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# ECONOMETRIC ESTIMATION OF INVESTMENT FACTORS IN AGRO-INDUSTRIAL PRODUCTION OF UKRAINE

*Проаналізовано основні концептуальні умови та негативні чинники функціонування інвестиційного процесу агропромислового виробництва в Україні. Встановлено, що неефективність інвестиційної інфраструктури агропромислового виробництва є вагомою перешкодою використання конкурентних переваг вітчизняного агропромислового виробництва на сучасному етапі розвитку України в умовах євроінтеграції. В умовах, коли взаємне відкриття ринків, імплементація технічних аспектів забезпечення якості сировини та продуктів харчування потребує сучасних форм інфраструктурної підтримки.*

**Ключові слова:** інвестиційна інфраструктура, агропромисловий комплекс (АПК), сільське господарство, економетричне оцінювання факторів інвестування.

## 1. Introduction

Analysis of investment activities in the agro-industrial complex of Ukraine shows a significant reduction in financing of the agrarian sector at the expense of all sources. The high poverty level of rural residents and mostly natural forms of income used for own consumption, rather than to compensate for the services of industries and infrastructure, reduce the volume of industrial, technical and social services for the agricultural sector. To date, the level of development of investment infrastructure does not meet the optimal requirements for the rural society and does not provide extended agricultural production. In this connection, the need for a substantial correction of the priorities for the formation and development of the investment infrastructure is being actualized. It is necessary to take into account the tendencies of transformation processes in the agro-industrial complex and apply strategic approaches to the integration of its functional links into an integrated, harmonious system of management. This will create the prerequisites for improving the general conditions for reproduction on the basis of cooperative links between the subjects of different sectors of the agro-industrial complex, its segments, sectors and levels.

## 2. The object of research and its technological audit

Investments in agro-industrial production of Ukraine are *the object of research*.

Factors affecting investment should be objectively divided into qualitative and quantitative. To qualitative factors, the influence of which is significant, let's refer the level of investment attractiveness of the agro-industrial sector, the state of its social and economic development, financial and economic efficiency, environmental sustainability in the implementation of investment. Among these factors, a special place is taken by investment security (the level of investment safety is considered a quantitative indica-

tor) as the main condition for investors' propensity to invest. According to the methodological recommendations, investment security is defined as such level of national and foreign investments (provided they are optimally correlated), which can provide long-term positive economic dynamics.

A characteristic disadvantage of the research object is the dynamism of the indicators and the dependence on the natural and climatic conditions.

## 3. The aim and objectives of research

*The aim of research* is studying the operating conditions, investment factors that influence the development of the investment process of the agro-industrial complex of Ukraine.

To achieve this aim, it is necessary to perform the following tasks:

1. To determine the negative conditions that, to date, significantly affect the investment process of agro-industrial production in Ukraine.
2. To identify the negative factors that hamper the development of agro-industrial production in the context of attracting investment.
3. To develop a methodology for econometric estimation of investment factors in the agro-industrial complex.

## 4. Research of existing solutions of the problem

The scientists [1, 2] pay considerable attention to the study of various aspects of the functioning of the business infrastructure in the conditions of economic development. In particular, in their works they investigate:

- approaches to the consideration of infrastructure (institutional, market, marketing, logistics);
- its separate levels (federal, regional, local);
- directions (financial, investment, innovation, information, legal foreign economic, etc.);

- analyze the impact of state and non-state support, public and business associations on the development of a favorable business environment in the country and regions.

The methodological basis for managing investment processes in the agro-industrial sphere is reviewed in [3], which describes the economic aspects of the mechanism of managing investment processes in agro-industrial production.

The authors of works [4–6] define the investment infrastructure of entrepreneurship as a set of state, private and public institutions that serve the interests of agrarian entrepreneurship and ensure their economic activities and contribute to increasing its effectiveness.

At the same time, the regional aspect of the business infrastructure in scientific works [7–9] is traced rather limited. Scientists in [10, 11] note that the formation and development of infrastructure should be both integrated at the national level, and differentiated by regional characteristics.

