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## Article

# Research of the development of the electronic industry and economy on the example of Ukraine

Technology audit and production reserves

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## RESEARCH OF THE DEVELOPMENT OF THE ELECTRONIC INDUSTRY AND ECONOMY ON THE EXAMPLE OF UKRAINE

*The object of research is the electronic industry and economy on the example of Ukraine. The rapid development of national economies is accompanied by the introduction of the best innovative technologies and knowledge, which leads to the informatization of all processes in society. The electronic industry plays a key role in the development of the economies of market countries. And the problem of the global shortage of semiconductors, which are components in most devices, actualizes the pressing issue of the development of the electronic industry in Ukraine.*

*In the course of the study, the method of theoretical analysis was used in the study of the electronic industry in Ukraine and statistical tools were used in the identification and assessment of trends in the development of the industry in Ukraine. As well as methods of theoretical analysis, comparison and generalization for the general analysis of the development of the domestic economy, and a graphic method for the analysis of statistical data on changes in the socio-economic state of the country and industry.*

*The proposed work examines the development of the electronic products market and industry in Ukraine. The obtained results of the study indicate the insufficient level of development of the electronic industry in Ukraine, as well as the need to build a sustainable partnership between enterprises of the electronic industry and scientific institutes conducting developments in the field of nanomaterials.*

*Thanks to the obtained research results, electronics manufacturers will be able to focus their attention on methods of building joint alliances with scientific institutes and increase the level of technology transfer in Ukraine. The results of the study can be used to compare the development of the electronic industry and the economy of European countries in conditions of constant crisis phenomena.*

**Keywords:** *electronic industry, semiconductors, knowledge economy, knowledge globalization, society informatization, knowledge-intensive products, economy digitalization.*

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### 1. Introduction

The gradual transition of the world economy to the «knowledge economy», enhanced by scientific and technological progress, forms a global informatization of all layers and industries. The main characteristic of such a process is the globalization of the use of knowledge and innovation. The rapid spread of new technologies is in the nature of the total integration of the economies of countries and the barrier-free exchange of technologies and knowledge. Today, the electronic industry is not only a science-intensive branch of mechanical engineering, but also a high-tech one.

The electronics industries include:

- production of electronic components;
- development and production of computing, communication and radio equipment;
- production of control and measuring equipment, etc.

The electronics industry needs constant innovation. The problem of introducing innovations into the activities of knowledge-intensive enterprises on the example of developed countries and countries with economies in transition is considered by leading scientists from the USA, the EU and other countries [1, 2]. The results of research into the introduction of innovations by enterprises confirm the need to use both domestic and foreign innovative experience and knowledge.

The electronic components industry produces semiconductors, resistors, capacitors, coils, batteries, connectors, etc. These components are used in critical industries such as military, medical, aerospace and aviation. The development of innovative ecosystems in the US, the EU and China contribute to the development of knowledge-intensive enterprises, both in a market-oriented and technology-oriented direction [3–5]. Such ecosystems accelerate the

development of the electronic industry in countries. The lack of developments in this area encourages scientists to study the problem of the development of the electronic industry on the example of Ukraine. Also, in further research and analysis, the problem of determining modern trends in the development of the economy and industry is required [6, 7].

Thus, *the object of research* is the electronic industry and the economy on the example of Ukraine. *The aim of research* is to study the development of the market for electronic products and industry in Ukraine.

## 2. Research methodology

The following scientific methods were used in the study:

- method of theoretical analysis in the study of the electronic industry in Ukraine;
- statistical tools for identifying and evaluating trends in the development of industry in Ukraine;
- methods of theoretical analysis, comparison and generalization for a general analysis of the development of the Ukrainian economy;
- graphical method for analyzing statistical data on changes in the socio-economic state of the country and industry.

## 3. Research results and discussion

Modern permanent changes are generated by the transition from the industrial-market to the information-network economy. Such transformations create bifurcation points that become factors in the development of the economy and society in the context of digitalization.

It should be noted that in the industry of Ukraine, which can be considered quite competitive, there is a tendency for a general increase in the volume of sold industrial products, with the exception of the 2009 and 2014 crisis years [8].

Average annual absolute increase in the volume of industrial output of Ukraine for 2001–2013 amounted to +2.535 billion USD, and the average growth rate was +3 %. For the period 2014–2021 the volume of sold industrial products increased by 200 % and, accordingly, increased by 59.6 billion dollars.

