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Department of Management and Economic Processes Management,  
Mucachevo State University (Mucachevo, Ukraine)***ESTIMATION THE IMPACT OF MACROECONOMIC FACTORS  
ON THE INNOVATION ACTIVITIES OF ENTERPRISES IN UKRAINE**

*In this paper the analysis of the current state and trends of innovation activity in Ukraine was conducted. The macroeconomic factors which affecting the level of innovation activity of domestic enterprises was systematized and we have made forecasting of their display during the current period. It has been established the correlation and regression dependence between the volume of innovative products and these factors. The analyses of index dynamics relevant macroeconomic relative indicators to the average value were made and level of their turbulence was determined. The main opportunities and threats of macroeconomic environment and direction of innovation activity in the future have been identified.*

**Keywords:** innovation, innovative activity, macroeconomic factors, financing, investment, exports of innovative products, indices deviations.

**Problem statement.** In modern conditions innovation is the foundation of economic growth and competitiveness of enterprises, industries and the economy in the long run. The level and success of innovative activity of enterprises, along with the domestic potential is determined by many factors which have a positive and negative impact on economic activity of enterprises at regular intervals.

Analysis and forecasting of relevant factors enables companies to form innovative development potential, attracts investments and develops effective innovation strategies. This greatly increases the probability successful implementation of innovations. In this regard, there is an urgent need for research and systematization of factors influencing the development of innovation. The current issues are also developing methods of analysis and forecasting of these factors to improve the information support level of the innovation process.

**Analysis of recent researches and publications.** The important contribution to the study of the essence of innovation and innovation factors of the enterprises is realized by A. Hrynov [1], S. Illyashenko [2], O. Kuzmin [4]. These authors had viewed them from the positions of influence on the final results of economic activity. Analysis and classification of factors of enterprises innovative development at different levels were used in the works of M. Broad [13], A. Miroshnichenko [7], V. Sizonenko [11], N. Sobchenko [12], N. Thompson, E. Stam [14] and other scientists. The factors of innovative activity of certain regions and sectors have been investigated by international, governmental organizations, rating agencies and consulting firms.

**Previously unsettled problem constituent.** Despite the achievements of scientists and practitioners, the problem of comprehensive assessment of macroeconomic factors of innovative development is not fully disclosed and requires further research.

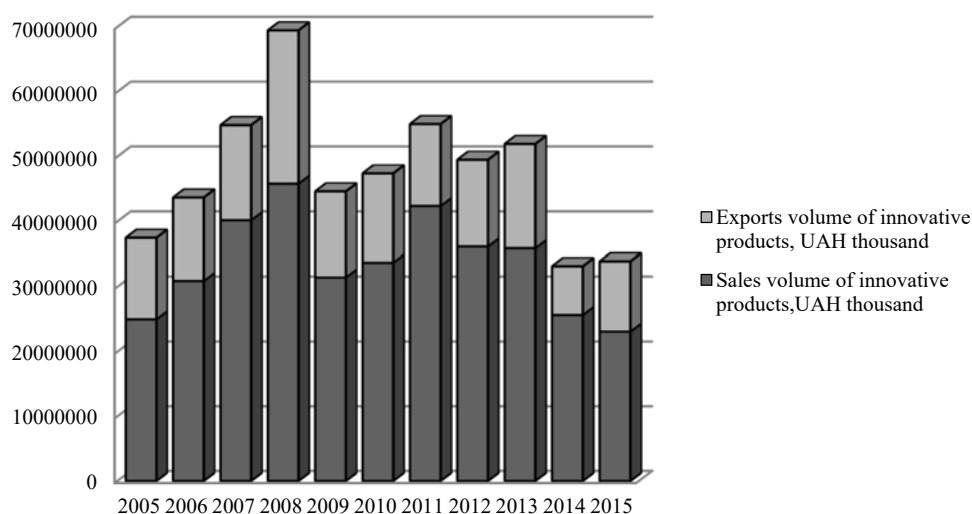
**The main purpose of the article** is to analyze macroeconomic processes and phenomena that determine conditions of modern innovation stage of enterprises in Ukraine for practical recommendations developing to use them in strategic planning.

