

The Performance of Activity Diversification Efficiency for Ukrainian Gas Transportation Enterprises

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Abstract—The annotated article presents methods for assessing the effectiveness of diversification of enterprises, offers a system of criteria and indicators to assess the efficiency of diversification changes that take into account economic, social and ecological effects. An algorithm has been developed, stages and sequence of calculations have been justified for the quantification of a complex integrated indicator of the efficiency of diversification changes. On the example of highly specialized gas transportation enterprises, which have found themselves in a crisis due to a drop in demand for their services, there has been demonstrated the feasibility of applying the proposed methodological approach to justify the expediency and extent of diversification of their activities, as well as predicting the possible consequences of the implementation of such diversification strategies.

Keywords—diversification, efficiency of diversification, gas transportation enterprises, Ukraine.

I. INTRODUCTION

Within a market economy a business activity diversification is crucial in enterprise strategic development. By its reason enterprises adapt to environmental changes, which become more transient and difficulty predicted in the XXI century. A business activity diversification of an enterprise facilitates the stabilization of its market position, competitive growth and credit worthiness.

While conducting a research work, the authors called their attention to the specific characteristics of the Ukrainian gas transportation enterprises, which are highly specialized and deliver limited range of services. There is a belief that a topical issue nowadays is the practicability and effectuality of business activity diversification for the gas transport enterprises and its efficiency performance, at least for the following major two reasons. Firstly, as Jia Ailin noted «...production and consumption of natural gas are soaring high these days and the role of which is gradually prominent in energy sources» [1]. The author also states «that natural gas development will enter into a new stage of attaching

equal importance to both unconventional and conventional gas; natural gas demand potential will be great and its consumption structure will become more diversified; gas imports will rise year by year, resulting in the vigorously increasing external dependency; and natural gas will become the main growth engine in the process of energy mix adjustment» [1].

Second of all, in «Final Report Options for Gas Supply Diversification for the EU and Germany in the next Two Decades», Ukraine's potential to serve as a transit country for gas supply to the EU until 2035 is virtually ignored. The report notes that by reducing tariffs on natural gas transit across Ukraine, the profitability of North Stream 2 will decrease, which will allow Ukraine to increase its own transit volumes. If gas transit tariffs remain at 2016 levels in 2035, then Ukraine's natural gas transit will disappear, but gas flows through the North Stream will increase. If Ukraine lowers gas transportation tariffs, for example, by 60 percent, North Stream-2 will no longer be needed and Ukraine will transport more than 70 billion cubic meters to the EU [2].

Also the aim of the workshop “EU Energy Independence, Security of Supply and Diversification of Sources” was to determine the level of the current and future EU gas import dependence and to assess the EU's capacity to further improve gas security, diversify sources and routes of gas supply [3].

The external factors, therefore, as well as internal natural gas consumption reduction by Ukrainian consumers, decrease of gas transportation and transit, available excess capability of main gas pipelines make gas transportation enterprises look for new ways for their further development. One of these ways is business activity diversification.

The goal of this research paper is an efficiency performance and prediction of the diversification results for Ukrainian gas transportation enterprises.

II. LITERATURE REVIEW

The research shows that there are different criteria and methods to the efficiency performance of the enterprise activity diversification. Ginevicius, Podvezko & Andruskevicius propose to use Berry's index (D_B) for determining the diversification level of construction enterprises [4]:

$$D_B = 1 - \frac{\sum_{i=1}^n P_i^2}{n} \quad (1)$$

where

P_i - relative volume of the i -th activity;

n - the number of activities;

i - (1, 2 ...n).

The authors identified criteria for evaluating diversification efficiency as coefficients (ratios) of current, overall and critical liquidity and debts.

Yeon-Jung evaluating the effectiveness of the diversification strategies of a private railway company in Japan, used estimate the production function and technical efficiency using stochastic frontier analysis (SFA) to investigate the effect of diversification strategies on the firm's efficiency [5]. By comparing technical efficiency between firms, his study discusses the efficiency of diversification strategies in utilizing managerial resources.

