Issue 3, pp.177-191. http://dx.doi.org/10.1002/bse.564

8. *Kaplan, R., Norton, D. (1992). The Balanced Scorecard – Measures that drive performance, Harvard Business Review, January-February 1992, pp. 71-79.*
9. *Kaplan, R. S., Norton, D. P. (1996). The balanced scorecard. Boston, MA: Harvard Business School Press.*
10. *Kaplan, R., Norton, D. (2001A). The Strategy-Focused Organisation. Boston (Massachussets): Harvard Business School Press.*
11. *Kaplan, R. S., Norton, D. P. (2001B). Transforming the Balanced Scorecard from Performance Measurement to Strategic Management: Part I, American Accounting Horizon, Vol. 15, No. 1, pp. 87–104.*
12. *Zingales, F. G. G., O'Rourke, A., Orssatto, R. J. (2002). Environment and Socio-related Balanced Scorecard: Exploration of Critical Issues, The Tenth Annual Business Strategy and the Environment Conference. Devonshire Hall, University of Leeds, UK, 10-11 September 2000.*
13. *Chlistalla, M., Schaper, T. (2009). Modifying the balanced scorecard for a network industry - The case of the clearing industry, The 9th IFIP Conference on e-Business, e-Services, and e-Society. Nancy, France. 23-25 September 2009. http://dx.doi.org/10.1007/978-3-642-04280-5_21*

Shumska Svitlana
PhD in Economics, Associate Professor, Leading Researcher Institute for Economics and Forecasting, National Academy of Sciences of Ukraine (Kyiv, Ukraine)

INNOVATION IN ECONOMIC DEVELOPMENT OF UKRAINE: FROM THEORY TO CURRENT STATE AND EMPIRICAL RESULTS

As is known, in a recession period or while confronting crisis phenomena, any country in the global world faces the problem of finding such sources and factors of its economic growth that will allow the country to benefit in the struggle for resources as well as will lead it to the path of stable development. The analysis of various scientific ideas about economic growth and development shows that the description of these multidimensional phenomena is not yet complete, while the discussions among scientists and practitioners grow to become rather heated, which leads to the formulation of new tasks. However, the results of research as well as modeling of factors, reasons and

mechanisms affecting the nature of economic growth make it possible to forecast it considering the practice of today and to develop effective tools for its regulation and management. According to the experience of different in terms of its economic development countries, at present-day the key factor of economic growth is the development of science and innovation, which defines the potential of the country's development and its competitiveness in the global world.

The analysis of the evolution of theories of the interrelation of economic growth, science, innovation and applied research with the empirical testing of the effectiveness of these concepts in practice has a long history and is characterized by national specificities [1-3]. Depending on the chosen method of research – factor analysis, regression analysis, functional analysis, cluster analysis, practical knowledge function, nonlinear modeling, Bayesian approach, panel data models, spatial econometrics – the scholars have confirmed the direct connection between proxy variables representing the rate of economic growth and the country's development and the indicators reflecting the development of science, R & D, and innovation technologies in the country (Rodriguez-Pose & Crescenzi [4], Fagerberg &Schrolec [5], Jaffe [6], Audretsch & Feldman [7], Pakes &Griliches [8], Teplykh [9], Anselin &Varga &Acs [10]).

As for Ukraine, which has come through a number of crises over the last 20 years, it was limited in possibilities to increase the scientific research expenditures, since it keeps on solving its permanent problems of anti-crisis recovery. However, the scientists bring up the challenging issues of Ukraine's innovation development in the context of the analysis of enterprises' innovation activities (Denisenko [11]), problems of the state institutional development (Vishnevsky [12]), the assessment of innovation activity impact on the country economic development (Pisarenko [13]) comparative characteristics of Ukraine with developing countries (Zhukovski & Gedranovich [14]). There were discussions about the need for innovative development of the country, proposed measures to strengthen the national innovation system.