Thus, the results of the analysis lead to the conclusion that the key function of the investment infrastructure of agro-industrial production is ensuring the functioning and enhance the effectiveness of the interrelations between the elements of the business environment.

## 5. Methods of research

To solve the problems, the following methods are used: analysis and synthesis, logical generalization, analogies, comparative comparison and graphoanalytical method.

## 6. Research results

Ukraine has a powerful and one of the largest potential in the world for the development of agro-industrial production, for which there are favorable natural and climatic conditions, large areas of fertile soils, intellectual, human and labor resources. However, the level of its implementation is not enough, which is confirmed by the reduction in agricultural production (in the base year 1990), lower than in economically developed countries, indicators of yield and use of resource support for the agro-industrial complex, a significant decline in livestock production. Modern advanced technologies and means of labor are used on an insignificant number of lands attracted to agriculture. This negatively affects the basic indicators of the country's socio-economic development and the competitiveness of its economy.

An important condition for the restoration of high rates of development of agro-industrial production in Ukraine is the formation of sufficient investment support, which will allow to:

- modernize the material and technical and technological base, warehouse, production and logistics infrastructure;
- attract modern technologies;
- increase production capacity;
- form local integrated agro-industrial structures;
- develop the export potential;
- systematically introduce all types of innovation.

In turn, one of the determining conditions for the growth of investment activity is the availability of a well-formed and efficiently functioning investment infrastructure.

Thanks to it, functions of accumulation and distribution of investment resources, effective investment and reinvestment of capital, investment process safety and capital transfer, the formation of a «transparent» investment environment and its high information and communication capacity, etc. are indicated. This shows the importance of the task of improving the theoretical, methodical and applied support of the implementation of the state policy for the formation and development of the investment infrastructure of agro-industry production in the current conditions of development of the Ukrainian economy.

Let's believe that to date, such negative factors and conditions for the functioning of the investment process of the agro-industrial production of Ukraine are significant:

1. The quality of products remains insufficient. The main reason for this is that more than 70 % of agricultural production is produced by small private households (77.9 % – crop production, 69.5 % – livestock products). They are limited by financial, material, technological, information resources. The quality is also affected by the fact that in the production of agricultural products are mainly people without proper training. Therefore, the purposeful work on the introduction of scientifically based technologies for keeping livestock, balanced feeding, veterinary care, breeding in subsidiary farms is not conducted. This leads to the fact that their products do not meet international quality and safety requirements [1].

2. There is a small proportion of enterprises certified according to international standards (for example, only about 3 % of meat processing plants and 35 % of milk processing enterprises have international certificates). This is due to the high cost and complexity of the process of obtaining ISO or HASSP certificates (from 6 to 18 months), the lack of a procedure for obtaining Euro-numbers in Ukraine [2].

3. The efficiency of this industry remains low. In Ukraine, the productivity of the dairy herd is 3.8 thousand kg (in Denmark – 8,1 thousand kg, the Netherlands – 7.1 thousand kg, Israel – 9.2 thousand kg). Let's dwell on the yield indicators:

- cereals – about 25 centner/ha (in the Netherlands – 82.2 centner/ha, France and Great Britain – 67.1 centner/ha);
- sugar beet – 380 centner/ha (in Switzerland – 842.4 centner/ha, France – 773.2 centner/ha);
- potatoes – 130 centner/ha (in the Netherlands – 424.6 centner/ha, Great Britain – centner/ha) [5].

