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SUBSTANTIATION OF PREREQUISITES FOR THE INTENSIFICATION OF INNOVATIVE AND INVESTMENT ACTIVITY IN THE FOOD INDUSTRY

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Abstract. *The article substantiates the need and prerequisites for intensifying innovation and investment in the food industry using economic and statistical analysis. The stimulants and destimulants of the intensification of innovation and investment activity of the food industry are identified. The stimulants for intensifying innovative activities include increasing profitability, stabilizing the USD exchange rate and increasing demand for food, and destimulants – reducing net profit or increasing losses, increasing the USD exchange rate due to the outflow of foreign investment and reducing the period of supply of orders for food production . A real possible level of additional net profit, a range of fluctuations in the USD exchange rate and changes in the period of supply with orders for food production, contributing to the intensification of innovation and investment in the food industry, were established.*

Keywords: *innovation and investment activity, stimulants, destimulants, prerequisites of intensification, production facilities, capital investment, foreign investment, Student's t-criterion.*

JEL Classification: C12, E22, L66, O31
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1. Introduction

The amplitude of fluctuations and trends of the main indicators of innovation and investment activity in the food industry indicate its unstable slow growth. The most negative impact on this is provided by the low share of innovation costs in the structure of capital investments and their instability. Under these conditions, funds are usually invested in the purchase of finished equipment, machines and software, which are no longer a novelty to the market, and are not directed to research, development or implementation of new production technologies. Therefore, an extremely urgent problem of today is the creation of prerequisites for the intensification of innovation and investment activities of food industry enterprises.

2. Recent research and publications analysis

Innovation and investment activity of enterprises was studied in their works by the scientists: Geyets V.M. [1], Sabluk P.T. [2], Sychevskiy M.P. [3], Lupenko Yu.A. [4], Bruijnis, M. R. N., Stassen, E. N., Gremmen, H. G. J. [5], Blok, V., Lemmens. P. [6] etc. At the same time, the scientific substantiation of the current prerequisites for the intensification of innovation and investment in the

food industry of Ukraine requires further research. To expand the boundaries of these studies, in our opinion, is possible with the help of economic and statistical analysis, in particular, Student's t-tests.

Student's criterion – is the general name for a class of methods for statistical testing of hypotheses (statistical criteria) based on Student's distribution. Most often, the cases of applying the t-criterion are associated with checking the equality of average values in two samples. Using this criterion, the effectiveness of the proposed activities can be evaluated and management decisions can be substantiated.

This criterion was developed by William Gosset to assess the quality of beer at Guinness. In connection with the obligations to the company for non-disclosure of trade secrets, an article by Gosset was published in 1908 in *Biometrika* journal under the pseudonym "Student" [7].

3. Purpose of the article

The purpose of the article is the justification of the conditions for the intensification of innovation and investment in the food industry of Ukraine based on Student's t-student criterion and analysis of stimulants and destimulants.

4. Results and discussion

Until recently, the problem of significant equipment depreciation was relevant for the food industry (the value of the wear coefficient is above 50%). Now this problem has found its solution through active investment injections to replace worn-out machinery and equipment (Fig. 1). Due to the additional capital investment of UAH 11285.2 million in 2018 compared to 2017, the depreciation rate decreased to 48.2%. For 2019, such problems as insufficient capacity utilization and insufficient emphasis on the innovative component of the production process remained relevant. The share of innovation costs in the investment structure in 2018 decreased by 3% compared to 2017 and amounted to 4.4%, and production facilities were loaded by 70% – on average by the food industry [8]. In order to load production facilities up to 80% (that is, to the optimum working capacity), additional capital and foreign investments are necessary.