In O. Tsohla's opinion [6] the choice criteria and successful use of marketing strategy is the following: investment attractiveness of an enterprise towards commercial profitability, earning capacity and development potential; implementation and realization of closed manufacturing cycles; stable financial position and place of an enterprise for diversification; associative links between enterprise profile and business needs, where an enterprise diversify its business activity; prompt and adequate response on shift in consumers' tastes and preference etc.

The Yu. Soina-Kutishcheva's approach is also noteworthy, which suggests the following economic criteria for diversification performance [7]: income that may provide an entrepreneur with additional business; time lag from the capital investment in the diversification object to the value realization; high level of risk for the diversification project; rights which are granted to a new entrepreneur; liquidity position that determines how quickly assets can be converted into money with minimal risk of value loss; restrictions to additional business operations; advantages and privileges over competitors caused by diversification; alternatives for investment, that is, how much realized profit differs from the profit that could be available by the other alternatives realization.

The methods of diversification efficiency performance and its criteria depend on the basic objectives of the diversification process. Under the strategic diversification orientation toward enterprise activity development, entrepreneurial risk reduction, internal redistribution of capital some of the researches determined the diversification efficiency by means of empirical and expert estimates. It is offered to use strategic criteria such as sales volume or

market share with diversification efficiency performance if reached synergistic effect on different types of business activity and competitive recovery.

Ukrainian economists suggest their own methods for business activity diversification efficiency for enterprises from different economic sectors. To our mind, it is necessary to emphasis the following ones.

Mazurenok O. [8, p.14-15] suggests to use a system with 8 ratios characterizing asset value, personnel work efficiency and enterprise profitability. The author also proposes to use the mentioned below analytical model for efficiency performance of diversification decision:

$$Ed = f(Rpd, PRdm, Rdmp, Rdcp, Rcad, Rpd, Rld, Rmd), \quad (2)$$

where

Rpd – profitability diversification ratio;

$PRdm$ – profitability ratio on diversification of the manufacturing process;

$Rdmp$ – ratio on diversification of the manufacturing process profitability;

$Rdcp$ – ratio on diversification of the capital productivity;

$Rcad$ – ratio on capital assets diversification;

Rpd – ratio on personnel diversification;

Rld – ratio on liquidity diversification of the enterprise assets;

Rmd – material/output diversification ratio.

Ye. F. Perehuda [9, p. 55-56] suggests a methodological approach for determination of ratio on agricultural enterprises diversification, which compares actual and basic levels of such indices as the number of types of products or goods, gross production volume, number of employees, and from this to identify the possibilities for diversification development:

$$Rdd = \sqrt[3]{Ip \cdot Iv \cdot Ie}, \quad (3)$$

where

Rdd – ratio on diversification development for an enterprise activity;

Ip – index on the number of types of products;

Iv – index on gross production volume;

Ie – index on number of employees at the enterprise;

t – term of implementation for the diversification project.

Thus, most of the known approaches for diversification efficiency performance are built upon the use of methods of investment project analysis, statistical methods of analysis, and also specific proprietary methods and algorithms for the diversification level for an enterprise. Each estimation method has its both advantages and disadvantages, which

specifies the use of a comprehensive approach to get the most objective and complete information on the diversification level for industrial enterprises.

III. METHODOLOGY AND MODEL SPECIFICATION

The implementation of business activity diversification promotes positive economy of scale at the enterprise which results in expenses decrease and enterprise profitability improvement. Consequently it will be followed with income increase and improvement of the staff material or financial position. Despite economic diversification properties, at determining its efficiency performance it is reasonably necessary to consider social and ecological results upon its implementation. As diversification implies business expansion, then the social aspect of diversification principally appears in employment creation. Diversification is also characterized by an ecological effect as long as business profitability rise enables to invest more in green production processes and waste products decline improves environmental conditions.

It's a matter of fact that diversification influences not only on business activity of an enterprise but on a country as a whole. The primary diversification effects at the macrolevel are the infrastructure development and domestic output volume increase.