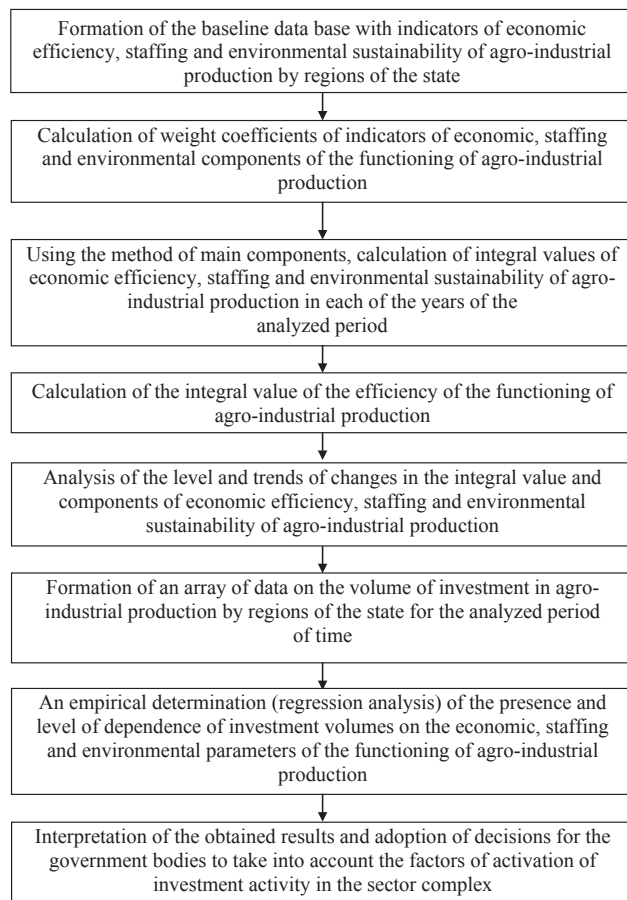
4. A high proportion of unprofitable agricultural enterprises.

The following factors significantly inhibit further improvement of the investment environment of agriculture in Ukraine:

- lack of state and regional programs of targeted financing of scientific and applied developments in the country's agricultural sector, which results in unsatisfactory quality of seed and pedigree material, limits the productivity of agricultural production. In addition, interaction has been established between scientific institutions and producers of Ukrainian agro-food products;
- backwardness of the infrastructure of the agro-industrial complex, which leads to an increase in the cost of production, to significant losses of production during its transportation and storage;

– the lack of state and regional strategies for development of foreign trade in agri-food products, which leads to a deformed structure of exports of agri-food products. In general, agricultural raw materials are exported, and not finished products, which hampers the development of the agricultural processing industry and significantly reduces the profits of Ukrainian farmers. In addition, food imports are growing every year. Thus, imports of agri-food products account for only about 18 % of total imports. State authorities have insufficient control over the importation of environmentally hazardous technologies, substances, materials and genetically modified organisms.

In order to implement a deeper econometric estimation of investment factors in the Ukrainian agribusinesses, let's consider it expedient to conduct a number of methodical actions and measures. The general logic of the analysis technique is shown in Fig. 1.



**Fig. 1.** Methodology of econometric estimation of investment in agro-industrial production of Ukraine (author's development)

Compliance with this sequence and conducting the appropriate analysis allows:

- firstly, to identify the existence of interrelation and mutual influence of certain factors – indicators of the functioning of agro-industrial production on the amount of investment in the industry;
- secondly, to assess the degree of influence of factors and, accordingly, spheres that require strengthening or, on the contrary, minimization of risks;

– thirdly, to establish the degree of influence of the main indicators and directions of the functioning of agro-industrial production on the volume of investment in the industry.

Let's believe that such information base will serve as the best basis for making informed and effective managerial decisions.

The information base for the analysis is the indicators characterizing the economic efficiency, staffing and environmental sustainability of agriculture in the regions of Ukraine in 2011–2015 [3, 4, 8]. Using the method of principal components, weights and integral values for each of the components of the functioning of the Ukrainian agricultural production sector are calculated. Table 1 shows the results of the assessment of the economic component. As it is possible to say, in 2015 the economic efficiency of the industry in Zakarpattia, Donetsk, Zhytomyr, Zaporizhzhya, Ivano-Frankivsk, Kyiv, Odesa and Chernivtsi regions was high. But low – in the Mykolaiv and Ternopil regions.

