Intellectual Leadership in Global Space

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INTELLECTUAL LEADERSHIP IN GLOBAL SPACE

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The monograph examines the phenomenon of intellectual leadership of national economies and the imperatives of its manifestation in the global economic environment. The mechanisms of intellectualization and the growing role of intellectual factors in the formation of the knowledge economy have been identified. The economic dimensions of global intellectualization are revealed on the basis of a three-stage assessment (resource level, level of intermediate results and general progress). The influence of the intellectual component on the final macroeconomic indicators and the international competitiveness of national economies is studied. The disposition of countries in the global economic environment is determined, paradigmatic principles of effective involvement of national economies in global processes of intellectualization are formed.

Contents

Foreword

The transformation of general economic conditions under the influence of globalization and the formation of a knowledge economy is accompanied by an aggravation of competition at all levels, a rapid change in competitive positions, a significant stratification of the competitive environment, changes in the rules and methods of competition. The interweaving and interdependence of economies because of the deepening of globalization processes become both a source of threats and a source of opportunities for the development of the countries all over the world. In this context, minimization of the negative impact of globalization, while simultaneously searching for advantages and maximization of the positives formed in the process of interaction, are becoming an important issue. We are deeply convinced that these are intellectual factors that are becoming prerequisites for achievement of breakthrough development of national economies of the world, assurance of competitiveness and leadership in the context of the formation of the knowledge economy.

Active and comprehensive intellectualization accompanies all key processes of the XXI century (regionalization, integration, and transnationalization) and ensures the inclusion of national economies in the processes of innovative development. In the context of increasing interaction and interdependence of national economies, these trends require multi-level subjects of the global economy to pay special attention to new phenomena and processes that have a radically transformative character. The identification and analysis of factors in the development of the modern world economy has led to the formation of a new phenomenon – intellectual leadership. It is considered to be not the ultimate goal itself, but a key tool in achievement of global leadership, which allows you to strengthen competitiveness and economic efficiency through the accumulation of intellectual resources.

In such highly dynamic conditions, the task of achievement of leadership positions is updated, which in itself becomes a competitive advantage and gives a new character to the achievement of economic development. Intellectual leadership acts both as a result and as a tool for its further provision. The structure of leadership subjects changes significantly, their role is modified, and the connections among them are transformed, acquiring new features and characteristics. Leadership is perceived much more broadly than the phenomenon of management and psychology, acquiring the features of the economic process, forming a new scope of economic analysis.

A study of scientific developments and world opinion on intellectual leadership has confirmed the lack of a unified approach to understanding its nature, factors and essence, and even more – for individual subjects. However, important bricks have been laid in the construction of the theoretical structure of

intellectual leadership in every theory or concept.

The concept of intellectual leadership at the present stage of development of the global economy requires an understanding of both the phenomenon itself and the factors and conditions for its achievement. First of all, this is due to the need for understanding of the intellectual leadership itself, as well as a set of factors that contribute to its achievement and activation. Understanding the basics of leadership is important in terms of determination of the ability of the national economy to realize their own or borrowed opportunities, options for combination of them to produce modern goods using modern technology. We strongly believe that intellectual resources are a key factor in the competitiveness of the economy in the XXI century, and a combination of sound public policy and active economic activity to formation of the foundations and results will lead to intellectual leadership.

The phenomenon of intellectual leadership in the modern global context

The modern understanding of leadership is significantly expanded and acquired new meaning in the process of evolution of social development and theoretical attempts to explain it. The subjective base, types and forms of leadership are expanding. In the process of evolution, the understanding of leadership has changed: from the leader-monarch to a multifaceted concept, that covers all activities. Identification of such a key factor in world development as intellectualization, at the same time, necessitates the study of such a phenomenon as intellectual leadership. Leadership based on knowledge and intelligence has been studied by many researchers, but it has not yet been thoroughly generalized. Intellectual leadership is often considered at the level of an individual, but in modern conditions the structure of the subjects is constantly becoming more complicated, so it needs further study.

The understanding of leadership and even more global leadership in the economic literature is ambiguous and has been considered in various aspects. However, the ability to control the object can be considered as the main feature. Thus, according to the Cambridge Dictionary, global leadership provides the ability to control a group, country, etc., the importance of which is recognized in different parts of the world[1].