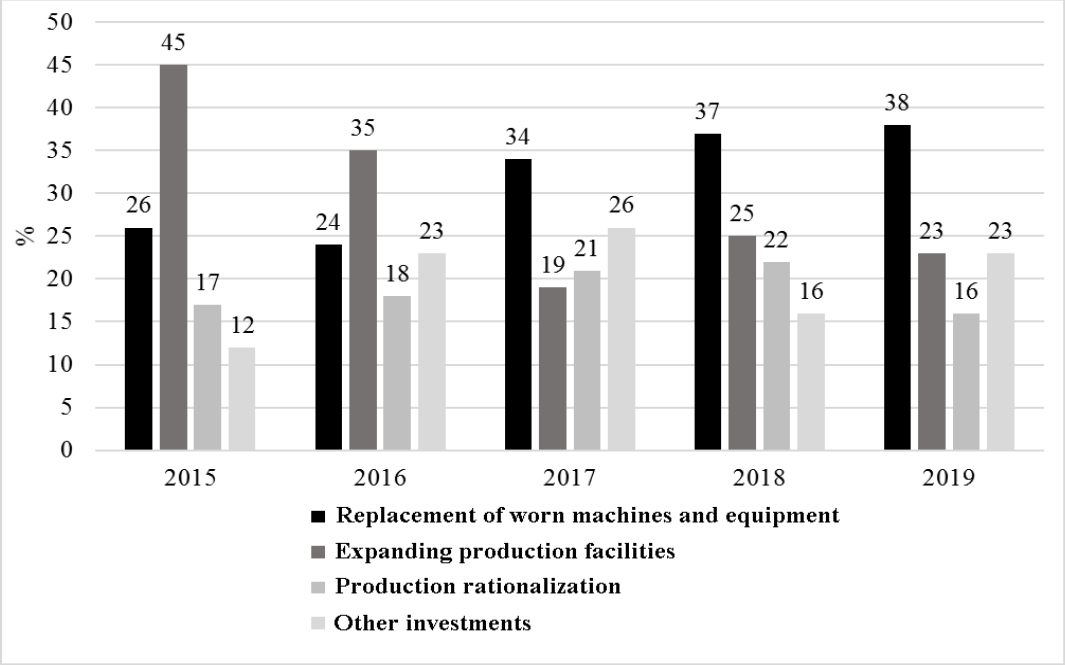

Figure 1 Principal directions of investments in food industry of Ukraine
Source: developed according to data of State Statistic Service of Ukraine

In order to determine the size of the necessary investments, to find out the prerequisites for the intensification of innovation and investment activity and evaluate their effectiveness, we proposed to use Student's t-criterion.

Student's criterion is used to determine the statistical significance of differences in average values, it can be used both in cases of comparing independent samples, and when comparing related populations.

To apply Student's t-criterion, it is necessary that the initial data have a normal distribution. In the case of applying the two-sample criterion, for independent samples it is also necessary to observe the conditions for the equality of variances (homoskedasticity). If the observance of these conditions is impossible, similar methods of nonparametric statistics should be used when comparing the sample means, the most well-known of the said methods being the Mann - Whitney U-test (as a two-sample criterion for independent samples), as well as the sign criterion and Wilcoxon criterion (used in cases of dependent samples).

To compare the average values, Student's t-test is calculated according to the formula [9]:

$$t = \frac{M_1 - M_2}{\sqrt{m_1^2 - m_2^2}} \quad (1)$$

Where:

M_1 - is the arithmetic mean of the first population (group);
M_2 - arithmetic mean of the second population (group);
m_1 - is the average error of the first arithmetic mean;
m_2 - is the average error of the second arithmetic mean.

The obtained value of Student's t-criterion must be correctly interpreted. To do this, one needs to know the number of objects in each group (n_1 and n_2). The number of degrees of freedom f is found by the formula [9]:

$$f = (n_1 - n_2) - 2 \quad (2)$$

After that, the critical value of Student's t-test is determined for the required level of significance (for example, p = 0.05) for a given number of degrees of freedom f.

The critical and calculated value of the criterion are compared:

- if the calculated value of Student's t-criterion is equal to or greater than the critical value found in the table, the conclusion is drawn that the differences between comparable values are statistically significant.
- if the value of the calculated Student's t-test is less than the tabular one, then the differences of the compared values are not statistically significant.

The methodology for substantiating the prerequisites for intensifying innovation and investment in the food industry of Ukraine is as follows:

1. It is found out how changes in capital and foreign investments effect the increase in production capacities. It is also determined how much capital investment is needed to increase the capacity utilization up to 80% (optimal workload).
2. It is determined how changes in income affect the activation of investment activity and what a level of changes in net profit can attract domestic and foreign investors?
3. It is revealed how the stabilization of the exchange rate affects changes in capital investment. It is determined what should the average annual changes in the USD exchange rate to activate innovation.
4. The effect of foreign investment upon USD is evaluated and the need of its stabilization is determined.
5. It is found out how changes in the period of supply with food production orders (demand for food products) affect the activation of investment activity. It is also determined what should be the average quarterly changes in the number of months for which production must be additionally secured by orders to be attractive for capital and foreign investments.
6. Stimulants and destimulants of intensification of innovative activity of food industry enterprises are indentified. It should be noted that the same indicator can be both a stimulant and a destimulant, depending on the direction of change.

The analysis is based on quarterly (for I quarter of 2015 – II quarter of 2019) and annual (for 2010 – 2018) data on production capacities, capital and foreign investments, net profit, dollar exchange rate, number of months of orders.
In the Table 1 the results of testing the significance of the Student's criterion to justify the effectiveness of the proposed activities are summarized.

Table 1 The results of checking the significance of indicators to substantiate the effectiveness of measures aimed at enhancing innovation and investment in the food industry

Relationship of parameters	t	Significance (two-tailed)
The effect of changes in capital investment on changes in capacity utilization	4.442	0.021
The effect of changes in foreign investment on changes in capacity utilization	6.503	0.007
The effect of changes in net income on changes in capital investment	2.983	0.042
The effect of changes in net income on changes in foreign investment	4.266	0.025
The effect of changes in USD exchange rate on changes in capital investment	2.254	0.041
The effect of changes in foreign investment on changes in USD exchange rate	3.907	0.035
The effect of changes in the number of months of orders on changes in capital investments	3.720	0.035
The effect of changes in the period of provision with orders on changes in foreign investment	3.905	0.032

Source: the authors' own development

The calculations confirmed the impact of the proposed measures on the activation of innovation and investment activity, since the significance value is less than 0.05 (Table 1). As a result, stimulants and destimulants of intensification of innovation and investment activity of the food industry were identified. The stimulants are: increased profitability; stabilization of USD exchange rate; increased demand for food; and to destimulants – a decrease in net profit or an increase in losses; USD appreciation due to outflow of foreign investment; reduction of the period of supply with food production orders.

