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EVALUATION OF EFFECTIVENESS OF INNOVATIVE MODERNIZATION OF FOOD INDUSTRY

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Abstract: *The article presents a methodological approach to the evaluation of innovative modernization of food industry and its constituent branches. The innovative modernization of the food industry is proposed to be understood as systematic improvement in all spheres of activity and in the state of the productive potential, the said improvement to be reached through the effective implementation of the results of innovation activity and providing fundamentally new level of production base. The innovation index is proposed as the criterion for assessing innovative modernization of food, this index being a numeric characteristic facilitating comparison of the effectiveness of modernization on an annual basis. It was found that most part of food industry branches feature low degrees of the efficiency of innovative modernization. To achieve strategic innovation development objectives as the basis of formation of agricultural and food policy, such priorities are denoted: lingering political and economic crisis, unstable fiscal and monetary policy, inflation, expansion of foreign producers the domestic markets, etc., these priorities being possible to be implemented only when negative phenomena in national economy would be overcome.*

Keywords*: food industry, innovative development, modernization, innovation index, efficiency.*
JEL: L66, C15, C42, C51
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Introduction. The food industry of Ukraine consists of specialized branches, including more than 40 forms of production activity. It provides not only primary processing of crop and livestock raw materials, but also production of food products – from essential goods (meat, dairy, bakery products, sugar, fat and oil, etc.) to delicacies and functional products for health promotion. The share of food sector output to national economy Ukraine was about 10% in 2015. According to its specificity and also taking into account the current needs of consumers, the food industry can supply goods produced both according to traditional and novel knowledge-intensive technologies. Technologies and industries are considered knowledge-intensive when their innovation level is high. Sufficient economic efficiency based on resource-saving and significant share of added value in the products produced, are their key characteristics.

Development of the economy of food industry, its structure being complex and multi-level is stipulated by a number of factors. Now particular attention is paid to the detection and study of innovative factors as they determine the effectiveness of the modernization of food industry economy, and the knowledge becomes the basis for the formation of effective agricultural and regional policy.

Modernization of the economy has been and remains the priority in the programs of economic reform developed by a number of Ukrainian governments. However, the main drawback of these programs

is the lack of timely evaluation and clear understanding of measures and resources necessary to fulfill the said reforms.

Analysis of recent research and publications. Development of modernization paradigm dates back to the mid-twentieth century. Some of its provisions are set out in the works of American scientists Daron Acemoğlu and Joan Robinson [1], N. Gilman [2], A. Przeworski, F. Limongi [3], many Russian scientists, including I. Gyliazutdynova [4], V. Sadkov, P. Mashehov, Ye. Zbiniakov [5], S. Dyomin [6], D. Ushakov [7]. This paradigm was reflected in the well-known Marshall Plan.

Theoretical and methodological aspects the modernization of national economy are highlighted in the works of the Ukrainian scientists B. Andrushkiv [8], O. Bilorus [9], K. Buzhymska [10], N. Valinkevych [11], V. Heyets [12], L. Deyneko [14], P. Sabluk [13], M. Sychevskyi [14], A. Chukhna [15], O. Shubravska [16] and other scientists. However, the issues of effectiveness evaluation of modernization of the economy of food industry have not yet been properly studied.

The aim of the article is to develop scientific approach to evaluating the effectiveness of the modernization of food industry and its branches.

Research results. In a broad sense, the modernization is the willingness and ability to develop on the innovative basis, to move from one way of activity to another, more progressive, the ability to build progressive forms of activity on the innovative basis, to create models of these forms according to peculiarities of the national economic environment. In modern conditions innovativeness shall be the characteristic feature of modernization its traits being: innovative flexibility, willingness to change, including the formation of a comprehensive infrastructure for management, forecasting and use of versatile information on industries.

Researchers believe that innovativeness is the ability of objects or phenomena to update themselves, when recovery processes become permanent, technological and minimally costly [4]. The effectiveness of the implementation of modernization measures directly affects the level of economy competitiveness of states and regions, their level of manufacturability, the quality of life in these areas. In this sense, important indicators of the state of modernization of economy are: The Global Competitiveness Report – Global Competitiveness Index (GCI), which is developed according to the methodology of the World Economic Forum (WEF) [17, 18]; The Doing Business Rating; Corruption Index – Transparency International; Index of Economic Freedom – Heritage Foundation etc.

In the works of classical economic theory the use of new technique, new technological processes; organization of production, logistical support; introduction of products with new properties; use of new raw materials, identification of new markets were defined as the evaluation criteria of innovativeness [19].