Theoretical background. The first stages of the formation of theory of economic growth in the 40-80s of the previous century were associated with the development of basic concepts of the post-Keynesian and neoclassical approaches (Harrod [15], Domar [16], Solow [17]), which were later on supplemented by the ideas of the evolution theory. However, a significant number of issues that were not confirmed in practice, in particular regarding the countries' convergence

and the exogenous nature of the factor of scientific and technological progress, made scholars and practitioners search for the answers beyond the framework of basic theories. This led to the emergence of new theories of endogenous growth, which in general terms was viewed as the growth, conditioned by the person's economic activity. Models of exogenous growth could not explain the features of modern economic growth due to the assumption about the diminishing returns of its main production factors. The key idea of the theories of the "second generation" was that the skills and technologies created in one industry are transferred to others, and thus the return on investment in innovation ceases to decrease for the economy as a whole [18].The impetus to the development of endogenous growth theory was given by the ideas of P.Romer. He found a solution to the question of how to make endogenous the main source of growth - technical progress (Romer [19, 20]).

Today, a whole set of existing theories and models of endogenous economic growth are traditionally (Jovanovic [21], Sharaev [22]) united into 7 groups:

1) models representing the production of innovations as a product put forward by a special sector of economy, i.e. directly in the process of research and development activities (Research & Development);

2) models in which the human capital is the most important source of economic growth;

3) models of learning by doing;

4) models of the international trade and technology transfer and distribution;

5) models of the technical progress and population;

6) models of inequality and economic growth;

7) models of the state policy and economic growth.

In publications focused on the analysis of results of empirical studies verifying theoretical stipulations put forward within the framework of the theory of endogenous growth the scholars often draw attention to the interrelation of the chosen factors as well as emphasize the important role of the science and technology development. In particular, in the study of M. Kaneva and G.Untura concerning the evolution of theories and empirical models of the interconnection of economic growth, science and innovation (Kaneva & Untura [3]), the scholars confirm that the current trends of theoretical research evolve, permeating one another. Having looked at macroeconomic exogenous models, one should mention the model of Grossman & Helpman [23] and Aghion & Howitt [24], being among the first endogenous modes based on

Schumpeter's "creative destruction" ideas [25]. These models have acquired the status of well-known theoretical models presenting the endogenous growth, since they correlate economic growth, technological progress, innovative activities and innovations implementation. The empirical proof of these ideas effectiveness was obtained by the model by Barro and Sala-i-Martin [26] as well as by other models implemented in the format of the "production function of knowledge" (Griliches [27]).

One of the most important results of the development of the theory of endogenous growth since the first works of Romer was that innovations are now analyzed at the level of individual firms [18]. In the paper of Acemoglu and co-authors (Acemoglu et al., [28]), the next step was taken in the direction of detailing decision making - firms not only determine the level of costs, as in the Rohmer model, but also choose the level of employment and investment in various types of innovations, as well as decide on market entry and exit [Zamulin & Sonin [18]).

At the same time, along with the models of endogenous and exogenous growths, based on macro- and microeconomic dependencies, in related sciences there appeared other theories, being rather descriptive, which proved the correlation between economic growth, the development of science, and innovations. Among them M. Kaneva and G. Untura (Kaneva & Untura [2]) distinguish the following most famous models:

- a linear model of innovations, known as the "traditional phase-gate model", with the priority given to the research and development. According to this model, it is the research activity that launches the innovation process (presented in two versions: "technology push" and "demand pull") (Bush [29], McLaurin [30]);

- the theory of innovation systems, named as an "innovation system" (Lundvall B.-A. [31]), according to which the effectiveness of new technologies introduction and the speed of innovations spread-out depend on a combination of institutions and participants (enterprises, universities, research institutes) in innovation processes;

- the theory of innovations diffusion and knowledge spillovers that includes two components: the theory of diffusion of innovations and the theory of knowledge spillovers (Rogers [32], Glaeser [33], Jacobs [34]).

The active development of the method of econometric modeling allow one to use it as a tool for studying the interconnections between economic growth, research and innovations in the spatial dimension that has formed a new direction of economic science, namely spatial

econometrics of innovations (a kind of symbiosis of theoretical and empirical models) (Anselin [35]). Practical realization of the ideas presented in the theory and models of endogenous growth has made it possible to conduct a comparative cross-country analysis as well as prove the competitive advantages obtained by leaders as a result of the R & D expansion and innovations introduction.