Changing general conditions of economic activity, formation of qualitatively new trends of networking and technology are accompanied by aggravation of competitive struggle at all levels, rapid change of competitive positions, significant stratification of the competitive environment, change of rules and methods of competition. Given the increasing interdependence and interpenetration of national economies, these new trends require the attention of diverse actors in the global economy to new phenomena and many economic

1 Cambridge Dictionary. Cambridge University Press. 2017. URL: http://dictionary.cambridge.org/dictionary/english/global-leader

and managerial processes.

In such highly competitive conditions, an important task for different actors is not merely the achievement of economic development, but, first of all, the achievement of leadership positions. Leadership is becoming a competitive advantage and not only a goal but also instruments of competition that can bring even greater gains. Identification of leadership becomes relevant for actors of different levels: as individuals (in politics, business and other circles), as well as companies, universities, regions, national economies. The necessity of identifying the key factors for achieving intellectual leadership and forming a method for its evaluation is emerging. It is worth highlighting the main levels at which subjects can realize their leadership ambitions. All these dynamic processes require thorough analysis and identification of common trends in the development of mechanisms for the achievement and assessment of intellectual leadership of multilevel entities in the global economy.

The concept of "intellectual leadership" occurs in the scientific and analytical literature, but is understood differently. The generalization of the available views allowed us to identify three main approaches to understanding intellectual leadership. The first prevails in the psychological sciences and is most often used to denote the process of personality management and expansion of the boundaries of its intellectual activity. The second approach is based on the study of the role of science, education, intelligence in development assurance. The third approach is closely related to the previous one, but mainly focuses on the institutional aspects. The reports of world and international organizations often talk about the intellectual leadership of countries, multinational enterprises, organizations and companies. In general, this means expansion of the use of intellectual resources to achieve leadership and competitiveness (Fig.1).

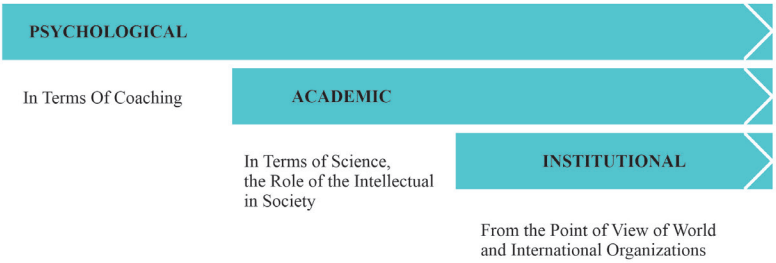

FIGURE 1. Approaches to understanding intellectual leadership in modern society

**compiled by the authors*

Most approaches at the individual level define knowledge management as a basic aspect of intellectual leadership, forms of self-management and self-

improvement, which is generally close to the historical concepts of ancient thinkers. Thus, "... intellectual leadership means much more than assimilation of the thoughts of scientists and theologians or generation of one's own ideas. Intellectual leadership means leading other people on the way to Christian way of thinking"[2].

At the same time, we find the definition of intellectual leadership as "smart management" of the team. Studies of individual leadership and its intellectual demonstration are formed in the model of "intellectual leader", which includes such components of intelligence as: social, personal and creative components[3]. In general, individual leadership and its demonstration remains the object of study of psychology, and in economics they are the most common in management.

Recently, in the academic literature, the understanding of intellectual leadership has been expanding. Thus, the issues of the possibility of intellectual leadership of higher educational institutions and intellectuals, as their representatives, are being actively raised. The study of the phenomenon of intellectual leadership in western literature concerns the study of the impact of universities on economic and social development. In addition, the work of Bruce MacFarlane studies the role of the professor and his disposition in the structure of the university[4]. From MacFarlane's point of view, a professor should act as:

- a mentor for less experienced colleagues through the encouragement and development of their potential;
- a custodian of academic standards through reviewing;
- a recipient of resources to support research centers and groups;
- an ambassador on behalf of the institution[5].

In general, in the process of research of intellectual leadership at the university level, the following categories of leadership have been identified: intellectual, emotional, social and moral[6]. Although they are interrelated, they can be determined by the tasks that prevail at a given time[7]. Thus, university administrators consider that intellectual leadership is a key factor in the development of universities[8].

