

6.2 The analytical aspects of evaluating enterprise efficiency, through the lens of innovative renewal of fixed assets

In market conditions, the independent economic activity of enterprises and responsibility for its results make it necessary to monitor the company's financial condition in order to prevent the occurrence of crisis phenomena. Therefore, the role of assessing the financial condition of the enterprise and its constituent parts: liquidity, financial stability, solvency, profitability, and business activity in order to find and develop ways to improve it is currently growing.

In particular, one of the tools of such assessment is the "golden rule of economics", the indicators of which can be used to characterize the performance of individual enterprises as well as at the macro level to assess the performance of the country's economy as a whole. The "golden rule of economics" characterizes the important conditions that ensure the expanded reproduction of production and the development of the economy. It analyzes the dynamics of changes in assets, revenue from the sale of products, and profit. The economic literature also describes a more extended formula of this rule, which also includes the company's own capital. The key in this rule is the relationship between these indicators, and not just the dynamics of each of them [255-258]. In a number of scientific works, the "golden rule of economics" is described by the following formula [258, 260]:

$$100\% < \eta_A < \eta_V < \eta_P < \eta_G, \quad (1)$$

where η_A – growth rate of company assets (chain);

η_V – growth rate of the company's equity capital (chain);

η_P – growth rate of net income (revenue) from the sale of the company's products (chain);

η_G – net profit growth rate (chain).

A slightly different version of the "golden rule of economics" described in [259] is also widely used, which is considered basic:

$$\eta_G > \eta_P > \eta_A > 100\% \quad (2)$$

where η_G – net profit growth rate (chain);

η_P – a growth rate of the volume of sold products (chain);

η_A – the growth rate of the average value of assets (chain).

In equation (2) inequality $\eta_A > 100\%$ means expanding the scale of the enterprise's activities and increasing its assets; inequality $\eta_P > \eta_A$ predicts a higher rate of growth of production volumes than the rate of growth of assets, i.e. actually an increase in capital return; inequality $\eta_G > \eta_P$ assumes that profits grow at a higher rate than output, which means lower production costs.

The formula of the "golden rule of economics" is quite often considered in economic literature with minor modifications. In a simplified form, this formula can be presented as follows:

$$\eta_G \geq \eta_P \geq \eta_F, \quad (3)$$

where η_F – growth rate of the production fixed assets (FA).

We should agree that the "golden rule of economics" is an indicator that characterizes the development of an enterprise and its economic potential. According to this reference ratio, the positive dynamics of indicators of the value of assets, volumes of production and profit indicate favorable trends in the development of the enterprise. It is believed that non-compliance with this ratio of growth rate of indicators shows the presence of clear or hidden crisis factors in the enterprise.

At the same time, it is noted that there is a possibility of deviation from the "golden rule", which is not always interpreted as a negative phenomenon. So, for example, technical rearmament of the enterprise, introduction of new technologies, and modernization of existing fixed assets in a certain period may require significant capital investments, which, as a rule, do not give a quick return, but this does not mean a decrease in the business activity of the enterprise.

We will analyze the rates of growth of the main indicators of the activity of domestic enterprises in recent years and their correlation in the context of the "golden rule of economics". Statistical data on the dynamics of net profit, volumes of sold products, equity and assets of Ukrainian enterprises were used as primary information (Tables 1, 2, 3, 4).

Table 1

Net profit (loss) of enterprises of Ukraine
and its growth rate for 2016-2022

Years	Net profit, mln.UAH	Chain growth rate
2016	29705.0	—
2017	168752.8	5.6809
2018	288305.5	1.7084
2019	523779.0	1.8167
2020	68054.9	0.1299
2021	885276.5	13.0083
2022	46127.2	0.0521
Average annual growth rate		1.1000

Source: compiled from [261]

The average growth rate of net profit for the studied period is:

$$\sqrt[6]{1.5522} = 1.076 \approx 1.1.$$

According to the data in the table, the average annual rate of profit growth indicates a generally positive trend in the development of domestic enterprises, as it is a fairly significant positive value. At the same time, in individual years, the rates' values fluctuate greatly and significantly deviate from their average value in the direction of increase or decrease. A significant decrease in enterprises' profits in 2022 is associated with military actions on the territory of Ukraine, as a result of which some enterprises did not receive profits, and also did not provide appropriate statistical reporting on their activities.

Table 2

Volumes of sold products (goods, services) of enterprises
of Ukraine and their growth rate for 2016-2022.

