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Cross-country clustering of labor and education markets in the system of strategic economic management

Agrupación entre países de los mercados laborales y educativos en el sistema de gestión económica estratégica

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Abstract.
The study focuses on the clustering of European countries in terms of labor market and education indicators, as well as the justification of strategic directions for ensuring GDP growth. It is proved that the management of the national economy in modern conditions acquires supranational features and can be effective, provided that the same approaches to the strategic management of facilities that have the same characteristics (belonging to the same cluster) are used. A comparative analysis of the development trends of labor markets of the EU and Ukraine is carried out. Using the K-means method, three cross-country clusters were formed according to indicators of the labor market and education. The applied use of the formed clusters of European countries according to indicators of the labor market and education is that for each cross-country cluster strategic directions of economic development can be justified by regulating the situation on the labor market and in the field of education. On the example of Slovakia, Austria, Greece and Ukraine, models that describe the impact on GGP of labor market and education indicators for countries are constructed. As a result of the study, strategic directions for each cluster are substantiated, which should ensure economic growth.

Keywords: labor market, education, strategic management, clustering, personnel policy, GDP, regulation

Resumen.
El estudio se centra en la agrupación de países europeos en términos de indicadores del mercado laboral y de educación, así como en la justificación de direcciones estratégicas para garantizar el crecimiento del PIB. Está comprobado que la gestión de la economía nacional en condiciones modernas está adquiriendo características supranacionales y puede ser efectiva siempre que se utilicen los mismos enfoques para la gestión estratégica de las instalaciones que tienen las mismas características (pertenecientes al mismo grupo). Se realiza un análisis comparativo de las tendencias de desarrollo de los mercados laborales de la UE y Ucrania. Utilizando el método K-means, se formaron tres grupos entre países de acuerdo con los indicadores del mercado laboral y la educación. El uso aplicado de los grupos formados de países europeos en términos del mercado laboral y los indicadores de educación es que para cada grupo internacional, las direcciones estratégicas del desarrollo económico pueden justificarse regulando la situación en el mercado laboral y en el campo de la educación. En el ejemplo de Eslovaquia, Austria, Grecia y Ucrania, se construyen modelos que describen el impacto en el GGP del mercado laboral y los indicadores de educación para los países. Como resultado del estudio, se confirman las direcciones estratégicas para cada grupo, lo que debería garantizar el crecimiento económico.

Palabras claves: mercado laboral, educación, gestión estratégica, agrupamiento, política de personal, PIB.

Introduction

In modern conditions the economy management is carried out under conditions of a high degree of uncertainty, which determines the expansion of the scope of strategic management. At the same time, the paradigm of the new economy focuses on human capital as a driver of development and a competitive factor (Shmygol et al., 2020); therefore, the areas of its formation (education) and use (labor market) become priority objects of management. That's why labor and education markets are traditionally interdependent elements of the national economy, their organicity of which contributes to socio-economic growth, and imbalance is a source of crisis phenomena.

The integration processes, which embraced the economies of European countries in recent decades, are clearly manifested in the actual merging of national labor markets into a single European market, the intensification of the labor migration movement, and the formation of a single educational space.

Ukraine is a country which lies geographically close to the EU integration union and has also declared the vector of European integration. Therefore, Ukraine is an active donor of labor to the European labor market and students to the educational services market.

Thus, in modern conditions the management of the national economy acquires supranational features (characteristics) and can be effective, provided that the same approaches to the strategic management of facilities which have the same characteristics (belong to the same cluster) are used.

The aim of this research is the clustering of European countries in terms of the labor market and education, justification of strategic directions for ensuring GDP growth based on the obtained results as an indicator of the development of the national economy.

Materials and methods

To achieve a purpose of investigation such general scientific and special methods and techniques were used: theoretical analysis and synthesis, methods of grouping, clustering, modeling, comparison, economic-statistical, graphical representation, as well as methods of systematization and scientific generalization.

Literature review

The study of the principles and methods of strategic management began with the research of Ansoff (2014), Andrews (1999), Chandler Jr. (2013), who popularized this approach to management for company. Later it was adapted by scientists not only for the corporate level, but also for managing the national economy. So, the team of scientists of the Vilnius University Danuta Diskienė, Birutė Galinienė, Albinas Marčinskas (2008) justified the structure of the strategic management model for rational economic development by evaluating the new challenges facing the national economy development. Scott (1997) noted that national economic strategy comprises a vision of a desired future state of the economy, a time frame within which that state is to be achieved, and a set of policies and institutions for influencing the mobilization and allocation of resources and for promoting their efficient utilization. Michie and Sheehan (2005) using original data collected from manufacturing and service sector companies, found positive relationships between Business Strategy, Human Resources, Labour Market Flexibility, and Competitive Advantage. In our opinion, it is logical to assume that this dependence will also be relevant on the macro level.

The issues of ensuring the effective functioning of the labor market, the formation of interaction between the labor market and the market of educational services are widely covered in scientific literature. Increased attention to the study of these issues is due to

their extremely important role in ensuring the socio-economic development of countries. In particular, it should be noted that there is a significant backlog of European Union scientists in this area: Kirkegaard (2018), Crouch (2016), Fadejeva (2019), Jovovic, Draskovic, Jovovic (2016), Radukic (2019), Mastilo, Kostic, Vladusic (2019). Among Ukrainian researches who dedicated their work to this problem are Arzamasova (2019), Krymova (2020), Luchko (2019), Vovk (2019), Yakymova (2020).

Jacob Funk Kirkegaard in the publication "Positive signs in European labor markets in 10 charts" identifies the main trends in the EU labor market (Kirkegaard, 2018), including declining unemployment, rising employment rates of 15-64 years during 1999-2017. Given the general deterioration of the economic situation in 2012-2013, significant growth rates in the Eurozone were due to increased domestic demand for consumption and investment. According to Kirkegaard (2018), the key factor in continuing the trend of improving the economic performance of the euro area will be the ability of labor markets to create new jobs.