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2 Masters of Arts in Intellectual Leadership. A.W. Tozer. URL: http://tozer.simpsonu.edu/index.htm

3 Петренко В. П. Проблеми інтелектуалізації управління: інтелектуальна модель особи керівника. Науковий журнал Вісник Хмельницького національного університету. Економічні науки. 2007. №6. Том 1. С. 43 – 46

4 Macfarlane B. Intellectual Leadership. 2011. URL: https://www.kcl.ac.uk/study/learningteaching/kli/NewsandEvents/Events/scap/2011/macfarlane-scap2011.pdf

5 Macfarlane B. Exploring intellectual leadership. 2010. C.12. URL: https://www.srhe.ac.uk/conference2010/abstracts/0308.pdf

6 Wepner SB, D'Onofrio A, Wilhite SC, 2008. The leadership dimension of education deans. Journal of Teacher Education 59, 153-169

7 Antonakis J, Ashkanasy N. M, Dasborough M. T, 2009. Does leadership need emotional intelligence? Leadership Quarterly 20, 247-261

8 Dealtry R, 2001. Managing intellectual leadership in corporate value. Journal of Workplace

Intellectual leadership is actively associated with the intelligence of an individual, and it is consistent with psychological aspects even in economic research. Thus, Amanda Goodall defines intellectual leadership as the ability to "lead the intellectuals". According to her, "scientists can be leaders of thought, but leadership is a hierarchy and real power"[9].

Many scholars view intellectual leadership through the prism of educational activity. Thus, in the work "Intellectual leadership of the university in the context of globalization" the latter is determined as "a set of needs, values, opportunities,personal activity and results of intellectual activity"[10] and it is considered to be a specific activity of teachers and students. For teachers, this is a constant intense intellectual work, conducting research, updating the content of educational material, the use of intellectual and developmental tasks in the classroom. For students such an activity consists in deepening of their professional orientation and aspiration of scientific work and scientific knowledge.

Scientists have spread similar research not only to the academic community, but to society as a whole. The model of society in terms of cultural characteristics was studied by Hofstede[11]. He is convinced that intellectuals in society carry out their activities both within and outside specially created places, such as universities, mass media, political arenas, and so on.

Robin Middlehurst defines the intellectual leadership of Great Britain through the number of Nobel laureates and the system of national awards (state awards, prizes, etc.). He considers universities as enclaves and a source of the nation's intellectual leadership. These are the universities that have the function of encouragement of intellectual leadership at all levels. Intellectual leadership of the university is possible through the development of intellectual leadership of individuals and groups of individuals.

According to Rosemary Deyem, intellectual leadership is "leadership that includes installation and enables others to contribute new knowledge to intelligent programs, to the production and communication. At the same time, it is the reconstruction and connection of previous knowledge in new ways and the ability to create and use in the future the direction of intellectual streams

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Learning 13, 119-124.

9 Goodall Amanda H. Leading Intellectuals. Exploring Intellectual Leadership / Society for Research into Higher Education Annual Conference «Where is the wisdom we have lost in knowledge?». Roundtable «Exploring Intellectual Leadership». URL: http://www.srhe.ac.uk/conference2010/abstracts/0308.pdf

10 Резнік С.М. Інтелектуальне лідерство університету в умовах глобалізації. 2016. С.99. URL: http://www.kpi.kharkov.ua/archive/MicroCAD/2016/S20/s99.pdf

11 Hofstede, G. Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations. Thousand Oaks, 2001. CA: Sage (co-published in the PRC as Vol. 10 in the Shanghai Foreign Language Education Press SFLEP Intercultural Communication Reference Series, 2008). URL: http://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1014&context=orpc

in the academic or social sphere"[12]. There is close to this the understanding of intellectual leadership as the ability to "… shape the understanding of others in a way that arouses interest, informs and provides support; the ability to influence the actions and opinions of others"[13].

In general, at the individual level, intellectual leadership can be defined in two main areas: firstly, it is the leadership of the intellect in a particular field of human knowledge among individuals endowed with similar intellectual abilities and knowledge; secondly, it is the leadership of an individual within a group with the ability to influence the intelligence of the whole group with its own intelligence, ideas, decisions, activities, example[14].

In the scientific literature, we find attempts to understand intellectual leadership and apply this definition to the economic activities of both individuals and other subjects. In particular, Morne Mostert's work "Leadership and the Role of Intelligence" identifies the challenges of leadership and its relationship to intelligence. He notes "we suffer from a lack of intelligence in the current governing body of the society"[15]. In addition, this researcher is sure, that there is a complication of leadership understanding at the present stage and psychological models of his research are become insufficient. Intelligence is a critical but insufficient criterion, and the perception of leadership depends on the "dominant paradigm of time and a unique geopolitical context"[16]. While defining the characteristics of a leader through the prism of "lenses", in his view, there are eleven of them (vision, power, behavior, emotional intelligence, etc.), he argues that intellectual influence includes leadership of thought, new ideas and knowledge, the leader's ability to influence the level and content of other people's thinking.

