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ACCELERATING THE PROCESS OF FORCED IMPORT SUBSTITUTION USING THE INTRODUCTION OF THE TRIPLE SPIRAL MODEL

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Abstract. In the current circumstances, successful implementation of forced import substitution is impossible without creating conditions for the interaction of innovation actors. In this context, the article explores the possibilities for accelerating the import substitution process by introducing the triple helix concept. This model's components — the government, business, research and education sectors — are at the same time subjects of innovation. Based on an analysis of the features of their development and functioning, the growing importance of the educational sector and the need to restore the interrelationships between the elements are shown. The aim of the research is to find tools for the triple helix model's adaptation to Russian circumstances in order to accelerate the import substitution and technology transfer processes.

Keywords: triple helix model, import substitution, education, sanctions

Introduction

The need to organize domestic high-tech and knowledge-intensive enterprises is growing due to recent global economic changes driven by events like pandemics, geopolitical conflicts, and energy crises. This is especially relevant to Russia, which is facing unprecedented sanctions pressure. Western countries use Russia's technological isolation as a means of manipulation to hinder Russian economic and technological development and its path to becoming a developed nation. This is a vivid example of how rapidly the global community can break relationships and global production chains. Any country can face such unfair competition at any given time. To preserve its sovereignty, a state must be ready to address and manage these risks.

Prior to the escalation of the geopolitical conflict, Russia had the objectives of import substitution, autonomization, and a transition to an innovative way of development. All development programs called for import substitution, but before the introduction of prohibitive measures, imports of equipment and components were substantial. All development programs called for import substitution, but before the introduction of prohibitive measures, imports of equipment and components were substantial. Sanction pressure has made it challenging to complete this task. It has significantly reduced the range of opportunities, partners, tools, and time for decision-making. Thus, Russian industry found itself under forced import substitution, as noted in the works of a number of economists (Skvortsov V.A [1]., Seliverstov Y. I., Chizhova E.N. [2], Stroganov A. O., Zhilina L. N. [3]).

In order to eliminate the levers of pressure, reduce the consequences of sanctions, and operate in an uncertain environment, it is necessary to find effective tools for the formation, accumulation, preservation, and development of technological and intellectual capital as soon as possible. All these processes require highly skilled human resources, which are provided by the science and education sectors. The need for training highly skilled workers becomes a pressing issue when knowledge, technology, and innovation ability become key factors in the competitiveness of the state. Restoring the links between production, science, and universities can increase the quantity and quality of skilled employees. However, Russia does not yet have the necessary level of cooperation for this kind of successful activity.

The Russian economy is a market system with command system's components, where paired relationships with state dominance and the absence of feedback prevail. Such relationships are not even double helixes [4]. Thus, the study's objective is to determine how the triple helix model (THM), that improves horizontal communication and close cooperation between the three primary subjects of innovation — universities, government, and business [5] — can be applied to Russian realities to intensify technology transfer.

Materials and Methods

The study's methodological foundation is built upon the scientific works of domestic and international researchers, who explore the 'triple helix' concept and its application in both developed and developing economies.

Professors G. Itzkowitz and L. Leydesdorf developed the Triple Helix model (THM) in the late 1990s [6, 7]. While L. Leydesdorf studied the mechanisms of exchange in the process of creating innovations, G. Itzkowitz concentrated on the relationship between a university and an industrial enterprise. The "government" element was added as an equal, not a controlling, component to the double-helix "university-industrial enterprise" as a result of the research. This advanced our understanding of how the structure of the innovation process operates.

A number of researchers (Kirillova E. A., Katukov D., and Altunina A. B.) identified a number of features of this model determined by the transition from pairwise to spiral interaction:

- the spiral must have close horizontal three-way links between its main elements [8]. The horizontal structure of relations in this paradigm is caused by the state being represented as an equal element instead of a managing entity [9];
- increasing universities' role in the field of interdisciplinary applied research is becoming the leading element in the innovation process;
- shifting the regulation of the innovation process towards market relations;
- the subjects of the innovation process assume each other's functions, which determines the flexibility of the model [10].

Kirillova E. A. [8] and Katukov D. D. [9] also highlight that the triple helix metaphor is used to underline the nonlinear interaction of components and to take into account the influence of the time factor on them [8]. The THM also has the ability to respond faster to the environment changes [9].