Years	Volumes of sold products (goods, services), million UAH	Chain growth rate
2016	6237535.2	—
2017	7707935.2	1.2357
2018	9206049.5	1.1944

Continuation of table 2

2019	9639730.6	1.0471
2020	10049870.8	1.0425
2021	13616793.2	1.3549
2022	11033018.1	0.8103
Average annual growth rate		1.1000

Source: compiled from [261]

The average annual growth rate of production volumes for this period is:

$$\sqrt[6]{1.7688} = 1.1.$$

As shown in Table 2, starting from 2017, there was a gradual decrease in the growth rate of the volumes of sold products and (with the exception of the indicator of 2021) it reached its lowest level in 2022, when this rate was 0.8103, i.e. the increase in production was a negative value.

Table 3

Own capital of enterprises of Ukraine and
its growth rate for 2016-2022

Years	Own capital, million UAH	Chain growth rate
2016	2445803.7	—
2017	2458527.6	1.0052
2018	2708576.9	1.1017
2019	3092765.9	1.1418
2020	3339806.1	1.0799
2021	4113338.8	1.2316
2022	3975952.5	0.9666
Average annual growth rate		1.084

Source: compiled from [261]

According to the data in Table 3, the average growth rate of equity capital for 2016-2022 will be equal to : $\sqrt[6]{1.6256} = 1.084$.

As can be seen from the tabular data, the rates of growth of own capital during the analyzed years are variable, in particular, a decrease in these rates occurred in 2022 in connection with military actions on the territory of Ukraine.

Table 4

Assets of enterprises of Ukraine and their
growth rate for 2016-2022

Years	Assets of enterprises, million UAH			Chain growth rate of assets
	Non-current assets	Current assets	Total assets	
2016	4212813.14	5772816.52	9985630	—
2017	4303282.79	5650817.42	9954100	0.9968
2018	4584315.56	6285066.56	10869382	1.0920
2019	4844512.94	6640282.37	11484795	1.0566
2020	5312301.38	7360593.62	12672895	1.1035
2021	5650750.25	8411902.48	14062653	1.1097
2022	5622236.90	9024337.90	14646575	1.0415
Average annual growth rate				1.0660

Source: compiled from [261]

The average growth rate of enterprise assets for the period from 2016 to 2022 is :

$\sqrt[6]{1.4668} = 1.066$. At the same time, it should be noted that the ratio between non-current and current assets during this time period is almost constant and is approximately 0.75.

We will analyze the implementation of the "golden rule of economy" by Ukrainian enterprises for 2016-2022 (Table 5).

Table 5

Evaluation of the dynamics of indicators of production and
economic activity enterprises of Ukraine for 2016-2022

Years	Profit growth rate (η_G)	Growth rate of production (η_P)	Equity growth rate (η_V)	Asset growth rate (η_A)
2016	—	—	—	—
2017	5.6809	1.2357	1.0052	0.9968
2018	1.7084	1.1944	1.1017	1.0920

Continuation of table 5

2019	1.8167	1.0471	1.1418	1.0566
2020	0.1299	1.0425	1.0799	1.1035
2021	13.0083	1.3549	1.2316	1.1097
2022	0.0521	0.8103	0.9666	1.0415
Average annual growth rate	1.1000	1.1000	1.0840	1.0660

Source: own calculations

As the data in the table show, in 2017 compared to 2016, the "golden rule" was not fulfilled, since the growth rate of assets were even slightly less than 100%, that is, there was practically no increase in the economic potential of enterprises, and equity did not increase either. At the same time, with the growth of production volumes by 23.57%, the profit increased more than 5 times, which indicates its high profitability.

In 2019, compared to 2018, the "golden rule of economics" was also not fulfilled. Thus, the growth rate of production volumes (1.0471) is lower than the growth rate of the value of assets (1.0566), at the same time, the growth rate of profit is quite high (1.8167). According to the data in the table, in 2020, in comparison with 2019, there is a violation of the "golden rule". Moreover, all inequalities are violated, except for the ratio $\eta_A > 100\%$. That is, equity grows more slowly than the value of assets, and the growth rate of production volumes are lower than the growth rate of both assets and equity. The growth rate of profit is much lower than the growth rate of production. Also (in connection with full-scale military operations in Ukraine) ratios of the "golden rule of economy" are not fulfilled in 2022, which was mentioned above. It should be noted that the average annual values of the indicators of the dynamics of the activity of enterprises for the studied period generally correspond to the "golden rule of economics".

Let's consider some analytical aspects of the application of the "golden rule" for evaluating the efficiency of the enterprise, taking into account the innovative renewal of its fixed production assets.

