# Integrated Model of the Higher Education Financing Under the Quadruple Helix Concept

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**Summary**
Rapid growth of the higher education role in ensuring the socio-economic and innovative development of the national economy in the context of the development of the information society and the knowledge economy is observed. Achieving positive synergistic effects of the higher education development requires proper funding for university education and research. The existing funding models for national higher education systems in a number of developing countries need modernization in accordance with the modern challenges of economic and innovative development. The purpose of the article is to formulate theoretical – methodological and applied foundations for the development and implementation of the integrated model of the higher education financing under the Quadruple Helix concept. At the center of the developed model are the areas of interaction identified by the authors, namely: Personnel, Science, Management, Innovation, Social area. This made it possible to specify the interests of all stakeholders and orient the activities of higher education institutions to the satisfaction of these interests. Effective implementation of the integrated Model of the higher education financing requires increasing the level of investment attractiveness and practical value of university research; activation of innovative development of enterprises; state stimulation of business participation in university research and education; harmonization of current legislation with EU standards. Implementation of the Model will diversify sources of funding for universities, increase their level of economic security and achieve integrated synergies from the interaction of universities, business, government and the public (as the main stakeholders within the Quadruple Helix concept).

***Key words:***
*higher education; Quadruple Helix concept; integrated model of financing; diversification of funding sources; R&D commercialization.*

## 1. Introduction

Development of knowledge-based economics and widespread digitization of socio-economic processes transform the activity of all economic entities, regardless of their spheres of functioning and ownership. In such circumstances, approaches to enterprise competitiveness are changed, the need to find new competitive advantages, in particular in the areas of introduction of innovative products, modern information and communication technologies, scientific developments and inventions, is actualized. This, in turn, leads to an increase in the role of the higher education system in the economic development of economic entities, as higher intellectual property is concentrated in the nation's main intellectual capital (Kalenyuk et al., 2018).

Attraction and retaining talents, conducting high-quality university research requires significant financial resources. Similarly, training highly qualified professionals who can think and act in an innovative way. Crucial role of higher education in the competitiveness and economic growth of the country is recognized by some of the leading countries in the world. This is reflected in the volumes of public expenditures on tertiary education: 2.13% of GDP in Norway; 1.85% in Sweden; 1.83% in Finland; 1.79% in Austria; 1.75% - in the Netherlands (European Commission Database, 2020). Instead, developing countries still have problems attracting private investment and international grants to higher education. Solution to this problem is seen in wide involvement of stakeholders from different sectors of the national economy and civil society. Identifying the common interests of stakeholders will allow them to synchronize their collaboration and aim for maximum satisfaction of needs. On this basis, it is possible to develop a long-term mutually beneficial partnership of universities with business, government and the public, and provide the higher education system with additional revenues from diversified funding sources. In our view, exploration of the aspects described above can be done using conceptual provisions of the Quadruple Helix Concept.

Manuscript received July 5, 2021
Manuscript revised July 20, 2021
https://doi.org/10.22937/IJCSNS.2021.21.7.16

## 2. Literature Review

Theoretical and methodological foundations of the Quadruple Helix Concept were developed by Carayannis E.G. (Carayannis et al., 2012; Carayannis et al., 2009; Carayannis et al., 2016) and Campbell D.F. (Campbell et al., 2012). By studying scientific publications on the Triple Helix Model (Etzkowitz, 2008; Dizisah et al., 2008; Etzkowitz al., 2000), these scholars have proven the need to extend the Concept. In particular, it was justified that economic growth and innovative development of the country are ensured by active interaction of universities, business, government and civil society. The Quadruple Helix Concept describes the following key roles for the entities: *higher education sector* – generation and transfer of knowledge, research and commercialization of their results in the real economy; *business enterprise sector* – investment of R&D and implementation of R&D results in production process, enterprise management system; *government sector* – regulation of legal aspects and regulatory support of commercialization processes; promoting university and business collaboration to maximize public satisfaction; *civil society* – formation of the demand for innovative, high-tech products; a participant of innovation process and co-owner of achieved results.

