cdot w_i), \\ \sum\limits_{i=1}^{m} (w_i \cdot z_i) = \lambda \cdot \sum\limits_{i=1}^{m} (w_i) + \alpha \cdot \sum\limits_{i=1}^{m} (w_i \cdot x_i) + \beta \cdot \sum\limits_{i=1}^{m} (y_i \cdot w_i) + \gamma \cdot \sum\limits_{i=1}^{m} (w_i)^2, \end{cases}$$

we find the elasticity coefficients $\alpha, \beta, \gamma, \lambda$. The found numerical values of the elasticity coefficients are used to find the coefficient A by the next formula

$$A = \frac{\sum\limits_{i=1}^{m} z_i \cdot x_i^{\alpha} \cdot y_i^{\beta} \cdot w_i^{\gamma} \cdot e^{\lambda t}}{\sum\limits_{i=1}^{m} (x_i^{\alpha} \cdot y_i^{\beta} \cdot w_i^{\gamma} \cdot e^{\lambda t})^2}.$$

To construct an economic and mathematical model of the operating activities of the RBT company, the author's computer program for mathematical modeling "ElasticShow", written in Java, was used [5]. The parameters of the production function (1) found in accordance with the described algorithm using a computer program represent an economic and mathematical model of the operating activities of the RBT company

$$CP = 7.88 \cdot N^{-0.02} \cdot FA^{-0.04} \cdot CA^{0.6} \cdot e^{0.01 \cdot t}.$$

Conclusion

The obtained indicator of the elasticity of production $h = 0.55 < 1$ indicates the presence of problems in ensuring economic sustainability due to the decreasing effect of the growth of production scale, that is, the return of resources involved in the operating activities of the RBT company decreases. Fixed assets (elasticity of production with respect to fixed assets -0.04) and personnel (elasticity of production with respect to labor -0.02) are used ineffectively. These data mean that with an increase in the resource by 1%, the volume of commercial products of the RBT company decreases by 0.04% and 0.02%, respectively.

References

1. Schmidt A. V. Modern Methodical Approaches to the Estimation and Forecasting of the Industrial Enterprises' Economic Stability Indicators. *Bulletin of the SUSU. Series: Economics and Management*, 2010, vol. 14, no. 20, pp. 37–41. (in Russian)
2. Khisamutdinov I. A. [Socio-Ecological-Economic Assessment of the Region in the Context of the Transition to Sustainable Development]. *Regional Economy: Theory and Practice*, 2013, no. 4, pp. 9–15. (in Russian)
3. Mokhov V. G. Methodological Aspect of Marginal Analysis of an Entrepreneur. *Bulletin of the SUSU. Series: Economics and Management*, 2012, vol. 21, no. 9, pp. 79–83. (in Russian)
4. Chistov L. M. [*Methodological Foundations of the Formation and Distribution of Enterprise Income as a Socio-Economic System.*] Saint Petersburg, Asterion Publ., 2007. (in Russian)
5. Mokhov V. G. [Program for Mathematical Modeling of the Enterprise's Operating Activities]. Moscow, 2021, State Registration no. 2021615082. (in Russian)

Veniamin G. Mokhov, DSc (Economics), Full Professor, Professor at the Department of Applied Economics; Leading Researcher at the Department of Mathematical and Computer Modelling, South Ural State University (Chelyabinsk, Russian Federation), mokhovvg@susu.ru.

Tatyana S. Demyanenko, PhD (Economics), Associate Professor at the Department of Mathematical and Computer Modelling, South Ural State University (Chelyabinsk, Russian Federation), oop_flp@mail.ru.

Roman S. Smirnov, Undergraduate at the Department of Applied Economics, South Ural State University (Chelyabinsk, Russian Federation), vsc.littleuser@gmail.com.

Received May 10, 2021.

УДК 658.1:001.895, 519.86 **DOI: 10.14529/jcem210202**

АНАЛИЗ УСТОЙЧИВОГО РАЗВИТИЯ ООО «КОМПАНИЯ РБТ»

В. Г. Мохов, Т. С. Демьяненко, Р. С. Смирнов

В статье приведен анализ устойчивого развития ООО «Корпорация РБТ», реализуемый обществом за последние шесть лет. Рассмотрены все три составных сегмента устойчивости: экологический, социальный и экономический. Особое внимание уделено последнему, который является единственным блоком, питающим всех остальных. Для оценки экономической устойчивости построена на основе производственной функции экономико-математическая модель операционной деятельности, параметры которой рассчитаны на основе компьютерного обеспечения. Расчеты модели проведены с использованием языка программирования «Java». Анализ коэффициентов эластичности производственной функции показал, что обществу необходимо пересмотреть кадровую политику и оптимизировать используемые средства труда.

Ключевые слова: устойчивое развитие; экономико-математическая модель; операционная деятельность; производственная функция; компьютерное программирование.

Литература

1. Шмидт, А. В. Современные методические подходы к оценке и прогнозированию показателей экономической устойчивости промышленных предприятий / А. В. Шмидт // Вестник ЮУрГУ. Серия: Экономика и менеджмент. – 2010. – № 20 (14). – С. 37–41.
2. Хисамутдинов, И. А. Социо-эколого-экономическая оценка региона в контексте перехода к устойчивому развитию / И. А. Хисамутдинов // Региональная экономика: теория и практика. – 2013. – № 4. – С. 9–15.
3. Мохов, В. Г. Методика маржинального анализа деятельности предпринимателя / В. Г. Мохов // Вестник ЮУрГУ. Серия: Экономика и менеджмент. – 2012. – № 9 (21). – С. 79–83.
4. Чистов, Л. М. Методологические основы формирования и распределения доходов предприятия как социально-экономической системы / Л. М. Чистов. – С.-Пб.: Астерион, 2007.
5. Мохов, В. Г. Программа математического моделирования операционной деятельности предприятия / ФГАОУ ВО «ЮУрГУ (НИУ)»; автор В. Г. Мохов. – М., 2021, гос. рег. № 2021615082.

Мохов Вениамин Геннадьевич, доктор экономических наук, профессор, профессор кафедры прикладной экономики; ведущий научный сотрудник кафедры математического и компьютерного моделирования, Южно-Уральский государственный университет (г. Челябинск, Российская Федерация), mokhovvg@susu.ru.

Демьяненко Татьяна Сергеевна, кандидат экономических наук, доцент кафедры математического и компьютерного моделирования, Южно-Уральский государственный университет (г. Челябинск, Российская Федерация), oop_flp@mail.ru.

Смирнов Роман Сергеевич, магистрант кафедры прикладной экономики, Южно-Уральский государственный университет (г. Челябинск, Российская Федерация), vsc.littleuser@gmail.com.

Поступила в редакцию 10 мая 2021 г.