**Table 1**

The results of the assessment of the economic component of the functioning of agriculture in the regions of Ukraine in 2011–2015\*

Regions	Years				
	2011	2012	2013	2014	2015
Autonomous Republic of Crimea	0.490437	0.587512	0.615462	–	–
Vynnytsia	0.363694	0.299193	0.238964	0.215861	0.345123
Volyn	0.35711	0.353529	0.354668	0.348704	0.3515
Dnipropetrovsk	0.418116	0.485984	0.4	0.405828	0.388708
Donetsk	0.42261	0.472151	0.439961	0.493544	0.490226
Zhytomyr	0.410174	0.392068	0.390614	0.381737	0.409121
Zakarpattia	0.536799	0.495003	0.505042	0.536478	0.557305
Zaporizhzhya	0.505654	0.614565	0.512212	0.492427	0.477656
Ivano-Frankivsk	0.557923	0.494986	0.482382	0.451306	0.43209
Kyiv	0.474266	0.440923	0.434157	0.442954	0.473277
Kirovohrad	0.376063	0.476721	0.336603	0.33534	0.345599
Luhansk	0.51233	0.489326	0.480078	0.4842	0.372902
Lviv	0.430488	0.431342	0.434297	0.398085	0.393676
Mykolaiv	0.276985	0.352591	0.263759	0.265637	0.261091
Odesa	0.460515	0.566321	0.445449	0.452471	0.470799
Poltava	0.430373	0.427021	0.344825	0.374139	0.327588
Rivne	0.372499	0.307622	0.290643	0.290395	0.306412
Sumy	0.410291	0.40656	0.334718	0.346801	0.341974
Ternopil	0.355793	0.342582	0.322999	0.295577	0.295553
Kharkiv	0.478002	0.515658	0.41148	0.372528	0.392517
Kherson	0.451748	0.469589	0.448216	0.3885	0.394214
Khmelnitskyi	0.4443	0.410066	0.425093	0.356471	0.376179
Cherkasy	0.4321	0.447462	0.411397	0.399655	0.39007
Chernivtsi	0.508274	0.50896	0.534539	0.432502	0.454109
Chernihiv	0.429838	0.427583	0.405337	0.38841	0.379537

**Note:** \* calculated by the authors.

Table 2 shows the results of the assessment of the staffing component of the functioning of the industry, from which it can be concluded that the staffing of the

industry is much better than its economic efficiency. At the same time, it is especially important to note the availability of human resources in the industry in such areas as Donetsk, Kirovohrad, Poltava, Sumy, Kharkiv, Khmelnytsky and Chernihiv. Significantly worse was the staffing of the industry in the Zakarpattia, Volyn and Chernivtsi regions in 2015.

At the same time, the value of the integral coefficient was the highest for this region throughout the entire period under review – 2011–2015. High values also characterized Dnipropetrovsk, Donetsk, Zakarpattia, Kirovohrad, Luhansk, Mykolaiv, Odessa, Khmelnytsky and Chernihiv regions.

**Table 2**

The results of the assessment of the staffing component of the functioning of agriculture by regions of Ukraine in 2011–2015\*

Regions	Years				
	2011	2012	2013	2014	2015
Autonomous Republic of Crimea	0.540212	0.526736	0.525677	–	–
Vynnytsia	0.670996	0.661996	0.670192	0.669203	0.680103
Volyn	0.589073	0.574004	0.575027	0.580585	0.590069
Dnipropetrovsk	0.669128	0.668986	0.667235	0.683083	0.691352
Donetsk	0.706686	0.697887	0.703612	0.732403	0.756181
Zhytomyr	0.7206	0.713365	0.719778	0.717398	0.690527
Zakarpattia	0.45854	0.464123	0.464249	0.466427	0.479539
Zaporizhzhya	0.673354	0.653465	0.651102	0.669653	0.687503
Ivano-Frankivsk	0.536827	0.529044	0.532372	0.536253	0.542455
Kyiv	0.699494	0.691827	0.688335	0.69722	0.691819
Kirovohrad	0.698381	0.69527	0.690399	0.706663	0.737642
Luhansk	0.748624	0.741023	0.746174	0.741206	0.569208
Lviv	0.587847	0.57687	0.578718	0.582976	0.591797
Mykolaiv	0.635998	0.624716	0.626933	0.637475	0.658756
Odesa	0.530621	0.525376	0.527256	0.525831	0.543706
Poltava	0.758702	0.746443	0.74951	0.758517	0.777063
Rivne	0.535408	0.52037	0.526391	0.52933	0.534874
Sumy	0.822009	0.816116	0.82319	0.827848	0.83982
Ternopil	0.643172	0.628487	0.631457	0.643281	0.660557
Kharkiv	0.711316	0.698105	0.701331	0.718695	0.739746
Kherson	0.602346	0.593314	0.596189	0.598471	0.62484
Khmelnytskyi	0.732822	0.72488	0.726082	0.736209	0.746756
Cherkasy	0.688646	0.676678	0.687368	0.686826	0.696151
Chernivtsi	0.507551	0.476442	0.478413	0.481309	0.492252
Chernihiv	0.918434	0.909624	0.913232	0.924205	0.933351