Considering that the significant diversification effect can be achieved by positive results from effective diversification process both on enterprise quality of service (microlevel) and on country quality of service (macrolevel), we offer to use a system of criteria for business activity diversification which complements and covers these aspects and the disadvantages of the available approaches (Table 1).

TABLE I. SYSTEM OF CRITERIA FOR EFFICIENT DIVERSIFICATION CHANGE

Diversification effect	Criterion
Internal efficient diversification	
Economic	efficient use of fixed capital stock
	efficient use of circulating or working assets
	efficient use of human resources
	profitability and earning power
Social	prevent of staff reduction
	additional labor power intake in diversified types of activities
	pay rise to an employee
	advanced professional training to an employee
	management development
	working conditions improvement
External efficient diversification	
Economic	GTE output increase
	GTE taxation increase
	GTE capital expenditure increase
Social	pay rise to a GTE employee
	employment level increase
	working conditions improvement
Ecological	qualification and training level improvement
	introduction of environmentally friendly technologies, investment in green production processes
	natural resources use increase
	economic consequences of pollution

To summarize the efficient diversification change in any enterprise performance, we propose to use a complex integral indicator (coefficient) for efficient diversification.

The calculating steps and chains for efficient diversification change of the enterprise performance are demonstrated in Figure 1.

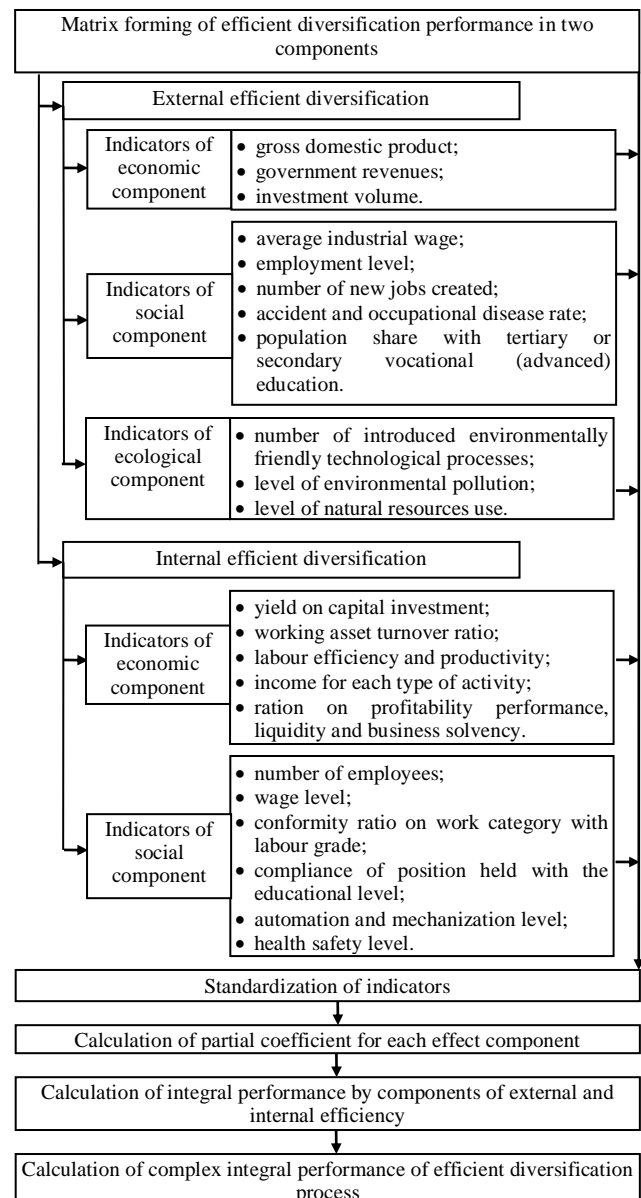


Fig. 1. Integral scoring model for efficient diversification change.

Though this process, it is suggested a method for efficient diversification of enterprise performance that is based on considering principal economic, social and ecological indices and provides calculations of partial indices followed by their further grouping into a complex integral index of efficient diversification.