**Results and discussions.** The increase of domestic enterprises innovation activity and the effectiveness of innovation sphere is one of the key objectives and priorities for management at all levels.

According to the State Statistics Service of Ukraine in 2015 the part of enterprises which was engaged in innovative activities was 17,3% of the total number of industrial enterprises with an average number of employees 50 people or more. This represents an increase (over 9,1%) compared with 2005 and by 5,2% compared to the previous period.

Companies spent UAH 13,8 million on innovation, including: the purchase of machinery, equipment and software – UAH 11,1 million (80,7% of total innovation expenditures); on internal and external research and development – UAH 200 million (14,8%), the acquisition of other external knowledge (acquisition of new technologies) – 0,1 million (0,6%). The main source of funding for innovation expenditures are own funds – UAH 13,427 million. The financing volume from other sources has totaled: by the domestic and foreign investors – UAH 132,9 million, loans – UAH 113,7 million, state and local budgets – UAH 93,5 million. In 2015 innovations implemented 87,7% of enterprises engaged in innovative activities, including innovative products – 57,3%, new processes – 55,3% [3].

Important indicators of innovation activity are the sales of innovative products and its export potential. The Fig. 1 shows the dynamics of production and export of innovative products in Ukraine.



*Figure 1 – The dynamics sales of innovative products industry Ukraine*  
(compiled on the basis of [3; 8; 9])

The total volume of innovative products in 2015 reached UAH 23100 million, that is over UAH 2569 million (-10%) less than in the previous period and is over UAH 10223 million (8%) less compared to 2005.

In 2014 exports of innovative products have fallen almost 2-fold compared with 2013, and taking into consideration the level of devaluation of the national currency – by 4-5 times.

These parameters are catastrophic. The main factor that led to this situation is military action. Because the part of enterprises producing innovative products were on the temporarily occupied territories and many enterprises have lost the traditional markets. At the same time, the data in 2015 indicate the recovery of exports of innovative products by 44%, which is a positive sign for the economy.

The dynamics of innovative expenses in 2015 was also positive, as their total volume is twice higher than the previous period and amounted to UAH 13, 8137 million.

For comparison, in the European Union, the proportion of enterprises engaged in innovative activities is about 53%. The greatest number of innovative enterprises is in Germany (79,3%), the lowest one is in Bulgaria (27,1% to the total) [7, p. 74].

During analyzing the main areas of innovation, it should be noted some negative trends that are characteristic for the period under review, which we can see in Table 1. In particular, it is reducing the innovative products number by 0,5% compared with 2005 and by 14,3% compared with the previous period.

Slowing of the rate of new technological processes introduction (30%) and energy saving technologies (14%) compared to 2014 is the result of increasing prices in national currency for new equipment and technology, which are mainly imported from abroad.

*Table 1 – Implementation of innovations in industrial enterprises\**

Indexes	2005	2010	2011	2012	2013	2014	2015	Increment 2015/2005, %	Increment 2015/2014, %
The share of enterprises that implemented innovations, %	8,2	11,5	12,8	13,6	13,6	12,1	17,3	9,1	5,2
Was introduced new technological processes, units	1808	2043	2510	2188	1576	1743	1217	-32,7	-30,2
including the low-waste and saving	690	479	517	554	502	447	458	-33,6	2,5
Was introduced production of innovative products, names	3152	2408	3238	3403	3138	3661	3136	-0,5	-14,3
Including new types of appliances	657	663	897	942	809	1314	1131	72,1	-13,9
The share of sales of innovative products in industrial, %	6,5	3,8	3,8	3,3	3,3	2,5	2,3	-4,2	-0,2

\* – formed by the author based on data [3; 8; 9]

As you can see from the Table, most indicators of innovation activity in 2015 show a negative trend. In particular, they are: the share of innovative products in the total volume of industrial production, the number of implemented innovative products and new processes. But, in terms of reorienting businesses to new standards within the association with the EU,

these figures should rise. So the state of innovation activity in Ukraine requires increased attention at all levels. It should strive to design legal, economic and administrative measures feigning innovation enterprises.

Conducted analysis indicates that the development of innovation activity is unstable and in most cases correlates with the economic processes taking place in the country. In particular, the highest level of innovative activity was observed in certain periods of economic stability (2007, 2008 and 2011), which is an important indicator of investment climate.