Change of factors of influence, geopolitical situation, revenue growth, increase in customers, improvement of technologies and innovations increase the uncertainty of the development of the environment, which complicates the job of today's manager. Leadership provides a strategic vision of the situation, which is impossible due to the comprehensive uncertainty of economic development. Mostert emphasizes that although the complexity of the environment has increased many times, the ability to comprehend this situation has remained at

12 Macfarlane B. Exploring intellectual leadership. 2010. C.12. URL: https://www.srhe.ac.uk/conference2010/abstracts/0308.pdf

13 Intellectual Leadership. The CASRAI Dictionary. URL: http://dictionary.casrai.org/Main_Page

14 Дзвінчук Д. І. Економіка знань і необхідні зміни в моделях лідерства. Гуманітарний вісник ЗДІА. .2016. № 64. С. 44-59. URL: www.zgia.zp.ua/gazeta/gvzdia_64_44.pdf.

15 Mostert M. Leadership and the role of the intellectual. 2014/10/07. USB Executive Development. 6c. URL: http://www.usb-ed.com/content/Knowledge%20Centre%20Documents/Leadership%20and%20the%20role%20of%20the%20intellectual.pdf, p.3.

16 Mostert M. Leadership and the role of the intellectual. 2014/10/07. USB Executive Development. 6c. URL: http://www.usb-ed.com/content/Knowledge%20Centre%20Documents/Leadership%20and%20the%20role%20of%20the%20intellectual.pdf, p.4.

the previous level[17]. This applies to both the ability of companies to manage the market and the organizational leadership of the most successful companies that have overcome market uncertainty. However, this situation is defined as short-term, with the predominance of consumer leadership in the market.

The impact of intellectual capital and intellectual leadership on the value of a company has been studied by Richard Dealtrey[18]. The Intellectual Justice Index and the Intellectual Capital Index of the company were proposed to be used for evaluation, thus, they become the basis for determination of the quality of intellectual leadership of the company, which is determined by intellectual leadership, the company's ability to achieve and maintain such leadership in selected business segments.

According to Husieieva O. and Kotlynskyi Yu., intellectual leadership of an enterprise can be seen as "the ability to effectively and efficiently manage knowledge, which allows forming and protecting the unique and strategic competencies of the enterprise using the tools of high-speed information technology"[19].

In some works we meet the understanding of "intellectual leadership" as a part of intellectual capital. Thus, according to Rybokene Ye.V., intellectual leadership is "the status, stance, position in the professional environment, which allows you to dictate the rules of the game in the intellectual capital market and influence the behavior of economic subjects, activating them to reproduce new knowledge, and to promote the process of commercialization of innovations, to intensify creative thinking and innovative behavior of employees[20].

In modern works, the term "intellectual leadership" is quite common in the context of marketing decisions of the company and its behavior in the market. For example, Scott D.M. in his work "New rules of marketing" notes that "an effective strategy of network content, if it is skillfully implemented, forces people to act. Although the technologies for each form of communication have their own characteristics, they are united by a common characteristic - it allows the company to prove itself as an intellectual leader, rather than just advertise its products"[21]. In this case, it remains unclear what exactly is the intellectual

17 Mostert M. Strategic Thinking in the Era of MORE. 9 April 2014 USB Executive Development. 7c. URL: http://www.usb-ed.com/content/Knowledge%20Centre%20Documents/Strategic%20Thinking%20in%20the%20Era%20of%20MORE.pdf

18 Dealtry R, 2001. Managing intellectual leadership in corporate value. Journal of Workplace Learning 13, 119-124.

19 Гусєва О.Ю. Концептуальні основи управління інтелектуальним лідерством підприємств. Економіка. Менеджмент. Бізнес. 2016. № 4 (18). С. 45-49. URL: http://journals.dut.edu.ua/index.php/emb/article/view/1363/1296.

20 Рибокене Е.В. Поведенческие установки субъектов рынка интеллектуального капитала в условиях институциональной неоднородности. Транспортное дело России. 2013. № 6. С. 74-75.