Position of E. Carayannis and D. Campbell on the extension of the Triple Helix Concept is supported by Park H. Woo (Woo, 2014), R. Yawson (Yawson, 2009), C. Colapinto and C. Porlezza in their research (Colapinto et al., 2012). The Quadruple Helix Concept is considered as a theoretical and methodological platform for the innovative development of the country in papers of A. Oscar, S. Monterino and M. Thomshon (Oscar et al., 2010).

The European Commission also acknowledges the significant impact of the Quadruple Helix Concept on the innovation development. In particular, in the period 2008-2012, the project "Creating Local Innovation through a Quadruple Helix" (total EU grant - 1,472,602.52) was funded. A comprehensive report on the results of this project was released in 2010 by R. Arnkil, A. Järvensivu, P. Koski and T. Piirainen (Arnkil et al., 2010). Implementation of the above-mentioned project has made it possible to prove the practical value of the Quadruple Helix Model in providing the innovative development at the microeconomic level; in the formation of legal frameworks of business partnerships, government, higher education and civil society; in enhancing citizen participation in innovative projects.

In the scientific literature, there are attempts to use the Quadruple Helix Model to address a variety of research questions (Carayannis et al., 2016; Grosu et al., 2021). In our research, we used the Concept as a theoretical and methodological basis for the development of the integrated model of the higher education financing.

The purpose of the article is to formulate theoretical - methodological and applied foundations for the development and implementation of the integrated model of the higher education financing under the Quadruple Helix Concept.

## 3. Methodology

The study was conducted in several successive stages, each of which used relevant general scientific and specific methods. In the first phase, we analyzed current trends in the development of national higher education systems in EU countries and identified common features in universities' funding. For this purpose, the method of statistical analysis was used. Official Eurostat statistics available in the public domain was the source database (in particular, data on aggregate expenditure on higher education in EU countries, their structure by source of funding, the share of such expenditure in GDP).

In the second phase of the study, we analyzed the totality of interconnections between different sectors of the national economy and civil society. We are based on the Quadruple Helix Concept, which was used to study research methods of analysis, synthesis and logical generalization. Methodological provisions of this concept have been analytically applied to the financial issue of the higher education development.

In the third phase, using the method of scientific modeling, the theoretical construct of the integrated model of the higher education financing is constructed, integrated synergistic effects of stakeholders' interaction within the Quadruple Helix Concept are identified.

Research *hypotheses*:

*H1:* results of educational and research activities of universities have a stimulating effect on the knowledge-based economy;

*H2:* cooperation with higher education institutions in the areas of training and R&D contributes to improving the competitiveness of partner enterprises (through the employment of highly qualified university graduates and introduction of innovative R&D results);

*H3:* The Quadruple Helix Concept could be effectively applied to solve financial issue of the national higher education systems development;

*H4:* Development of the cooperation between universities and stakeholders within the Quadruple Helix Concept is capable of generating integrated synergies for the national economy and society;

*H5:* The Quadruple Helix Concept can be used to develop an integrated model of higher education financing, focused, on the one hand, to diversify university funding sources; on the other hand, to meet the needs and interests of stakeholders.

## 4. Results

*Areas of Synergetic Cooperation of Stakeholders within the Quadruple Helix Concept*

Developing an effective model for financing the higher education system requires identification of areas of interest common to all engaged partners. The stakeholders' synergy within the Quadruple Helix Concept is manifested in the greater effects of partner collaboration than on their autonomous, uncoordinated functioning. In a formalized form, the synergies of such cooperation can be summarized as follows:

$$E_G + E_E + E_b + E_p < E_S,$$

$E_G$ – the effect of autonomous functioning of public sector entities;

$E_E$ – the effect of the autonomous functioning of the subjects of the higher education sector;

$E_b$ – the effect of the autonomous functioning of the entities of the business sector;

$E_p$ – the effect of the autonomous functioning of the public sector;

$E_S$ – the effect of the joint activity of the subjects.

$$\begin{cases} SE = ES - (EG + EE + Eb + Ep) = ES - \Sigma EQH \rightarrow \max \\ EGS \geq \frac{\Sigma E_G}{n} \\ EES \geq \frac{\Sigma E_E}{n} \\ EbS \geq \frac{\Sigma E_b}{n} \\ EpS \geq \frac{\Sigma E_p}{n}, \end{cases}$$

SE – synergistic effect

n – number of partners involved;

$E_{GS}$, $E_{bS}$, $E_{ES}$, $E_{pS}$ – the effect of joint activity obtained by public, business, educational and public sector entities, respectively.

$$\sum E_{QH} \leq E_S$$
$$SE = E_S - E_{QH},$$

$E_{QH}$ – the effect of the joint activity of the entities within the Quadruple Helix Concept.