The determining factor of the modern development of any economic system is an efficient innovation process. So, when it comes to the effectiveness of economy modernization, scientists always look for confirmation of its innovativeness, namely consequences of influence of innovation activity and scientific and technical progress. In this regard, now the notion of innovative modernization has been spreading in the economic science.

We consider that innovative modernization of the food industry should be understood as systemic improvement of all areas of business activity and the state of the production potential to be achieved through the effective implementation of results of innovation activity and providing qualitatively new level of production base.

No clear methodological approaches to assess the degree of efficiency of innovative modernization have been yet proposed. In Ukraine to evaluate the development of innovation processes a system of statistical indicators is used: the number of enterprises implementing innovation (scientific research works, new equipment, technology, organizational and marketing innovation); the volume of innovation production sold, including that new for the market; the number of new technological processes implemented and of innovative kinds of products, acquisition and transfer of new technologies; the volume of expenditure on innovation etc.

According to the defined system of indicators, the results of the assessment of innovative activities in 2015 are: only 178 food industry enterprises of 984 surveyed (18%) showed certain innovation activity, and no more than 2% of those 178 enterprises performed any kind of research. Innovative activities of a half of innovation active enterprises consisted in acquisition of new machinery, equipment, software and the corresponding spends reached 87.2% of the total amount of costs. However, only 13% of implemented innovative products were new to the

market. Overall dynamics of innovation development of food industry demonstrates the come-down of economic situation in accordance to most of indicators (Table 1).

Table 1. Effectiveness of innovation processes in the food industry (authors' development on the basis of State Statistics Service of Ukraine)

Indicator	Year				The increase (decline) 2015 to 2012, %
	2012	2013	2014	2015	
Number of innovation active economic entities, units	420	324	334	178	*-57.6*
The share of the total number of economic entities investigated, %	*18.7*	*17.1*	*16.8*	*18,1*	*-0.6*
Total expenditure on innovation activity in the food industry, million UAH	1566.3	1700.7	2173.61	1143.3	*-27.0*
The share of expenditure on purchase of machinery, equipment and software, %	*78.9*	*88.1*	*86.2*	*87.2*	*8.3*
Volume of sold innovative products in the food industry, million UAH	4612	7275	6290	4874,5	*5.7*
The share in total volume of food industry products sold, %	*1.8*	*2.8*	*2.5*	*1.3*	*-0.5*
including new for market, %	*0.6*	*0.7*	*0.2*	*0.2*	*-0.4*

Source: State Statistics Service of Ukraine

The system of existing statistical indicators to assess the status and dynamics of innovation processes (Table 1) does not give a fair idea of the final results of food industry innovative modernization.

In macroeconomic studies the indicator of gross value added (GVA) is applied to show the effectiveness of economic development. In particular, if GVA growth rate outpaced the cost growth rate in the industry, then it is considered, that the economy is developing effectively. Applying this methodological approach to assess the effectiveness of food industry's innovative modernization the growth rate of gross value added and total costs are calculated by the formula:

$$GR_{GVA} = (GVA_t / GVA_{t-1} \times 100)-100, \quad (1)$$

$$GR_C = (C_t / C_{t-1} \times 100)-100, \quad (2)$$

where

GR_{GVA} і GR_C – the growth rate of gross value added and total costs in the food industry, %;

GVA_t і GVA_{t-1} – the gross value added of food industry in the time periods *t* та *t-1* respectively, million UAH;

C_t і C_{t-1} – the total costs in food industry in the time periods *t* та *t-1* respectively, million UAH.

The calculation results are presented in Table 2.

Indexes of increase (or lag) of GVA growth rate compared to cost growth rate show that in 2014 the industry began to develop effectively (Table 2). However, the indexes are not consistent with dynamics of innovative activity of food industry (Table. 1) and do not characterize the degree of effectiveness of its innovative modernization in each year of the time period studied. To remedy this shortcoming, we propose to define a criterion for assessing innovative modernization of the food industry – an index of innovativeness. The gross domestic product (GDP) of food industry and the total costs of the industry, calculated in USD to avoid inflation factor are chosen as input data for its calculation. The selected input parameters of the study show a downward trend during the years 2010-2014 (Fig. 1).