21 Скотт Д.М. Новые правила маркетинга и PR. М.: Альпина Паблишерз, 2011.

leadership of a company, because it is only about Internet content, the speed of its action and reaction. Intelligence as such remains outside the scope of this activity.

A similar idea is described by Yefremin A.L., who notes that there is possibility for the growth of "intelligent energy by increase of the power of such parameters as speed, frequency of operations, information, an increase in "Internet memory" - increase in information stability, longevity and volume, which is being stored, highlighting the intellectual component of the network as fundamental one for its further development"[22].

The strategy of intellectual leadership of an organization is singled out in the works of Serbinovskyi B. Yu., who defined it out only as one of the basic strategies, in parallel with which cost and quality minimization strategies are used[23];[24]. Serbinovskyi notes that when the company's goal is to lead the organization in the market, the company must do everything possible to create conditions for the formation of leaders within the organization. That is, a company's leadership in the market is seen as a consequence of the realization of its potential and internal capabilities, including realization of the leadership potential of its employees.

The idea of the growing role of human capital in the innovation of the economy is revealed in the works of Alieksashyna T.V., who notes that such an economy requires the advanced development of human capital and intellectual potential[25, 26]. This, in turn, sets new goals for companies to achieve competitive advantage and form a new strategy of "intellectual leadership".

The results of an intellectual leadership strategy can be:

Accumulation of intellectual capital of the company through increase in the level of intellectualization of the staff;

Formation of innovative products on the basis of research and applied inventions;

Creation of a creative and stimulating environment for the realization of the opportunities of the company's employees;

The company's presence in the market with innovative products, the

22 Еремин А.Л. К интеллектуальному интернету URL: http://www.i-intellect.ru/articles-of-intellect-theory/by-intelligent-internet.html.

23 Сербиновский Б.Ю. Диагностика и совершенствование производственных систем. Ростов-на-Дону: Пегас, 1996.

24 Сербиновский Б.Ю. Стратегия интеллектуального лидерства университета нового типа на рынке образовательных и научных услуг. Юж. федеральный ун-т. Новочеркасск: ЮРГТУ (НПИ), 2010. С. 113-120.

25 Алексашина Т.В. Рынок интеллектуального капитала: перспективы формирования и развития МУ им. С.Ю. Витте. М.: изд. ЧОУВО «МУ им. С.Ю. Витте», 2014. 150 с.

26 Алексашина Т.В. Формирование и функционирование рынка интеллектуального капитала в инновационной экономике: автореферат диссертации на соискание ученой степени кандидата экономических наук / Орловский государственный технический университет. Орел, 2010.

commercialization of innovations[27].

Some studies focus on the intellectual leadership of countries as new players in international markets. Thus, intellectual leadership is understood as the use of intelligence as the main source of ideas and moral authority[28]. According to Khasenov M.Kh., intellectual leadership is "a system of management decisions taking into account the interests of different groups of influence, characterized by a high level of functional integration, synchronization of management units and the use of intellectual tools"[29]. However, the author himself uses the criteria and forms of demonstration of intellectual leadership to determine the growth rates of small business, services, the share of self-employed people, "life expectancy" of business, and the level of export-oriented business. In this case, there is a certain contradiction, because the definition is based on qualitative criteria, while these criteria determine the purely quantitative characteristics of development, which do not determine the quality of this development.

The leadership of intelligence-based companies is the subject of research of Tichy N.[30]. These works consider the approaches of companies to achieve leadership positions in the context of constant market transformation, taking into account the latest knowledge and using them as a prerequisite for ensuring the competitiveness of the company. In paperworks of Boydell T. et al.[31] issues of the development of leading companies in the context of the transition to a knowledge economy are considered, these issues are rising at the end of the twentieth century, with the formation of a modern stage of world economic development. Intellectual leadership of organizations is also studied in the works of Senge P., Kleiner A., Roberts C., Ross R., and Smith B.[32]. The basis of these works is the idea of determining the prerequisites for leadership in the formation of new markets for high-tech products, innovative products, etc.

The transformation of society and the need to form a new paradigm of leadership are considered in the works of Pongpearchan P.[33] Determine the preconditions for achieving leadership positions of individual companies, and

27 Пронин С.Н., Пронина Е.В. Условия достижения интеллектуального лидерства организацией. Теоретическая и прикладная экономика. 2015. № 4. С.65-71. DOI: 10.7256/2409-8647.2015.4.16134. URL: http://e-notabene.ru/etc/article_16134.html

28 Burns J.M. Leadership. N.Y: Harper and Row. 1978. 530 c.

29 Хасенов М. Х. Интеллектуальное лидерство в социально-экономической политике Казахстана: тенденции развития и точки роста. URL: http://pandia.ru/text/80/170/46532.php.

