

# Structural Shifts in The System of Higher Education of Ukraine in the Realm of the Specialists Supply for the National Economy

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Received 13 August 2020; Revised 13 September 2020; Accepted 22 October 2020; Published online 30 October 2020  
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## ABSTRACT

*The article deals with the integrated harmonious structure deviation indicator in the system of post-graduate training, which is constructed according to the rule of the “golden ratio”. Calculated deviation of the indicator of five-sector model that corresponds to the GDP in the post-industrial economy. Selecting components integrated the indicator deviation from the harmonious structure is based on the objective statistics and systematic research of GDP from a five-sector model. According to the proposed method of estimation of structural shifts in the sectoral structure of the educational environment, the integrated harmonious structure deviation indicator for the 2010/11-2018/19 academic years was calculated; the dynamics of the integrated harmonious structure deviation indicator for the GDP of Ukraine and for the higher educational system of Ukraine is compared. The calculation of the integrated harmonious structure deviation indicator in dynamics has led to the conclusion that over the last nine years there has been a tendency to train insufficient number of highly qualified specialists who provide the production of intellectual product, based on the requirements of the knowledge economy.*

**KEYWORDS:** *Structural shifts; Integrated harmonious structure deviation indicator; Estimation; Harmonious structure; Post-industrial economy; Sectors of national economy; Rule of “golden ratio”; Training of specialists.*

## 1. Introduction

### 1.1. First subtitle

Training, retraining and advanced training of personnel in accordance with the innovative development of the national economy is a complex process in which close interaction of scientific, scientific and technical and industrial spheres, multilevel educational systems, as well as business structures should be ensured. In addition to the changes that have taken place in the structure of post-graduate training in recent years (against the background of maintaining a high level of competition between educational

institutions, rising costs of training and development of information technology), there have been significant shifts in the formation of requirements for the quality of education. As such the transition from a process approach in training to a competency aimed at developing a student's well-established knowledge and skills necessary for future employment has gradually begun.

### 1.2. Second subtitle

Extensive research on the problems of structural shifts in the context of transformation of socio-economic systems was conducted and described by Roe T. and Saracoglu S. [26], Rudiger A. and Codrina R. [27], Schafran A. and other [28]. Shifts in the structure of economies of developed countries, which have been observed recently, have been systematized in scientific work in comparison with the shifts in the economy of modern Ukraine.

In the research of theoretical aspects of state regulation of higher education the authors [23] outline the prospects for its development, conduct an analysis of the current state of training of the

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specialists in the system of higher educational institutions of Ukraine, carry out analytical evaluation of economic and control methods of state regulation of higher education in Ukraine, substantiate the feasibility of applying the relevant principles regulation. The scientists identified strategic guidelines and priorities for the innovative development of the higher educational system, formulated proposals for improving the pricing procedure in the field of research and the formation and placement of state orders for the training of the specialists.

V. Bobrytska [2] characterizes the tendencies of formation of the State personnel policy of Ukraine, defines the conditions for its effective implementation taking into account actual social challenges.

O. Melnykova [24] determines the peculiarities of the market of educational services for the training of junior specialists, analyzes the current state of the national market of higher education of elementary level by quantitative parameters, combined into three blocks: the first - educational activities (contingent of students, export of educational services, compliance of the structure of training by industries to the needs for specialists in the economy of the country); the second is staffing (the structure of the teaching staff, the ratio of the number of teachers and students); the third is financial security (structure of financing of the higher educational institutions at I-II accreditation levels, scholarship fund).

O. Kravchenko, exploring the relationship of production with scientific institutions and educational institutions, emphasizes its increasing role in the context of structural transformation of the economy, as well as ensuring its innovative development, since the integrative interaction of production, science and educational institutions has a positive multiplier effect [19].

I. Gryshchenko conducts research on modern innovative changes in the integration of science, education and business. In particular he notes that clusters are a form of cooperation of universities with enterprises and organizations of the region, they make it possible to increase the efficiency of production, trade, labor, investment potential of participants and the region in general. The author proposes to consider the educational cluster as a set of territorially localized interconnected institutions of vocational education, providing training in related professions/specialties and related partnerships with each other, as well as with the employers of the industry. As a component of the production cluster, educational institutions are obliged to perform their economic

function primarily - to train personnel that would meet the needs of employers, to create "islands" of workforce in the region with the necessary professional and qualification characteristics, focusing on the regional priorities of innovative economy [6].

The main reasons for the emergence of problematic phenomena in the field of post-graduate training are the lack of response of higher educational institutions to current requests of the national economy; imperfection of the organizational and economic mechanism of higher educational management both at the micro level (at the level of individual higher educational institution) and at the macro level (at the state level); slight diversification of forms and types of higher educational institutions, etc.