The current stage is characterized by the emergence of new challenges facing the economy of Ukraine, which are primarily related to the need of industrial complex restructuring on new innovative principles. This requires the development of effective strategic decisions on complex support innovation at all levels.

The level of innovation activity in the enterprises and the development of innovation, along with the internal potential, depend on a number of factors that are in the environment. The innovation factors could be interpreted as processes, conditions and phenomena which influence on the industrial enterprises opportunity to implement innovations in production, management, market activity and gaining economic benefit in the current planning period.

In strategic management the factors of external environment are divided into direct action factors (microenvironment) and factors of mediated actions (macro environment) [12].

Macro factors affect the investment and innovation activity at the state level. The level and trends marked by those factors form the condition of providing of investment and innovation and significantly affect the activity of economic entities. In view of this, methodological tools to ease evaluation of impact macro environmental factors are needed to be improved.

In scientific literature there is no uniform approach to the classification of macro factors that affect the development of innovative activity. For example, Alexander Kuzmin identifies the following groups of factors [4]: legislative, organizational, managerial, financial, economic, technical, technological, social, environmental, humanitarian, information. The authors [1; 12] distinguish the following groups of factors that influence the development of innovative enterprises: economic, technological, organizational, managerial, political, legal, social, psychological and cultural.

A group of scientists [13] investigated the impact of external economic factors on the development of innovative businesses of Israel. They have defined the state financial and institutional support of innovation, the banking and foreign trade policy as key determinants of the innovation growth.

Some researchers [5; 12] as key factors of innovation of domestic enterprises have identified an international factor, namely: the level of international cooperation of Ukraine and its participation in international programs, projects and activities of innovative direction.

Thompson N. and Stam E. [14] had explored the relationship between the level of innovation in the enterprises and macroeconomic factors such as GDP, long-term interest rate and unemployment in England.

Of course, each of these groups of factors is affecting the level of innovation activity of enterprises and requires in-depth research. However, we believe that the most significant impact on the innovation produce economic factors, because their evaluation helps enterprises identify and anticipate opportunities to obtain economic benefits from innovation in the plan period.

The economic factors, which affect the level of investment and innovative activity of economic entities, include the full range of public and market levers of economic management. The most important factors in terms of their impact on decision making on

the enterprise level are shown in Table 2.

*Table 2 – Macro economic indicators impacting innovation* (developed by the author)

Indicators		Symbols	Character of influence on innovation processes
Investment (I)	Foreign direct investment in Ukraine, \$ million	$i_1$	Reflects the level of attractiveness of country for foreign investors. Accordingly, the positive trend of this indicator shows the capacity building of domestic enterprises to attract foreign investments in innovation
	The volume of capital investments, UAH thousand	$i_2$	Reflects the possibilities of creation, augmentation and modernization of logistics enterprises
	State financing of innovation, UAH thousand	$i_3$	Shows the level of state support of domestic enterprises innovation activity, creating favorable conditions for the development of innovative component of potential businesses
Market (M)	The level of consumer income, UAH million	$m_1$	Affects the size of the domestic market innovative products and provides a basis for the formation of savings as one of the important sources of domestic investment
	The total volume of exports, \$ million	$m_2$	Show the status and development of the country's relations with foreign partners, the state's position in the global market. Accordingly, the growth of these indicators shows the activation of goods and services exchange with other countries, the success of globalization and integration processes and a positive signal to enhance the innovation process
	The total volume of imports, \$ million	$m_3$	
Financial (F)	Discount rate, %.	$f_1$	It is a price for refinancing commercial banks by the National Bank of Ukraine. Its growth leads to higher cost of credit to businesses and individuals, thereby it is difficult to attract external financial resources to fund innovation
	The average official exchange rate of national currency	$f_2$	Reducing of the national currency has a negative affect on the capacity of the enterprise concerning production and sale of innovative products
	Corporate income tax rate, %	$f_3$	Corporate income tax rate plays an important role in <del>decision</del> decisions on innovation as a prerequisite for payback innovation and formation of innovative enterprise funds