A number of authors: Altunina A V. [10], Antonov A.G., Pomogaeva K.Yu. [11], Solovyova Yu.M., Solovyova R.P. [12], Pakhomova E.A. [13], Bogdanovich O. I., Merkulov A. S., Ruposov V. L. [14], Istomina S.V., Lychagina T.A. [15], considered in their works the roles, functions and relationships of the main subjects of the innovation process. The empirical basis of this research allows us to dissect the THM into components and illustrate how the elements of the THM interact with one another in different ways at different stages of economic development and the innovation process. The main functions of these elements and how they interact with one another in the environment have been determined. The nature and function of the relationships between each subject of the innovation process are changing as we transition from the command to the post-industrial economy. The results of this analysis are systematized in Table 1 in the Results and Discussions section. It will help to advance understanding of the most effective way to integrate TMH's elements that act as innovation process agents. It will advance understanding of the best integrating strategy for TMH's elements that act as innovation process agents.

Results and discussion

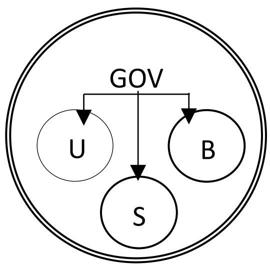
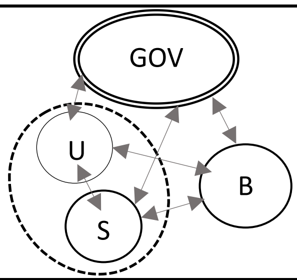
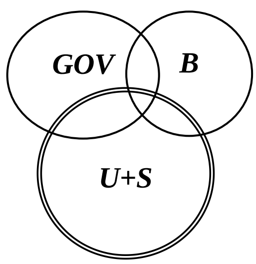
The tabular systematization of functions and links among subjects of the innovation process, which are also elements of THM, aids in better understanding whether these factors remain constant or change when transitioning between different economic models. The graphical representation of the interaction schemes shows that elements completely interact only at the intersection of "spaces." The leading element is indicated by a circle with a double border, the relationships are indicated by arrows. The elements Science and University are separated in this table because Russia adopted the Soviet Union's institutional policy of separating scientific organizations from educational institutions [16]. However, then the boundary turns into a dotted line, and ultimately it disappears because, as institutional development progresses, it becomes more difficult to distinguish clearly between the two institutions.

There is no partnership in the command model, which is characterized by hierarchical systems with a strict type of coordination. This is illustrated by the linear control system in the scheme. The government is the main coordinator and the regulator, using a directed communication system through administrative decisions [11]. Hierarchical systems can't correctly fit into the reality of the digital age anymore.

Although the industrial model has increased flexibility, its elements are too autonomous, which complicates the creation of sustainable linkages with one another, so the connections indicated by arrows in the diagram are in gray. Practice has demonstrated, that as technology advances the independent activity of the elements does not provide the required results, especially independent adaptation to constantly changing environmental conditions without the use of cooperation and joint decisions [9]. The so-called double helixes, or paired interactions with feedback (marked by arrows), are developed between institutions in an industrial (market) economy [11]. Science and education cooperate during the process of training personnel; science and the state interact during the knowledge-generating stage; science and education cooperate with business during the technology transfer phase; and finally, the state and business work together to bring the finished product to market [12].

The hybrid model combines flexibility and integration. In the post-industrial economy, there is a collective strategy for adapting to environmental changes and managing collectively, as well as the formation of stable relationships between subjects of innovative activity and the desire to organize cluster structures [4]. Besides, cooperation mechanisms affect all subjects of innovative activity. In the process of this cooperation, each of the participating institutions gains new roles and partially assumes those of the other participants. For example, the state starts acting like a venture capitalist, and businesses start offering educational services, opening training centers in the manufacture. At the intersection of the institutional fields of the state and business, capital-intensive projects are implemented in the form of public-private partnerships with high economic efficiency for business. Resource-intensive projects with a high level of long-term potential are being implemented at the intersection of the institutional fields of science and business.

Table 1. Functions and interactions of elements

THM's Element	**Type of economics**		
	Pre-industrial (Command economy)	Industrial (Market economy)	Post-industrial (Hybrid economy)
Business (B)	Mass production of the same type of production		Individualization of manufactured products; High level of uncertainty; Participant in the process of knowledge sharing; Offering educational services
	Slow rate of changes	High rate of change Generation and diffusion of innovations to other enterprises; Production and commercial support of projects	
	Demand for personnel		
	Non-competitive environment	*Competitive environment*	*Hypercompetitive environment*
University (U)	Training/retraining of personnel; Accumulation, storage, transfer and dissemination of knowledge;		
		Generation of knowledge by fundamental and applied research	Technology transfer to production; Educational services and scientific research; Commercialization; Organization of intellectual products production, realization of the results of their scientific activities in the market; University becomes a leading player in the innovation process
Science (S)	Knowledge generation and storage		
	Scientific research	Individual decision making; Quick response to changing conditions	
Government (GOV)	Expertise and consumption of knowledge; Management of the activities of the innovation Process subjects; Supervision and control; State order; Conflict resolution		Consumption of knowledge
	Financing of knowledge generation;		
	Principal regulator	Legal support; Improvement of legal framework; Opening of institutes and enterprises;	
		Information security, secrecy; Patent and licensing activities.	Role of venture fund; Creation of conditions for public-private partnership; Sharing of R&D costs and risks with business;
Scheme of interaction			