O. Brit [3] emphasizes the considerable discrepancies between the demand and supply in the labor market by particular specialties and regions in his research, since there is a clear trace of the excess supply of labor in some specialties in the absence of specialists from others (especially in rural areas), the imperfection of the retraining system and improving the skills of experienced specialists, which reduces the ability of personnel to upgrade their knowledge and, consequently, reduces their competitiveness in the domestic and world labor markets. The author noted that the practical implementation of modern approaches to the post-graduate training at the national and regional levels makes it possible to improve the system of relations between higher education and the labor market, which will lead to an increase in the national security of the country.

M. Krymova, considering the tendencies of structural transformations of the supply on the national labor market, notes that the existing system of training affects its structure and volumes of supply. The commercialization of higher education, the more active development of non-productive sectors of the economy, as well as changes in the motivational and professional attitudes of young people have led to significant structural shifts in the structure of directions and volumes of training in Ukraine [21].

O. Khmelevska analyzes changes in the basic parameters of the higher educational system of Ukraine at the national and regional levels, compares national and international trends in higher education, emphasizes the necessity to adapt the network of educational institutions to existing demographic and socio-economic challenges [18].

In order to training of the in-demand specialists, MESU should take into account the experience of forming a quality educational environment in the European Union countries. For example, the team of researchers [5] emphasizes the necessity to make active usage of the best experience of other countries, especially with regard to financial support for training activities. In particular, targeted regulatory funding, as is the case in France; results-based funding (UK and US); direct financing of individuals through educational vouchers, grants, loans (UK, Austria, Belgium, France); a dual system that combines public funds with the contributions of employers and municipalities (the Netherlands); multilevel financing (USA, France); financing of in-house training of specialists at the expense of corporations and enterprises (Japan, South Korea); financing through various corporate taxation schemes, profitable economic activities of educational institutions, etc.

Considering the thorough research of the quality of the educational process with the combination of national traditions and foreign experience, one should note that in practice there is a lack of adequate indicators of structural shifts in the higher educational system of Ukraine.

The objective of the article is to investigate structural shifts in the higher educational system of Ukraine by calculating the integrated harmonious structure deviation indicator based on the need for measures to strengthen the role of the state to improve the quality of higher education in Ukraine, taking into account the capabilities of higher educational institutions (HEI) and the employers' needs for skilled specialists.

The article proposes a technique for constructing an integrated harmonious structure deviation indicator within a five-sector harmonious model in the system of post-graduate training based on the rules of mathematics of harmony, namely the golden ratio. The authors hypothesize about the interdependence of this indicator with the one corresponding to the structure of GDP in the post-industrial economy. The authors emphasize the importance of exploring these relationships as they intensify in the context of structural shifts in the national economy.

## 2. Research Methodology

The higher educational system is a complex socio-economic system that needs to be explored in dynamics to identify the relationship between existing and predicted demand for higher educational personnel and changes in the priority

directions of national economy development in post-industrialism. According to L. Serhieieva and other, any complex socio-economic system is inertial, and the inertia of the system is determined by its structure, the scenarios of development of all directions of activity in the long run depend on it [29]. The scientist defines the harmonious structure of the economy, which is inherent in the post-industrial stage of its evolutionary development, in the following ratio: services sector (tertiary sector) - 62%, industry sector (secondary sector) - 24%, agriculture (primary sector) - 14%.

Given the process of globalization, current status and trends in national higher education and research studies of academics [4, 7, 22, 25], it is necessary to carry out detailed research on the five-sector model, which was used by scientists in the research [19] to evaluate structural shifts in the sectoral structure of GDP.

Thus, using the previous developments of the authors, the proposed model for studying the structure of the higher educational system in accordance with the rules of the golden ratio and the post-industrial stage of development of the national economy, takes the following form:

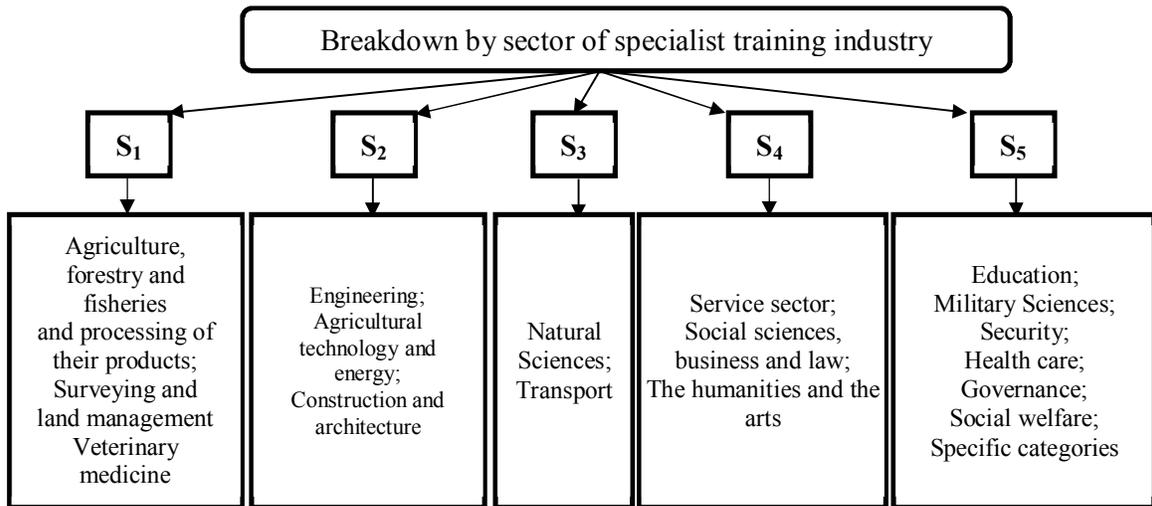
$$S_{EDUC} = |0,24 - S_5| + |0,24 - S_4| + |0,14 - S_3| + |0,24 - S_2| + |0,24 - S_1|, \quad (1)$$

where  $S_{EDUC}$  – the value of integrated harmonious structure deviation indicator ( $0 < S_{EDUC} < 1$ );  $S_1$  – share of primary sector (agriculture, mining), sector related to the production of raw materials for other industries;  $S_2$  – share of secondary sector, converting raw materials into ready-to-use product (processing industry, production and supply of electricity, gas, steam and air-conditioning, construction);  $S_3$  – the share of the tertiary sector (part of the service sector) associated with the production and usage of the latest intellectual capital and knowledge economy, as well as providing knowledge production, processing and dissemination activities;  $S_4$  – share of the tertiary sector (part of the service sector), activities in the field of administrative and support services, cultural and creative component of being and personal growth;  $S_5$  – the share of the tertiary sector (part of the service sector) that implements public policy.

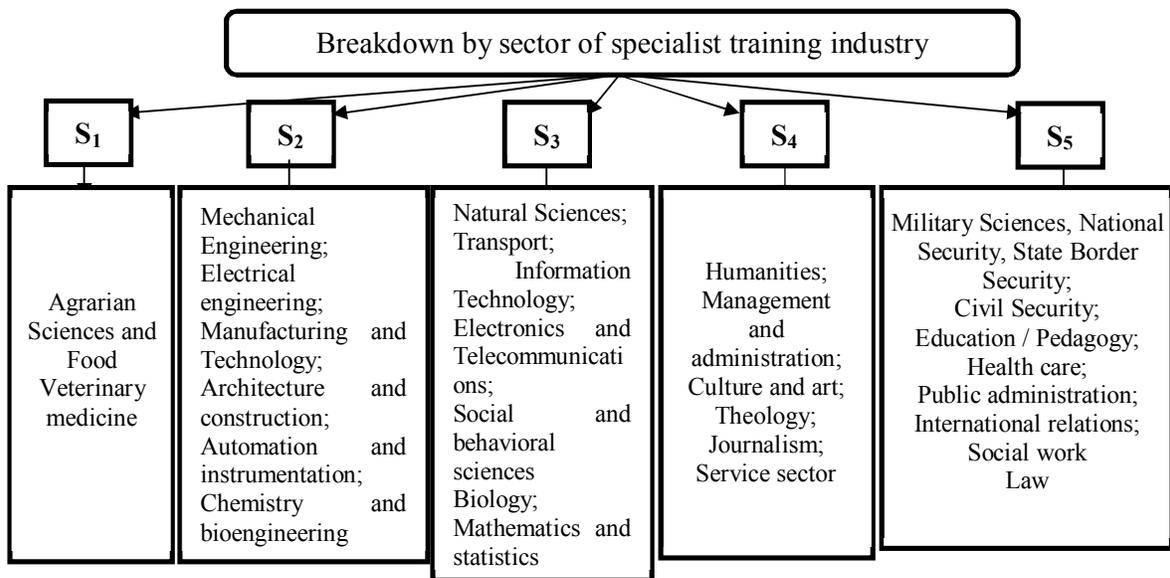
$$S_1 = 0,14; S_2 = 0,24; S_3 = 0,14; S_4 = 0,24; S_5 = 0,24.$$