30 Tichy N. Cohen E. The leadership engine: How winning companies build leaders at every level. New York: Harper business. 2002. 452 p.

31 Boydell T. et al. Developing the Developers, AMED. London: Departament for Employment, Sheffield. 1991

32 Senge P., Kleiner A., Roberts C., Ross R., Smith B. The Fifth Disciplines Fieldbook: Tools and Strategies for Building a Learning Organization, New York: Doubleday/Currency. 1994.

33 Pongpearchan P. Effect of transformational leadership on strategic human resource management and firm success of Toyota's dealer in Thailand The Business and Management Review. 2015. URL: http://www.abrmr.com/myfile/conference_proceedings/Con_Pro_19580/conference_33767.pdf

even retain these positions by existing leaders. The role of intelligence and knowledge in managing a company to provide leadership and competitiveness is grounded in the article of Frost A.[34] However, it focuses more on internal management processes in the company, not taking into account environmental factors.

The essence of transformational leadership is explored in the article Chris Roche[35], where the necessity of transformation of the company in response to the transformation of the external environment is grounded, taking into account the key trends of strengthening the influence of the intellectual component on the formation of market conditions. The practice of implementing intellectual leadership for business entities is covered in the work of Senge P. M.[36]. Studying a new paradigm of leadership in companies is a prerequisite for its provision. The role of intelligence in achieving leadership positions is studied of Mostert M.[37]. His work expresses the idea of the exceptional role of intelligence to ensure the leadership of companies and economies as a whole.

The research of intellectual leadership is the basis of scientific research of Macfarlane B.[38] However, he concentrates only on the leadership of scientific and educational institutions, not taking into account other subjects of economic activity. A similar subject is also explored in the works of a whole group of scholars Wepner S.B., D'Onofrio A., Wilhite S.C.[39] but this studies do not take into account the opportunities of other subjects of the economy for the implementation of intellectual leadership.

Global innovative space became the subject of study in a large number of research papers of both domestic and foreign scientists. B. Klinger and D. Lederman[40] explore the empirical relationship between economic development and innovations inside the Global Technological Frontier. Boutellier, Gassmann et all[41] analyze the key areas for the accumulation of innovation and the

34 Frost A. Knowledge Management. 2010. URL: http://www.knowledge-management-tools.net.

35 Chris Roche. What is transformative leadership? 2016. URL: http://www.universityworldnews.com/article.php?story=20160412200253987

36 Senge, P. M. The art and practice of the learning organization. The new paradigm in business: Emerging strategies for leadership and organizational change, 1990. 126-138.

37 Mostert M. Leadership and the role of the intellectual. USB Executive Development. 2014. URL: http://www.usb-ed.com/content/Knowledge%20Centre%20Documents/Leadership%20and%20the%20role%20of%20the%20intellectual.pdf

38 Macfarlane B. Exploring intellectual leadership. 2010. URL: https://www.srhe.ac.uk/conference2010/abstracts/0308.pdf

39 Wepner SB, D'Onofrio A, Wilhite SC. The leadership dimension of education deans. Journal of Teacher Education. 2008. №59. P.153-169.

40 Klinger B., Lederman D. Innovation and Export Portfolios Policy: Research Working Paper; No. 3983. World Bank: Washington, DC. 2006. 28 p. URL: https://openknowledge.worldbank.org/handle/10986/8362

41 Boutellier R., Gassmann O., von Zedtwitz M. Managing Global Innovation. Uncovering the Secrets of Future Competitiveness. Springer-Verlag Berlin Heidelberg. 2008. 626 p.

formation of intra-industry networks. Cooke[42] identifies opportunities for the creation of global innovation networks and territorial ICT-based innovation systems. Jensen[43] explores the role of global innovation in the global dynamic environment, the opportunities for collaboration to shape global innovation and global knowledge flows.

In general intellectual leadership is a new concept for economics, but the processes of intellectualization and their role in society have been studied for a long time, and with the aim to denote their role and new changes in the functioning of society, there are used terms, acquiring a certain synonymous meaning with the definition of "intellectual leadership" (Table 1).