The scientist Colin Crouch in the publication “European Employment and Labor Market Policy” (Crouch, 2016) defines the features of the European policy under the influence of which the main trends in the development of the labor market in the context of globalization, in particular, emphasizes the need for a wider range of employment policy instruments.

Latvian researches Lyudmila Fadeeva investigates not only modern tendencies of EU labor market development, but also points out features of state politics that helped to build positive market reforms (Fadeeva , 2019; Nazarova et al., 2019).

Countries with economies in transition deserve a special attention in the process of integration of the labor market into the European community. In particular, this applies

to the Balkan countries and Ukraine. The study of the efficiency of the labor market of the Western Balkans is devoted to the study of Snezana Radukic, Zoran Mastilo, Zorana Kostic, Ljubisa Vladusic (2019). It substantiates that countries with more efficiently functioning goods markets are characterized by favorable labor market indicators.

So, economists Radislav Jovovic, Veselin Draskovic, Nebojsa Jovovic (2016) studied the quality of education in higher education. In particular, in the scientific publication "Quality of Knowledge in Higher Education in Montenegro", the perception of the degree of destabilization of the influence of four factors (human resources, culture, decision making and information technology) on the quality of higher education in Montenegro. The study emphasizes that it was during the transition period of the country's economy that there was a general decline in the quality of higher education under the negative influence of the low level of quality of human resources, culture, solutions and information technology.

An important prerequisite for economic growth is the balance of the labor market with the market of educational services and the effectiveness of national policy in the field of education. These issues are studied by scientists, in particular, in the context of finding areas of interaction (Furia, Castagna, Mattoscio, Scamuffa, 2010; Ionescu, 2012; Lauder & Mayhew, 2020), the study of transformations, occurring in the education sector to challenge changes in the labor market (Walkenhorst, 2008; Kaarsen, 2014), as well as the introduction of mechanisms to ensure the quality of education as a factor in the formation of a competitive workforce.

Ukrainian researchers Luchko, Arzamasova, Vovk (2019) study the impact of human potential development on gross domestic product. Therefore, their findings are of

some interest in relation to the specific purpose of this study and can be used to model the impact on GDP of labor market and education indicators.

Results and Analysis

Current trends of labor market development in EU and Ukraine: comparative analysis

The modern realities of the development of the European Union countries (expansion of the creative sector of economies and increasing part of the gross domestic product produced in this sector) are rebuilding of the labor market structure, and the number of people employed in industry and services is gradually decreasing in favour of an increase in science, education and information technology. These trends are most evident in the developed countries of Western Europe - Switzerland, Sweden, Netherlands, United Kingdom, Denmark, Belgium, Finland and Norway (the share of the employed in the quaternary sector of economy in these countries is more than 20%). The countries of Central Europe, which demonstrate more moderate progress in the development of innovation and the expansion of innovative employment, in particular Poland and Ukraine, are not left aside of these processes (Shaulska, Yakymova, Krymova, 2020; Kostetska et al., 2020).

The modern development of the European labor market also is characterized by increased migration trends due to the free movement of labor within the EU, the spread of professional and academic mobility, which is associated with integration processes in all areas of economic activity (Koval et al., 2019; Gubanova et al., 2019). At the same time, there is a risk of rising unemployment and structural imbalances in the labor market due to the movement of cheap labor from countries that have recently become EU members.

In order to assess the state of the labor market of the EU and Ukraine in modern conditions of its development, it is advisable to analyze such indicators as the level of employment, unemployment, the level of minimum and average wages.

Given the latest trends in the level of employment, it should be noted that the state of employment in the EU as a whole has improved and the situation in Ukraine has

worsened. In particular, most EU countries are characterized by the positive trends in the growth of employment during 2005-2018, including Austria, Belgium Bulgaria, Estonia, Latvia, Lithuania, Luxembourg, Malta, Poland, Romania, Slovakia, Slovenia, the United Kingdom, Hungary, Czech Republic, Sweden. An interesting example for Ukraine is the presence in this list of countries of the former socialist camp that have recently joined the EU. The increase in employment in this case is explained by the integration processes in the labor markets of these countries, the simplification of the movements of labor migrants, which in turn reduces the burden on the national labor markets, as well as the emergence of new opportunities to attract foreign investment, improving the investment climate (Yankovyi et al., 2020), creating new workers places.

According to the European Statistical Service (Eurostat), the highest level of employment in 2018 was observed in Sweden (61.9%), the Netherlands (61.8%) and the UK (60.6). The lowest employment rates were recorded in the following countries: Greece (41.9%), Italy (44.6%), Croatia (46.9%) (Eurostat, 2020). At the same time, an increase in employment is observed only in Croatia. It should be noted that despite the relatively short period of the country's stay in the EU, Croatia has managed to significantly improve the employment rate over the past five years. At the same time, a decrease in the level of employment occurred in Greece and Italy. This is due to the general deterioration of the economic situation in the countries and a decrease in the standard of living of the population (Greece), as well as a large number of immigrants constantly arriving into the country (Italy).