Ukraine competitiveness in the light of the global innovation index. Since 2007, the most comprehensive analysis of the situation in countries that effectively carry out their innovative activities by investing in education and research, and by turning R & D expenditures into high-quality developments has been annually presented in the report on the Global Innovation Index (GII), which is the result of the joint work of Cornell University, INSEAD Business School and the World Intellectual Property Organization (WIPO) being co-publishers.

The GII is a detailed quantitative assessment method that allows the representatives of decision-making authorities around the world to better understand the mechanisms stimulating the innovation as a source for economic growth and human potential development.

The Global Innovation Index, which was presented in 2018 for the eleventh time, consists of 80 different variables describing in detail the innovative development of 126 world countries being at different levels of their economic development [36]. The authors of the study believe that success of the country's economy is related to both the presence of the innovation potential and the conditions for its implementation. Therefore, the Index is calculated as a sum total of the assessments of two groups of indicators: Innovation Input, characterizing the available resources and conditions for innovations, and Innovation Output – the achieved practical results of implementing innovations. Thus, the final Index comprises the cost-effect ratio, which allows an objective assessment of the effectiveness of efforts put into innovations development in different countries.

According to the GII-2018 rating, the global leaders are the following [36]: Switzerland, Netherland, Sweden, United Kingdom, and Singapore. Ukraine has increased its rank to 43, rising by 7 positions as compared with the previous year. Among 39 European countries Ukraine ranks is at the 30^{th} position, while it ranks 1st among the 30 lower-middle-income countries. Figure 1.2 demonstrates the dynamics of Ukraine's rating within the period of 2009–2018, which signals about the improvement in the situation over the past four years. Among the main reasons for such an increase in ranking is the improved Innovation

Efficiency Ratio (a much higher ranking in innovation outputs (35th) compared to inputs (75th)). The Innovation Efficiency Ratio is the most important GII strength for Ukraine (it takes the 5th position globally).

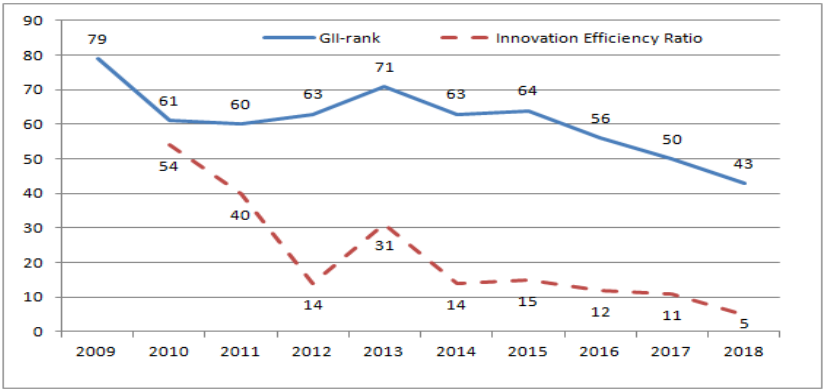

Figure 1.2 Dynamics of GII Ukraine's ranks and Innovation Efficiency Ratio within 2009-2018

A more detailed analysis of the constituent elements of GII is presented in Table 1.8, which makes it possible to see the strengths and weaknesses of Ukraine.