In a point of fact a suggested methodological approach involves the determination of complex integral index of efficient diversification process upon three methodological levels. Specific indices of economic, social and ecological components for micro- and macrolevels are calculated at the first level; internal and external efficient diversification process is evaluated at the second level; and the final result is gained at the third level, that is a complex integral index of efficient diversification process.

It is suggested to determine the partial coefficient of economic, social and ecological components at the micro- and macrolevels due to the given below formula:

$$I_j^k = \sum_{i=1}^{n_j^k} v_{ij}^k \cdot r_{ij}^k, \quad (4)$$

where

v_{ij}^k – is a weight coefficient of i -factor j -effect component k -efficient components;

r_{ij}^k – index of i -factor j -effect component k -efficient components, gained with direct calculation method;

n – number of indices in a group.

Due to the developed approach, the sum of group weight coefficient should be equal to 1.

The weight coefficient values are defined with the Delphi method, which are based on the developed questionnaire form [10].

Index on internal efficiency of economic component:

$$I_{econ}^{int} = \sum_{j=1}^{n_{econ}^{int}} v_{iecon}^{int} \cdot r_{iecon}^{int}. \quad (5)$$

Index on internal efficiency of social component:

$$I_{soc}^{int} = \sum_{j=1}^{n_{soc}^{int}} v_{isoc}^{int} \cdot r_{isoc}^{int}. \quad (6)$$

Index on external efficiency of economic component:

$$I_{econ}^{ext} = \sum_{j=1}^{n_{econ}^{ext}} v_{iecon}^{ext} \cdot r_{iecon}^{ext}. \quad (7)$$

Index on external efficiency of social component:

$$I_{soc}^{ext} = \sum_{j=1}^{n_{soc}^{ext}} v_{isoc}^{ext} \cdot r_{isoc}^{ext}. \quad (8)$$

Index on external efficiency of ecological component:

$$I_{ecol}^{ext} = \sum_{j=1}^{n_{ecol}^{ext}} v_{iecol}^{ext} \cdot r_{iecol}^{ext}. \quad (9)$$

It is advisable to use the analogic approach for obtaining the integral results for efficient diversification performance on the internal and external efficiency components, but the weigh values are set not for a separate indicator or coefficient but for a separate effect component:

$$I^k = \sum_{j=1}^{m^k} v_j^k \cdot I_j^k, \quad (10)$$

where

v_j^k – weight coefficient of j -effect component k -efficient components;

I_j^k – value index of j -effect component k - efficient components;

m – number of groups of component indices.

Internal efficiency index:

$$I^{int} = v_{econ}^{int} \cdot I_{econ}^{int} + v_{soc}^{int} \cdot I_{soc}^{int}. \quad (11)$$

External efficiency index:

$$I^{ext} = v_{econ}^{ext} \cdot I_{econ}^{ext} + v_{soc}^{ext} \cdot I_{soc}^{ext} + v_{ecol}^{ext} \cdot I_{ecol}^{ext}. \quad (12)$$

The same method is used to evaluate the complex integral coefficient but the weight values are set for the internal and external efficiency components:

$$C_{ef,d} = v^{int} \cdot I^{int} + v^{ext} \cdot I^{ext}. \quad (13)$$

The given below gradation table is suggested to interpret the gained performance of activity diversification efficiency for the gas transportation enterprise based on the complex integrated indicator (Table 2).

TABLE II. GRADATION OF THE COMPLEX INTEGRATED INDICATOR FOR EFFICIENT DIVERSIFICATION PROCESS

Coefficient	Diversification efficiency
$C_{ef,d} < 1$	Business activity diversification is inefficient
$C_{ef,d} = 1$	Additional criteria or subtests shall be considered to determine the practicability of the efficient business diversification
$C_{ef,d} > 1$	Business activity diversification is efficient

Thus, the given integrated indicator accumulates the values of the corresponding total adjusted particular indicators to give a complex performance for efficient diversification process.