Table 1. Comparative dynamics of the level of employment in Ukraine and the EU in 2005-2018 (in % of the population aged 15 years and older, for Ukraine aged 15-70 years)

Country	2005	2013	2014	2015	2016	2017	2018	2018 to 2005 (+/-)
Ukraine	**57,7**	**60,3**	**56,6**	**56,7**	**56,3**	**56,1**	**57,1**	-0,6
EU (28 countries) *	**51,8**	**51,5**	**51,7**	**52,2**	**52,8**	**53,5**	**54,1**	2,3
Austria	56,3	58,5	57,3	57,2	57,5	57,9	58,4	2,1
Belgium	48,8	49,0	48,9	48,8	49,0	50,0	51,0	2,2

Bulgaria	44,7	46,9	48,0	49,1	49,3	51,9	52,4	7,7
Greece	48,0	38,4	38,1	39,0	39,9	40,9	41,9	-6,1
Denmark	62,5	58,0	58,1	58,4	59,6	58,7	59,4	-3,1
Estonia	53,9	56,0	56,6	58,3	58,6	60,0	60,4	6,5
Ireland	59,3	52,4	54,4	55,7	57,0	57,8	58,6	-0,7
Spain	51,5	43,9	44,5	45,9	47,0	48,1	49,1	-2,4
Italy	45,3	43,0	42,8	43,1	43,7	44,2	44,6	-0,7
Cyprus	59,8	53,2	53,5	53,0	53,3	54,8	57,2	-2,6
Latvia	52,6	52,4	52,8	54,1	54,6	55,5	56,9	4,3
Lithuania	51,9	51,2	52,6	53,8	55,6	56,3	57,8	5,9
Luxembourg	53,1	55,9	56,6	56,0	55,2	56,0	56,5	3,4
Malta	45,9	49,8	52,1	52,7	54,1	55,6	57,3	11,4
Netherlands	61,9	60,8	59,6	60,0	60,2	60,9	61,8	-0,1
Germany	52,3	57,1	57,4	57,4	58,5	58,9	59,2	6,9
Poland	45,2	50,2	51,2	51,9	52,8	53,7	54,2	9
Portugal	57,5	50,4	50,7	51,3	52,0	53,7	55,0	-2,5
Romania	50,1	51,1	51,1	50,8	50,6	52,2	52,7	2,6
Slovak Republic	49,8	50,9	51,5	52,8	54,2	55,1	55,9	6,1
Slovenia	55,4	51,5	52,1	52,2	52,1	54,6	55,8	0,4
United Kingdom	59,3	58,1	58,8	59,4	59,9	60,2	60,6	1,3
Hungary	46,6	47,1	49,5	51,0	52,8	53,9	54,6	8
Finland	55,7	54,3	53,8	53,4	53,4	53,8	55,1	-0,6
France	51,4	50,9	50,3	50,3	50,3	50,5	50,7	-0,7
Croatia	-	-	43,3	44,2	44,6	45,8	46,9	-
Czech Republic	54,7	55,2	55,7	56,4	57,6	58,5	59,2	4,5
Sweden	58,3	59,1	59,6	60,0	60,4	61,2	61,9	3,6

* Croatia joined the EU in 2014

Source: calculated by the authors according to Ukrstat (2020), Eurostat (2020)

Similar trends are also observed in assessing the unemployment rate of the population during 2005-2018 (tab. 2).

Table 2. Comparative dynamics of the unemployment rate in Ukraine and the EU in 2005-2018 (in % of the economically active population aged 15-74 years, for Ukraine aged 15-70 years)

Country /year	2005	2013	2014	2015	2016	2017	2018	2018 to

								2005 (+/-)
Ukraine	**7,2**	**7,2**	**9,3**	**9,1**	**9,3**	**9,5**	**8,8**	1,6
EU (28 countries) *	**8,9**	**10,8**	**10,2**	**9,4**	**8,6**	**7,6**	**6,8**	-2,1
Austria	5,2	4,9	5,6	5,7	6,0	5,5	4,9	-0,3
Belgium	8,5	8,4	8,5	8,5	7,8	7,1	6,0	-2,5
Bulgaria	10,1	13,0	11,4	9,2	7,6	6,2	5,2	-4,9
Greece	9,9	27,3	26,5	24,9	23,6	21,5	19,3	9,4
Denmark	4,8	7,0	6,6	6,2	6,2	5,7	5,0	0,2
Estonia	7,9	8,6	7,4	6,2	6,8	5,8	5,4	-2,5
Ireland	4,4	13,1	11,9	10,0	8,4	6,7	5,8	1,4
Spain	9,2	26,1	24,5	22,1	19,6	17,2	15,3	6,1
Italy	7,7	12,2	12,7	11,9	11,7	11,2	10,6	2,9
Cyprus	5,3	15,9	16,1	15,0	13,0	11,1	8,4	3,1
Latvia	8,9	11,9	10,8	9,9	9,6	8,7	7,4	-1,5
Lithuania	8,3	11,8	10,7	9,1	7,9	7,1	6,2	-2,1
Luxembourg	4,5	5,9	6,0	6,5	6,3	5,6	5,4	0,9
Malta	7,3	6,4	5,7	5,4	4,7	4,0	3,7	-3,6
Netherlands	5,3	6,7	7,4	6,9	6,0	4,9	3,8	-1,5
Germany	11,2	5,3	5,0	4,6	4,1	3,8	3,4	-7,8
Poland	17,8	10,3	9,0	7,5	6,2	4,9	3,9	-13,9
Portugal	7,7	16,5	14,1	12,6	11,2	9,0	7,0	-0,4
Romania	7,2	7,3	6,8	6,8	5,9	4,9	4,2	-3
Slovak Republic	16,3	14,2	13,2	11,5	9,7	8,1	6,5	-9,8
Slovenia	6,5	10,1	9,7	9,0	8,0	6,6	5,1	-1,4