The brunches of knowledge for which highly qualified specialists are trained in Ukraine were assigned to the corresponding vertices of the

graph (Fig. 1 - according to the 2010 list; Fig. 2 - according to the 2015 list)



**Fig. 1. Suitability of the Post-graduate Training industry with the Five-Sector Model Sectors According to the 2010 list.**



**Fig. 2. Suitability of the Post-graduate Training industry with the Five-Sector Model Sectors According to the 2010 list.**

Since 2015, the system of higher education has undergone significant changes, in accordance with the Decree of the Ministry of Education and Science of Ukraine "On the features of the introduction of the list of branches of knowledge and specialties for the training of higher education applicants", approved by the Cabinet of Ministers of Ukraine of April 29, 2015 No. 266, the table of correspondence of the list of directions, specialties, by which specialists were trained in higher educational institutions, which led to the redistribution of the branches of

science, referring to other sectors s S1-S5, consolidation of some perspective specialties and identify new.

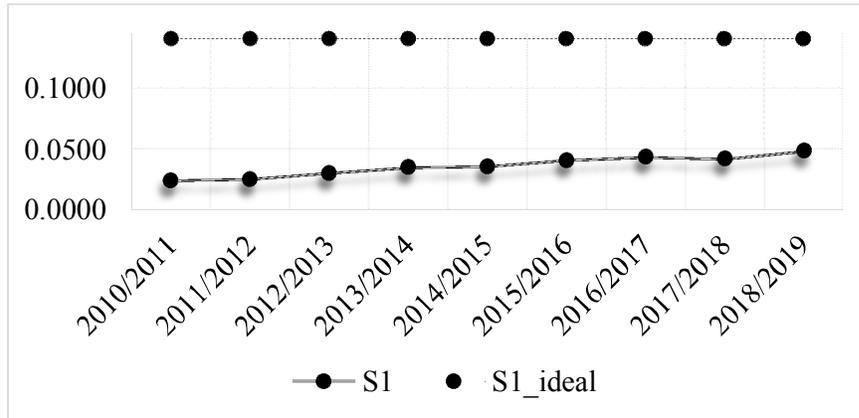
Calculations of the integrated harmonious structure deviation indicator were made according to statistics related with the number of graduates of higher educational institutions at the beginning of the academic year.

### 3. Results and Discussion

According to the proposed methodology for the estimation of the structural shifts in the sectoral

structure of the post-graduate training, the integrated harmonious structure deviation indicator for the 2010/11-2018/19 academic years was calculated. To determine the indicator, the calculations of its components (the share of sectors S1-S5), deviations from the harmonious structure were carried out to estimate structural shifts in 2010-2018. The results of the calculations of deviations of values S1-S5 from

ideal (according to the theory of "golden ratio") are visually illustrated in Fig. 3-7. Exploring the S1 sector (Fig. 3), it should be noted that the maximum deviation from the ideal structure is 0.1155 (11.55%) in 2010/11 academic year, the minimum - 0.0916 (9.16%) in 2018/19 academic year, the average deviation in structure is 0.1039 (10.39%).



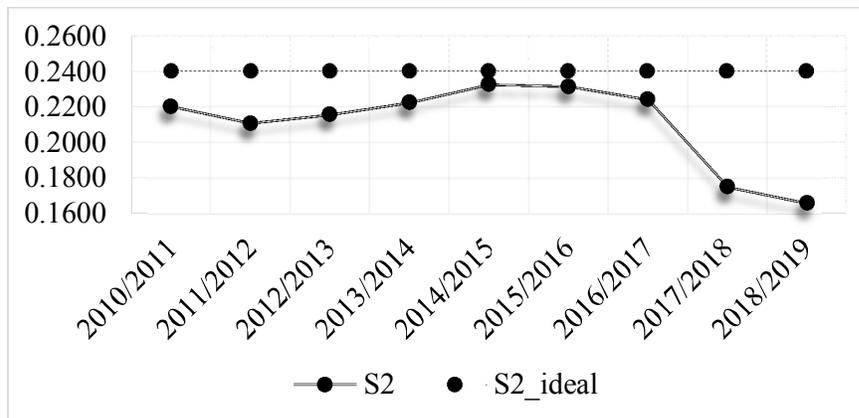
**Fig. 3. Share of S1 sector of in the sectoral structure of training skilled personnel for 2010/2011-2018/2019 academic years.**

Therefore, the amount of training required to supply the agrarian sector's workforce from S1 is insufficient.

Modern challenges require Ukraine to develop agriculture in the presence of high quality land resources and potential in the agricultural production area, to address the problem of food security, the transition from the status of a raw

material importer to a producer of high quality agricultural products.