We'd like to emphasize separately that the synergistic effect obtained from the cooperation should be shared between all the involved entities in order to ensure their interest in continuing the cooperation, and thus:

$$SE = \sum SE_{QH} = \sum( SE_G + SE_E + SE_b + SE_p$$

$SE_{QH}$ – the synergistic effect for subjects within the Quadruple Helix Concept

$SE_G$, $SE_E$, $SE_b$, $SE_p$ – synergetic effects of ensuring the adaptability of the higher education system to the conditions of the information economy, obtained accordingly by the subjects of the state, educational, business, public sectors (Djakona et al., 2020).

We believe that it is necessary to take a comprehensive approach to the analysis of the synergistic effect of $SE_{QH}$, taking into consideration both economic (quantifiable) and social (mainly qualitative) effects. In particular, it is difficult to quantify the effects in the educational sphere (the quality of educational services, their compliance with employers' requests, the dynamism of updating educational content, innovativeness of pedagogical methods and technologies, etc.), as well as the effects obtained by civil society (consumer satisfaction with educational services, prestige of professions of a teacher and a scientist, public recognition of the role of education in the socio-economic development of the country, etc.).

Stability of positive synergetic effects and tendency to increase them make the prospect of developing long-term cooperation of universities with stakeholders more realistic, contributes to expanding areas of their common interests. Traditional areas of the mutually beneficial cooperation between higher education institutions, the government, the business sector and civil society are represented in Table 1.

Each area of interaction reflects the totality of needs, requests, interests of government, business and civil society. The practical value of identifying such areas is that it gives universities the opportunity to become acquainted with the interests of different stakeholders and orient their activities to meet their interests and needs. This will create conditions for diversification of funding sources for higher education institutions (Kholiavko, 2019).

**Table 1:** Areas of interaction between subjects of the Quadruple Helix Model

| Area | Direction / natureofinteraction | Prospective sources of synergies from interaction |
|---|---|---|
| Personnel | *Government sector* - monitoring the quality of higher education;<br>*higher education sector* - providing high quality educational services;<br>*business sector and civil society* - involvement in the process of curriculum development / updating (list of competences and practical skills, etc.) | - increasing the level of competitiveness of the national higher education system and domestic higher education institutions in particular;<br>- increasing the competitiveness of graduates of higher education institutions in the labor market;<br>- reduction of the youth unemployment level;<br>- improving skills of the staff and the level of innovative capacity of young professionals;<br>– orientation of the personnel to lifelong learning |

| | | |
|---|---|---|
| Management | *Government sector* - ensuring flexibility of the activity of state structures;<br>*higher education sector* - generation of managerial and organizational innovations;<br>*business sector* - flexibility of organizational structures of enterprises;<br>*business sector and civil society* - involvement in the planning of higher education institutions | - optimization of management processes at the macro and microeconomic levels through the introduction of managerial and organizational innovations;<br>- accelerating the processes of management decision-making and communication between partners through the introduction of information and communication technologies;<br>- improvement of communication channels between subjects of Quadruple Helix Model;<br>– regular updating of information bases;<br>– improving strategic planning processes and motivational mechanisms |
| Science | *Government sector* - setting priorities and supporting scientific and technical activities;<br>*higher education sector* - organizing, providing and conducting research;<br>*business sector* - initiation and financing of applied scientific projects;<br>*civil society* - enhancing society's willingness to use innovative inventions | – activation of scientific and technical development of the country;<br>– enhancing the practical value of scientific research;<br>– implementation of research results into the practice of the economic entities management;<br>– optimization of production processes and profit growth of enterprises due to the introduction of scientific achievements;<br>– improvement of working conditions, acceleration of production processes, automation of production;<br>– increasing the investment attractiveness of the field of science |
| Innovation | *Government sector* - identifying priorities for innovation; promotion of the innovative development of the national economy;<br>*higher education sector* - innovation generation; transfer of innovative research results to the real economy; implementation of innovation-investment projects;<br>*business sector* - initiating and financing the implementation of innovative projects; participation in joint research, validation and implementation of their results;<br>*civil society* - development of the innovative culture in society | – increasing the pace of the innovation development of the national economy;<br>– increasing the number of innovative enterprises;<br>– an increase in the share of innovative products in the country's gross domestic product;<br>– activation of the knowledge-intensive sector of the national economy;<br>– improving the competitiveness of enterprises through the innovations introduction;<br>– improving the quality of goods and their ability to meet consumer needs;<br>– cost savings for businesses through the innovation;<br>– development of the innovative infrastructure;<br>– sharing elements of information and innovation infrastructures;<br>– reducing the duration of business processes;<br>– increasing the efficiency of the intellectual property rights protection;<br>– introduction of innovative technologies |
| Social area | *Government sector* - implementation of state social programs;<br>*higher education sector* - implementation of social projects;<br>*business sector* - increasing the level of corporate social responsibility;<br>*civil society* - promoting the extension of sustainable development in society | – raising the level of public recognition of the role of education and science in the national economy development;<br>– enhancing the prestige of the profession of a scientist;<br>– balancing the interests of government, universities, business and society;<br>– increasing trust in society;<br>– increasing the youth civil activism |