Table 1.8

The 7 GII areas of Ukraine's rank within 2012-2018

(*1 is the highest possible rank in each column*)

	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Institutions	103	105	103	98	101	101	107
Human Capital & Research	40	44	45	36	40	41	43
Infrastructure	101	91	107	112	99	90	89
Market Sophistication	64	82	90	89	75	81	89
Business Sophistication	45	79	87	78	73	51	46
Knowledge & Technology Outputs	40	45	32	34	33	32	27
Creative Outputs	70	81	77	75	58	49	45
The total number of countries	***141***	***142***	***143***	***141***	***128***	***127***	***126***

The "Ukraine's innovation profile" presented in the Report GII-2018 contains the values (score and rank) of indicators that form seven groups, which in their turn constitute two sub-indices (Input / Output). The developers of GII-2018 emphasize that the strengths of Ukraine are concentrated on the innovation output side of the GII [36]: two out of three GII strengths are found in Human Capital & Research (43rd), where Ukraine demonstrates a strong performance in the indicators Tertiary enrolment (12th) and Pupil-teacher ratio, which positions 3rd in the world. The third strength is in Business Sophistication (46th) in the indicator Females employed with advanced degrees, in which Ukraine is the third in the world.

Ukraine's relative weaknesses are mainly accrued in innovation inputs, across all 5 GII input areas but mostly in Institutions [36]: Institutions (107th), being the lowest ranked GII area for Ukraine, is itself signaled as a GII weakness. Here the country shows a relatively weak performance in one of its three components, Political environment (122nd), as well as in the indicators Political stability & safety (123rd), Rule of law (107th), and Ease of resolving insolvency (118th). In Human Capital & Research (43rd), one relative weakness lies in the indicator Global R&D companies' expenditure (40th). In Infrastructure (89th), the area Ecological sustainability (115th) and the indicator GDP per unit of energy use (113th) also present a relatively weak performance. In Market Sophistication (89th), Ukraine exhibits weaknesses in one of its three components, namely Investment (115th), and in two indicators: Microfinance gross loans (79th) and Venture capital deals (79th). In Business Sophistication (46th), one of GII weaknesses is in the Indicator State of cluster development (98st). On the innovation output side, only two indicators are signaled as weak: ICTs & business model creation (106th) and National feature films (101st), both in Creative Outputs (45th).

Since innovations play an important role in increasing the level of the countries competitiveness, stimulating changes in the society and laying the foundations for the country's future development, the presence of weak points in the innovative development of Ukraine and its relatively low ranking in terms of the global dimension signal not only about the lost opportunities, but also about the need to revitalize the innovation policy in order to ensure the economic growth of Ukraine.

R&D and innovations as determinants of economic development: the empirical results. Two hypotheses are put forward to test empirically the theoretical concept of the importance of R & D and

innovations for the economic development of different countries:

Hypothesis 1: R & D is a factor of economic development;

Hypothesis 2: Innovations have a positive effect on the country's economic development.

For the analysis, we selected a group of countries of different economic development and geographic location such as USA, China, Japan, Israel, Great Britain, France, Germany, Poland, Czech Republic, Lithuania, Latvia, Ukraine, Russian Federation, Kazakhstan, and Moldova. For Ukraine, such a selection of countries is interesting, since it includes not only world leaders, but also the states of the former CIS and Europe (that is, it describes the Ukrainian past and the desired future).

The data have been collected from World Economic Outlook (WEO) database of IMF, Eurostat, OECD, U.S. government data, and State statistics service of Ukraine [37-40]. All observations are annual (within the period of 2005-2017) and processed on the basis of the required procedures. Among the variable models we distinguish: *GDP_PC_PPP* – Gross domestic product per capita, constant prices (Purchasing power parity; 2011 international dollar); *RD* – R&D – % of Gross domestic product; *PATENT_R* – amount of patents.; *RESEARCHER* – amount of researches per 1 million of population.

The result of Hausman Test statistics suggests that the Fixed Effect Model (FEM) is the appropriate panel data estimator for this study. The tests for heteroscedasticity, autocorrelation and multicollinearity helped define specification and estimation.