**Note:** \* – calculated by the authors.

Table 3 shows the results of the environmental component assessment. How can it say that in 2015 high was the environmental sustainability of the industry in Mykolaiv, Odessa, Vynnytsia and Dnipropetrovsk regions. Low – in Ivano-Frankivsk, Kyiv, Khmelnytsky, Cherkasy and Rivne regions.

As a result, the information given in Tables 1–3, serves as an information basis for assessing the integral level of the functioning of agriculture in Ukraine (Table 4). In 2015, the level of the Zhytomyr region was high (0.51).

**Table 3**

The results of the assessment of the environmental component of the functioning of agriculture in the regions of Ukraine in 2011–2015\*

Regions	Years				
	2011	2012	2013	2014	2015
Autonomous Republic of Crimea	0.179285	0.181697	0.239381	–	–
Vynnytsia	0.302757	0.314706	0.311775	0.323642	0.310781
Volyn	0.093621	0.119761	0.130936	0.123653	0.121219
Dnipropetrovsk	0.250054	0.275492	0.296915	0.30658	0.311177
Donetsk	0.153238	0.186177	0.191956	0.244673	0.253672
Zhytomyr	0.193601	0.208707	0.227064	0.206852	0.216865
Zakarpattia	0.179472	0.183923	0.176804	0.141922	0.189685
Zaporizhzhya	0.185573	0.179603	0.187343	0.199952	0.203576
Ivano-Frankivsk	0.126028	0.103542	0.095088	0.097828	0.106761
Kyiv	0.166466	0.107463	0.109244	0.107045	0.111349
Kirovohrad	0.258512	0.262082	0.247751	0.253604	0.27655
Luhansk	0.249045	0.255222	0.280239	0.284808	0.261388
Lviv	0.223765	0.234621	0.231462	0.194983	0.208787
Mykolaiv	0.367214	0.345297	0.416491	0.439788	0.503265
Odesa	0.225702	0.326509	0.319868	0.512993	0.425374
Poltava	0.205263	0.192516	0.186981	0.183472	0.19317
Rivne	0.181422	0.141999	0.148201	0.156934	0.147652
Sumy	0.160357	0.189768	0.199293	0.206843	0.195452
Ternopil	0.299317	0.260141	0.261728	0.242804	0.233808
Kharkiv	0.121912	0.116454	0.130521	0.158908	0.15239
Kherson	0.31259	0.232204	0.186505	0.188308	0.22374
Khmelnytskyi	0.167596	0.128992	0.134236	0.159663	0.126842
Cherkasy	0.121162	0.116166	0.120132	0.120532	0.131939
Chernivtsi	0.212186	0.181427	0.188593	0.208664	0.195383
Chernihiv	0.183488	0.199402	0.189266	0.210983	0.174662

**Note:** \* – calculated by the authors.

Fig. 2 shows the integral indices of the functioning of agriculture in Ukraine in 2011–2015. As it is possible to see, the integral coefficient of efficiency of the industry throughout the analyzed period was low and amounted to only 0.387 in 2011 and 0.383 in 2015. This can't be evidence of high efficiency of the industry and, accordingly, its investment attractiveness. Let's believe that government bodies need to work to improve the economic efficiency and environmental sustainability of the industry.

