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## Evaluation of the Efficiency of Enterprises by the Method of Analysis of Functioning Environment

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### Abstract:

The purpose of the research is to assess the efficiency of enterprises by the means of analysis of the functioning environment, which made it possible to identify reserves for improving the results of their economic activity. For the first time, it was proposed to use the positioning (relocation) technique of enterprise positions, although previously the method of analysis of the functioning environment was used to determine the technical inefficiency of business entities. Based on the calculated line of technical efficiency on the actual results of the enterprises, a new line of technical efficiency was constructed by moving their positions to improve the income (revenue) from sales of products and labor costs of hired workers and capital (fixed assets) in the context of maximizing profits in the environment functioning of economic entities. It is proved that improvement of the position of an enterprise allows reducing expenses not only on capital, but also on wages of hired workers. Despite the ability to reduce capital expenditures and thus increase the cost of wage labor, almost all enterprises prefer saving capital over the possibility of investing in wage earners. The results of the study can be used by managers in planning the ways to achieve profit in the context of the sustainable development strategy of the enterprise.

**Keywords:** efficiency; profit; income; labor costs; capital expenditure; enterprise; method of analysis of the functioning environment; Ukraine.

**JEL Classification:** D24; M20; O12; Q56.

### Introduction

Profit achievement is a prerequisite for the functioning of the entity. At the same time, an urgent problem of the adequacy of profit arises, proceeding from the volume of sales of products and expenses for its production. Therefore, the profit as the final result of the enterprise should be evaluated not only in terms of financial efficiency, but also in terms of technical and social efficiency.

Taking into consideration the importance of financial efficiency, it is possible to assess the activity of enterprises in terms of technical efficiency using elements of the method analysis of the functioning environment. This means that the profitability analysis of business entities is used as an auxiliary tool for the achievement of technical efficiency.

The method of analysis of the functioning environment, as a rule, is used to assess the effectiveness of natural monopolies, but it can be used to assess the economic performance of production enterprises, which allows to identify opportunities to increase revenue (income) from sales of products and reduce costs, compared with the effectiveness of other sub- objects of management. For managers, this is important for planning revenue streams in the context of the sustainable development strategy of the enterprise: to maximize profits under any conditions or maximizing sales when minimum profit is reached.

The success of an enterprise is a victory in a competitive struggle and is measured not only by the volume of profit, but also by the market share occupied by the business entity. As a result, there is a debate in science about the importance, on the one hand, of maximizing the volume of sales of products, and, on the other hand, maximizing profits. As a result of communication with the managers of leading companies, Baumol (1967) concludes that the advantage of maximizing the volume of sales even under conditions of profit limitation. Thaler (2014) believed that there is a point of equilibrium in which some firms are ready to reduce their profits for the sake of their growth. Such firms take market shares from competitors that maximize profits, but not vice versa. Fischer, Dornbusch and Schmalenzi (1995) point out that «no firm accepts neither its engineering nor its economic decisions once and for ever. Firms are constantly trying to find more cost effective (that is, less costly) methods of production». Thus, using the usual production function, we can determine the optimal combination of resources, which allows to reach the maximum output.

Holmström (1979) made a significant contribution to the theory of contracts, which, with the help of econometric methods, proved that information in transactions allows to evaluate the efficiency not by the volume of earned profits, but by assessing the dynamics of profit compared with other enterprises. In its turn, the need to expand an enterprise by concluding profitable contracts, Coase (2007) formulated as follows: «the firm becomes larger when additional transactions (for coordination of which it would be possible to use the mechanism of prices) are organized by the entrepreneur, and it becomes smaller when he refuses the organization of such transactions».

Victory in the market, profit maximization is also the result of politicization of economic relations. An example is the approach of Becker (2003), who determined that the economic approach to the analysis of political behavior implies that, in reality, the political choice made by individuals and the whole group is determined by their attempt to satisfy their own interests. Proceeding from the features of political competition, Becker (2003) makes two important conclusions based on his theorems:

- the success of the group is determined not by absolute indicators of its effectiveness, but by their correlation with the performance indicators of other groups;
- the likelihood of taking measures that increase efficiency is greater than the likelihood of taking measures that reduce it.

Social efficiency can be considered in the context of human capital formation. Human capital is a measure of a person's ability incarnation to generate income. Human capital includes innate abilities and talent, as well as education and qualifications Fischer, Dornbusch and Schmalenzi (1995, 303). It is believed that the natural ability of a person is difficult to measure, but the availability of education, according to scientists, increases productivity.

The study should use the same parameters as in the example given by Farrell (1957) – labor costs and cost of capital. Such a decision is substantiated by the significance of these indicators in terms of ensuring the economic activity of the enterprise, since labor costs allow to assess the effect of remuneration on the financial result (social efficiency), and the cost of capital is the scale of the enterprise indicator.

In their studies, Lulaj and Izeni (2018) argue that the number of products produced positively affects the value of sales of enterprises and increases profits to the production business environment. In addition, the authors conclude that there is an important relationship between production and sales, and CVP analysis contributes to the profitability and break-even in the business environment.