The correlation and regression analysis was conducted in order to determine the degree of influence of these factors on innovation processes in Ukraine. One of the main indicators of innovative activity is volume of innovative products sales. So this indicator has been selected as the dependent variable ( $y$ ) for analyses. During the regression equations statistical parameters of macroeconomic factors for the period 2005-2015 were used. The results of the correlation and regression analysis using matrix calculations in Microsoft Excel spreadsheets are summarized in Table 3. On the basis of the analysis it has been found, that there is a significant dependence of innovative products sales volume from the effects of major groups of macroeconomic factors. So, this is shown by the following data: all of coefficients of multiple correlations for equations are above 50%; the level of materiality communications of all equations corresponds to the Fisher criterion ( $F_{cm} > F_{кр}$ ).

**Table 3 – Results of regression analysis of the impact of macroeconomic factors on sales volume of innovative products** (calculated by author)

Factors	Regression equations	The coefficient of multiple correlation $R$ , %	The coefficient of determination $R^2$ , %	Checking the materiality of communication (Fisher criterion), $F_{cm} > F_{kp}$
Investment	$y = 21343566 - 352i_1 + 112i_2 + 16,7i_3$	62	38	$F_{cr} = 1,46$ $F_{kp} = 1,44$
Market	$y = -23429141 + 3,32m_1 + 735,64m_2 + 855,68 m_3$	95	90	$F_{cr} = 20,58$ $F_{kp} = 18,88$
Financial	$y = 559295 - 3715,95f_1 + 1265,92f_2 - 6476,60f_3$	61	37	$F_{cr} = 1,36$ $F_{kp} = 1,32$

On the basis of the correlation and regression analysis results we have made the following conclusions:

1. The group of investment factors affects the volume of innovation activity ( $R = 62$ ), but according to coefficients of determination ( $R^2 = 38$ ), only 38% of innovative products volume can be explained by influence of these factors. The regression parameter  $i_1$  is negative and shows the inverse relationship between the amount of foreign direct investment and sales volumes of product innovation. That is, an increase in foreign direct investment for \$1 million leads to reduction of sales of innovative products by UAH 352 thousand. This can be explained by the structure of foreign investments, a significant share of which (about 30%) are in the service sector. And also it can be explained by the fact, that foreign investors are mostly interested in sectors with high profit and short payback period, but are not interested in raising the innovation of enterprises.

Traditionally, capital investments and government funding of innovation carry out the positive impact on innovation processes. In particular, an increase of capital investment to UAH 1 million leads to the increase of the innovative production manufacturing by UAH 112 thousand. The increase in funding innovation from the state budget to UAH 1 thousand leads to increase of innovation product by UAH 16,7 thousand.

2. Group of market factors has the greatest impact on the sales volume of innovative products, as it was evidenced by the resulting coefficient of determination  $R_2 = 90\%$ . Parameter  $a_0$  is negative (-23429,141) and shows which sales volume of innovative products ( $y$ ) would be, if factorial signs  $m_1, m_2, m_3$  were 0. So, all market factors are important to innovative activity of enterprises. Thus, with increasing income levels of consumer by UAH 1 million the volume sales of innovative products will increase by an average of UAH 3,32 thousand. The result of regression showed also a significant dependence of innovation in the enterprises from the state of foreign trade in the country, namely exports and imports. With an increase in exports on \$1 million, the sales volume of innovative products will increase by UAH 735,64 thousand. The increase in imports by \$1 million leads to the increase of innovative products sales to UAH 855,68 thousand.

3. Studies have shown that financial macrofactors also affect the production of innovative products. This is evidenced by the resulting coefficient of multiple correlation ( $R = 61$ ). However, only 37% of innovative processes in Ukraine are caused by factors data. The equation parameters  $f_1, f_2, f_3$  show the impact of macro financial factors to average change in sales of innovative products. It is established, that an increase of NBU discount rate by 1% leads to the reduction of sales volume of innovative products an average by

UAH 3715,95 thousand. This shows the importance of the banking sector in stimulating innovation in the enterprises. Due to a high share of exports of innovative products, the devaluation of the national currency for \$ 1 leads to an increase in sales of innovative products to UAH 1265,92 thousand. The positive impact on innovation processes has also reducing of Corporate Income Tax, as a significant part of innovation expenditures of enterprises at the expense of internal resources. So, on the basis of correlation-regression analysis it has been found that the macro factors affect the volume of innovation. In this regard, there is a need in assessment and forecasting the trends of development of these factors for strategic planning process innovation in enterprises.