Analyzing the sector S2 (Fig. 4), it should be emphasized that the maximum deviation from the ideal structure is 0.0742 (7.42%) in the 2018/19 academic year, the minimum - 0.0074 (0.74%) in 2014/15 academic year, the average deviation in structure, - 0.0291 (2.91%).



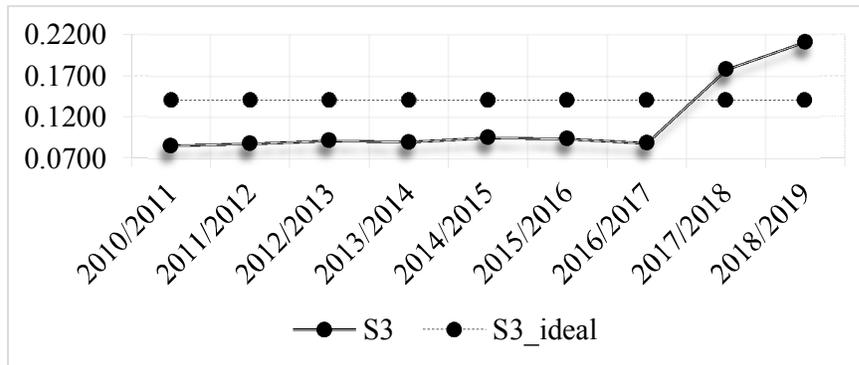
**Fig. 4. Share of S<sub>2</sub> sector in the sectoral structure of higher education of Ukraine for 2010 / 2011-2018 / 2019 academic years.**

Based on the data obtained, it can be noted that the issue of providing engineering personnel of industrial production, construction, chemical and bioengineering industries is rather acute today,

that is, the structural correspondence between the results of training and the real of highly developed productions' needs for the specialists is not harmonious and does not meet the needs of

economists. As a result, there is a deficit in highly intelligent and creative specialists, only 15.6% of domestic industrial enterprises in 2018 implemented innovations, the share of sales of innovative products in total sales of industrial enterprises in the same year was 0.8% [10]. A particularly negative trend in the training of highly qualified engineering personnel for different sectors of the national economy has been observed since 2017, which indicates an

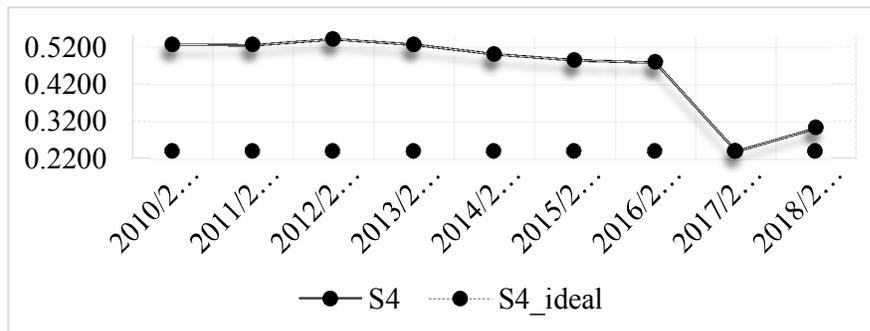
ineffective state policy on the promotion of these specialties and the lack of support from leading technical higher educational institutions. The research of the deviation of the structure from the harmonious one sector S3 (Fig. 5) revealed that the maximum deviation from the ideal structure is 0.0716 (7.16%) in the 2018/2019 academic year, the minimum - 0.0384 (3.84%) in the 2017/18 academic year, the average structure deviation was 0.0501 (5.01%).



**Fig. 5. Share of S<sub>3</sub> sector in the sectoral structure of higher education of Ukraine for 2010 / 2011-2018 / 2019 academic years.**

That is, the situation of providing information technology and electronics, telecommunications, social and environmental specialists with a view to filling GDP from this sector in 2015-2016 was quite negative, since the indicator did not have a positive upward trend but already beginning of 2017/18 and 2018/19 academic years exceeds the ideal value. In our view, this is due to the growing market demand for information technology specialists; rapid development of Internet technologies, digital communications. For the two quarters of 2019, the volume of telecommunication services sold amounted to: cable television UAH 1188 million, Internet services UAH 6571.7 million, which shows 19.4% and 6.7 increasing compared to the same period of the previous year [30-32].