United Kingdom	4,8	7,5	6,1	5,3	4,8	4,3	4,0	-0,8
Hungary	7,2	10,2	7,7	6,8	5,1	4,2	3,7	-3,5
Finland	8,4	8,2	8,7	9,4	8,8	8,6	7,4	-1
France	8,9	9,9	10,3	10,4	10,1	9,4	9,1	0,2
Croatia	-	17,4	17,2	16,1	13,4	11,0	8,5	-
Czech Republic	7,9	7,0	6,1	5,1	4,0	2,9	2,2	-5,7
Sweden	7,8	8,1	7,9	7,4	6,9	6,7	6,3	-1,5

* Croatia included in the EU in 2014

Source: calculated by the authors according to Ukrstat (2020), Eurostat (2020)

In the EU as a whole, this indicator decreased by 2.1 percentage points, while at the same time in Ukraine there is an increase in unemployment. It is worth noting a sharp decrease in the corresponding indicator on the Ukrainian labor market in 2014 compared to 2013, which was caused by the economic crisis and political instability as a result of the military conflict in the east of the country and the annexation of Crimea. Among the EU countries, most of them are characterized by a decrease in unemployment, which, in fact, influenced the European indicator. At the same time, there is a significant increase in unemployment in Greece and Spain; the corresponding indicator increased slightly in Denmark, Ireland, Italy, Cyprus, Luxembourg and France.

The lowest unemployment rate in 2018 was recorded in the Czech Republic (2.2%), Germany (3.4%), Malta (3.7%), the Netherlands (3.8%), which is explained by an effective policy to promote employment. High unemployment is characterized by Greece (19.3%), Spain (15.3%,) Italy (10.6%).

The criterion of the minimum wage plays a significant role in the process of assessing the state of the labor market, since wages are the price of labor and a source of formation of the corresponding level of well-being of the population. It is the provision of minimum social guarantees that is an integral part of an effective European policy of social protection of the population. Since not all EU countries have a legislatively fixed concept of the minimum wage, table 3 displays information on individual countries.

Table 3. The minimum wage in Ukraine and the EU in 2005-2018 (euro)

Country /year	2005	2013	2014	2015	2018
Ukraine *	**43,43**	**107,70**	**112,36**	**63,34**	**106,98**
Austria	1210,00	1501,82	1 501,82	1 501,82	1562,59
Belgium	76,69	158,50	173,84	184,07	260,76
Bulgaria	667,68	683,76	683,76	683,76	683,76
Greece	171,92	320,00	355	390	500,00
Denmark	1183,00	1461,85	1 461,85	1 461,85	1613,95
Estonia	598,50	752,85	752,85	756,7	858,55
Ireland	114,63	286,66	320	360	430,00
Spain	144,81	289,62	289,62	300	400,00
Italy	1466,77	1874,19	1 921,03	1 922,96	1998,59
Cyprus	555,06	702,82	717,95	720,46	747,54
Latvia	1264,80	1469,40	1 485,6	1 501,8	1594,20
Lithuania	-	-	-	1 440	1498,00
Luxembourg	207,86	392,73	404,4	409,53	480,20
Malta	437,15	565,83	565,83	589,17	676,67
Netherlands	78,70	157,50	190,11	217,5	407,45
Germany	167,76	337,70	352	380	480,00
Poland	490,07	783,66	789,15	790,73	842,79
Portugal	1134,67	1249,85	1 251,05	1 378,87	1463,80
Romania	231,74	335,27	341,7	332,76	418,47

Slovak Republic	1286,09	1430,22	1 445,38	1 457,52	1498,47
Slovenia	-	372,35	395,67	395,61	465,72
United Kingdom	235,85	318,08	309,91	331,71	468,87

* The minimum wage in Ukraine is calculated in accordance with the official rate of the NBU

Source: calculated by the authors according to Ukrstat (2020), Eurostat (2020)

Thus, the level of the minimum wage in Ukraine is much lower than in the countries of the European Union (106.98 euros), while a significant reduction in the size of the indicator in 2015 compared to 2014 should be noted. The reason is the sudden increase of the cost of Euro compared to Ukrainian hryvnia, which indicates the depreciation of the national currency and the crisis in the financial system of the country. All this negatively affected the income level and well-being of the population. Among all the EU countries studied, there is a tendency to a gradual increase in the minimum wage, while Belgium, Greece, Ireland, Spain, and Croatia are characterized by relative stability of this indicator. The highest minimum wage in 2018 was set in Luxembourg (1998.59 euros), Ireland (1613.95 euros), the Netherlands (1594.20 euros) and Belgium (1562.59 euros). The lowest minimum wages among EU countries are set in Bulgaria (260.76 euros), Lithuania (400 euros), Romania (407.45 euros), Hungary (418.47 euros) and Latvia (430 euros). Thus, there is an objective cross-country differentiation of the minimum wage - its highest sizes are set in the highly developed EU countries.

A clear indicator of the labor market is the average wage, which reflects both the cost of labor, its productivity, and the level of development of the economy as a whole. Differences in the level of remuneration in the European labor market are presented in Fig. 1.