Some industries have increased output, in particular: the production of basic pharmaceutical products and preparations (by 240 %); manufacture of wood and paper products (by 193.5 %) (Fig. 1).



**Fig. 1.** Dynamics of industrial production indices and producer prices in 2012–2021, % (compiled according to [9])

According to Fig. 1, the following conclusions can be drawn:

1. Inflationary processes have a significant impact on the dynamics of industrial producer prices (in 2021, the price index was 162.2 %).
2. Industrial output against the background of the acute phase of the war in 2014–2015.
3. The gradual recovery of the dynamics of industrial production has unsatisfactory growth rates, offset by significant inflation rates in the country.

However, the growth of the index of physical volume and the number of profitable enterprises in 2012–2021 indicates an increase in the volume of sales of industrial products, and, consequently, an increase in the economic activity of industrial enterprises due to the profits received. At the same time, an innovative orientation is characteristic, which is manifested in an increase in investment in the purchase of new technologies and equipment [9].

The analysis of industrial enterprises showed that the main problems of the industrial complex of Ukraine are related to:

- insufficient innovative activity of enterprises;
- loss of established markets for products;
- technical obsolete and low quality products;
- insufficient domestic funding;
- inefficient spending of depreciation funds by enterprises.

Although in developed countries up to 80–95 % of GDP is the production and sale of high technology products. Thus, the largest exporters of innovations are the USA, Japan, Germany, the Netherlands, Italy, etc. The most famous international companies from these countries are: Freescale Semiconductor, Rohm, Semikron, NXP, STMicroelectronics [10].

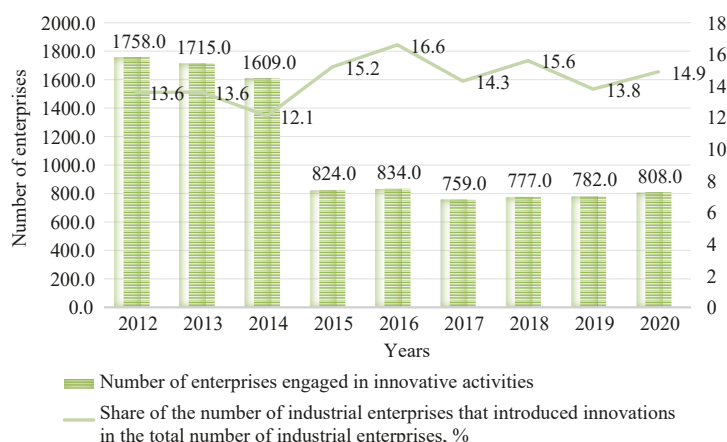
Ukrainian science-intensive products account for less than 0.2 % of the world market share of nanotechnology products. The number of the largest electronics manufacturers in the country includes more than 50 production associations [11, 12]. They are engaged in both the development and manufacture of modern components. Among these manufacturers, it is worth noting enterprises [13] from Zaporozhye (OJSC Zaporizhzhia Plant Preobrazovatel, LLC Inkofer, LLC Elimeks), as well as from Kyiv (LLC Barion), from Lviv (PJSC Concern Electron) and the like.

The change in the number of innovatively active enterprises and enterprises that introduced innovations and carried out scientific research is shown in Fig. 2.

The study of the Ukrainian experience of industrial production indicates a high intellectual and human potential. However, the number of enterprises introducing innovations in 2020 amounted to only 14.9 % of the total number of industrial enterprises. This indicator is 3–4 times less than in developed countries, and the number of innovatively active enterprises is 808.

A sharp reduction in innovatively active enterprises occurred in 2015 against the background of the aggravation of hostilities in Ukraine (by 100 %). At the same time, the amount of spending on technological innovations amounted to 0.36 billion USD, which is 30 % more than in 2012 [14].

In 2020, the share of the volume of sold innovative products (goods, services) in the total volume of sold products (goods, services) of industrial enterprises amounted to 1.3 %, while in 2012 it was 3.3 %. In the rating of innovations, Ukraine is on the 49th place [14].