Source: compiled and finalized by the author based on research [13;14;17]

In developed countries, universities and science are frequently merged into one subject of innovative activity. Universities have a leading role in the innovation process. They generate ideas and engage in R&D, conduct basic and applied scientific research, but only with the support of the government and business. Universities become a resource of knowledge-intensive production [18]. In addition, the commercialization function appears in this subject due to the innovation process and the integration of science into the market. The "leading element" in the relationships between the institutions taking part in the innovation process has also changed. The role of science and education (U+S) grows in the post-industrial model.

Institutions capable of performing non-traditional functions become the most important source of innovation [19].

The THM began to be actively introduced into the economic practices of developed countries in the 2000s. This was a new approach to the processes of integration and creation of a single knowledge market. Though a number of countries have successfully realized this conception, it is still important to take into account the state and characteristics of the national institutional environment into which we are going to immerse this model, as well as what factors will speed up the innovation process.

For example, in developed countries, civil society (The Quadruple Helix Model; Carayannis E., Grigoroudis E., [20]) and the environment (The Quintuple Helix Model; Carayannis E., Campbell D. J., [21]) are introduced as additional elements to the Triple Helix model. However, in a developing economy, these elements can influence the functions of the institutions that make up the innovation system, but not to be part of it. Obviously, copying the latest foreign production infrastructure (business incubators, technology platforms, technology parks, venture funds, etc.) is insufficient for a successful and speedy transition to a knowledge economy.

For example, when adapting the THM to Russian conditions, the distinction between science and education is need to maintain and to take into account cooperation in the form of a quadruple helix, in which science, government, education, and business are considered complex systems connected by the carrying out of basic general economic functions [19].

In any case, the model's first point of adaptation is the science and education sector. This is especially true for universities, where youth — future researchers — are concentrated and knowledge is disseminated. Researchers are increasing in countries with significant innovation activity [22], but Russia has the opposite tendency (see Fig. 1). A shortage of qualified personnel is a problem wherever we begin to think about how to accelerate the innovation and import substitution process.

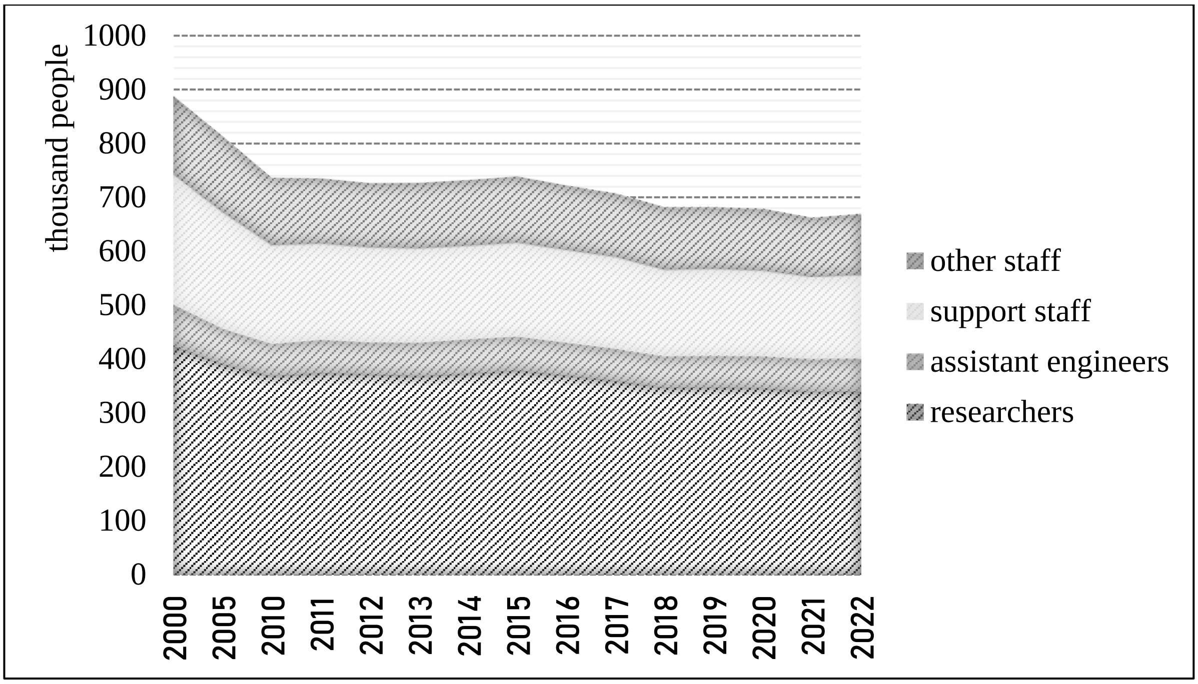


Figure 1. Dynamics of the number of researchers in Russia

Source: compiled by the author based on Rosstat data

The modern economy requires a completely different workforce that is able to learn quickly and respond to external changes. This workforce is mobile, moving from one institutional sphere to another, accumulating and disseminating experience.

