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METHODOLOGICAL BASES OF SECTORAL INNOVATION PRIORITIES EVALUATION WITHIN SECURITY-BASED STRATEGIES

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ABSTRACT

The aim of research is to develop methodical base for complex analytical and optimization models of the innovation development management regarding the sectors of national economy taking into account their compliance with technological progress and resource potential. In order to construct the models of sectoral innovation development, we propose to observe structural models. They demonstrate the structure of the system, which is the subject of the survey, its internal parameters, features of external fluctuations. The main terms, which make possible evaluation the innovation development level of the national economic sectors were studies. The proposed conceptual foundations of innovation processes evaluation at the sectoral level are based on the fact that tasks for the innovation development management are combinatory, and its complexity is growing when projects' number is increasing or when planning horizon is extended. The improved multiplicative dynamic model of Tinbergen-Solow production function through the technological progress parameter is presented.

Key words: Integrated Assessment, Technological Development, Industrial Production, Indicator, Effectiveness, Policy

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1. INTRODUCTION

Under current conditions, the innovation development management of either national economy in general, or an economic sector, is a key factor for the economic growth.

In these conditions, the decisive role to improve the methodical provision of the innovation development management regarding the sectors of the national economy is played by their compliance with the technological progress and proportionality of the resources provision via the technological substitution marginal norm. Such an aspect enables to analyze the structural improvement processes of the sectoral economic system, which is achieved through the practical introduction of new knowledge. That is why there is a possibility to assess the completeness and timeliness of the organizational and resource provision processes regarding the innovation development of the sector.

The significance to develop the sectoral indicators is an information source to regulate the innovation investment and to evaluate the multiplicative effects when dealing with other economic sectors.

In order to provide the faithfulness and transparency to assess the innovation development of the national economy and to form the relevant development strategies, there is a necessity to investigate models, which will consider the systematic properties, particularly, differentiation of the technological progress parameters due to the constituents of the economic system and technological substitution marginal norm, based on the publicly available data.

The technological changes integration into the economic equations is an important aspect. The research [1] demonstrates of variables (education, SRRCW and new technologies) into the equation with purpose to isolate the impact, made by the components of technological changes.

Basic methodological principles to assess the innovation development of the national economy taking into account the technological progress factor, have been formed by studies [2–5], modifications of which make the base for modern models of the innovation development.

The practical aspects of the above models in various interpretations were observed through the examples of Poland [6] and Iran [7]. The analysis of the mentioned studies demonstrated the fragmentation character of conclusions, since functions were observed for the whole economy, that complicates the process to make decisions regarding innovation priorities and intersectoral complexes.

The research [8] analyzes the innovation policy of Great Britain in the bioenergy sector with a due account on various financing resources. The results of the study prove that every subject prefers various expectations from effect regarding the introduction of innovations into the bioenergy sector. Authors propose the concept « expectations arena», which helps to explain how some ways of development can obtain an innovation priority. The proposed methodology requires an adaptation to evaluations, which are relevant for the country.

The research [9], based on a number of indicators, gives reason that power industry, health protection, informational and communicative technologies, food, modern materials, services,

tourism, sustainable innovations, modern producing systems, cultural and creative fields are the most priority areas of the innovation policy in the EU.

The study [10] focuses on the main aspects to provide the country's technological security, increasing the efficiency to select the innovation development priorities, and proposes the methodology to define the innovation priorities. It is based on the evaluation of technologies criticality level and on the social and economic development strategies, based on the conception "policy deployment". The implementation of the proposed methodology requires to be analytically reasoned. The study [11] deals with it to assess the country's resource security.

The study [12] is useful to evaluate the impact of technological progress since it proves that the buyer's innovation strategy strengthens the supplier's innovation orientation. That is why these relationships do not complicate the contact between the firm and innovation activity.

The research [13] proposes a methodology to evaluate the determination of priorities in the studying area and innovations for smart specialization at the national and regional levels. It was performed basing on the great selection of research and innovation strategies for smart specialization through the example of Italy and Poland.