Source: compiled by the authors

*The Integrated Approach To Higher Education Financing*

Potential sources of attracting additional financial resources to the higher education system can be analysed through the prism of the traditional areas of the stakeholders' interaction:

I – Area *Personnel*:

- government sector: government procurement for training at universities;

- business enterprise sector: payment for training, retraining, training of personnel under contracts with contracting companies; payment for specific educational services (specialized courses, training programs, workshops, etc.);

- civil society – students' education at the expense of individuals; fees for providing students with related services; payment for specific educational services (aimed at forming additional competencies);

II – Area *Science*:

- government sector: financing in accordance with the legislatively approved strategic priorities for the development of the country / region;

- business enterprise sector: financing under applied research contracts; royalty as payment for the use of university-patented inventions;

III – Area *Innovation*:

- government sector: financing within the framework of the state programs implementation to support innovative development of the national economy;
- business enterprise sector: commercialization of university-patented innovative R&D results and their implementation in the real economy;

IV – Area *Management*: investment from the business enterprise sector to develop and implement managerial and organizational innovations.

The main synergistic effects of the stakeholders' interaction within the Quadruple Helix Concept, which could be considered as promising factors of attracting additional financial resources to the higher education system, are systemized in Table 2.

**Table 2:** Synergistic effects of the stakeholders' interaction within the Quadruple Helix Concept

| Area of cooperation | Expected synergistic effects by stakeholders | Offers of higher education institutions for stakeholders | Expected synergistic effects for higher education |
|---|---|---|---|
| *Personnel* | - productivity growth of the personnel of enterprises;<br>- increasing the level of the competitiveness of graduates in the labor markets | - involvement of entrepreneurs in forming the list of competences of future specialists;<br>- providing the enterprises with highly qualified specialists | - improving the quality of educational services;<br>- bringing the educational process in line with the needs of the business;<br>- increasing the competitiveness of domestic higher education institutions |
| *Management* | - optimization of the management structure;<br>- improving the efficiency of the personnel motivation system | - generation of effective approaches to staff motivation;<br>- research and adaptation of the world experience of effective management | - implementation of the world's best management practices for organizations and staff;<br>- modernization and flexibility of the organizational structure of universities |
| *Science* | - modernization of production processes;<br>- cost savings through the introduction of resource-, energy-saving technologies | - development of technologies, including information and communication technologies;<br>- activation of scientific and technical development of the national economy | - commercialization of R&D results;<br>- ensuring that scientific developments are in line with the needs of the real economy |
| *Innovation* | - ensuring the innovative nature of production;<br>- increasing the competitiveness of enterprises through the introduction of innovative products | - generation of innovations;<br>- implementation of innovative projects | - commercialization of innovations in industry;<br>- increasing the role of higher education and science in the innovative development of the national economy;<br>- transformation of higher education institutions into innovation centers |
| *Social area* | - increasing the level of trust in society;<br>- development of public-private partnership | - implementation of social projects;<br>- involvement of young people in volunteer, civic, and social activities | - improving the reputation of higher education institutions;<br>- increasing the value of education and science |
| *Integral synergistic effects* | - increasing the competitiveness level of the national higher education system;<br>- bridging the gap between education, science, and business;<br>- activation of the innovative, scientific and technical development of the national economy;<br>- diversification of sources of funding for higher education institutions;<br>- balancing the national labor market;<br>- integration of the national higher education system into the global scientific and educational area | | |