The Data Envelopment Analysis (DEA) method is widely used to study the performance of enterprises in various industries. So, Seviņ and Eren (2019), DEA, BBC and CCR, carried out an analysis of the efficiency of 82 enterprises operating in the automotive sector. Fenyves, Tarnóczy and Zsidó (2015), using the DEA method, evaluated the financial efficiency of agricultural enterprises. Moreover, Pasichnyk, Kucher and Khirivskiy (2015), using the DEA method, evaluated the efficiency of agrarian enterprises of various organizational and legal forms and sizes of land use.

To assess the technical efficiency of the enterprise on the basis of the accounting data, Oberholzer (2014) also applied the approach to the analysis of the functioning of the environment. Marjanović, Stanković and Popović (2018) used the same method to evaluate the effectiveness of commercial banks on the basis of financial indicators, Smriti, Khan (2018) analyzed the efficiency of the operation of manufacturing enterprises, and Cesaroni (2018) determined the economic efficiency of industry. The wide application of the DEA method is also demonstrated by Emrouznejad, Yang (2018), Khezrimotlagh *et al.* (2019). Scientists Lynenko, Konyev (2017) assess the financial security of enterprises, Dudoglo proposes an unconventional approach to the assessment of efficiency (2018), Parmacli *et al.* (2019) proposes methodical bases of graduation of indicators of efficiency, Nikoomaram measures the efficiency of enterprises using financial variables (2010).

At the same time, the problem remains to resolve the problem of determining the optimal for the environment of functioning of technically efficient enterprises the magnitude of income (proceeds) from sales of products and labor costs for wage earners and capital expenditures (fixed assets) in relation to the maximum possible profit of economic entities.

## 1. Materials and Methods

The purpose of the research is to assess the performance of enterprises by the method of analysis of the functioning environment, which made it possible to identify reserves for improving their economic activity results. The research uses the method of analysis of the functioning environment for placing the positions of the enterprises under study and their displacement carried out to find the improved positions by geometric design, which allows conducting an assessment based on the adequacy of the profit received by the subjects of management.

Study methodology envisaged its implementation according to the following algorithm:

1. The rating is based on the data of Vinnytsia region enterprises of the mechanical engineering industry.
2. The rating of the enterprises was made according to the financial result, which allowed to identify three groups of enterprises – loss – making, with a profit of up to 1 million UAH, and with profit more than 1 million UAH.
3. Using the method of analysis of the functioning environment, the coefficients of covering the income (revenue) from the sale of the products of labor costs of employees and capital expenditures (fixed assets) are calculated, and the technical efficiency line is constructed in order to achieve maximum profit.
4. Using geometrical design methods the functioning environment analysis method, a new line of technical efficiency with improved positions of the most profitable subjects of management was constructed.
5. For enterprises that have improved their position in the operating environment, new (improved) value of income (proceeds) from sales of products and labor costs for hired workers and capital expenditures (fixed assets) has been calculated.
6. Conclusions are made regarding the possibility of increasing the profit of these enterprises as a result of changes in income (revenue) from sales of products and labor costs of employees and capital expenditures (fixed assets).

## 2. Results and Discussion

According to the results of 22 machine-building enterprises of the Vinnytsia region in 2017 (Table 1), three groups of business entities can be distinguished as follows:

- eight enterprises, which, according to the results of management, received a loss;
- five enterprises whose activities were profitable, while the profit was less than 1 million UAH;
- nine enterprises, the size of profit from the performance of which exceeded 1 million UAH.

According to Baumol's (1967) theory, the achievement of minimum profitability is a sufficient motivation to increase sales (growth of sales revenue). The effectiveness of economic activity is reflected by the financial result, that's why the greater the profit, the greater the efficiency of the enterprise. Therefore, the most effective economic entity was PJSC «Plasmatek», that received the highest profit compared to other economic entities.

As known, the level of profit depends on the proceeds from sales of products and expenses, which allows us to consider approaches to achieving efficiency not only through maximizing the financial result, but also through the marginal approach to assessing the effectiveness (M. Farrell's analysis of the functioning environment). To do this, it is necessary to determine the ratio of income (revenue) from the sale of capital expenditures (fixed assets) ( $K / Y$ ) and the ratio of income (revenue) to the sale of labor costs ( $L / Y$ ) products.

The calculation of these coefficients (Table 1) and the construction of the technical efficiency line (Figure

1) allowed us to identify the adequacy limits of covering the income (revenue) from the sale of capital expenditures (fixed assets):