Tasks to select priorities and to assess their dynamics were implemented in studies in order to evaluate a technological package of the intersectoral complex and technologies transfer strategies [14–15], choice of the priority innovation communications [16] and tasks to predict the innovation security and its investment provision [17]. However, based on the study [18], we can point out their fragmentary character from the practical viewpoint caused by the absence of some system indicator.

Research [19] presents the methodology of linked employer–employee analysis within the sectoral perspective. Another approach is given in [20] and is based on sectoral characteristics of relational capital in innovation activity. Additionally, studies [21-23] give the base for some sectoral innovation development indicators, but these approaches are fragmental and don`t match with the new system economic theory of innovation development.

The analysis of the above researches proves that ideas regarding the evaluation of the state's innovation priorities within the framework of the national economic development in sectoral terms have not lost their significance even today. Scientists-economists have not enough studied the management of the innovation development in the economic sectors taking into account their compliance with technological progress and marginal norm of technological substitution. Besides, there are no optimization models, which enable to perform the management function.

Describing the impact of the scientific and technical progress, any assumptions about reasons, which lead to the scientific and technical progress, and about factors, which influence its intensity, are not made. It forms the ground to range sectors of the national economy (by economic activity) taking into account their innovation priority and analytical base.

Thus, methodological ideas to evaluate the innovation development of either national economy in general, or some sectors, for the innovation nets formation, have not lost their significance today, particularly, given the intersectoral relationship and innovations diffusion [24-25].

The aim of the research is to develop methodical base for complex analytical and optimization models of the innovation development management regarding the sectors of the national economy taking into account their compliance with technological progress and proportionality of the resource potential.

In order to achieve this aim, it is necessary to solve the following tasks:

1) to define the conceptual bases of the innovation processes optimization modelling at the sectoral level;

2) to investigate the conceptual bases of the innovation processes optimization modelling at the sectoral level;

3) to improve the multiplicative dynamic model of Tinbergen-Solow production function for aims in the analysis;

4) to approbate and to analyze the obtained results and to define further directions to use the developed models.

2. PREREQUISITES TO CONSTRUCT MODELS OF THE SECTORAL INNOVATION DEVELOPMENT

In order to construct the models of sectorial innovation development, we propose to observe structural models. They demonstrate the structure of the system, which is the subject of the survey, its internal parameters, and features of external fluctuations. These models enable to plan the resources saving, structural shifts, external relationship, and it is reasonable to create the optimization models.

Another class of models, which can be used for innovation development management, includes the optimization models. Such a model consists of elements, which form the structure of decisions and provide the decision-making process in the given conditions.

We can observe the development of sectors from the technological viewpoint by the following positions (fig. 1):

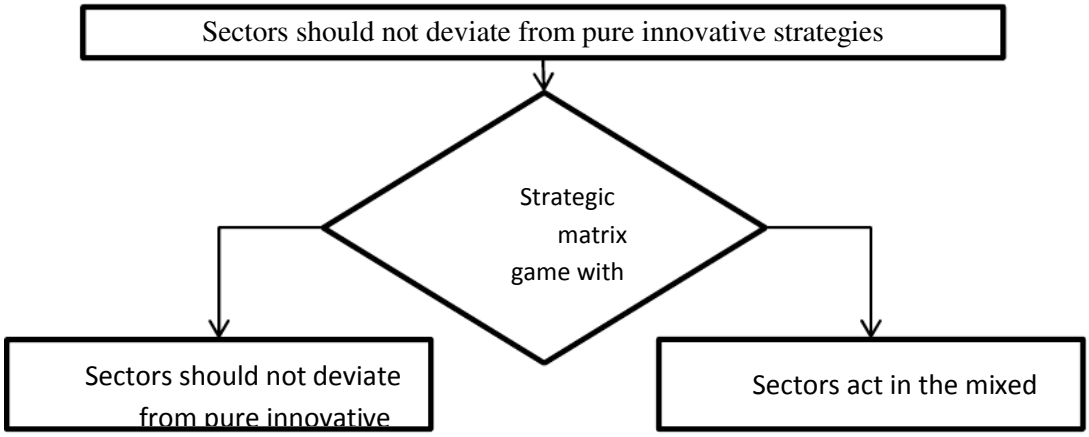


Figure 1 Classification of sectors by the innovation strategies types

1. Distinguishing of the pure industry indicators and the problem of sectors aggregation, the solution of which provides:

– each sector has only one technology of production, which is characterized by the relevant vector of expenses coefficients.