Source: compiled by the authors

In addition to the above, it should be noted that cooperation in the "university-business" format can be sufficiently diversified. In this context, it is necessary to focus on research of Kalenyuk (Kalenyuk et al., 2020), which we consider highly relevant and reasonable. According to the studies (Butko et al., 2019; Marhasova et al., 2020; Popelo et al., 2021; Shkarlet et al., 2016), modern business is interested in attracting talents and raising the qualifications of its personnel, as this significantly affects the competitive advantages in the global economy. Therefore, the need to develop cooperation between higher education institutions and business is becoming more urgent, in particular, in the direction of training and retraining of personnel.

But the cooperation between universities and business is prospective not only within the education activity, but also in diversified directions of collaboration. In particular, higher education institutions can commercially provide

business with quality engineering, expert, consulting services, carry out business planning, maintain accounting, simulate development scenarios, develop feasibility studies and budget for projects, carry out various examinations, etc. Moreover, universities may provide businesses with specific services (depending on the profile of the higher education institution: medical, legal, telecommunications, computer, etc.). Existence of incubators, techno parks, PR-agencies, consulting centres, marketing departments at universities extends the possibilities of their mutually beneficial cooperation with business. We agree with Cosmulese (Cosmulese et al., 2019), Shkoda (Shkoda et al., 2020), Shkarlet (Shkarlet et al., 2019) and Polishchuk (Polishchuk et al., 2019) that such "university-business" cooperation is becoming more prospective in the context of digital transformation of national economies.

In addition, available laboratories, convention halls, conference rooms, offices, innovative infrastructure facilities can be rented out to universities, thus generating additional revenues to their budgets. Particular emphasis should be placed on legal aspects, namely provisions of current legislation in the field of regulation of the rights of higher education institutions to dispose of real estate, dispose of attracted financial resources, as well as to invest temporarily free funds in bank deposit accounts.

The results of the research made it possible to build a conceptual scheme of the integrated model of the national higher education financing under the Quadruple Helix Concept (figure 1). Developing the integrated model, we based on the research results of Degtyarova (Degtyarova et al., 2018) and Woźnicki (Woźnicki, 2013), who studied the peculiarities mechanism of higher education funding in Ukraine and Poland, respectively. The research results of scholars (Polishchuk et al., 2019; Degtyarova et al., 2018; Popelo, 2017) correlate with the results of our study that confirms their validity and relevance.