TABLE 1 Terms used in parallel (synonymously) with the definition of "intellectual leadership"

Definition	Understanding
Transformational (transformative) leadership	Leadership that changes physical and social systems (James V. Downton)
Knowledge-oriented leadership	Involves the use of the entire system for management
Self-studying organizat ions44	Management in such companies is based on the need for continuous training, which, in turn, is due to constant changes in the environment (Peter Senge)
Social management	Management of society to achieve prosperity based on economic development in the context of globalization

Transformational leadership is a form of leadership in which the leader forms a general vision of the company and changes the internal forces so that they are aimed at achievement of this goal by increase of motivation, morale, and understanding of the collective goal. In this case, the company becomes a role model for followers and can even change their activities by taking into account their strengths and weaknesses, mitigation of threats and maximization of opportunities, which increases overall efficiency. A transformational leader can generate interest and increase attention to individual projects, bring them to market and form a proposal, taking a proactive position.

The concept of "transformational leadership" was first introduced and explored by James V. Downton. This concept was later developed by James MacGregor Burns, who defined it as a process in which 'leaders and their

42 Cooke Ph. Complex spaces: global innovation networks & territorial innovation systems in information & communication technologies. Journal of Open Innovation: Technology, Market, and Complexity. 2017. Vol. 3. No. 1: 1–23. URL: https://doi.org/10.1186/s40852-017-0060-5

43 Jensen K.R. Leading Global Innovation: Facilitating Multicultural Collaboration and International Market Success. Springer-Verlag Berlin Heidelberg. 2017. 182p.

44 Senge P. M. The art and practice of the learning organization. The new paradigm in business: Emerging strategies for leadership and organizational change, 1990. P.126-138.

followers raise each other to a higher level of morality and motivation"[45]. Transformational leaders, by virtue of their vision and influence, can change expectations, perceptions and motivations to achieve common goals or change the structure and direction of market development.

This idea was continued in the works of Bernard M. Bass (1985)[46] , who noted that transformational leaders inspire confidence and admiration in their followers. However, the scientist focused on the psychological aspects of individual leadership and the mechanisms of its implementation within teams, explaining how it affects the productivity of individual employees. He noted that the followers of such a leader admire him, showing confidence and willingness to work more than expected or planned. The leader offers the team something more than just work for a common goal; the team has a mission, understands it and is motivated to achieve it. Such leader transforms his team by the influence of his individuality, intellectual stimulation and individual approach.

This study identifies several components of transformational leadership, including: influence of ideals (idealized influence), motivation of inspiration, individual approach and intellectual stimulation. Intellectual stimulation means that the leader will constantly challenge his followers to be innovative and creative, thus raising them to a new, higher level of productivity and efficiency.

The first studies of the problems of transformational leadership in these works concerned mainly the psychological aspects of this phenomenon. Over time, transformational leadership, like leadership in general, gradually becomes the subject of economic analysis, as its demonstrations become important in economic processes and relations. Thus, the demonstrations of transformational leadership can be observed when key innovation companies change the direction of market development and form a constellation of follower-companies, while setting new trends.

Thus, transformational leadership is understood as a kind of guiding influence of the leader that causes the transformation of the system, the structural distribution of power and resources. Moreover, the transformation is understood not at the individual level, but as a form of collective effort. According to Roche K., the current national and global mechanisms of governance simply do not meet their purpose and only the constant pressure of coalitions and public organizations on government will help to effectively avoid structural obstacles on the way of progressive social changes[47].

According to Roche K., this happens in several ways:

- Building a theoretical basis and substantiation of the role of social

45 Burns J.M. Leadership. N.Y: Harper and Row. 1978. 530 p.

46 Bass B.M. Leadership and Performance, N.Y. Free Press. 1985.

47 Chris Roche What is transformative leadership? URL: http://www.universityworldnews.com/article.php?story=20160412200253987

agents in the changes taking place; study of multilevel processes and models of the relationship between them;

- Observation and analysis of research on social and economic change, documentation of processes and development of a basis for supporting leadership in companies and in collective action;
- Institutional structure of universities, which helps to create opportunities for professional growth for practitioners, to form new generations of managers from students;
- Combination of theory and practice occurred through the involvement of specialists-practitioners in theoretical discussions of constant social change. This helps to develop an interdisciplinary approach to solving problems in the course of social and ec onomic change.