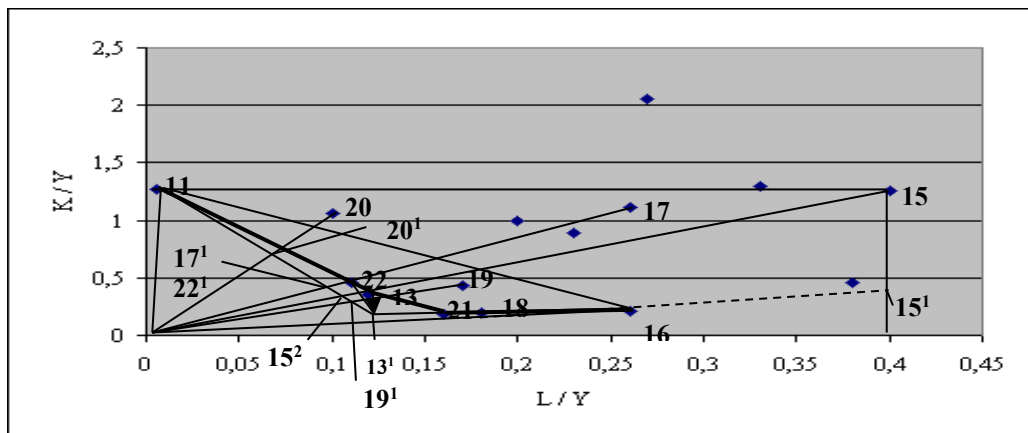
- sufficiency of income and / or minimum capital costs (fixed assets) ( $K / Y < 1$ ), indicating a high profit probability (out of 22 surveyed enterprises only for two, where such a condition was met, a loss was received in 2017);
- minimum income shortage and / or minimal capital expenditures (fixed assets) ( $1 < K / Y < 2$ ), which indicates a high probability of profit, but there are opportunities for increasing the efficiency of capital use (fixed assets) by reorienting the development of other types of economic activity at the enterprise;
- significant income deficiency and / or significant overcapacity (fixed assets), indicating a high probability of loss or «ineffective» profit.

Table 1. Rating of machine-building enterprises of the Vinnytsia region by financial results in 2017

№	Enterprise	Code for QED	L/Y	K/Y	Financial result, thousand UAH
<i>Loss-taking enterprises</i>					
1	PJSC «Khmilnysilmash»	28.30	9.61	121.46	-1950
2	PJSC «Kalinovsky District Enterprise «Agromash»	28.30	0.20	0.99	-572
3	PJSC «Mogiliv-Podilsky Gas Equipment and Devices Plant»	26.51	0.42	7.00	-306
4	PJSC «Shargorod District Enterprise «Agromash»	25.11	0.23	0.89	-259
5	PJSC «Vinnytsya Specialized Enterprise «Remtechsilmash»	68.20	0.33	1.30	-230
6	PJSC «Bershadsky District Enterprise «Agromash»	33.12	0.23	9.06	-133
7	PJSC «Vinnitsa Auto-Special Equipment»	33.12	0.27	2.06	-132
8	PJSC «Hercules»	28.30	1.22	1.22	-128
<i>Enterprises with profits up to 1 million UAH</i>					
9	PJSC «Nemyrivske District Enterprise «Agromash»	33.12	1.32	10.36	55.4
10	PJSC «Autoelectro equipment»	27.40	1.94	30.63	82
11	PJSC Trostianetsky District Enterprise «Agromash»	68.20	0.006	1.27	115
12	PJSC «Enterprise «Medtehnika»	33.13	0.38	0.46	243
13	PJSC «Dashivsky Repair and Mechanical Plant»	24.51	0.12	0.35	954
<i>Enterprises with profits over 1 million UAH</i>					
14	PJSC «Vinnytsia Plant «Budmash»	25.11	0.24	8.81	1200
15	PJSC «Bershad Electrotechnical Plant»	27.12	0.40	1.26	1365
16	PJSC «Yampolsky Instrument-Making Plant»	26.51	0.26	0.21	2789
17	PJSC «Mohyliv-Podilsky Machine-Building Plant»	28.93	0.26	1.11	3755
18	PJSC «Mayak»	27.51	0.18	0.20	4818
19	PJSC «Barsky Machine-Building Plant»	28.93	0.17	0.43	6404
20	PJSC «Vinnytsia Research Plant»	28.29	0.10	1.06	6641
21	PJSC «Kalinovsky Machine-Building Plant»	28.93	0.16	0.18	10406
22	PJSC «Plasmatek»	25.93	0.11	0.46	143855

Source: author's calculations.

Figure 1. The technical efficiency line of machine-building enterprises formation of the Vinnytsia region in order to achieve maximum profit



Source: own composition based on the own research.