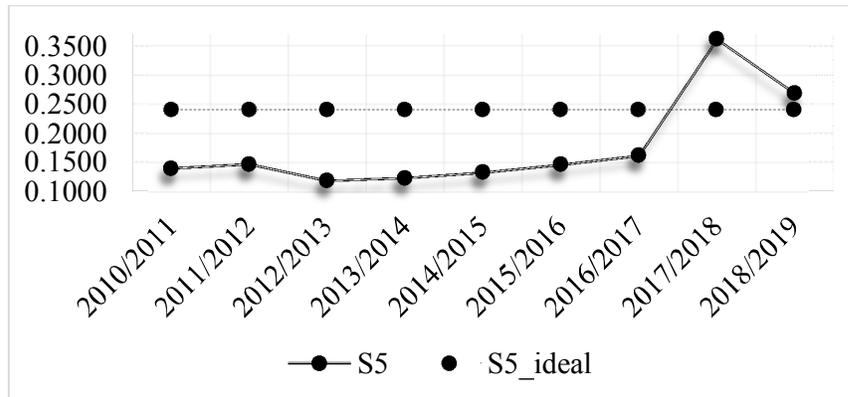
In the S4 sector study (Fig. 6), it was observed that the maximum deviation from the ideal structure is 0.3020 (30.2%) in the 2012/13 academic year, the minimum - 0.0031 (0.31%) in 2017/18 academic year, the average deviation in structure - 0,2203 (22,03%). The provision of specialists to supply GDP from the S4 sector is significantly more than the labor market requires (service sector; social sciences; business and law; humanities and arts). Therefore, the MESU should apply some leverage to regulate, for example, public procurement of these training areas and carry out effective educational work to reorient the demand of the population for professions in demand in the real sector of the economy.



**Fig. 6. Share of the S<sub>4</sub> sector in sectoral structure of higher education of Ukraine for 2010 / 2011-2018 / 2019 academic years.**

When examining the changes in the indicator in S5 sector (Fig. 7), it should be noted that its maximum deviation from the ideal structure is 0.1214 (12.14%) in the 2017/18 academic year,

the minimum is 0.0289 (2.89 %) in the 2018/19 academic year, the average structure deviation is 0.0951 (9.51%).



**Fig. 7. Share of the S5 sector in sectoral structure of higher education of Ukraine for the 2010/11-2018/19 academic years.**

Therefore, in this sector there is also a mismatch between the requirements of the modern labor market and the training of specialists. The steep increase in S5 in the 2017/2018 academic year indicates the application of some levers of regulation by the state, for example, the requirement for public health officials to obtain a profile education in public service. In general, this sector of training specialists in these areas is strategic for the state, as it produces specialists in national and civil security, military affairs, state border, etc.

As the result of the separate investigating of each sector S1-S5 in the sectoral structure of post-graduate in dynamics, the tendency of their inconsistency with the values of the ideal indicators of a harmonious structure is revealed. The trends identified structural shifts in the S4 sector during the 2010/11-2016/17 academic

year, that is, the number of graduates of S4 sector majors does not correspond to ideal values, exceeding the number of specialists needed for the labor market, but after redistribution specialties in 2015 decreased the deviation from the ideal values. S2 data for the 2010/11-2016/17 academic years were close to ideal values, but since 2017/18 academic year there has been a trend of minor structural shifts (mechanical engineering, electrical engineering, manufacturing and technologies, architecture and construction, automation and instrumentation, chemical and bioengineering).

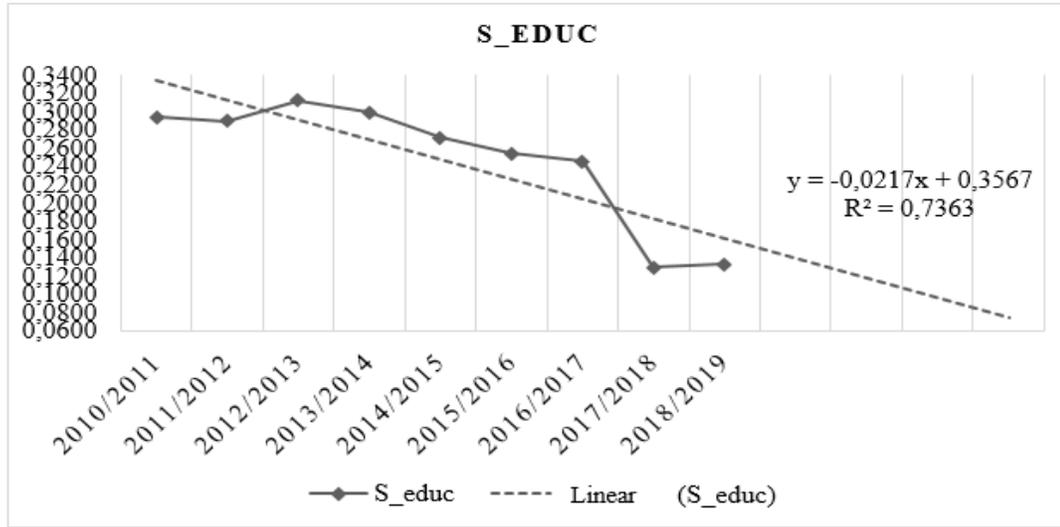
The deviations of the specific gravity of each sector S1-S5 from the ideal values in the sectoral structure of higher education of Ukraine for the 2010/11-2018/19 academic years are presented in table 1.