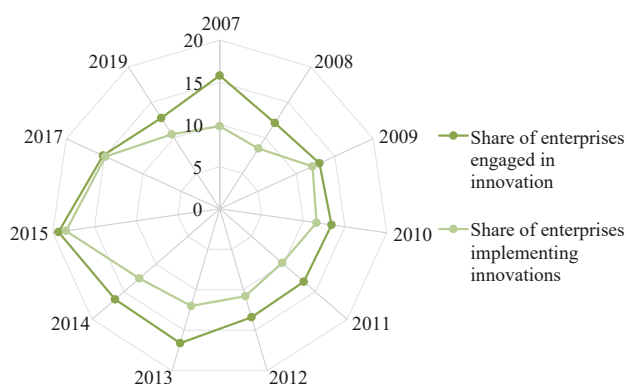


**Fig. 2.** Change in the number of innovatively active industrial enterprises and their share in the total number of industrial enterprises for 2012–2020 (compiled according to [9])

According to the materials of parliamentary hearings in the Verkhovna Rada of Ukraine, regarding the strategy of innovative development of Ukraine for 2010–2020 in the context of globalization challenges, the main factors complicating the innovative activity of enterprises are:

- lack of own funds (80.1 % of the surveyed enterprises);
- high costs for innovations (55.5 %);
- insufficient financial support from the state (53.7 %);
- high economic risk (41 %);
- long payback period for innovations (38.7 %);
- lack of funds from customers (33.3 %);
- imperfection of the legislative framework (40.4 %);
- lack of qualified personnel (20 %);
- lack of opportunities for cooperation with other enterprises and scientific organizations (19.7 %);
- lack of information about sales markets (17.4 %);
- lack of information about new technologies (17.3 %);
- lack of demand for products (16 %) [14].

The noted problems of competitiveness of Ukrainian products at the macroeconomic level are also characteristic of the regional level. The share of innovatively active industrial enterprises in the Lviv region in 2019 is 12.8 % of the total number of industrial enterprises, which is 2.4 % less than in 2017. The dynamics of the share of enterprises that introduced innovations is shown in Fig. 3.



**Fig. 3.** Dynamics of the share of enterprises that were engaged in and implemented innovations for 2007–2019, % (compiled according to [12])

In general, it can be argued about fluctuations in the share of the volume of sold innovative products both in the Western region and in Ukraine as a whole. The largest

share of the volume of sold innovative products falls on industry and amounts to 1.49 billion USD, or 1.1 % of the total volume of products sold. At the same time, the share of new innovative products for the market is 18.1 %, and the share of new products at the enterprise is 81.9 %. Compared to previous years, the volume of sales of innovative products has increased, which indicates a positive trend.

The electronic industry is also characterized by general problems of industrial enterprises, namely [12, 15]:

- high depreciation of fixed assets due to inefficient restoration and lack of own funds;
- bureaucratized mechanisms for attracting investment funds;
- insufficient level of support from the state.

The limitation of this study is the time frame for the analysis of macroeconomic indicators of the Ukrainian economy.

A promising direction for the development of this study should be considered the search for methods for the effective development of electronic industry enterprises. This is due to the fact that fundamental research is being carried out in Ukraine and the latest element base of nanotechnologies is being developed, which can be used to create devices and devices, but with the cooperation of business and Ukrainian institutions. The results of the study can be used to compare the development of the electronic industry and the economy of European countries in the context of constant crisis phenomena.

## 4. Conclusions

Consideration of the dynamics of industrial production in Ukraine shows growth during 2012–2021. The quantity of products produced mainly due to inflationary processes. At the same time, the number of enterprises introducing innovations in 2020 amounted to only 14.9 % of the total number of industrial enterprises. This indicator is 4 times less than in developed countries, and as a result, Ukraine ranks 49th in the innovation rating.

In developed countries, the export of science-intensive products is approaching 90 %, while in Ukraine, products with a low level of knowledge-intensity dominate. The ratio of exports of low-tech goods to high-tech goods is increasingly reminiscent of the Pareto ratio (80/20).

The identified number of problems that hinder the innovative activity of enterprises in the face of globalization challenges are of a financial and informational nature, which once again emphasizes the need to move away from the traditional distribution of financial flows in favor of financing scientific research, as well as an active international exchange of knowledge and technologies.

Summing up the above, it should be noted that the driving force behind economic development is, first of all, the effective use of scientific and technical potential, which is not sufficiently implemented on the example of Ukraine.

## Conflict of interests

The authors declare that there is no conflict of interest regarding this study, including financial, personal nature, authorship or other nature that could affect the research and its results presented in this article.

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## Data availability

Data will be provided upon reasonable request.

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