автономних економічних моделях. Це, в свою чергу, дає можливість більш повно виявити існуючі взаємозв'язки між окремими складовими прибутку, і на цій основі здійснювати інновації (оновлення) продукції і технологій, формувати набір важелів стабілізаційного характеру, адекватний рівню зовнішньої нестабільності. З іншого боку, розроблена система економіко-математичних моделей дозволяє більш чітко розмежувати факторні ознаки на об'єктивні (матеріальні) і суб'єктивні (організаційні).

В ринкових умовах для окремих підприємств це має важливе значення, адже основним мотивом постійного розвитку підприємства виступають мінливі індивідуальні і суспільні потреби, що реалізуються через економічні інтереси контрагентів ринкових відносин.

Таким чином, аналіз економіко-математичних моделей і синтез їхніх систем, побудова різноманітних підкомплексів складають найважливішу частину загальної теорії економіко-математичного моделювання і є необхідною умовою проектування АСУ в агропромисловому комплексі.

Застосування економіко-математичних моделей для об'єктивної оцінки формування товарної стратегії підприємств різних форм власності в ринкових умовах дають не лише можливість зменшити ризик, запобігти банкрутству, але й досягти максимальної ефективності агропромислового комплексу на довгострокову перспективу.

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R&D AND INNOVATIONS AS DETERMINANTS OF ECONOMIC DEVELOPMENT: THE EMPIRICAL RESULTS

Introduction. 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, in scientific circles there were discussions about the need for innovative development of the country, proposed measures to strengthen the national innovation system.

Empirical results. In this research 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 [36-39]. 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 researchers 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) empirically confirm the correctness of the Hypothesis 1, e.i. 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.

$$GDP\_PC\_PPP = 15959.65 + 2614.26*RD + 4352.89*RD(-5) + [CX=F] \quad (1)$$

Figire 1 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.

The model (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 (Prob.(t-Statistic)<0.01).

$$GDP\_PC\_PPP = 0.01*PATENT\_R + 1.95*RESEARCHER + \\ + 21754.13 + [CX=F] + [AR\ (1) =0.757271907553] \quad (2)$$

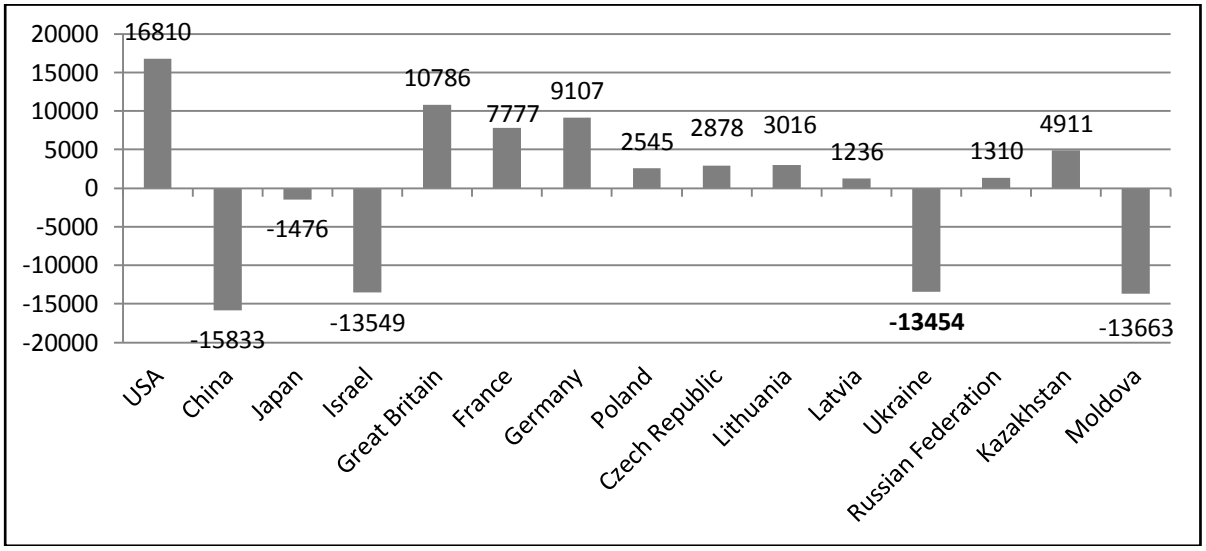

Fig. 1. Fixed effects of the Gross domestic product per capita for the panel data model (1) by countries

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

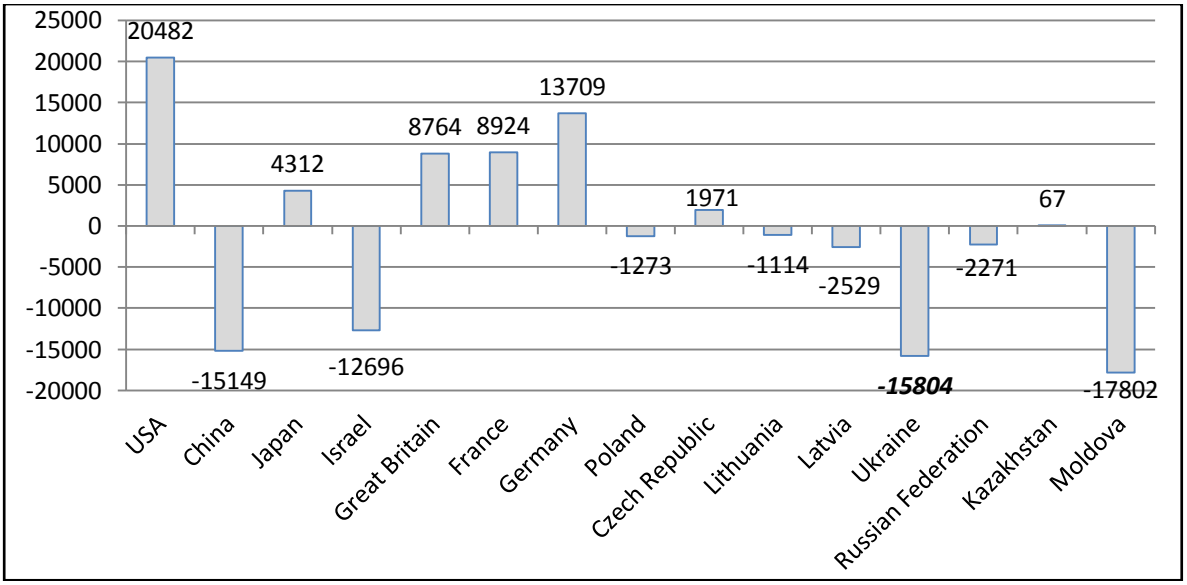

Fig. 2. Fixed effects of the Gross domestic product per capita for the panel data model (2) by countries

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. 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.

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