**Tab. 1. Deviations of S1-S5 Sectors from Ideal Values in the Sectoral Structure of Higher Education of Ukraine for 2010/11-2018/19 Academic Years**

Academic years	Sector					Min value	Max value
	S1	S2	S3	S4	S5		
2010/11	0.1159	0.0198	0.0536	0.2886	0.0993	0.0198	0.2886
2011/12	0.1154	0.0293	0.0510	0.2881	0.0925	0.0293	0.2881
2012/13	0.1132	0.0244	0.0476	0.3056	0.1204	0.0244	0.3056
2013/14	0.1106	0.0176	0.0493	0.2935	0.1160	0.0176	0.2935
2014/15	0.1096	0.0074	0.0440	0.2675	0.1065	0.0074	0.2675
2015/16	0.1070	0.0086	0.0454	0.2540	0.0929	0.0086	0.2540
2016/17	0.1041	0.0159	0.0503	0.2478	0.0775	0.0159	0.2478
2017/18	0.1022	0.0649	0.0384	0.0073	0.1214	0.0073	0.1214
2018/19	0.0983	0.0742	0.0716	0.0719	0.0289	0.0289	0.0983

In the study of the system of post-graduate training on a five-sector model, it was determined that its structure is not harmonious across the studied sectors. integrated harmonious structure

deviation indicator in the sectoral structure of education (Seduc), calculated by the formula (1) presented in Fig. 8.



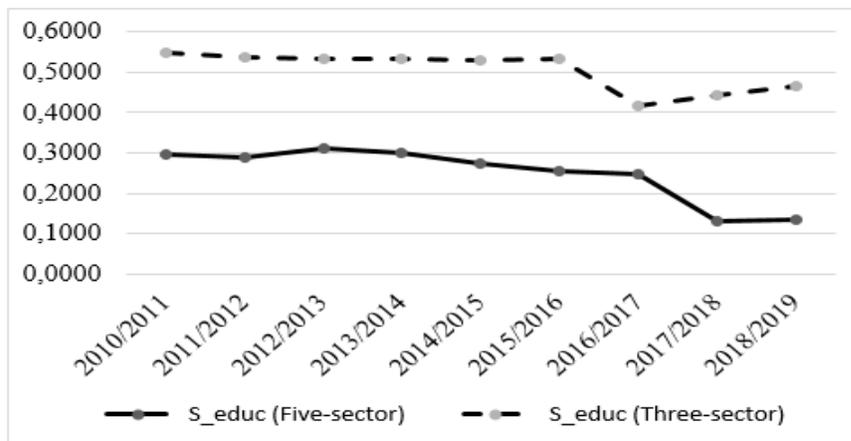
**Fig. 8. Dynamics of integrated harmonious structure deviation indicator in sectoral structure of higher education of Ukraine.**

The calculations of the integrated harmonious structure deviation indicator in the sectoral structure of higher education of Ukraine by the five-sector model presented that the maximum deviation from the ideal structure is 0.3126 (31.26%) in the 2012/13 academic year, the minimum – 0.1303 (13.03%) in the 2017/18 academic year, the average deviation is 0.2481 (24.81%).

As the value of integrated harmonious structure deviation indicator Seduc approaches so close to zero, this indicates the presence of structural

shifts towards the approximation of the system to the harmonious structure, that is the expediency of the higher education reform carried out in 2015 and the identification of new promising specialties and areas of preparation should be stated.

Fig. 9 presents the accordance of the integrated harmonious structure deviation indicator in the sectoral structure of higher education of Ukraine, calculated within the three-sector and five-sector model.