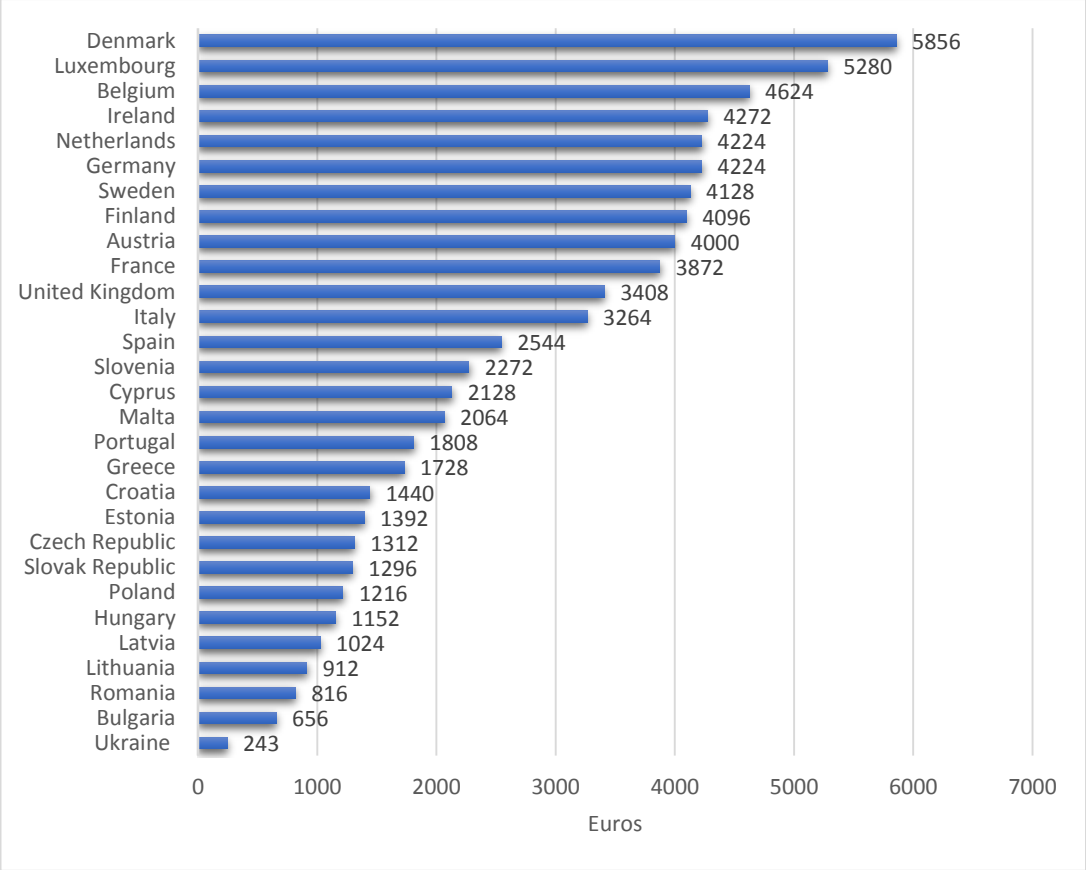


Figure 1. Ranking of labor markets in European countries by average monthly salary in 2017

Source: calculated by the authors according to Eurostat (2020)

So, in 2017, the highest level of average monthly salary (the so-called average gross salary in the EU countries) was recorded in Denmark (6856 euros), Luxembourg (5280 euros), Belgium (4624 euros); the lowest level among the EU countries was in Bulgaria (656 euros), Romania (816 euros), Lithuania (912 euros). Ukraine stands out against European countries by its extremely low average monthly wage (only 243 euros), which indicates a crisis in the labor market in the context of the availability of jobs with an attractive level of wages. This, in turn, provokes intensive Ukrainian labor migration to developed EU countries with a much higher level of wages.

In the near future, the aforementioned trends are forecasted to persist. According to the salary research site Salaryexplorer.com, the highest average monthly salary in 2020 will be received by citizens of Denmark (18333 euros), Luxembourg (15200 euros), Ireland

(12300 euros), Germany (11900 euros), Great Britain (11788 euros), Sweden (11103 euros), the Netherlands (10400 euros). Among the countries with the lowest average monthly wages are Lithuania (1089 euros), Latvia (1922 euros) (www.salaryexplorer.com).

Given the recent trends in the development of the labor market of the EU and Ukraine, it can be concluded that there is some improvement in the state of employment and a decrease in unemployment in most EU countries. At the same time, the current stage of socio-economic development is accompanied by the emergence of new challenges in the labor market, in particular, the spread of international migration (Prystupa, Koval, Kvach, Hrymalyuk, 2019) and the liberalization of the movement of labor, which will subsequently significantly affect the structure of the EU labor market and may strengthen existing structural imbalances. Among European countries, Ukraine is characterized by the worst situation, in particular, a low level of labor incomes and a high unemployment rate compared to economically developed EU countries (Shmygol et al., 2020). That is why it is advisable to form an effective state personnel policy, which will take into account the positive experience of the EU countries, actively use strategic management tools, the effectiveness of which will be justified by the use of modern economic and mathematical methods. At the same time, one of the priority tasks is the formation of an effective mechanism for the interaction of labor markets and educational services, which will contribute to the efficient use of the youth labor force and is a significant potential for the development of the national labor market and the economy as a whole.

Clustering of countries by indicators of labor and education market development

One of the methods that can be implemented in the process of making strategic decisions in order to increase its effectiveness is the clustering of management objects. Cluster analysis allows the classification of research objects using numerous computational procedures. Unlike other economic and mathematical methods, it makes it possible to classify objects not only by one attribute, but by several simultaneously. To do this, appropriate indicators are introduced that characterize a certain degree of proximity in all classification parameters.

In modern practice, various clustering methods are used. In this study, taking into account the characteristics of the subject of study, we will use the -means method, the purpose of which is to divide the observations into clusters, so that each observation belongs to a cluster with the average value closest to it. The method is based on minimizing the sum of squared distances between each observation and the center of its cluster. The advantage of using the -means method is its simplicity and speed of execution.