An important component of the "golden rule" formula when studying the business activity of an enterprise is the growth rate of profit η_G . Let's consider the question of calculating the increase in profit after updating fixed assets in more detail.

Let $G(t)$ be the profit before updating fixed assets; $G(t + 1)$ is the profit after updating the FA. Then the absolute change in profit ΔG is:

$$\Delta G = G(t + 1) - G(t) \quad (4)$$

This change can be found through the volumes of FA and their profitability:

$$\Delta G = F(t + 1) \times r_F(t + 1) - F(t) \times r_F(t), \quad (5)$$

where $F(t + 1)$ is the cost of fixed assets after updating of the FA;

$r_F(t + 1)$ is the profitability of the FA after the update of the fixed assets;

$F(t)$ is the cost of fixed assets before the renewal of the FA;

$r_F(t)$ is the profitability of the FA before the update of the fixed assets.

Expression (5) can also be expressed using growth rates:

$$\Delta G = F(t) \times r_F(t)(\eta_F \eta_r - 1), \quad (6)$$

where η_F is the growth rate of the cost of fixed assets;

η_r — the growth rate of profitability of fixed assets.

Since in equation (6) $F(t) \times r_F(t) = G(t)$, the increase in profit will be equal to:

$$\Delta G = G(t) (\eta_F \eta_r - 1) \quad (7)$$

In other words, the increase in profit after the renewal is equal to the product of the basic profit by the difference in the growth rate of FA, multiplied by the growth rate of the profitability of fixed assets minus one.

From the increase in profit in absolute value by means of algebraic transformations, we can easily move to the corresponding growth rate according to the following formula:

$$\eta_G = \frac{\Delta G}{G(t)} + 1 \quad (8)$$

It should be noted that when the cost of fixed assets does not change after the upgrade, and their profitability remains constant, then no increase in the level of profit will occur. This conclusion does not contradict logical reasoning.

As an illustration of the above provisions, we will use relevant examples of innovative updates to the FA.

1. Let's consider a conditional example of a one-moment replacement of all equipment with a new one, which can happen in practical activity. For example, the company replaces outdated models of drying chambers with new ones made according to the technology much more energy efficient. At the same time, the output of products (dried fruits) remains unchanged, i.e. $P_1 = P_2$ and, accordingly, $\eta_P = 1$. The cost of new and old equipment per unit of equipment, respectively, is $F_1 = 10$ (c. u.), $F_2 = 50$ (c.u.). The cost price of a unit of finished products is $C_1 = 60$ (c. u.), $C_2 = 6$ (c. u.).

The unit price (V) before and after the equipment replacement remains the same. Let's take the basic profitability of production (r_C) equal to 15%.

Then $r_C = \frac{V-C}{C} = \frac{V}{C} - 1$, i.e. $V = 1.15 * C$

Thus, the price of a product unit will be $V = 60 \times 1.15 = 69$ (c.u.).

Suppose that 10 units of equipment work, the productivity of which is also one unit (of products, in natural units). Then, under the accepted conditions, the total cost of production will be 600 c.u., and the cost will be 690 c.u., and the profit, accordingly, will be equal to 90 c.u.

Let's calculate the basic profitability of fixed assets ($r_F(t)$):

$$r_F(t) = \frac{G(t)}{F(t)} = \frac{90}{100} = 0.9$$

Let's make a similar calculation after replacing all the equipment with a new, energy-saving one, which provides a significant reduction in the cost of production.

The cost of products remains unchanged - 690 c.u., and the cost price will be $6 \times 10 = 60$ (c.u.). Then the profit will be equal: $G = 690 - 60 = 630$ (c.u.). Let's calculate the growth rate of profit in the process of updating the FA:

$\eta_G = \frac{630}{90} = 7$, that is, the profit increased 7 times.

The increase in profit in absolute terms is:

$$\Delta G = 630 - 90 = 540 \text{ (c.u.)}$$

Let's check the calculation using formula (7). To do this, we first calculate its components:

$\eta_F = 5$ (the cost of fixed assets increased by 5 times);

determine the profitability of the FA after replacement ($r_F(t+1)$), as well as the rate of growth of the profitability of fixed assets (η_r). Then we get:

$$r_F(t+1) = \frac{630}{500} = 1.26;$$

$$\eta_r = \frac{r_F(t+1)}{r_F(t)} = \frac{1.26}{0.9} = 1.4;$$

Therefore, $\Delta G = G(t) (\eta_F \eta_r - 1) = 90 \times (5 \times 1.4 - 1) = 540$ (c.u.)