IV. RESULTS

For practical testing of the developed theoretic-and-methodological approaches for business diversification performance, adequate assessment of the suggested model and determination of efficient diversification change we have developed a strategy of diversification development for the Ukrainian gas transportation system. Table 3 demonstrates the detailed objectives of the business activity diversification for the gas transportation system of Ukraine.

TABLE III. ASSESSMENT INDICATORS FOR A TARGET STATUS OF THE DIVERSIFICATION STRATEGY

Indicator	2020	2022	2024
Share of traditional services by means of consumer diversification, %	5	10	15
Share of new types of products (services) based on the use of available equipment of auxiliary and service departments, %	3	6	10
Share of absolutely new types of products (services) production or manufacturing, %	0	3	5
Annual wage rise, %	5	5	5
Level of labour automation and mechanization, %	83	84	85
Loss of working hours due to industrial injuries and occupational diseases, %	2	1	0

For the proposed scenario of diversification for a typical gas transportation enterprise of Ukraine and considering the actual business information of the Ukrainian gas transportation enterprises [11; 12] it is estimated the values of partial indices of economic, social and ecological components at the micro- and macrolevels, group integral indicator of external and internal efficiency, as well as a complex integral indicator, Table 4.

TABLE IV. THE FORECASTED COMPLEX INTEGRATED INDICATOR FOR DIVERSIFICATION EFFICIENCY OF GAS TRANSPORTATION ENTERPRISE UNDER TYPICAL STRATEGY FOR BUSINESS DIVERSIFICATION IMPLEMENTATION

Effect group	2020	2022	2024
Internal efficiency of diversification			
Economic effect	1,057149	1,133066	1,2094
Social effect	1,03527	1,070954	1,105698
Ecological effect	1	1	1
Group integrating indicator for the internal efficiency	1,047058	1,107337	1,167720
External efficiency of diversification			
Economic effect	1,000071	1,000096	1,000108
Social effect	1,000001	1,000004	1,000007
Ecological effect	1	1	1
Group integrating indicator for the external efficiency	1,000043	1,000058	1,000066
Complex integrating indicator	1,037655	1,085881	1,134189

An efficient introduction of diversification strategy for gas transportation enterprise development is proved by the calculated values of partial performance indicators on each effect component, on components of internal and external efficiency and complex integrating indicator of efficient diversification process.

Considering the fact that the Plan of development of gas transportation system of Ukraine for 2018-2027 [11], which is aimed to diversification implementation, does not provide any ecological efforts, the index of ecological effect in the chosen horizon period of strategic planning equals 1.

The gained values provide evidence of social and economic orientation of suggested diversification means and their efficient performance in a case of introduction at the gas transportation enterprises of Ukraine.

V. CONCLUSIONS

So, there has been proposed a model for calculating a complex integrated indicator of the efficiency of the enterprise diversification process, based on the use of a three-level hierarchical system of indicators. The peculiarity and novelty of the proposed approach is in the use of a set of indicators that allow us to comprehensively characterize the consequences and efficiency of diversification changes, and on the basis of their hierarchical structuring, to obtain consolidated integrated estimates for the micro- and macrolevels. The combination of indicators of the lower hierarchical level allows us to evaluate the individual components of diversification effects, such as economic, social and ecological. The indicators of the second hierarchical level allow us to assess the impact of diversification changes at the enterprise level (micro level) and the country level (macro level) through indices of

internal and external efficiency. A consolidated integrated assessment of the cumulative effects of diversification changes (the third level of the hierarchy) is characterized by the proposed complex integrated indicator of the efficiency of the enterprise diversification process.

This methodical approach to the performance of business activity diversification has been tested on the individual Ukrainian gas transportation enterprises and it can be used to predict the results of diversification changes under large-scale market fluctuations. It has been proved that the production diversification positively influences on their performance efficiency, improves income level, enables to diversify manufacturing and market risks, offers financial opportunities for technical production modernization, reliability grows of natural gas transportation, improves the use of manufacturing or production resources and also gives a chance to create additional employment, advances staff qualification and working conditions.

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