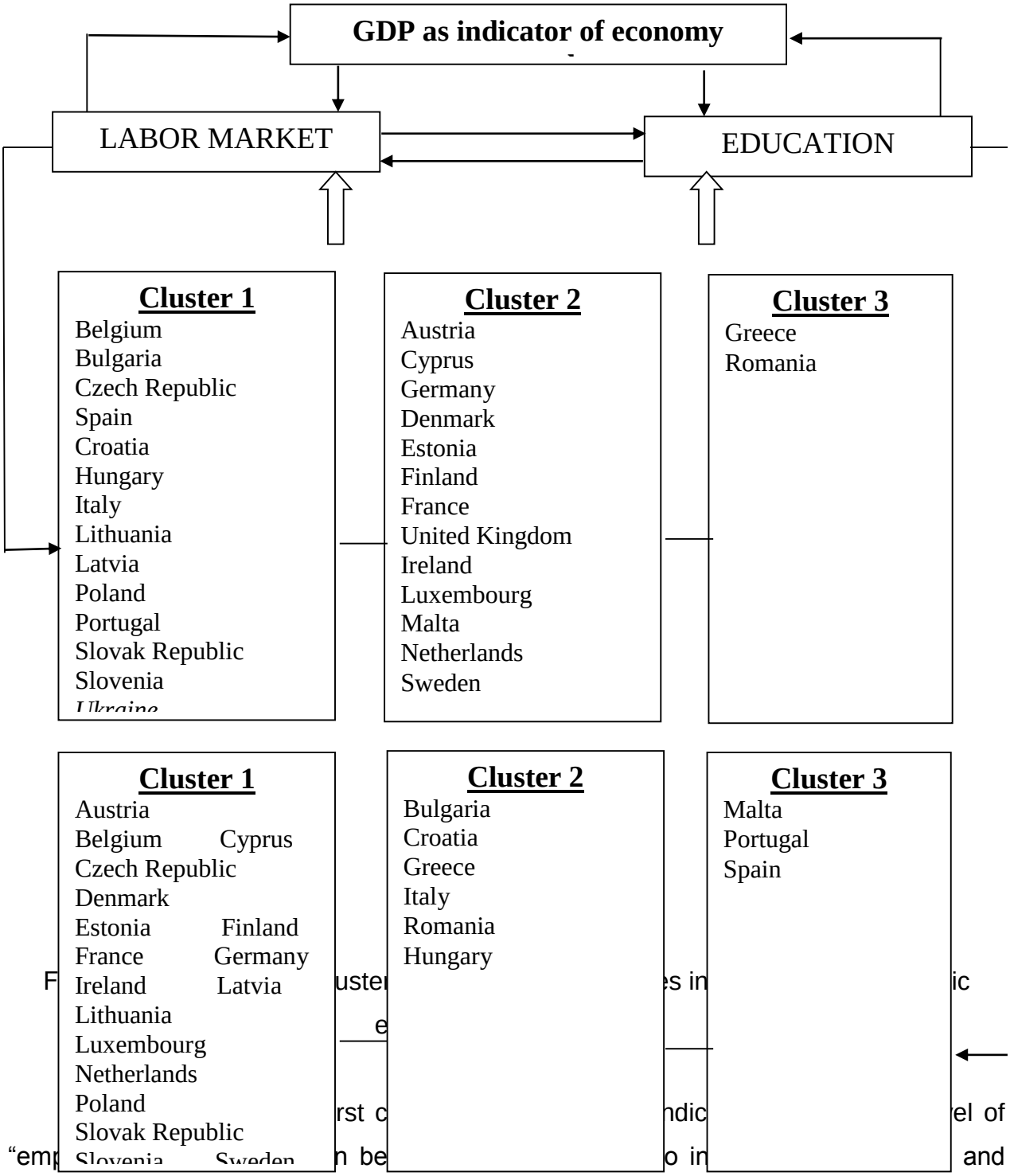
We will cluster the EU-28 countries based on the use of an array of information on the indicators presented in the table 4. As the state statistics of Ukraine is gradually being integrated into the system of indicators of European statistics, according to indicators characterizing the state and development of the labor market, there is an informational opportunity to include Ukraine in building clustering ("labor market"). However, the indicators characterizing the educational policy of Ukraine and the EU-28 countries are not yet fully correlated, therefore the second group of clusters ("education") will be determined only for the EU-28 countries.

Table 4. Information basis for the clustering of countries in terms of labor market and education indicators

Labor market (EU-28 + Ukraine)		**Education (EU-28)**	
№	Indicator	№	Indicator
1	Labor force participation rate, total (% of total population ages 15-64)	1	Government expenditure on education, total (% of GDP)
2	Unemployment, total (% of total labor force)	2	Labor force with basic education (% of total working-age population with basic education)
3	Employment in agriculture (% of total employment)	3	Labor force with intermediate education (% of total working-age population with intermediate education)
4	Employment in industry (% of total employment)	4	Share of youth not in education, employment or training, total (% of youth population)

5	Employment in services (% of total employment)	5	Employment rates of recent graduates, Upper secondary
6	Employment to population ratio, ages 15-24, total (%)	6	Employment rates of recent graduates, Post- secondary
7	Employers, total (% of total employment)	7	Employment rates of recent graduates, Tertiary- secondary
8	Self-employed, total (% of total employment)	8	Share of government budget appropriations or outlays on research and development
9	Employment to population ratio, 15+, total (%)	9	Human resources in science and technology
10	Vulnerable employment, total (% of total employment)	10	Total Government budget appropriations or outlays on R&Das a % of total general government expenditure
11	Wage and salaried workers, total (% of total employment)	11	At most lower secondary educational attainment by age from 25 to 64 years
12	Contributing family workers, total (% of total employment)	12	At least upper secondary educational attainment, age group 25-64 by sex
13	GDP per person employed (constant 2011 PPP $)	13	Tertiary educational attainment by sex
14	Mean weekly hours actually worked per employed person	14-18	Early leavers from education and training by sex from: 18 to 24; 25 to 34; 35 to 44; 44 to 54; 54 to 64

As a result of the study, all European countries are formed into three clusters according to the two groups of indicators listed above (Fig. 2)