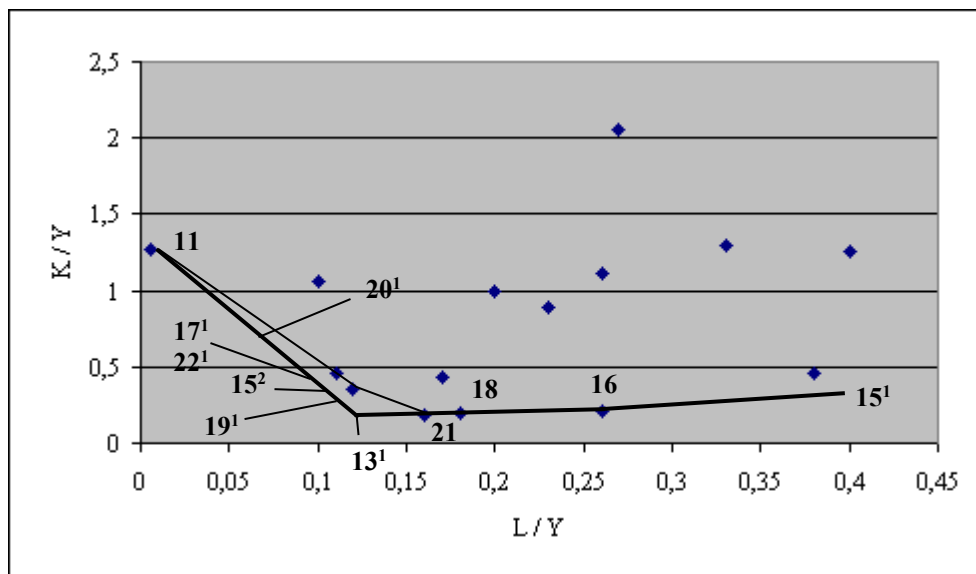


In the latter case, «ineffective» is profit, the size of which does not reflect the adequacy of both income and labor costs and capital (fixed assets). As a result, PJSC «Nemyrivske District Enterprise Agromash», PJSC «Avtoelektroaparatura» and PJSC «Vinnytsia Plant «Budmash» received profits in insufficient amount to preserve the main type of economic activity and to provide motivation for employees.

The technical efficiency line consists of the following items: 11 (PJSC «Trostyanetske regional enterprise «Agromash »), 22 («Plasmatek» PJSC), 13 (PJSC «Dashiv repair and mechanical plant»), 21 (PJSC «Kalinovsky machine-building plant»), 18 (PJSC «Mayak»), 16 (PJSC «Yampil'sky Instrument-Making Plant»). If we consider as the most acceptable option (in this case) a situation where the profit exceeds 1 million UAH, then the line of technical efficiency should consist of the positions of enterprises at numbers 14-22 (9 enterprises). Thus, on the existing line of technical efficiency, enterprises are not represented by the numbers of positions 14, 15, 17, 19, 20, but there are positions of enterprises by numbers 11 and 13, despite the fact their income in 2017 was lower than 1 million UAH.

Moving positions of enterprises along the axis of abscissa and ordinates will reveal new positions and, on the basis of them, determine the possibilities of growth of income (revenue) from sales of products and optimization of expenses on capital (fixed assets) and wages of wage earners. Moving method is based on the implementation of the principles of graphical relationship between the subjects of management (Figure 2).

Figure 2. Estimated and improved lines of the technical efficiency of machine-building enterprises of the Vinnytsia region



Source: own composition based on the own research.

Positions with the mark «1» are the positions of those enterprises that can improve their position based on the need to increase income (revenue) from sales of products and optimize costs. Each such position has its own formation sequence:

Position 15<sup>1</sup> – by connecting the elongation of the segment 0–16 (through the position of the «effective» enterprise of PJSC «Yampil'sky Instrument-Making Plant») with a perpendicular from the position of PJSC «Bershad Electrotechnical Plant». Therefore, this position has been improved for the last entity.

Position 13<sup>1</sup> – by connecting the lengthening of segment 16–21 («effective» enterprises of PJSC «Yampil'sky Instrument-Making Plant» and PJSC «Kalinovsky Machine-Building Plant») with a perpendicular from the position of PJSC «Dashivsky Repair and Mechanical Plant».

Positions 15<sup>2</sup>, 17<sup>1</sup>, 19<sup>1</sup>, 20<sup>1</sup>, 22<sup>1</sup> – in two stages: the first is to build the line 11–13<sup>1</sup> through the connection of the positions of the PJSC «Trostyanetske regional enterprise «Agromash» and Prashat «Dashivsky repair and mechanical plant»; the second – finding on the line 11–13<sup>1</sup> positions from the intersection with lines 0–15, 0–17, 0–19, 0–20.0–22. Thus, the improved positions of enterprises by numbers 15, 17, 19, 20 and 22 are reflected in the new line of technical efficiency by the method of calculating technical efficiency coefficients.

As a result of carried out actions to increase technical efficiency by taking into consideration the positions of the most profitable machine-building enterprises, a new line of technical efficiency was constructed: 11–17<sup>1</sup>–22<sup>1</sup>–15<sup>2</sup>–19<sup>1</sup>–13<sup>1</sup>–21–18–16–15<sup>1</sup> (Figure 2).

Built improved technical efficiency line of the machine-building enterprises of the Vinnytsia region has

been shown as follows:

- five business entities from the group of the most profitable enterprises (over 1 million UAH) managed to improve their positions due to the technical efficiency achievement: 15 (PJSC «Bershad Electrotechnical Plant»), 17 (PJSC «Mohyliv-Podilsky machine-building plant»), 19 (Barsky Machine-Building Plant), 20 (PJSC «Vinnytsia Research Plant»), 22 (PJSC «Plasmatek»);
- PJSC «Bershad Electrotechnical Plant» (15) is the only one investigated by the enterprise, the improvement of which position was carried out both by search of optimal projection, and through the use of elements of calculating the coefficient of technical efficiency;
- in a group of the most profitable enterprises (over 1 million UAH), a person whose parameters (income (revenue) from sales of products, capital expenditures (fixed assets) and wages of wage earners) were found to prevent the search for improved positions on lines of technical efficiency. This proved to be (14) PJSC Vinnytsia Plant «Budmash»;
- in the group of enterprises with a profit of less than 1 million UAH a business entity (13 PJSC «Dashivsky Repair and Mechanical Plant») was found which has the opportunity to increase the technical efficiency by using the optimal for this environment functioning of the parameters of income (proceeds) from sales of products, capital expenditures (fixed assets), as well as expenses to pay for hired workers;
- among the group of enterprises with a profit of less than 1 million UAH a business entity was identified (11 Trostyanets District AgroMash Company) with the possibility of forming an orientation to improve the technical efficiency line, since the position of this enterprise is the upper limit of the efficiency line, calculated on the basis of the coefficients of covering the income (revenue) from sales of products, costs to pay wage earners and capital expenditures (fixed assets), and therefore, it's inappropriate to change its location even with low profit;
- the location of the three most profitable enterprises in the calculation line of technical efficiency 16 (PJSC «Yampil'sky Instrument-Making Plant»), 18 (PJSC «Mayak»), 21 (PJSC «Kalinovsky Machine-Building Plant»), the position of which to improve is inappropriate, as their profit for all other indicators of economic activity is optimal, and therefore they are benchmarks for the positions of other economic entities.