For this purpose, in this investigation it has been used the index method proposed by A. Maslak [6, p. 36]. The essence of the index method is that all the components of external environment are measured as separate parameters (indexes), each of which reflects their level of influence factors for domestic entities.

However, this method we modified to determine not only the manifestation of certain factors but also to determine their directions and trends. Conducting research involves several stages:

1) identification of a list of indicators that affect the innovation activity of enterprises, data collection;

2) creating a data matrix of indicators  $X_{ki}$  used in the study, where  $X$  – value of  $k$ - in  $i$ -index in the period of observation;

3) determination of the average  $\bar{X}_k$ , which each index gained during the period. Comparison of the mean value makes it possible to determine the degree of individual factors turbulence, because the stability of the environment positively influences the direction of investment resources in the innovation sector and focuses on developing long-term plans;

4) standardization of indicators. The indicators, whose growth is a positive sign for the company, have been standardized by the formula:

$$I_{.ik} = \frac{X_{ki}}{\bar{X}_k} \cdot 100 - 100. \quad (1)$$

For indicators, the growth of which is a negative signal for companies, we use the inverse formula:

$$I_{.ik} = \frac{\bar{X}_k}{X_{ki}} \cdot 100 - 100. \quad (2)$$

As a result of standardization we obtain the degree and direction of deviation indicators in each period of their average values in percentage terms.

An important aspect of decision-making in innovation management is the prediction of factors and trends of their impact on economic activity of enterprises.

In this regard it has been made forecasting key indicators used in the study in 2016. The forecast is based on decisions made by the Government of Ukraine, covering: set the taxing a rate for income tax, projections of gross income, the national currency, the average prime rate [10]. Prediction other indicators carried out using the tool “TRENDS” in MS Exel on the basis of the calculation period 2005-2015 inclusive. Standardized macro economic component of innovation activity is shown in Table 4.

Table 4 – Analysis of macro economic component of innovation activity

Indicators	Average value*, $\bar{X}_k$	$X_{k2016}$ (forecast)	The standardized significance, %					
			2012	2013	2014	2015	2016	
Investment	Foreign direct investment in Ukraine, \$ million	36051,1	29991,9	36	49	58	20	-17
	The volume of capital investments, UAH thousand	148690,9	89214,5	51	-83	131	-63	-40
	State financing of innovation, UAH thousand	200659,9	193048,9	36	25	9	25	-4
Market	The level of consumer income, UAH million	1078450,0	1953256,0	35	44	41	62	81
	The total volume of exports, \$ million	52048,6	54928,4	32	22	4	-27	6
	The total volume of imports, \$ million	60887,4	67546,4	39	26	-11	-38	11
Financial	Discount rate, %	10,4	15,5	37	31	-16	-54	-33
	The average official exchange rate of national currency	9,5	25	13	13	-42	-62	-63
	Corporate income tax rate, %	23	18	8	19	26	26	26

\* – average values of the table are calculated for the period 2005-2015 by the author of the using sources [3; 8; 9; 10]

The analytic data showed that the macroeconomic environment of innovation of domestic enterprises is mostly unfavorable and in significant degree turbulent, that greatly complicates the possibility to develop forecasts and strategic planning. Indicators of individual components of the environment each year show significant deviations from their mean both in positive and in negative directions. This is due to constant changes in the legal framework, inconsistent economic policy and changes in the external vector development.