The real essence of this assumption consists in the fact that this production way is a combination of different ways, i.e. an averaged production method. This averaging of various technologies (calculations of the averaged sectoral coefficients of the direct expenses) is carried out on the basis of study and prediction of the progressive technical and economic tendencies and perspectives for the development of sectors;

– all goods, produced by the same sector, are uniform and are observed as a unit. It is supposed that every sector produces only one product (monoproduct). At the same time, often there are processes of the complex production in some sectors.

2. Objectivation of the innovation relationships between sectors (sectors act in the mixed strategies).

That is why there is a necessity to select technologies, which will be subjected to substitute (improve) and will provide maximum effective functioning of the system. The scheme to calculate indicators to select the improving object, proposed by the author, is demonstrated in fig. 2.

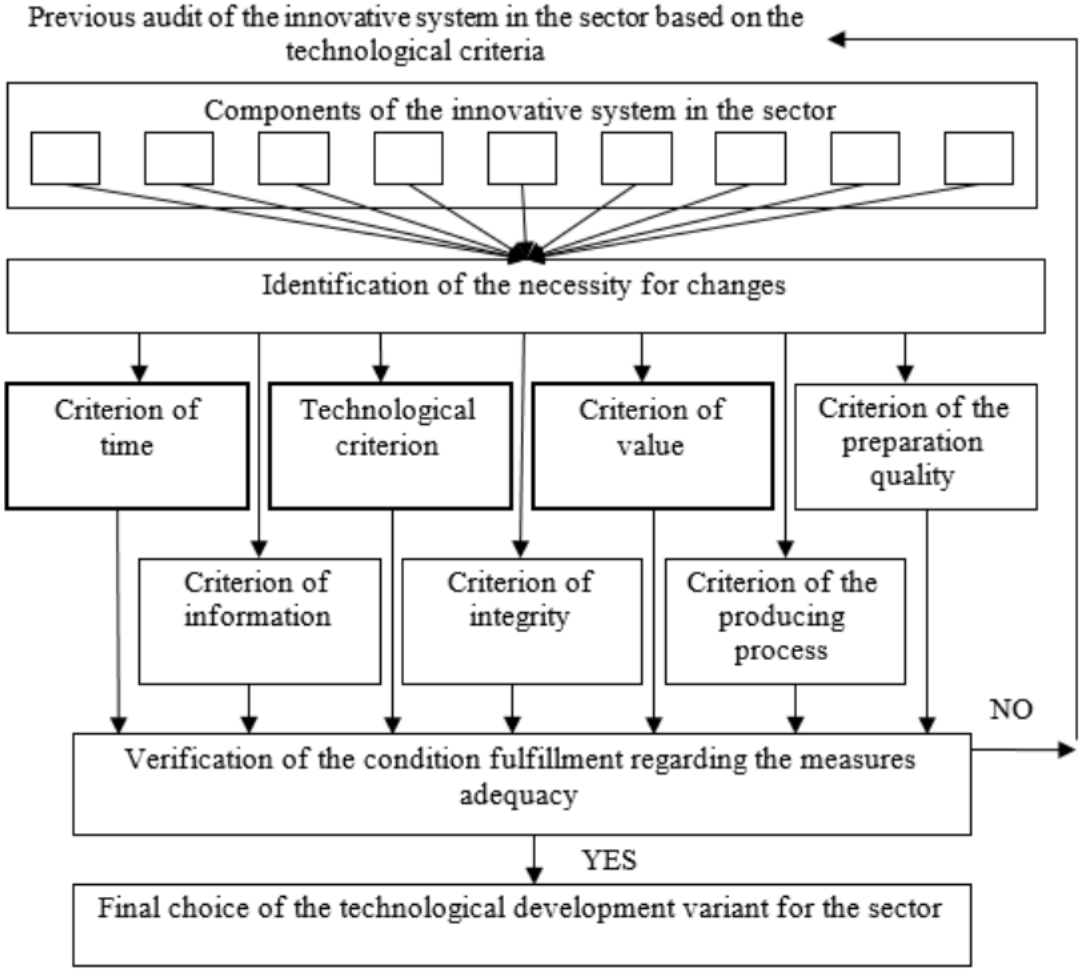


Figure 2 The sequence to select components of the innovation system for improvement

Thus, the task to form the innovation projects portfolio is combinatory, and its complexity grows with the increase of the projects' number or with the extension of the planning perspective. That is why in order to solve this task it is reasonable to use algorithms, which successfully work with data bulk, can solve multicriteria tasks and are flexible enough to take into account possible factors and criteria.

In our opinions, the perspectives for high technologies analysis based on the intersectoral relationship, first of all, relate to the possibility to improve technologies. The intersectoral relationship potential should be observed in terms of the fact that the concrete technological process is observed as a part of the more complicated process and as a set of less complicated technological processes, each of which is able either to form unique competitive advantages or

to balance the advantages of others. We can point out the complexity to calculate criteria mentioned in fig. 2. At the same time, the impact of technological progress is distinctive for all the above criteria. Thus, it makes the proposed approach urgent and reasonable.

In order to carry out the reliable system evaluation of the innovation development level, it is necessary to have information regarding types, volumes and state of innovations' introduction into the production and economic activity, volumes technological decisions made, etc. Everything here, definitely, makes the commercial secret of the business entity that is why it cannot be publicly accessed. The same situation is with the reporting information of the concrete respondent, submitted to State Statistics Service during the statistic inspections.