Based on the configuration of the improved technical efficiency line, we will graphically define the ratio of income (revenue) from the sale of capital expenditures (fixed assets) for PJSC «Dashivsky Repair and Mechanical Plant», PJSC «Bershad Electrotechnical Plant», PJSC «Mohyliv-Podil'skyi Machine-Building Plant», PJSC Barskiy Machine-Building Plant «Vinnytsia Research Plant», PJSC «Plasmatek» (Table 2).

Table 2. Calculation of the improved indicators of the ratio of income (revenue) from the sale of capital goods (fixed assets)

Enterprise	$p1 = \frac{K^1}{Y^1}$	$K^1 = K; Y^1 = K/p1$	$Y^1 - Y$	$Y^1 = Y; K^1 = Y \cdot p1$	$K - K^1$
PJSC «Dashivsky Repair and Mechanical Plant»	0.20	$6480/0.2 = 32400$	14148	$18252 \cdot 0.20 = 3650$	2830
PJSC «Bershad Electrotechnical Plant»	0.35	$10567/0.35 = 0191$	21801	$8390 \cdot 0.35 = 2937$	7630
PJSC «Mohyliv-Podil'sky Machine-Building Plant»	0.45	$71881/0.45 = 159735$	94981	$64754 \cdot 0.45 = 29139$	42742
PJSC «Barsky Machine-Building Plant»	0.25	$60490/0.25 = 241960$	100178	$141782 \cdot 0.25 = 35445$	25045
PJSC «Vinnytsia Research Plant»	0.70	$46571/0.70 = 66530$	22461	$44069 \cdot 0.70 = 30848$	15723
PJSC «Plasmatek»	0.40	$618112/0.40 = 1545280$	210056	$1335224 \cdot 0.40 = 534090$	84022

Note:  $p1$  – graphically determined coefficient of income coverage (revenue) from sales of products ( $Y^g$ ) of capital expenditures (fixed assets) ( $K^g$ );

$K$  – cost of capital (fixed assets) by results of enterprises in 2017;

$K^1$  – capital expenditures (fixed assets) calculated as a result of improvement position of the enterprise;

$Y$  – income (revenue) from sales of products by results of enterprises in 2017;

$Y^1$  – income (revenue) from sales of products, calculated as a result of position of the enterprise improvement.

Source: author's calculations.

While calculating the income (revenue) from sales of products for a better position of the enterprise ( $Y^1$ ), the indicator of improvement in the use of capital (fixed assets) is not taken into account and taken at the level of the indicator achieved by the results of activity in 2017 ( $K^1 = K$ ). The difference between the income (revenue) from sales of products, which is calculated as a result of the improvement of the enterprise position ( $Y^1$ ) and income (revenue) from sales of products by the results of the enterprises in 2017 ( $Y$ ), confirms a significant increase of this indicator for all business entities due to implementation of the proposed methodology.

Determination of the cost of capital (fixed assets), calculated as a result of improvement of the position of the enterprise ( $K^1$ ), is carried out under the condition of equalization of income (proceeds) from sales of products,

calculated as a result of improvement enterprise position of the income (revenue) from sales of products by results of enterprises in 2017 ( $Y^1 = Y$ ). The difference ( $K-K^1$ ) is the result of an improvement in the enterprise due to the reduction in the cost of capital (fixed assets).

Thus, it can be argued that the approximation of the coefficient of income coverage (revenue) from the sale of capital expenditures (fixed assets) to zero, allows to increase profits both through the growth of income (revenue) from sales of products, as well as the reduction of costs of capital (fixed assets).