Table 2. Calculation of indicators of efficiency of innovative modernization of the food industry
(authors' development on the basis of State Statistics Service of Ukraine)

Year	Gross value added of food industry			Costs in food industry			Index of increase (lag) GVA growth rate over the cost growth rate, %
	million UAH	absolute growth (ΔGVA), million UAH	the growth rate GVA, %	million UAH	absolute growth (ΔC), million UAH	the growth rate of intermediate consumption, %	
2010	45459	–	–	151956.0	–	–	–
2011	44134	-1325.0	-2.91	176548.0	24592.00	16.18	-19.10
2012	46904	2770.0	6.28	220388.0	43840.00	24.83	-18.56
2013	46070	-834.0	-1.78	221416.0	1028.00	0.47	-2.24
2014	56979	10909.0	23.68	248405.0	26989.00	12.19	11.49

Source: State Statistics Service of Ukraine

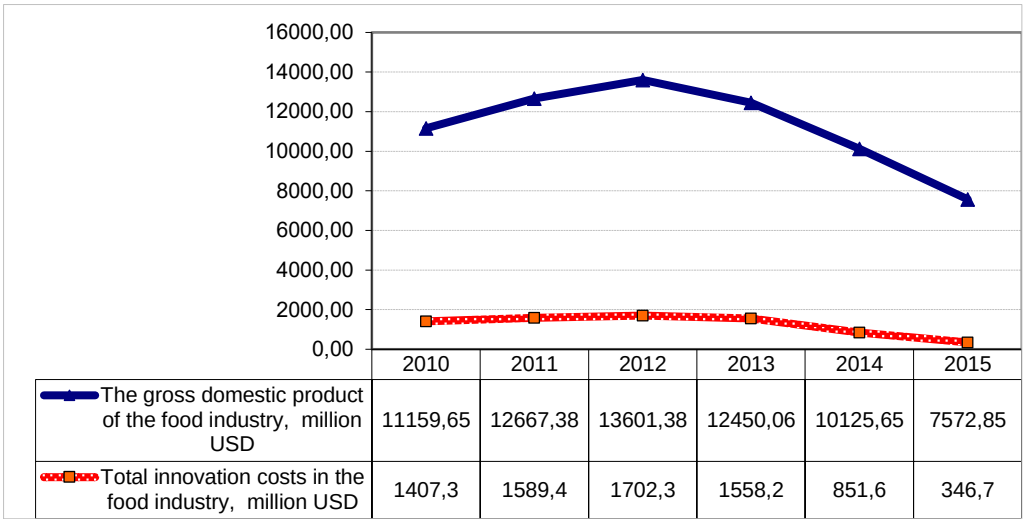

Figure 1. Input data for the calculation of the index of efficiency of innovative modernization of food industry (authors' development on the basis of State Statistics Service of Ukraine)

The index of innovativeness of the economic activity of food industry is characterized by growth rates of its resource intensity in certain periods of time:

$$I_{in} = \frac{r_t}{r_{t-1}}, \qquad (3)$$

where I_{in} – index of innovativeness of the economy of food industries; r_{t-1} і r_t – resource intensity: the amount of costs per unit of GDP in the time periods *t* та *t-1*:

$$r_t = \frac{C_t}{GDP_t}, \quad r_{t-1} = \frac{C_{t-1}}{GDP_{t-1}}, \qquad (4, 5)$$

where

GDP_t і GDP_{t-1} – gross domestic product of the food industry in the time periods *t* та *t-1* respectively, USD;

C_t і C_{t-1} – the total costs of innovative activities in food industry, USD.

Innovativeness of the technologies applied is defined by the fact that their application not only provides saving of production resources, but also increases production output. If the innovativeness relative index value (resource intensities ratio) converges to 1, then the amount of costs in the period under review hasn't change. The lower a value of the index, the higher efficiency of the innovative modernization of economy is.

We propose such gradation of efficiency of innovative modernization of food industry. If $I_{in} < 1$ – development of economy of a branch is innovative. If $I_{in} >$ **1.0 – a branch is under innovative stagnation. Indexes** I_{in} within the interval from **0.71 to 1.0 – characterize the low degree of modernization efficiency; the interval from 0.31 to 0.7 – the average degree; the interval from 0 to 0.3 –** the **high degree.** That is to say, the closer I_{in} value to zero (or the lower growth rates of resource intensity), the more effective modernization is.

Results of studies of the effectiveness of food industry innovative modernization, presented in Fig. 2, indicate that the development of economy of food industry in 2014 and 2015 was innovative and characterized by the average degree of modernization efficiency, because the index of innovativeness was in the range from **0.31 to 0.71** ($I_{in\ 2014}$=0.67; $I_{in\ 2015}$=0.54). In previous years, the economy of food industry was characterized by low degree of **innovative modernization** because the index of innovativeness was in the range **0.71÷1.0** ($I_{in\ 2011}$=0.99; $I_{in\ 2012}$=1.0; $I_{in\ 2013}$=**1.0**).