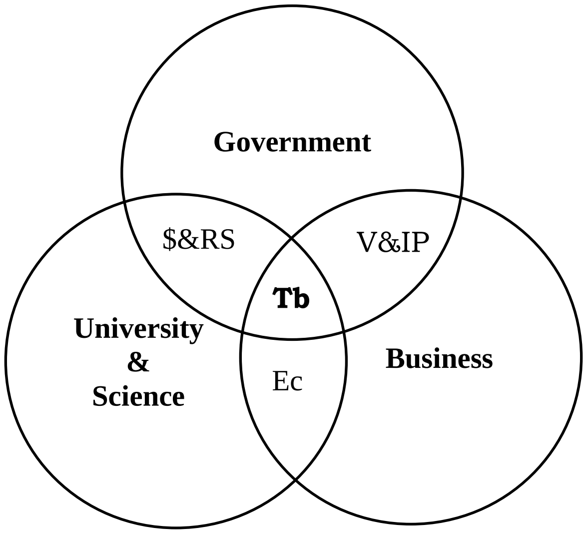
The primary purpose of education is to train highly qualified personnel. Russia inherited from the USSR a powerful scientific foundation: universities, research institutes, libraries, professors and researchers [15]. Since the USSR's collapse, the educational system has undergone several reforms. It led to a loss of industry orientation, a break in the relationship with production, and the obsolescence of material and technical equipment. Reviving relationships between universities and businesses is the first step in efforts to improve the quality of the educational system.

Due to the multidisciplinary nature of research, subjects of innovation process have to perform functions for each other [23]. These connections will help these THM's elements grow, accelerate the reproduction and dissemination of knowledge, and reduce costs. A correct understanding of THM and its integration into current socioeconomic conditions can yield significant results. Finding effective tools of institutional convergence is the first step to achieve this.

There is experience in applying a special project structure that establishes the relationships between the elements of THM and serves the following functions:

– creation, audit, replenishment, storage of knowledge base, data protection;
– information and legal support;
– searching for partners, creating and maintaining stable connections between components.

A permanent institution called a technology broker can become such structure. It serves similar functions [24]. The state's involvement in the organization is the best option because it will guarantee security and control. The technology broker appears at the intersection of all three elements of the triple helix (see Fig. 2). At the pairwise crossing of the elements, there are, respectively, scientific and educational centers in the production, venture public funds, developed innovation policy and forms of feedback between education and the government.



Tb – technological broker;

V&IP – venture funds and innovation policy;

$&RS – funding and feedback;

Ec – scientific and educational centers

Figure 2. A triple helix-based graphic depicting the interaction of subjects in the innovation process
Source: compiled by the author

Organization of effective forms government, business, and educational interaction will not only build an efficient training system but also accelerate the transfer of technologies, the decision-making process, and simplify the output of products to the market.

Each innovation actor has a unique set of resources, but by combining efforts, these players can change their core roles and reorganize their resources in ways that foster the emergence of new knowledge. Work should continue on creating conditions for interaction among innovation actors.

Conclusion

Forced import substitution with a wide range of restrictions on external interactions within the framework of double helixes is a difficult task. In the socioeconomic context of Russia today, it is necessary to fully involve participants of the innovation process. In Russia, where a market economy predominates with components of a command economy, paired connections formed with the government's dominance and the lack of feedback. It does not contribute to solving systemic problems and implementing an effective import substitution policy.

A double helix can be transformed into a triple helix with a number of steps and tools. The repair of the links connecting science and education with production, applying a crucial tool like a technology broker should be the first step in introducing the triple helix. The broker allows easier to get through infrastructure, information, and communication barriers, accelerate technology exchange, and hence import substitution. The second step is to update the training programs and technical training tools, including productive sector training centers. The tool might be the creation of a solid connection between the Ministry of Education and the education sector that would contribute to improvements in the education system through dialogue between educators and ministry staff. The third step, which lies in integrating education and science into one innovative entity that serves the tasks of generating, storing, and disseminating knowledge, should be carefully evaluated. Although universities in developed countries play a leading role in research, in Russia, it is probably more rational to keep the separation between the science and education sectors.

Progress necessitates the establishment of favorable conditions. Given the current environment and Russia's historical strengths in education and science, it's essential to focus on the stakeholders in the innovation process who contribute to human capital growth.

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