The model (1.1) empirically confirms the correctness of the Hypothesis 1, i.e. R&D, a factor of economic development having a high statistical significance, affects the countries' development level (Prob.(t-Statistic)<0.03; Adjusted R-squared=0.991287; F-statistic=733.4057; Prob.(F-statistic)= 0.000000). An interesting point to pay attention to is the R & D indicator significance impact with a delay of 5 lags. This points to the long-term effect of the R & D impact and highlights the importance of the system-based long-term policy in science and technology.

$$GDP\_PC\_PPP = 15959.65 + 2614.26*RD + 4352.89*RD(-5) + [CX=F] \quad (1.1)$$

Figure 1.3 shows the calculated values of fixed effects of the Gross domestic product per capita for the panel data model by countries. The

presence of a rather significant negative value of fixed effects for Ukraine means the presence of country-specific factors that negatively affect R & D as a factor of economic development. These factors will vary for different developing countries (China, Japan, Israel, Ukraine, Moldova), which requires additional research.

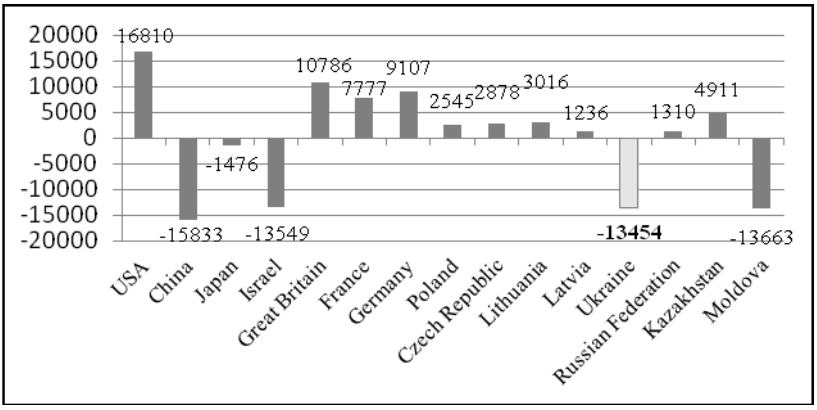

Figure 1.3 Fixed effects of the Gross domestic product per capita for the panel data model (1.1) by countries

The model (1.2) empirically confirms the correctness of the Hypothesis 2 – innovative activities have a positive effect on the country's economic development. (Adjusted R-squared=0.996196; F-statistic= 2280.714; Prob. (F-statistic) = 0.000000; Durbin-Watson stat.=1.780223). Proxy-variables representing the factor of innovation in the model (2) are the selected indicators characterizing the number of researchers and patents by the residents of the country. The impact of both variables on the dynamics of economic development is positive and statistically significant.

GDP_PC_PPP = 0.01*PATENT_R + 1.95*RESEARCHER + 21754.13 + [CX=F] + [AR (1) = 0.757271907553] (1.2)

Figure 1.4 shows the calculated values of fixed effects of the Gross domestic product per capita for the panel data model (2) by countries.

As we can see, the values of the fixed effects vary greatly from country to country. This means that we have to conduct a more comprehensive analysis with the division of the countries into subgroups.

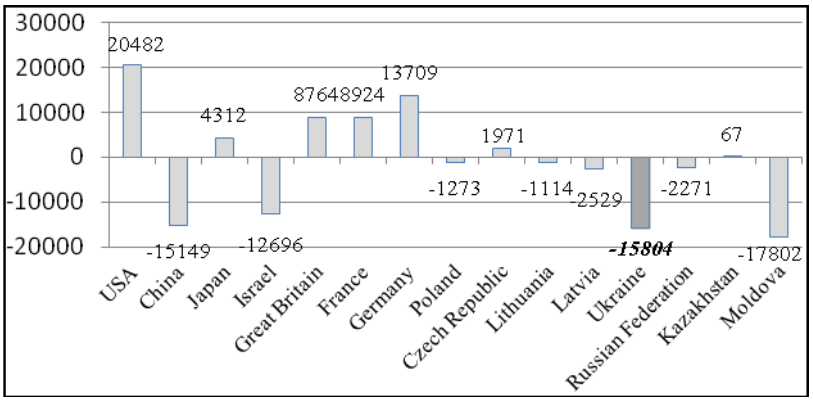

Figure 1.4 Fixed effects of the Gross domestic product per capita for the panel data model (1.2) by countries

Defining inter-country peculiarities can be useful for Ukraine, especially given the different experience of implementing the innovation policy of boosting economic growth.