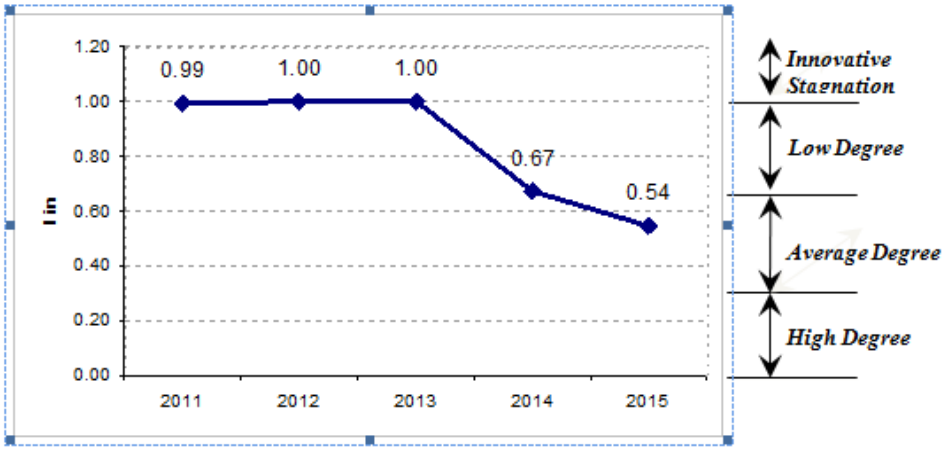

Figure 2. Effectiveness of modernization of the economy o food industry
(Source: authors' development)

The proposed approach can be used to assess the degree of efficiency of innovative modernization in particular branches of the food industry, with the difference that resource intensity is defined as the amount of costs of the relevant branch in a unit of added value (AV) in a certain period of time. Calculations of the indexes of innovativeness in the branches producing basic foodstuffs are shown in Table 3.

Thus, calculations of innovativeness indexes for the branches of food industry made it possible to determine degrees of the effectiveness of innovative modernization in 2015 (Table 3). The high degree was characteristic for the branches manufacturing milk products, oils and animal fats, products of flour and cereal industry, starches and starch products. The average degree of the effectiveness of innovative modernization is characteristic for the branches manufacturing bread, bread products, pastry products and beverages. The low degree of the effectiveness of innovative modernization is characteristic for the branches producing meat, meat products and other food products including sugar.

Table 3. Indicators of efficiency of innovative modernization in the industries producing basic foodstuffs

Branches of food industry	Total costs of innovations, thousand UAH		Added value in particular branches of food industry, million UAH		Resource intensity of innovative activities in particular branches of food industry, UAH per 1 UAH of added value		Index of innovati-veness (I_{in}) in 2015	Degree of efficiency of innovative modernizati on in 2015
	2014	2015	2014	2015	2014	2015		
Production of meat and meat products	34183.1	44531.7	6626.7	9529.4	0.052	0.047	0.91	low
Production of dairy products	477405.1	175557.9	6784.5	8476.2	0.704	0.207	0.29	high
Production of oils and animal fats	268533.7	9874.8	47564.6	36319.7	0.056	0.003	0.05	high
Production of products flour and cereal industry, starches and starch products	82808.5	30228.9	3466.9	6944.6	0.239	0.044	0.18	high
Production of bread, bakery and flour products	48604.2	27663.6	6671.5	10431.2	0.073	0.027	0.36	average
Production of drinks	247975.6	132513.3	10322.0	16162.4	0.240	0.082	0.34	average
Production of other food products (including sugar)	682330.8	842712.1	19996.2	28879.5	0.341	0.292	0.86	low

Source: Authors' Development

Conclusion.

The proposed methodical approaches to define the index of innovativeness **can be used to assess the degree of efficiency of innovative modernization of the food industry and its particular** branches. **Results of the study indicate that the competitiveness of the food industry can not be achieved without technological modernization, implementation of innovative technologies, products and services, which shall meet actual requirements of domestic and global market.** However we have to assert that the innovative development has not yet become the determining factor for the food industry of Ukraine.

The modern state of material and technical base of the food industry, which does not conform to the technological structure of developed nations, can not fully ensure transition to global standards. However, the achievement of the strategic goals of innovation development of food industry will only be possible when the nationwide negative developments, in particular: protracted political and economic crisis, unstable fiscal and monetary policy, inflation, expansion of foreign producers to domestic markets, etc. are overcome.

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