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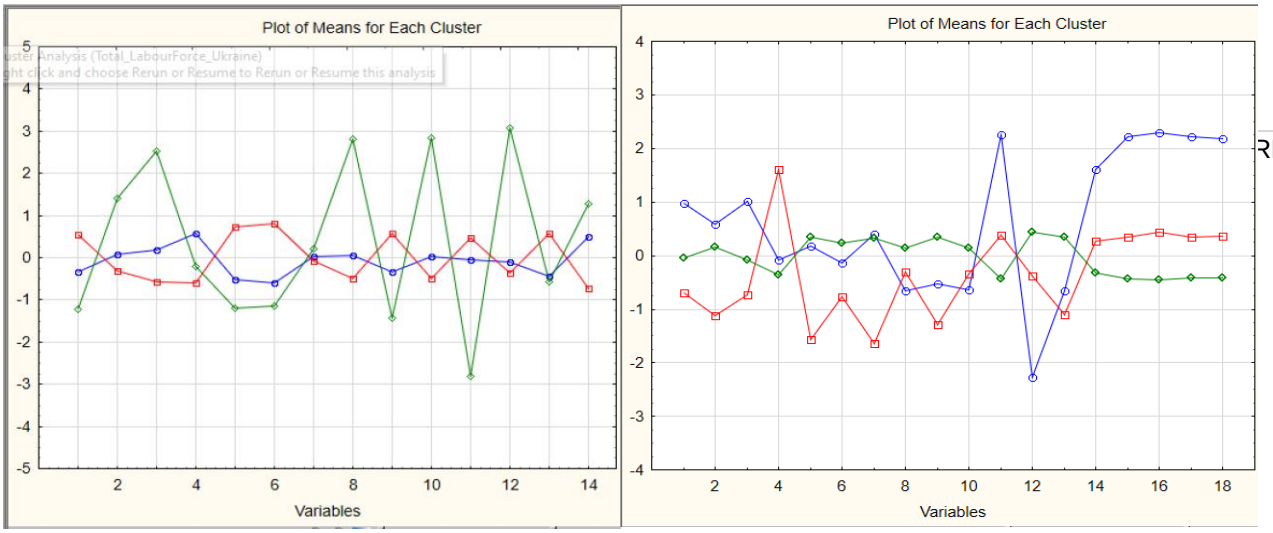
“contributing family workers”, the countries of the first and second cluster were close (Fig.3). Moreover, in terms of “employers”, countries of the third cluster are also close to them.



Labor market (EU-28 + Ukraine) Education (EU-28)

Figure 3. Visualization of the homogeneity of indicators of the development of the labor market and education across clusters of European countries

Countries in the second cluster are characterized by the largest “labor force participation rate”, “employment in services”, “employment to population ratio”, ages 15+, “wage and salaried workers”, and “GDP per person employed”. At the same time, these countries have the lowest levels of “unemployment”, “employment in agriculture”, “employment in industry”, “self-employed”, “vulnerable employment”, “mean weekly hours actually worked per employed person by sex”, “economic activity and rural / urban areas”.

As for countries that are in the third cluster, for them we can note a significantly lower level of indicators “wage and salaried workers”, “employment to population ratio”, 15+, “labor force participation rate”, “employment in services” compared to countries of the 1 and 2 clusters.

However, a number of indicators turned out to be significantly higher than the corresponding indicators of countries from clusters 1 and 2: “unemployment”, “employment in agriculture”, “self-employed”, “vulnerable employment”, “contributing family workers”, “mean weekly hours actually worked per employed person by sex”, “economic activity and rural / urban areas”. (Fig. 3).

Countries that fell into the first cluster by education indicators are characterized by *high* values of the following indicators: “early leavers from education and training by sex from 18 to 24 years”, “adult participation in learning by sex”, “adult participation in learning by sex”. The *lowest* indicator is “at least upper secondary educational attainment”.

The second cluster includes countries that have indicators with *low* values, among them: “labor force with basic education”, “employment rates of recent graduates, post-secondary”, “share of government budget appropriations or outlays on research and development”, “total Government budget appropriations or outlays on R & D”. The indicator with a *high* value among other clusters is “share of youth not in education”, “employment or training”.

The third cluster is characterized by a distribution of indicators from -0.5 to 0.5, the values of which are not distinguished by extrema against the background of other clusters.

The first and second clusters have intersections in such indicators as “share of government budget appropriations or outlays on research and development” and “total Government budget appropriations or outlays on R&D”.

Modeling of macroeconomic growth on the basis of labor market and education regulation

An applied use of the formed clusters of European countries based on indicators of the labor market and education is that for each intercountry cluster strategic directions of economic development by regulating the situation in the labor market and education can be justified. In this case, it can be used as a tool of strategic management to model the impact of indicators of the labor market and education on macroeconomic indicator – GGP (*Y*).

Based on the results of intercountry clustering of labour markets (Fig. 2), we will identify the countries that serve as a "benchmark" in each cluster, i.e. from the mathematical point of view their indicators have the shortest distance to the center of the cluster, while from the economic point of view the state and indicators of the development

of labour and education markets are typical for this group of countries and do not differ significantly from the corresponding average indicators. In cluster 1 such a country is Slovenia, in cluster 2 - Austria, from cluster 3 for calculations we will take Greece and build models for these countries, describing the impact on GGP of indicators of labor market and education. We will also perform the modeling using data for Ukraine (Table 5). In table 5, the factors that have the greatest impact on the resulting indicator are shown in a different font.

It should be noted that the obtained models, which are presented in the Table 5 are adequate with the initial data, because all coefficients of the regression are statistically significant, and the determination coefficient is high. The preconditions of the least squares method are fulfilled - the model lacks autocorrelation and heteroscedasticity. White's test results show no heteroscedasticity, since P-probability of accepting the hypothesis of heteroscedasticity in all regression equations is more than 0.05. So, we can use these models in the processes of economic management and its individual subsystems, related to the formation and use of human capital and is an important object of socio-economic management in modern conditions.