Table 3. Calculation of improved indicators of coverage ratio by income (revenue) from sales of labor costs for wage earners

Enterprise	$p_2 = \frac{L_9}{Y_9}$	$L^1=L;$ $Y^2=L/p_2$	$Y^2-Y$	$Y^2=Y;$ $L^1= Y \cdot p_2$	$L-L^1$
PJSC «Bershad Electrotechnical Plant»	0.104	$3358/0.104 = 32288$	23898	$8390 \cdot 0.104 = 873$	2485
PJSC «Mohyliv-Podilsky Machine-Building Plant»	0.049	$17064/0.049 = 348245$	283491	$64754 \cdot 0.049 = 3173$	13891
PJSC «Barsky Machine-Building Plant»	0.113	$23970/0.113 = 212124$	70342	$141782 \cdot 0.113 = 16021$	7949
PJSC «Vinnytsia Research Plant»	0.067	$4511/0.067 = 67328$	23259	$44069 \cdot 0.067 = 2953$	1558
PJSC «Plasmatek»	0.049	$151738/0.049 = 3096694$	1761470	$1335224 \cdot 0.049 = 65426$	86312

Note:  $p_2$  – graphically determined coefficient of coverage of income (revenue) from sales of products ( $Y_9$ ) of labor costs for hired workers ( $L_9$ );

$L$  – expenses on wages of employees according to the results of the enterprises in 2017;

$L^1$  – the cost of wage labor, calculated as a result of improvement of the position of the enterprise;

$Y$  – income (revenue) from sales of products by results of enterprises in 2017;

$Y^2$  – income (revenue) from sales of products, calculated as a result of improvement of the position of the enterprise.

Source: author's calculations.

The calculation of the improved indicators of income (revenue) ratio from the sale of products to the cost of wage labor (Table 3) has the following features:

- absence of directions for indicators improvement of this coefficient for PJSC «Dashivsky Repair and Mechanical Plant», since the position of this entity did not change its position on the axis of abscissa;
- PJSC «Bershad Electrotechnical Plant» orientation is carried out at position  $15^2$ , since it reflects the change along the abscissa, while  $15^1$  is the only direction perpendicular to this axis.

The estimated coefficient of income coverage (revenue) from sales of labor costs for wage earners ( $p_2$ ) is a graphical assessment basis of the improved income (revenue) from sales of products and labor costs for wage earners (Table 3).

The implementation of the optimization measures (Table 2, 3) made it possible to identify the possibility of increasing the income (revenue) from sales of products as a result of taking into account the costs of both capital (fixed assets) and the payment of wage earners.

Naturally, the indicators of income (revenue) from the sale of products of business entities ( $Y^1$  and  $Y^2$ ) do not match (Table 4).

Table 4. Estimation of income (revenue) from sales of products and profit as a result of changing positions of machine-building enterprises of the Vinnytsia region

Enterprise	Income (revenue) from sales of products, thousand UAH	Profit, thousand UAH
PJSC «Bershad Electrotechnical Plant»	$(Y^1 - Y) < (Y^2 - Y)$	$(Y^1 - Y) > \Pi < (Y^2 - Y)$
PJSC «Mohyliv-Podilsky Machine-Building Plant»	$(Y^1 - Y) < (Y^2 - Y)$	$(Y^1 - Y) > \Pi < (Y^2 - Y)$
PJSC «Barsky Machine-Building Plant»	$(Y^1 - Y) > (Y^2 - Y)$	$(Y^1 - Y) > \Pi < (Y^2 - Y)$
PJSC «Vinnytsia Research Plant»	$(Y^1 - Y) < (Y^2 - Y)$	$(Y^1 - Y) > \Pi < (Y^2 - Y)$
PJSC «Plasmatek»	$(Y^1 - Y) < (Y^2 - Y)$	$(Y^1 - Y) > \Pi < (Y^2 - Y)$

Source: author's calculations.

The fact that each of the above differences (Table 4) is higher than the profit due to the results of the enterprises in 2017 indicates a lack of income (revenue) from sales of products, which affected both the efficiency of the use of capital (fixed assets) and labor costs for hired workers. As a result, optimization of labor costs for wage earners will only increase income (revenue) from sales of goods larger than capital requirements (fixed assets) in only one case (PJSC «Barsk Machine-Building Plant»).

Reducing costs for an entrepreneur is an important component of economic activity. However, labor costs are not only economic, but also social value. In conditions of economic development, wage increases are the

main requirement of effective functioning of a business entity. In this context, financial efficiency is assessed on the basis of the ratio of wage labor costs to labor costs (fixed assets) (Table 5).

Improving the position of the company can reduce costs not only on capital (fixed assets), but also on the payment of wage earners. Despite the possibility of reducing capital expenditures (fixed assets) and thus increasing the cost of wage labor, all enterprises (except PJSC «Plasmatek») prefer saving capital (fixed assets) over the possibility of investing in wage earners.

Table 5. Estimation of the cost of wage labor and capital expenditures (fixed assets) in the context of profit achieved as a result of changing positions of machine-building enterprises of the Vinnytsia region

Enterprise	Expenses on capital (fixed assets) and wages of hired workers, thousand UAH	Profit, thousand UAH
PJSC «Bershad Electrotechnical Plant»	$(K - K^1) > (L - L^1)$	$(K - K^1) > \Pi < (L - L^1)$
PJSC «Mohyliv-Podilsky Machine-Building Plant»	$(K - K^1) > (L - L^1)$	$(K - K^1) > \Pi < (L - L^1)$
PJSC «Barsky Machine-Building Plant»	$(K - K^1) > (L - L^1)$	$(K - K^1) > \Pi < (L - L^1)$
PJSC «Vinnytsia Research Plant»	$(K - K^1) > (L - L^1)$	$(K - K^1) > \Pi > (L - L^1)$
PJSC «Plasmatek»	$(K - K^1) < (L - L^1)$	$(K - K^1) < \Pi > (L - L^1)$

Source: author's calculations.