Conclusions. Endogenous theories development of economic growth already has a long history which underlines that among determining factors of different countries growth and development level the R&D and innovations are very important. Statistical analysis and empirical testing of R&D and innovations influence on economic development indicator dynamics for small group of countries with different development level and geographical location confirm its importance through panel data models. Ukraine as well as other developing countries should focus on scientific and technological progress achievements and innovative development in order to improve society living conditions country competitiveness in global world.

References:

1. *Kozubynskiy, V., Ponomarev, Y., Ponomareva, E. (2013). Features of economic growth and its modeling. Publishing house "Delo", Russia*
2. *Kaneva, M. A., Untura, G. A. (2017). Evolution of Theories and Empirical Models of a Relationship between Economic Growth, Science and Innovations (Part 1). World of Economics and Management, Vol. 17, No. 4, pp. 5-21. (In Russ.)*
3. *Kaneva, M. A., Untura, G. A. (2018). Evolution of Theories and Empirical Models of a Relationship between Economic Growth, Science and Innovations (Part 2), World of Economics and Management, Vol. 18, No. 1, pp. 5-17. (In Russ.)*

4. *Rodriguez-Pose, A., Crescenzi, R. (2008). Research and development, spillovers, innovation systems, and the genesis of regional growth in Europe, Regional Studies, Vol. 42 (1), pp. 51-67.*
5. *Fagerberg, J., Schrolec, M. (2008). National innovation systems, capabilities and economic development. Research Policy, Vol. 37, pp. 1417-1435.*
6. *Jaffe, A. B. (1986). Technological opportunity and spillovers of R&D: Evidence from firms' patents, profit and market share, American Economic Review, Vol. 76, pp. 984-1001.*
7. *Audretsch, D. B., Feldman, M.P. (1996). R&D spillovers and the geography of innovation and production, American Economic Review, Vol. 86 (4), pp. 253-273.*
8. *Pakes, A., Griliches, Z. (1984). Patents and R&D at the firm level: A first look. R&D, Patents, and Productivity. Chicago, University of Chicago Press, pp. 55-72.*
9. *Teplykh, G. V. (2016). Proizvodstvennaya funktsiya znaniy firmy: obzor empiricheskikh issledovaniy [Knowledge Production Function: a Review of Empirical Research]. Ekonomicheskaya nauka sovremennoy Rossii [Economic Science of Modern Russia], vol. 1, no. 72, p. 28-38.*
10. *Anselin, L., Varga, A., Acs, Z. (1997). Local spillovers between university research and high technology innovations, Journal of Urban Economics, Vol. 42, pp. 422-448.*
11. *Denysenko, M., Shvablina, Y. (2008). Enterprises innovation activity in Ukraine, Science problems, Vol.6, pp. 9-16.*
12. *Vushnevskiy, V., Dementiev, V. (2010). Why Ukraine is not innovational country: institutional analysis, Institutional research journal, Vol.2, pp. 81-95.*
13. *Pysarenko, T., Kvasha, T. (2015). Innovation activity and its influence on economic development in Ukraine: Monography. Kyiv, Ukraine.*
14. *Zhukovski, I. V., Gedranovich, A. B. (2016). Analysis of Efficiency of Research & Development Activities among Countries with Developed and Developing Economies Including Republic of Belarus while Using Method of Stochastic Frontier Approach, Science & Technique, Vol. 15 (6), pp.528–535. (In Russ.)*
15. *Harrod, R. F. (1939). An essay in dynamic theory, Economic Journal, Vol. 49, pp. 14-33.*
16. *Domar, E. (1946). Capital expansion, rate of growth and employment, Econometrica, Vol. 14 (2), pp. 137-147.*
17. *Solow, R. (1957). Contribution to the theory of economic growth, Quarterly Journal of Economics, Vol. 70 (1), pp. 65-94.*
18. *Zamulin, O., Sonin, K. (2019). Economic Growth: Nobel Prize 2018 and Lessons for Russia, Voprosy Economiki, No. 1, pp.11-36.*