Only the summary data, particularly about: number of scientific personnel and organizations; volumes of performed scientific, scientific and technical works; the share of enterprises, which dealt with innovations; sources for the innovation activity financing; quantity of the innovation products names and share of the implemented innovation production in the volume of the industrial ones, are released in free access.

Thus, it is possible to evaluate the innovation development level of the national economic sectors, only holding to the following terms:

– the methodic provision of the innovation development assess should be based on real (official) statistic data, which may be publicly available;

– the research has to comprise great time lag, at least 10 years and to demonstrate real dynamics;

– the assessment object has to be simultaneously the subject of the innovation process.

3. INNOVATION DEVELOPMENT EVALUATION APPROACH

It should be mentioned that efficiency of sectors at the industrial enterprises is reasonable to be observed from position whether their innovation development complies with current innovation technologies in the sector or advances, and the result of their use consists in the real saving of time and other producing resources [26]. Then there is an extended intensive reproduction, otherwise, when innovation development of the national economy sector is provided through the outdated technologies, which do not comply with technological progress – simple extensive reproduction. Another important aspect of the efficiency of the national economic sector is the resource potential proportionality, i.e., the ratio between key factors of production – physical (C) and human (L) capitals – the Marginal Rate of Technical Substitution ($MRTS$):

$$MRTS = \frac{MP_L}{MP_C} = -\frac{\alpha L}{\beta C},$$

where MP – marginal product of resource; α and β – parameters of the Tinbergen-Solow production function.

The value $MRTS < -1$ indicates the predominance of the physical capital factor over human capital in the structure of productive resources, and $MRTS > -1$ – the prevailing significance of the human capital factor [27, p. 89-90].

Thus, while evaluating the innovation development of the national economic sectors, there is one more significant demand – to take into account compliance with technological progress and resource potential proportionality.

The multiplicative dynamic model of the Tinbergen-Solow production function provides compliance with the settled demands to the methodical support to evaluate the innovation development of the national economic sectors [3-4]:

$$Q = A\, C^{\alpha} L^{\beta} e^{\gamma t}.$$

The key constituent of the multiplicative dynamic model of the Tinbergen-Solow production function, improved by us, is a parameter of the technological progress γ, which will show the innovation development level of the national economic sector in our study.