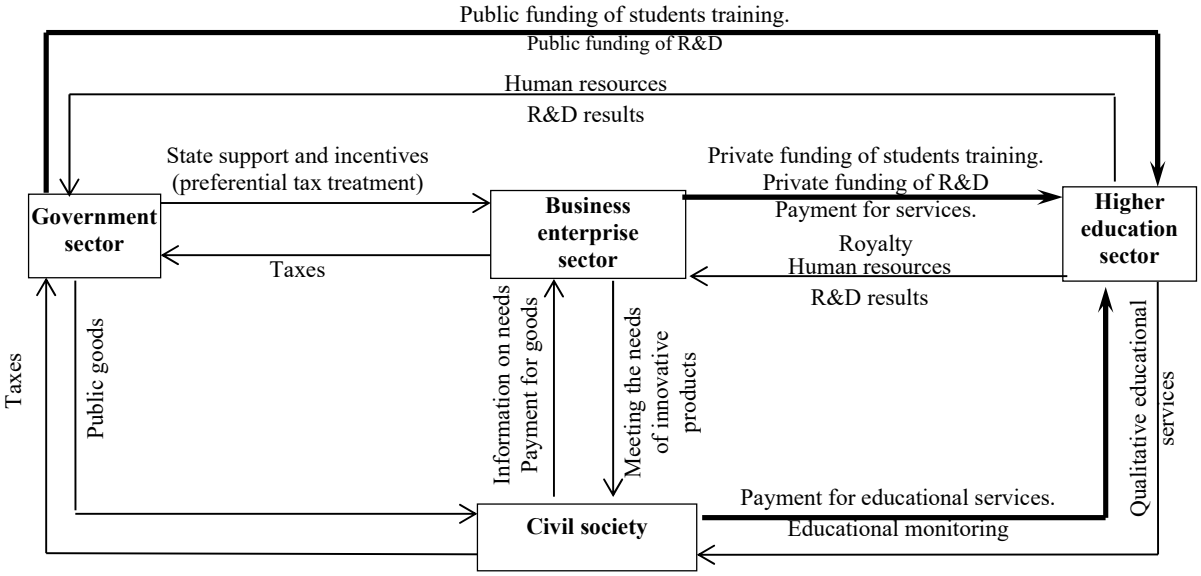


**Fig. 1.** Conceptual scheme of the integrated model of higher education financing

Source: compiled by the authors

Successful implementation of the Model is possible under the following prerequisites: the availability of state support for universities and innovative businesses; expanding the financial autonomy of universities; development of cooperation between universities and business; growing innovative business activity; advanced civil society, presence of powerful NGOs in the fields of education and science; academic mobility; high quality and practical value of university studies; guarantee of the protection of intellectual property rights, norms of the current legislation in the fields of higher education and science; presence of effective communication channels between economic actors; transparency of mechanisms for financing higher education institutions; minimizing bureaucratic and corruption risks.

Application of the Quadruple Helix Concept to the development of the integrated model of the higher education financing allows us to analyze the transformation of stakeholders' roles, in particular:

- civil society - representatives change their behavior from mostly passive to active; they are not merely consumers of educational services, but become public monitoring providers in the field of education;

- business enterprise sector - enterprises perform not only the role of investor, but also the initiator and co-executor of research, innovative projects;

- government sector - public authorities perform not so much regulating but stimulating functions (motivating business sector and higher education cooperation in the areas of training and R&D; promoting the efficiency and practical value of university research results).

Despite the change in the role of the government sector from the controller to the partner of universities, the monopoly right to adopt laws and other normative legal acts is retained by public authorities, which should be aimed on: coordination of all legal norms regulating the higher education institutions' activities; harmonization of the current domestic legislation in the fields of education and science with the relevant EU legal norms; development and legalization of economic incentives for business to intensify cooperation with universities in R&D; optimization of reporting on scientific, technical and innovative projects; elimination of bureaucratic barriers in the process of patenting and commercialization of intellectual property rights of universities. At the legislative level, the government sector should consolidate specific instruments of state support for the development of the national higher education system, science-intensive industries, innovatively active enterprises. In the knowledge-based economy, the government sector needs to become a link between academic science, university education, business and civil society.

## 5. Conclusions

Advantages of the integrated model of the higher education financing under the Quadruple Helix Concept are its focus on:

- taking into account of stakeholders' interests: higher education sector - increased investment through diversification of funding sources and increased commercial attractiveness of the scientific development; business enterprise sector - increasing the level of profitability of enterprises as a result of increased productivity of staff (highly qualified university graduates) and implementation of innovations (universities' R&D results); government sector - activation of socio-economic, innovative and scientific-technical development of the country; increasing the global competitiveness level of the national economy; civil society - obtaining quality education services to ensure high competitiveness in the labor market;

- consolidation of the capacity, reserves and resources of stakeholders (intellectual, human resources, financial, logistical and other resources);

- comprehensive stimulation of stakeholders' interaction within the Quadruple Helix Concept (state preferences; preferential conditions for the use of university infrastructure; special conditions for using the rights to patented research results, etc.);

- long-term mutually beneficial cooperation of stakeholders;

- flexibility of cooperation mechanisms and their high adaptability to changing economic conditions;

- ensuring the systematic interaction of stakeholders, preventing fragmentation of their cooperation;

- generation of synergistic effects from the stakeholders' cooperation.

Achieving synergies from the implementation of the integrated model of the higher education financing is possible after a certain period of time. Existence of a time lag is explained by the need for a certain period for testing by the subjects of the financial innovations system and for working out of effective mechanisms of functioning, forecasting and planning in the changed conditions. Frequent changes of the financing model do not allow to achieve the intended effects and to fully evaluate the results obtained.

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