19. *Romer, P. (1987). Growth Based on Increasing Returns Due to Specialization, American Economic Review, Vol. 77, No. 2, pp.56-62.*
20. *Romer, P. (1990). Endogenous technological change, Journal of Political Economy, Vol. 98, No. 5, pp.71-102.*
21. *Jovanovic, B. (1995). Learning Growth: NBER Working Paper, No. 5383.*
22. *Sharaev, Y. (2006). Economic development theory. Publishing house "GY VHE", Moscow, Russia.*
23. *Grossman, G.M., Helpman, E. (1991). Innovation and Growth in the Global Economy. Cambridge: MIT Press, 384 p.*
24. *Aghion, P., Howitt, P. (1992). A model of growth through creative destruction, Econometrica, Vol. 60 (2), pp. 323-351.*
25. *Schumpeter, J. A. (1942). Capitalism, socialism, and democracy. Routledge, London, 460 p.*
26. *Barro, R. J., Sala-i-Martin, X. (1995). Economic Growth. New York, McGraw-Hill, 539 p.*
27. *Griliches, Z. (1984). R&D, patents, and productivity. Chicago: University of Chicago, 593 p.*
28. *Acemoglu, D., Akcigit, U., Alp, H., Bloom, N., Kerr, W. (2018). Innovation, reallocation, and growth, American Economic Review, Vol. 108, No. 11, pp.3450-3491.*
29. *Bush, V. (1945). Science. The Endless Frontier. Washington: The US Government Printing Office, 220 p.*
30. *McLaurin, W. R. (1953). The sequence from invention to innovation and its relation to economic growth, Quarterly Journal of Economics, Vol. 67, pp. 97-111.*
31. *Lundvall, B.-A. (1985). Product innovation and user-producer interaction. Industrial development. Research Series 31. Aalborg: Aalborg University Press, 39 p.*
32. *Rogers, E. M. (1992). Diffusion of innovations. New York: Free Press of Glencoe, 367 p.*
33. *Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., Shleifer, A.A. (1992). Growth in cities, Journal of Political Economy, Vol. 100 (6), pp. 1126-1152.*
34. *Jacobs, J. (1969). The economy of cities. New York: Random House, 288 p.*
35. *Anselin, L. (1988). Spatial Econometrics: Methods and Models. Dordrecht: Kluwer Academic, 284 p.*
36. *36. The Global Innovation Index 2018: Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva. Mode of access: https://www.globalinnovationindex.org/gii-2018-report*
37. *Organization for economic co-operation and development Mode of*

access: https://stats.oecd.org/ (Date of apply: 15.02.2019)
38. *International monetary fund / World economic outlook – Mode of access: https://www.imf.org (Date of apply: 15.02.2019)*
39. *European statistics / Mode of access: https://ec.europa.eu (Date of apply: 15.02.2019)*
40. *U.S. Governments open data / Mode of access: https://www.data.gov/ (Date of apply: 15.02.2019)*
41. *State statistics service of Ukraine / Mode of access: https://ukrstat.org (Date of apply: 15.02.2019)*

Zhuvahina Iryna
PhD in Economics, Associate Professor, Department of Economics and Production Organization, Dean of the Faculty of Engineering Economics
Zamaraikina Tetiana
Student of Department of Accounting and Taxation
Zamaraikin Oleksii
Student of the Department of Thermal Power Engineering
Pervomaisk branch of the National University of Shipbuilding named after Admiral Makarov (Pervomaisk, Ukraine)

THEORETICAL-METHODOLOGICAL ENSURING OF FORMATION THE INNOVATIONAL POLICY OF MACHINE-BUILDING ENTERPRISE

Taking into account the fact that Ukraine has significant scientific and production potential of development, the introduction of new management technologies at the level of formation and implementation of economic and industrial policy of the state and at the level of a certain enterprise, in developing strategies for its development and improving the efficiency of functioning, will facilitate the return of the national economy to world economic leaders. Modern theories of catching up development are based on the innovation paradigm, therefore, the activation of the economic entities of innovative processes becomes the