In the Table 2 the average values of the main indicators of intensification of innovation and investment activity in the food industry as a whole with the distribution of stimulants and destimulants dependent on them are shown.

It was found that the intensification of innovation and investment activity has a positive effect on increasing the utilization of production facilities as each additional infusion of capital investment in the amount of UAH 1285802 thousand or foreign investment in the amount of USD 41167 thousand provides an additional load upon production facilities of 1.03% (entry 1 of Table 2) and 1.07% (entry 2 of Table 2).

In Table. 2, the influence of stimulants and destimulants on the activation of innovation and investment in the food industry is determined. For example, the growth of net profit attracts domestic and foreign investors, has a positive effect on the intensification of innovation and investment activity (capital investment per year on average can grow by UAH 3797.3 million, and foreign investment – by USD 189.2 thousand, entry 3 and 4 in Table 2).

Conversely, a decrease in net profit or an increase in losses discourages investors from investing in the development of the food industry (on average, capital investments come to UAH 107.8 million per year, and foreign investments – by USD 167.1 thousand, entries 11 and 12). The domestic investor is also attracted by the stabilization of USD (annual fluctuations up to UAH 0.9, entry 6), which can be achieved by additional attraction of foreign investment. At the same time,

capital investments grow on average over the year by UAH 3904.96 million (entry 5). At the same time, the average annual growth of the USD exchange rate by UAH 6.9 (entry 14), which occurs due to the outflow of foreign investment, also repels domestic investors (capital investments come in an average of UAH 430.7 million per year, entry 13).

Table 2 Distribution of the main indicators of activation of innovation and investment activity in the food industry depending on the influence of stimulants and destimulants

N	The rate of innovation and investment activity depending on the influence of a stimulant	Value	N	The rate of innovation and investment activity depending on the influence of a destimulant	Value
1	Average quarterly changes in production facilities utilization with additional infusion of capital investments, %	1.03	9	Average quarterly changes in production facilities utilization with a decrease in capital investment infusion, %	0.4
2	Average quarterly changes in production facilities utilization with additional infusion of foreign investment, %	1.07	10	Average quarterly changes in production facilities utilization with a decrease in the infusion of foreign investment, %	0.65
3	Average annual changes in capital investments with an increase in net profit, thousand UAH	3797328	11	Average annual changes in capital investments with a decrease in net profit or increase in losses, thousand UAH	-107824
4	Average annual changes in foreign investment with additional profit, thousand USD	189.2	12	Average annual changes in foreign investment with a decrease in net profit or an increase in losses, thousand USD	-167.1
5	Average annual changes in capital investments while stabilizing USD, thousand UAH	3904961	13	Average annual changes in capital investments with increasing USD exchange rate, thousand UAH	-430724
6	Average annual changes in USD exchange rate with the additional attraction of foreign investment, UAH	0.9	14	Average annual changes in USD exchange rate with the leakage of foreign investment, UAH	6.9
7	Average quarterly changes in capital investment with an increase in the period of supply with orders, thousand UAH	789553	15	Average quarterly changes in capital investments with a decrease in the period of supply with orders, thousand UAH	408952
8	Average quarterly changes in foreign investment with an increase in the period of supply with orders, thousand USD	36.8	16	Average quarterly changes in foreign investment with a decrease in the period of supply with orders, thousand USD	-22.5

Source: the authors' own development

5. Conclusions

The intensification of innovation and investment in the food industry helps to increase the production facilities utilization to the optimal working level (80%). For this, an additional infusion of capital investments in the amount of UAH 12483.5 million or foreign investments in the amount of USD 384.7 million is necessary.

Thus, on the basis of the study, the most attractive investment conditions (foreign and domestic) in the food industry were identified to enhance its innovation and investment activity and achieve the target level of production facilities utilization:

- provided that the industry receives additional net profit in the amount of UAH 6231.4 million on average per year, capital investments can be effectuated in the amount of UAH 3797.3 million, and foreign investments can be raised in the amount of USD 189.2 thousand per year;

- provided that USD exchange rate fluctuations do not exceed UAH 0.9 during the year, it is possible to additionally absorb UAH 3904.96 million of capital investment and attract foreign investment – USD 268.35 thousand annually;
- provided that the increase in the period of supply with production orders in the food industry is 0.2 months on a quarterly basis, it will be possible to additionally effectuate UAH 789,553 thousand of capital investments and USD 36.8 thousand of foreign investments.

In further studies, it is advisable to justify the prerequisites for the intensification of innovation and investment in certain sectors of the food industry of Ukraine.

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