Parameter γ is the technological progress parameter (coefficient of the sales volume elasticity by the technological progress; t – a factor of technological progress (serial number of the year).

The key constituent of the proposed dynamic model of Tinbergen-Solow production function is "a parameter of the technological progress γ", which will demonstrate the innovation development level of the sector in our research.

So, if $\gamma > 0$, it is concluded that the innovation development of the sector complies with the current technological progress since modern innovation technologies have been introduced into the production, the working places and logistic processes are automatized. Finally, it provides additional growth $+\gamma\%$ of the production implementation and increasing efficiency from the production scales. Then, the technological progress parameter $\gamma > 0$ will be an indicator of the extended intensive reproduction.

Otherwise ($\gamma < 0$) the innovation dynamics of the sector may be supposed extensive, that complies with simple reproduction, since the innovation technologies introduced into the production are outdated, "lagging behind" the modern technologies. As a result, the sector loses $-\gamma\%$ realization of the industrial products through the falling return from the industrial scales caused by the non-compliance with technological progress.

The improved multiplicative dynamic model of the production function is coordinated with innovation theories to promote high technology sectors and models, scientific and technical development, formed on the basis of the economic cycle, social and economic development conceptions theories and are oriented to the practice.

In these theories the role of innovations as a key factor of the economic dynamics is observed in the following aspects:

1) Economic cycles are based on technological dynamics (innovations in the real sector of the economy);

2) Institutes play a great role in the development of innovations; they are interpreted both as "brake" for innovations and as a way of choosing between technological alternatives;

3) In general, the objective necessity to strengthen the state's role in the innovation activity management (monitoring, planning and prediction) is defined;

4) Organization forms and sizes of firms are mostly defined by the implemented technology;

5) Industry and industrial innovations are in the center of economy.

4. SECTORAL INNOVATION DEVELOPMENT WITHIN THE TECHNOLOGICAL PLATFORMS

Technological platforms are significant tools of the national scientific and technical and innovation policy. They are formed on the basis of private and state partnership mechanism to unite efforts in the area of scientific and technological and innovation development of economy.

The technological platform is a communicative instrument, focusing on the activation of efforts to create the perspective commercial technologies, new products (services), to attract

additional resources to carry out researches and investigations, based on the participation of all parties concerned (business, science, state, civil society), improvement of the regulatory base in the scientific and technological, innovation development. The formation and implementation of technological platforms are oriented to solve the following tasks:

- to strengthen the impact of business and social needs to implement the important areas of scientific and technological development;

- to find new scientific and technological opportunities to modernize the existed sectors and to form new sectors of economy;

- to define the principal directions of the sectoral regulation for the rapid distribution of the perspective technologies.

The technological platforms make it possible to use different tools more flexibly, enhancing their potential effects and thus gaining the multiplex effect of knowledge transfer. Within the security based strategies we need to estimate the technological platforms' contribution to the development of priority sectors and their contribution to improving the competitiveness of the sector. It is also important that on all technological platforms not only the results should be evaluated (i.e., the achievement of some key parameters of project implementation), but also the effectiveness of the program from the point of view of its organization, management system, adopted financing system, etc. For these purposes we can apply the criteria defined in Fig. 2.

5. CONCLUSION

In the research, authors define the conceptual principles of the optimization evaluation of the innovation processes at the sectoral level. It is shown that mechanisms of the sectoral transformation owing to the technological progress factor are to provide the economic system transformations. This process is presented in the work as a scheme, developed by the author. The proposed conceptual foundations of innovation processes evaluation at the sectoral level are based on the fact that tasks for the innovation development management are combinatory, and its complexity is growing when projects' number is increasing or when planning horizon is extended. That is why in order to solve this task, it is reasonable to use the algorithms, which successfully work with a large amount of data, are able to solve multicriteria tasks and are flexible enough to take into account possible factors and criteria. The key component of the improved multiplicative dynamic model of the Tinbergen-Solow production function is a parameter of the technological progress γ, which demonstrates innovation development the level of the sector in the national economy in our study.

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