Attention is also drawn to the profit figures of PJSC Vinnytsia Research Plant and PJSC «Plasmatek». While most businesses, having the opportunity to reduce capital expenditures (fixed assets) and wage labor costs, receive insufficient profits, PJSC Vinnytsia Research Plant was able to increase its profits through the rational use of personnel, while PJSC «Plasmatek», in addition to the above, was not only able to increase its profits through the rational use of personnel but also from the use of capital (fixed assets).

## Conclusions

The study made it possible to reaffirm the opinion that the assessment of enterprise efficiency should be carried out not only on the basis of the profit indicator, but also in compliance with the functioning environment in terms of the amount of expenditure income (revenue) from the sale of products. The current rating of enterprises on the financial result allowed to identify three groups of enterprises – loss-making, with a profit of up to 1 million UAH, and with a profit of more than 1 million UAH. Using the analysis of the functioning environment method, the coefficients of covering the income (revenue) from the sale of production costs employees' wages and salaries and capital expenditures were calculated; a technical efficiency line was constructed in order to achieve maximum profit. Thus, these coefficients calculation and the construction of a line of technical efficiency have allowed to identify the limits of the adequacy of coverage of income (revenue) from the sale of products capital expenditure. As a result of actions to enhance technical efficiency, taking into consideration the positions of the most profitable enterprises, a new line of technical efficiency has been constructed that made it possible to identify economic entities that were able to improve their positions through technical efficiency achievement, which has the opportunity to enhance technical efficiency and those whose positions are improperly improved. Possibilities to increase income from sales of products and reduction of labor costs for hired workers and capital expenditures are considered, taking into consideration the received profit adequacy.

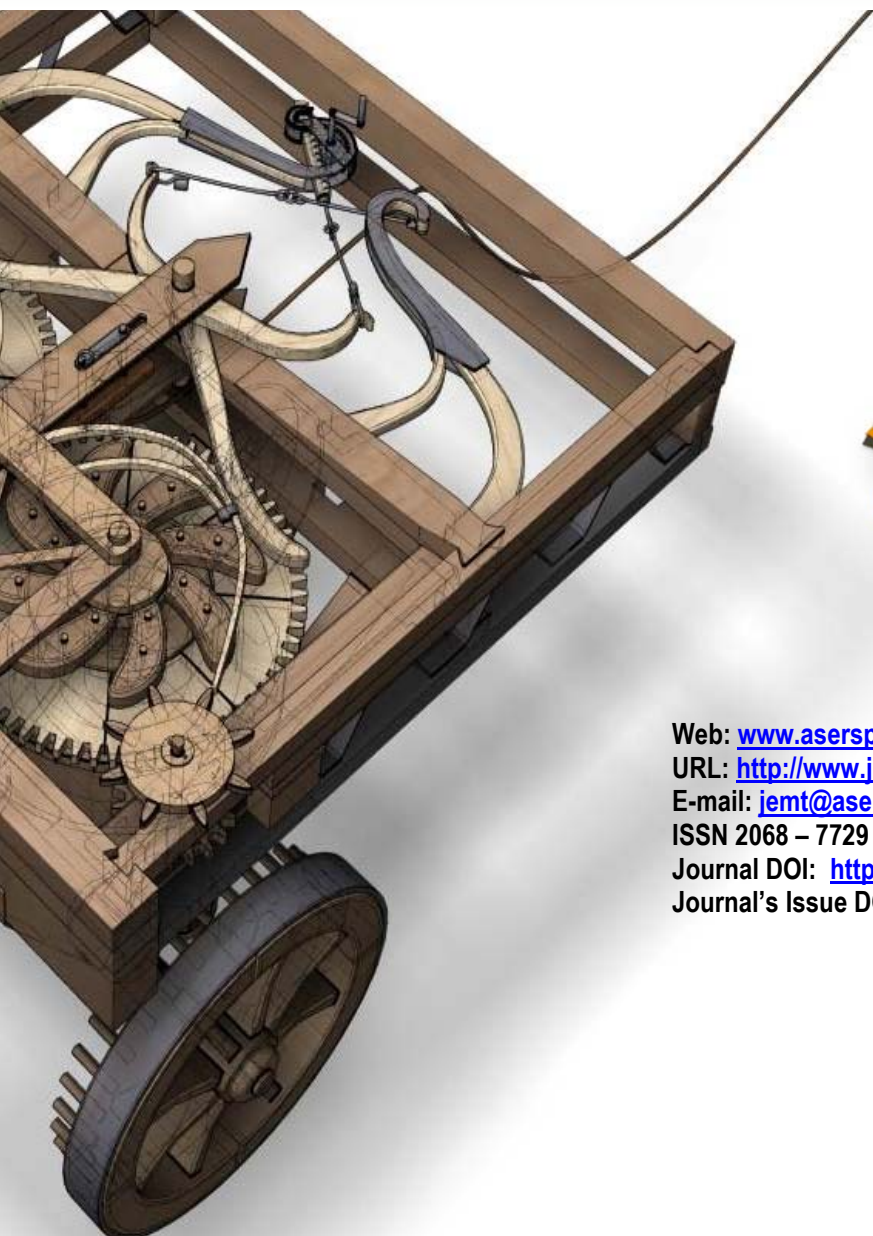
The results of the calculations showed that even the most profitable enterprises cannot maximize their income (revenues) from sales of products and optimize costs. As a result, business entities achieve profits that are insufficient to address the development of a particular industry. In this context, further research should be conducted in the direction of determining such profits, which will ensure the adequacy of production and justify the need to increase the cost spent of wage labor.