**Table 4**

The results of the estimation of integrated coefficients of agricultural functioning by regions of Ukraine in 2011–2015\*

Regions	Years				
	2011	2012	2013	2014	2015
Autonomous Republic of Crimea	0.376445	0.399728	0.440707	–	–
Vinnitsia	0.393188	0.368818	0.338015	0.329489	0.39038
Volyn	0.241926	0.264326	0.274418	0.267588	0.267379
Dnipropetrovsk	0.412655	0.446751	0.431507	0.44184	0.440135
Donetsk	0.349364	0.386315	0.382567	0.438144	0.447332
Zhytomyr	0.521224	0.508643	0.511355	0.503161	0.512221
Zakarpattia	0.437319	0.426192	0.42782	0.428228	0.456526
Zaporizhzhya	0.393314	0.410892	0.391985	0.399278	0.401125
Ivano-Frankivsk	0.278219	0.239291	0.22716	0.222909	0.227428
Kyiv	0.372257	0.310532	0.310279	0.311352	0.321663
Kirovohrad	0.425675	0.436294	0.41148	0.420195	0.446714
Luhansk	0.459459	0.45457	0.466885	0.469651	0.489439
Lviv	0.375503	0.379918	0.379415	0.347153	0.35565
Mykolaiv	0.403867	0.423324	0.414068	0.425472	0.448926
Odesa	0.389201	0.467282	0.426523	0.494482	0.479291
Poltava	0.407906	0.397379	0.35915	0.371493	0.35796
Rivne	0.321214	0.273358	0.273236	0.279291	0.279152
Sumy	0.370035	0.388867	0.368125	0.378291	0.370937
Ternopil	0.393548	0.366988	0.360212	0.341068	0.339
Kharkiv	0.333265	0.334426	0.323218	0.337693	0.341662
Kherson	0.463846	0.441353	0.414042	0.390208	0.413215
Khmelnyskyi	0.498716	0.465377	0.475398	0.449943	0.452626
Cherkasy	0.330923	0.328	0.324591	0.321848	0.330696
Chernivtsi	0.353513	0.324075	0.333597	0.331845	0.329192
Chernihiv	0.498973	0.504204	0.489715	0.494724	0.474295

Note: \* – calculated by the authors.

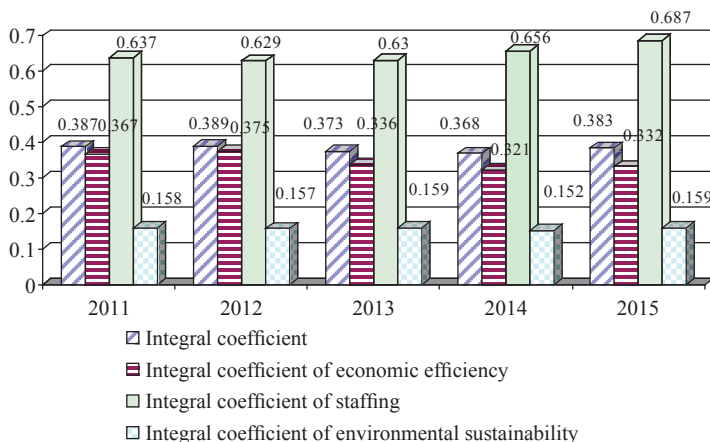


Fig. 2. Integral indices of the functioning of agriculture in Ukraine in 2011–2015 (Author's development)

The initial data for the regression analysis of the dependence of the investment volume in the industry on the parameters of its effectiveness estimated above [8]. By calculations, the regression equation is obtained:

$$Y = 99.8542 + 0.27x_1 + 0.29x_2 + 0.13x_3, \tag{1}$$

where  $Y$  – volumes of capital investments per 100 hectares of agricultural land, thousand UAH;  $X_1$  – the environmental component of the functioning of agriculture;  $X_2$  – the economic component of the efficiency of agriculture;  $X_3$  – the staffing component of the provision of agriculture.