**Fig. 9. Dynamics of integrated harmonious structure deviation indicator in the sectoral structure of higher education of Ukraine, calculated within the three-sector and five-sector model.**

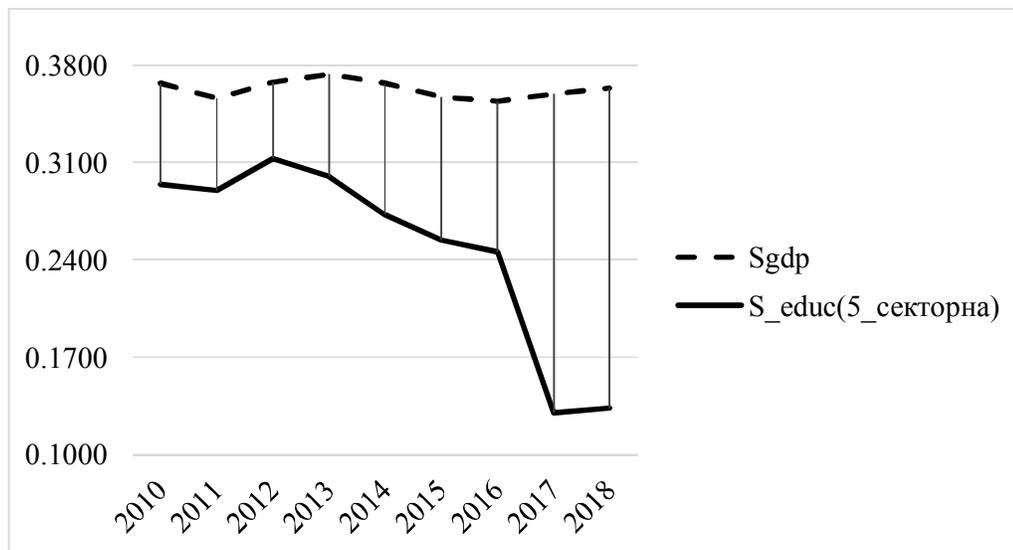
It should be noted that it is necessary to compare not absolute values of integrated harmonious structure deviation indicator, but the direction and speed of their change, that is, the dynamics of the integrated harmonious structure deviation indicator in the sectoral structure of higher education of Ukraine, calculated on the five-sector model, indicates its greater ability to evaluate shifts.

The authors also compared integrated harmonious structure deviation indicator (Sgdp) - corresponds to the GDP structure in the post-industrial economy and (Seduc) - corresponds to the sectoral structure of education, calculated on the five-sector model according to the rules of harmony (Fig. 10).

The significant gap in terms of indicators over recent years may indicate that today the system of higher educational institutions is capable of more significant structural shifts than the country's economy as a whole, but the interaction between higher educational institutions and other institutions is needed, namely:

- with business/enterprises - to ensure the commercialization of knowledge,
- with the labor market - to balance supply and demand, taking into account quality requirements for specialists,
- with public administration - to form and implement a state policy aimed at developing the knowledge economy.

This will ensure the functioning of the higher educational institute: improving the quality, enhancing its practical component in combination with the provision of basic knowledge, balancing supply and demand in the educational services market, strengthening the correlation of salaries of employees with their level of qualification, etc. It should be noted that today there are professions that require rapid personal growth, and the acquired knowledge and skills are losing relevance rapidly. In addition, there is a division into fundamental and applied directions of education that exist in parallel.



**Fig. 10. Dynamics ( Sgdp ) and ( Seduc ).**

#### 4. Conclusion

The study of structural shifts in the higher educational system and their impact on economic growth leads to the conclusion that it is necessary to improve the system of post-graduate training, increasing of the educational process quality, human capital, enhance the practical component in the curricula, effective cooperation with universities and various institutions, that must inevitably lead to growth of GDP and to improve the quality of life in turn.

The increasing integration and globalization of the educational space is leading to the gradual unification of the internal structure of national higher educational systems, which should be accompanied by the introduction of high educational standards and mechanisms for achieving them. In the process of deepening market relations, the range of entities involved in the management and financing of higher education expands, and the entrepreneurial functions of higher educational institutions are strengthened.

The estimating of structural shifts in the sectoral structure of post-graduate training has created a theoretical basis for identifying and evaluating the patterns of transformation of the higher educational institution in the conditions of knowledge economy formation, taking into account the trends of market relations, increasing integration and education. Higher education should be considered as a coherent entity, keeping track of major structural shifts not only at national but also regional levels; to balance the scope and results of its activities with the amount of funding, the needs of national and regional labor markets (through improving the ordering mechanism), the need to improve the social status of academic staff; to create a solid "platform" for the development of public and administration decisions.

The calculation of the integrated harmonious structure deviation indicator has made it possible to conclude that over the last nine years there has been a tendency to train insufficient number of highly qualified specialists who provide the formation of intellectual potential as the basis of innovative transformations in the economy based on the requirements of post-industrial economy.

### 5. Acknowledgements

The authors express their appreciation to the into-English interpreter Oksana Yurchenko.

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