## References

- [1] Baumol, W. 1967. *Business Behavior, Value and Growth*. New York, Harcourt Brace.
- [2] Becker, G.S. 2003. *Human behavior: an economic approach*. Moskow, Publishing House GU VSHE.
- [3] Cesaroni, G. 2018. Industry cost efficiency in data envelopment analysis. *Socio-Economic Planning Sciences*, 61: 37–43. DOI: 10.1016/j.seps.2017.01.001
- [4] Coase, R. 2007. *Company, market and law*. Moskow, Publishing House «Novoe izdatelstvo».
- [5] Dudoglo, T. 2018. Non-traditional approach to assessment of efficiency of agricultural production. *Agricultural*

- and Resource Economics: International Scientific E-Journal*, 4(1): 60–76. Available at: <http://are-journal.com>.
- [6] Emrouznejad, A. and Yang, G. 2018. A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016. *Socio-Economic Planning Sciences*, 61: 4–8. DOI: 10.1016/j.seps.2017.01.008
- [7] Farrell, M. J. 1957. The Measurement of Productive Efficiency. *Journal of Royal Statistical Society*, 120(3): 253–290. DOI: 10.2307/2343100
- [8] Fenyves, V., Tarnóczy, T. and Zsidó, K. 2015. Financial Performance Evaluation of Agricultural Enterprises with DEA Method. *Procedia Economics and Finance*, 32: 423–431. DOI: 10.1016/S2212-5671(15)01413-6
- [9] Fisher, S., Dornbush, R. and Shmalenzi, R. 1995. *Economics*. Moskow, Publishing House Delo LTD.
- [10] Holmström, B. R. 1979. Moral Hazard and Observability. *Bell Journal of Economics*, 10(1): 74–91. DOI:10.2307/3003320.
- [11] Khezrimotlagh, D., Zhub, J., Cookd, W. D. and Toloee, M. 2019. Data envelopment analysis and big data. *European Journal of Operational Research*, 274 (3): 1047–1054. DOI: 10.1016/j.ejor.2018.10.044
- [12] Lulaj, E. and Iseni, E. 2018. Role of Analysis CVP (Cost-Volume-Profit) as Important Indicator for Planning and Making Decisions in the Business Environment. *European Journal of Economics and Business Studies* 4(2): 104–120. DOI: 10.26417/ejes.v4i2.p104-120
- [13] Lynenko, A. and Konyev, V. 2017. Assessment of financial security of enterprises association participants. *Agricultural and Resource Economics: International Scientific E-Journal*, 3(4): 85–96. <http://are-journal.com>.
- [14] Marjanović, I., Stanković, J. J. and Popović, Ž. 2018. Efficiency Estimation of Commercial Banks Based on Financial Performance: Input Oriented DEA CRS/VRS Models. *Economic Themes*, 56(2): 239–252. DOI:10.2478/ethemes-2018-0014
- [15] Nikoomaram, H., Mohammadi, M. and Mahmoodi, M. 2010. Efficiency measurement of enterprises using the financial variables of performance assessment and data envelopment analysis. *Applied Mathematical Sciences*, 4(37): 1843–1854. <http://www.m-hikari.com/ams/ams-2010/ams-37-40-2010/nikoomaramAMS37-40-2010.pdf>.
- [16] Oberholzer, M. 2014. A model to estimate firms accounting-based performance: a data envelopment approach. *International Business & Economics Research Journal*, 13(6): 1301–1314. DOI:10.19030/iber.v13i6.8921
- [17] Parmacli, D., Soroka, L. and Bakhchivanji, L. 2019. Methodical bases of graduation of indicators of efficiency of realized production in agriculture. *Agricultural and Resource Economics: International Scientific E-Journal*, 5(1): 107–121. <http://are-journal.com>.
- [18] Pasichnyk, T.V., Kucher, A. V. and Khirivskyi, R. P. 2015. Efficiency of agricultural enterprises of various organizational and legal forms and the size of land use. *Actual Problems of Economics*, 175(1): 399–405.
- [19] Sevinç, A. and Eren, T. 2019. Determination of KOSGEB Support Models for Small- and Medium-Scale Enterprises by Means of Data Envelopment Analysis and Multi-Criteria Decision Making Methods. *Processes* 7(3): 130. DOI: 10.3390/pr7030130
- [20] Smriti, T. N. and Khan, H. R. 2018. Efficiency Analysis of Manufacturing Firms Using Data Envelopment Analysis Technique. *Journal of Data Science*, 16(1): 69–78.
- [21] Thaler, R. H. 2000. From Homo Economicus to Homo Sapiens. *Journal of economic perspectives*, 14(1): 133–141. DOI: 10.1257/jep.14.1.133

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