Table 5 Modeling the impact of labor market and education indicators on GGP growth

EDUCATION	LABOR MARKET
Slovenia (Cluster 1)	
$Y = 12.55 \cdot X_1^{5.18} \cdot X_2^{-2.33} \cdot X_3^{0.009} \cdot X_4^{0.006} \cdot X_5^{0.05} \cdot X_6^{-0.03}$,	$Y_t = 41450064.68 \cdot X_{1,t}^{6.46} \cdot X_{2,t}^{-15.55} \cdot X_{3,t}^{12.06} \cdot X_{4,t-2}^{-2.73}$
X1 —**Government expenditure on education,**	
X2 —Educational attainment, at least completed lower secondary, population 25+, total (%)	**X1 — Labor force participation rate,**
X3 — Share of youth not in education, employment or training, total (%)	X2 — Self-employed,
X4 —Educational attainment, at least completed post-secondary, population 25+, total (%)	X3 — Vulnerable employment,
X5 —Educational attainment, at least completed upper secondary, population 25+, total (%)	X4 — Wage and salaried workers,
	X5 — Employers

X6 — Educational attainment, at least completed short-cycle tertiary, population 25+, total (%)	
Austria (Cluster 2)	
$Y = X_1^{0.89} \cdot X_2^{0.11} \cdot X_3^{0.42} \cdot X_4^{2.25} \cdot X_5^{0.29}$ X1 —Government expenditure on education, X2 —Educational attainment, at least completed post-secondary, population 25+, total (%) X3 —Share of youth not in education, employment or training, total **X4 —Educational attainment, at least completed upper secondary, population 25+, total (%)** X5 — Educational attainment, at least completed short-cycle tertiary, population 25+, total (%)	$Y_t = 6.6095 \cdot 10^{-6} \cdot X_{1,t}^{2.42} \cdot X_{2,t-3}^{0.22} \cdot X_{3,t}^{6.32} \cdot X_{4,t-1}^{-0.26}$ X1 — Labor force participation rate, **X2 — Unemployment,** X3 — Wage and salaried workers, X4 — Self-employed
Greece (Cluster 3)	
$Y = 2.36 \cdot X_1^{2.6} \cdot X_2^{1.39} \cdot X_3^{0.28} \cdot X_4^{0.03} \cdot X_5^{0.03} \cdot X_6^{-1.63}$, **X1 —Government expenditure on education,** X2 —Educational attainment, at least completed lower secondary, population 25+, total (%) X3 —Educational attainment, at least completed post-secondary, population 25+, total (%) X5 −Share of youth not in education, employment or training, total (% of youth population) X6 —Educational attainment, at least completed upper secondary, population 25+, total (%) X7 — Educational attainment, at least completed short-cycle tertiary, population 25+, total (%)	$Y_t = 3.3 \cdot 10^{-7} \cdot X_{1,t}^{1.91} \cdot X_{2,t}^{-0.28} \cdot X_{3,t}^{5.53} \cdot X_{4,t}^{2.99}$ X1 — Labor force participation rate, X2 — Unemployment, **X3 — Wage and salaried workers,** X4 — Self-employed
Ukraine	
$Y = 51.86 \cdot 10^{10} \cdot X_1^{0.86} \cdot X_2^{-0,28}$, **X1 —Government expenditure on education,**	$Y_t = 750.19 \cdot X_{1,t}^{8.62} \cdot X_{2,t}^{-0.56} \cdot X_{3,t}^{-28.56} \cdot X_{4,t}^{36.76}$ X1 — Labor force participation rate,

X2 — Share of youth not in education, employment or training, total (%)	X2 — Unemployment, X3 — Self-employed, **X4 — Wage and salaried workers**

The obtained models allow us to note that for the countries classified as cluster 1 by labor market indicators, an increase in government expenditure on education and labor force participation rate is important from the point of GGP growth prospects. In the countries that are classified as cluster 2 economic growth and increase in GGP can be achieved through the introduction of programs that will increase the educational attainment rate, at least completed upper secondary, population 25 total and reduce the level of Unemployment. In the countries included in the cluster 3 and in Ukraine, the priority should be given to increasing government expenditure on education and Wage and Salaried workers.

In the system of strategic management it is important to calculate the prospects of development of a particular macroeconomic indicator for a certain period after the introduction of reforms in the socio-economic sphere (Popova, Koval, Antonova, Orel, 2019) and / or implementation of relevant programs. The models presented in Table 5 will make it possible to forecast the GGP value, provided that one or more factor signs indicate changes under the influence of changes in the state policy of labor market regulation and/or educational sphere.

Conclusions

The modern economy is a complex and dynamic system, in the management of which strategic approaches are the most effective. It is the strategic management of socio-economic systems that allows to take into account changes in the internal and external environment to predict their parameters, and also provide in the future a positive dynamics of performance indicators. Given the priority role of the human resources in the development of the new economy, special attention is required to such subsystems as education and the labor market, where the formation and capitalization of human potential

takes place. In recent years, the labor markets and educational systems of European countries have been actively integrating, which forms a similarity in development trends and substantive characteristics, and also allows to identify cross-country clusters that can be considered as an object in the system of strategic economic management. As a result of the research, strategic directions are substantiated for each cluster, which should become the basis of personnel policy and ensure economic growth. This directions are based on modeling the impact of labor market and education indicators on GGP growth in European countries. When developing and implementing promising programs in the field of education, employment and labor market regulation, we consider it appropriate to conduct a preliminary assessment of their impact on macroeconomic indicators, in particular, on the basis of the developed models.

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