The turbulence of most macroeconomic and other factors creates significant threats to the implementation of new technologies and the implementation of innovative projects, because it increases their riskiness and makes payback calculations impossible. The most significant barriers are: the reduction of state support for science, technology and innovation funding, rapid and unpredictable devaluation, currency restrictions, and unpredictable decision to change the NBU discount rate. At the same time, as a positive signal we have identified the gradual increase of the innovative costs by companies, indicating that entrepreneur's primarily on awareness of the fact that extensive development has exhausted its potential. The possibilities in 2016 are reducing the income tax rate and the NBU discount rate to 15,5% compared to the year 2015, which will create additional opportunities to attract financial resources in the innovation sector. We predict that the gross production of innovative products and export will increase in 2016 and in later periods, if other factors will constant. Conditionally positive signal is also nominal increase income of consumers and, consequently, costs for innovative products and services. But, this group of factors is conditional because



their growth is predetermined by the inflation and it is difficult to predict it in the current conditions.

The positive result for the promotion of innovative activity of enterprises in the future can be considered by means of economical signing association agreement with the European Union, because an important role in the agreement is given to cooperation in science and technology. It enables additional opportunities for investment, technology transfer, training and exchange of experience with European partners and also gives opportunities to participate in European innovation programs.

The analysis showed that the main driving force of innovation activity in Ukraine is just the business sector, which relies mostly on its own forces. As significant economic opportunities to attract additional funding in the current macro are not observed, entrepreneurs should focus on shaping their own innovation and investment potential and use the potential of micro and global environment.

**Conclusions and directions of further researches.** In summary, we have made the following conclusions:

1. The tendencies of innovation of domestic enterprises show their significant dependence on the macroeconomic situation and its dynamics, as it was evidenced by the results of correlation and regression analysis. In this regard, the strategic decisions on innovation require analysis and forecasting of macroeconomic factors.

2. On the basis of the studies it have been systematized the basic economic factors of macro environment, which indirectly affect the level of innovation activity of domestic enterprises with the release of the following groups: innovation, investment, financial and market.

3. In process of analysis of the factors by the index method it had been revealed, that the economic climate of innovation activity in Ukraine in recent years has deteriorated significantly. Most economic factors manifest themselves as barriers to development and innovation. Among them are: reducing of investment attractiveness of the country as a result of military operations, inefficient banking system, lack of financial resources, lack of government support, lower real purchasing power.

4. It was determined that promising opportunities to enter the European market and increase of domestic producers competition contributed to the emergence of some positive trends in 2015. These include increasing of the enterprises share that implement innovations volumes of innovation costs and improve their structure from the production of new types of equipment, active implementation of organizational and marketing innovation.

5. In the study it had been considered methodical approach and the results of the analysis can be used by enterprises in conducting a comprehensive analysis environment or target performance. According to the scale and complicated structure of macro environment, analysis requires the further study and evaluation of macro factors influence weight on innovation activities of enterprises in individual industries and economic activities. The further research should focus on the methodical approaches to the estimation weight of macro factors influence innovation enterprises in individual industries and economic activities.

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**Оцінювання впливу економічних факторів макросередовища на інноваційну діяльність підприємств в Україні**

*Проведено аналіз сучасного стану та тенденцій інноваційної діяльності підприємств в Україні. Систематизовано економічні фактори макросередовища, що впливають на рівень інноваційної активності вітчизняних підприємств, здійснено прогнозування їх прояву протягом поточного періоду. Проведено індексний аналіз динаміки релевантних макроекономічних показників відносно середнього значення, визначено рівень їх турбулентності. Окреслено напрямки розвитку інноваційної діяльності підприємств у перспективі та основні можливості і загрози макроекономічного середовища.*

**Ключові слова:** інноваційна діяльність, інноваційна активність, економічні фактори макросередовища, фінансування, інвестиції, експорт інноваційної продукції, індекси відхилень.

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**Оценка влияния экономических факторов макросреды на инновационную деятельность предприятий в Украине**

*Проведен анализ современного состояния и тенденций инновационной деятельности предприятий в Украине. Систематизированы экономические факторы макросреды, влияющие на уровень инновационной активности отечественных предприятий, осуществлено прогнозирование их проявления в течение текущего периода. Проведено индексный анализ динамики релевантных макроэкономических показателей относительно среднего значения, определен уровень их турбулентности. Определены направления развития инновационной деятельности предприятий в перспективе и основные возможности и угрозы макроэкономической среды.*

**Ключевые слова:** инновационная деятельность, инновационная активність, экономические факторы макросреды, финансирование, инвестиции, экспорт инновационной продукции, индексы отклонений.

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