Let's calculate the rate of profit growth using the formula (8):

$$\eta_G = \frac{540}{90} + 1 = 7$$

Thus, the results of the calculations coincided.

It should be noted that the fund return at the beginning of the replacement is: $f_1 = \frac{1}{10} = 0.1$, and at the end of the replacement – $f_2 = \frac{1}{50} = 0.02$.

We compare the growth rates of three indicators - profit, production volumes, and the cost of fixed assets. According to the calculations, we will get the following ratio: $7 > 5 > 1$, i.e. $\eta_G > \eta_F > \eta_P$.

2. Based on the data of the previous example, we will consider the option of partially replacing the equipment with a new one. The initial conditions are as follows: $P_1 = P_2$. The cost of new and old equipment per unit of equipment, respectively, is $F_1 = 10$ (c. u.), $F_2 = 50$ (c.u.). The unit cost of production is: $C_1 = 60$ (c. u.), $C_2 = 6$ (c. u.); $r_C = 15\%$.

The price per unit of production will be $V = 60 \times 1.15 = 69$ (c.u.).

According to the condition of the previous example, 10 units of equipment work, the productivity of which is also one unit (products in natural terms). Then the total cost of production will be 600 c.u., its cost will be equal to 690 c.u., and the profit, accordingly, will be 90 c.u.

We will calculate the increase in profit after replacing part of the equipment with a new one. Suppose that 4 units of equipment are replaced with new ones, and 10 units of equipment remain in total (that is, 6 units of the old and 4 units of the new).

The total price of products remains unchanged - 690 c.u., and the cost price will change slightly and will be: $C = 6 \times 60 + 4 \times 6 = 384$ (c.u.). Then the profit will be equal to: $G = 690 - 384 = 306$ (c.u.). Let's calculate the rate of profit growth:

$$\eta_G = \frac{306}{90} = 3.4, \text{ that is, the profit increased by 3.4 times.}$$

The absolute increase in profit is:

$$\Delta G = 306 - 90 = 216 \text{ (c. u.)}$$

Let's calculate the profit growth for this example using the formula (7). To do this, we will determine the indicators that are needed for this:

$$\eta_F = \frac{60+200}{100} = 2.6 \text{ (the cost of fixed assets increased by 2.6 times);}$$

$$r_F(t) = \frac{90}{100} = 0.9;$$

$$r_F(t+1) = \frac{306}{260} = 1.18;$$

$$\eta_r = \frac{1.18}{0.9} = 1.31.$$

Then the increase in profit in absolute value is:

$$\Delta G = G(t) (\eta_F \eta_r - 1) = 90 \times (2.6 \times 1.31 - 1) \approx 216 \text{ (c.u.)}$$

The rate of profit growth according to formula (8) is equal to:

$$\eta_G = \frac{216}{90} + 1 = 3.4$$

As we can see, we can determine the rate of profit growth after replacing the equipment with any proportions of this replacement.

The ratio between the growth rates of profit, production volumes, and the cost of fixed assets is as follows: $3.4 > 2.6 > 1$, i.e. $\eta_G > \eta_F > \eta_P$.

Considering all of the above, it can be stated that considering profit as the main goal of the enterprise and from the point of view of the criterion of maximizing its growth rate η_G in addition to the "golden rule" $\eta_G > \eta_P > \eta_F$ (formula 3) is legitimate another ratio regarding profit growth rate:

$$\eta_G > \eta_F > \eta_P \quad (9)$$

In conclusion, it should be emphasized that the "golden rule of economics" is certainly an important tool for evaluating the performance of enterprises, as it helps to evaluate the balance of growth of assets, capital, production volumes and profits.

The analysis of the dynamics of the main indicators of the activity of domestic enterprises in recent years showed that the average annual growth rates of profit, production volumes, equity and assets generally meet the requirements of the "golden rule of the economy", although some deviations were observed in different years. Although deviations from the "golden rule of economics" do not always indicate crisis phenomena, they must be analyzed in detail to assess the risks and opportunities for the development of the enterprise.

The implementation of innovative renewal of fixed assets, as shown by the examples given, can significantly increase the profitability of enterprises, even with unchanged production volume. This is due to the increased profitability of updated fixed assets. The calculation of the rate of profit growth after updating the FA proves that their modernization without increasing profitability does not provide an increase in profit.

Therefore, in order to ensure sustainable economic growth, enterprises should focus their efforts on innovative renewal of fixed assets and increase their profitability.