Let's pay attention to the fact that the obtained results are statistically significant, because the corresponding coefficients are:

$$R^2_{adj} = 0.9167; F(5.79) = 39.5000; Std. Er. = 0.0111.$$

Thus, there is reason to assert that all three components under consideration have a positive and significant influence on the volume of capital investments in the industry. At the same time, the influence of the staffing component and, more importantly, the economic and environmental components, which together account for more than 50 % of the factors affecting the investment environment and the volumes of investments attracted to the industry, are somewhat less significant.

The government should take these factors into account in order to create a better investment environment for the development of the agricultural production sector and to strengthen its role in the national economy of Ukraine.

### 7. SWOT analysis of research results

*Strengths.* The strength of this research is the analysis of the three components of the investment process in the agro-industrial complex: economic efficiency, staffing, environmental sustainability and analysis of the dependence of the volume of capital investment in agro-industrial production on these three components.

*Weaknesses.* The weak point is that the database of indicators could be expanded by indicators of the structure of investments in the agro-industrial complex.

*Opportunities.* Opportunities for further research are borrowing the experience of foreign countries to improve the investment process in Ukraine's agro-industrial production.

*Threats.* Threats to the results of the carried out research are that the process of agro-industrial production is constantly dependent on natural and climatic conditions, world prices for agricultural products.

### 8. Conclusions

1. Macroeconomic prerequisites for activating investment activities in Ukrainian agro-industrial production are identified, which are mostly unfavorable and are characterized by significant shortcomings of this industry complex:

- current status of functioning (low indicators of financial and economic efficiency of management and yield, raw materials of industry enterprises and low share of products

with added value, irrational sectoral structure and low capitalization of production, inadequacy of Ukrainian standards for product safety certification with international standards);

– development trends (decrease in production volumes in livestock, reduction in the number of agricultural animals, aggravation of the loss of livestock sector, reduction in the number of economic entities, deterioration of the natural fertility of soils, stagnation of the social and economic sphere of rural areas).

2. It is shown that these disadvantages have led to critically acute negative consequences in the context of the formation of the investment infrastructure and the formation of investment support for the agro-industrial production of Ukraine, namely:

- reduction of volumes and restrictions of sources of investment resource formation;
- weakening the practice of financial and investment integration;
- reduction of the possibilities of budgetary financial and investment support;
- reduction in the number of elements of the financial and investment infrastructure;
- strengthening of concentration and monopolization of investment support;
- deterioration of investment attractiveness of rural settlements;
- restraining the development of the sphere of financial services of the system of bank lending for the modernization of the technical and technological base and the development of agro-industrial production.

3. The author's methodology of econometric estimation of investment factors in agro-industrial production of Ukraine is developed. According to the received calculations, the basis for asserting a high investment dependence on the economic efficiency of the industry (regression coefficient is 0.29) and its environmental sustainability (0.27). At the same time, it is somewhat less, but also the staffing support of the enterprises of the industry (0.13) also makes a positive impact on the volume of investment. The low level of the efficiency of the functioning of the industry is established and proved (the integral coefficient in 2015 was 0.383 and decreased from 2011 to 0.004), which indicates its low investment attractiveness, which is deteriorating. It is identified that the main factor that led to this is the deterioration of the economic efficiency indicators of the industry (the integral index dropped to 0.332 in 2015) and environmental sustainability (up to 0.159).

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## ЭКОНОМЕТРИЧЕСКОЕ ОЦЕНИВАНИЕ ФАКТОРОВ ИНВЕСТИРОВАНИЯ В АГРОПРОМЫШЛЕННОЕ ПРОИЗВОДСТВО УКРАИНЫ

Проанализированы основные концептуальные условия и негативные факторы функционирования инвестиционного процесса агропромышленного производства в Украине. Установлено, что неэффективность инвестиционной инфраструктуры агропромышленного производства является весомым препятствием использования конкурентных преимуществ отечественного агропромышленного производства на современном этапе развития Украины в условиях евроинтеграции. В условиях, когда взаимное открытие рынков, имплементация технических аспектов обеспечения качества сырья и продуктов питания требует современных форм инфраструктурной поддержки.

**Ключевые слова:** инвестиционная инфраструктура, агропромышленный комплекс (АПК), сельское хозяйство, эконометрическая оценка факторов инвестирования.

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