Some scholars use the term "intellectual leadership" to mean "transformational leadership". Thus, Harold Kunz in his work on management defines intellectual leadership as a demonstration of group leadership and creation of conditions for its work links. However, in our opinion, these concepts should not be equated. This is primarily due to the fact that transformational leadership in its essence implies a process and an impact, and not the involved factors and achieved results. The transformation of market conditions ambiguously determines the growth of the intellectual component as a result of activity.

Quite often, in parallel with the term "intellectual leadership", a synonymous term "knowledge-oriented leadership" is used. Thus, the study usually emphasizes that such leadership "... is formed on the basis of close "interaction" of the basic triad of professional competencies of KM (Knowledge Management), IT (Information Technology) and HR (Human Resources) of leaders-specialists"[48].

Knowledge management is understood as a holistic system of accumulation, storage, distribution and redistribution, transformation of knowledge in the enterprise. This whole system is aimed at achievement of the success of the organization and the transformation of intellectual assets into higher productivity, efficiency and new value[49]. Such a system in the organization must be implemented in several key aspects, including:

- Strategy aimed at intellectual resources;
- Organizational culture, favorable for the formation of interaction and knowledge creation;
- Organizational processes that allow implementing a knowledge management system in the organization;
- Leadership at all levels, aimed at implementation of a knowledge

48 Приймак В. М. Лідерство в системі управління знаннями. Теоретичні та прикладні питання економіки. Збірник наукових праць. Вип. 25. К.: Видавничо-поліграфічний центр «Київський університет», 2011. С. 88-94.

49 Гапоненко А. Л. Управление знаниями. 2001. 60 с

management system;

- Technology that contributes to the implementation and functioning of the knowledge management system;
- Policies focused on supporting initiatives and knowledge production[50].

The process itself is presented as a sequence of stages of obtaining, processing, analysis, understanding, processing of information in the enterprise to increase the efficiency of its activities and intellectualization of the main processes.

Information technology as the second component of the strategy of intellectual leadership involves the intelligent use of today's technological capabilities. The Internet, communicators, and social networks - all this becomes a source of both receiving and disseminating information. In addition, it expands op portunities for crowdsourcing, information processing, expands opportunities for marketing, PR, etc. Today, such opportunities are actively used by leading companies to disseminate information about new products, survey consumers about the benefits, form a positive image of the company and attitude to products. The development of information technology opens wide opportunities for companies to communicate with real or potential consumers, minimize costs, and form a public response.

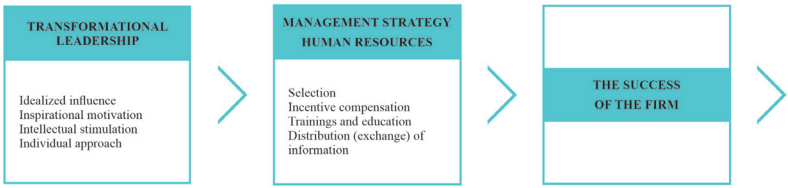


FIGURE 2. The system of relationships between transformational leadership and human resource management

Human resources as the third basic competence are defined as strategic opportunities of the company at the present stage of economic development. Moreover, they are considered a key factor in the company's success[51]. Some authors define human resources as the basis of the company's transformational leadership and opportunities to achieve leadership in certain markets. The success of the firm, its position in the market depends on the company's ability to lead and manage human resources (Fig. 2).

50 Frost A. Knowledge Management 2010. URL: http://www.knowledge-management-tools.net.

51 Pongpearchan P. Effect of transformational leadership on strategic human resource management and firm success of Toyota's dealer in Thailand. The Business and Management Review. 2015. C. 256–265. URL: http://www.abrmr.com/myfile/conference_proceedings/Con_Pro_19580/conference_33767.pdf

The success of a firm is expressed as a sequence and interrelation of factors of transformational leadership and human resources management in the enterprise. Transformational leadership is impossible without the support of the company's staff, without a corporate idea and a common belief in the possibility and necessity of transformation. In turn, a successful team will be a source of such transformations.

Under conditions of rapid changes in the external environment, understanding the strengthening of the role of knowledge in the company's activities in the market and the formation of knowledge as a competitive advantage, the term "self-learning organizations" is formed. This term was widely used by Peter Senge in his "Fifth Discipline" (1990)[52]. A self-learning organization must have certain characteristics, including: the level of support for innovation and competitiveness of the company; the level and speed of reaction to external pressure or internal changes; understanding the possibilities of using own resources to better meet the needs of consumers; constant improvement of the quality of own activity at all levels; customer orientation[53].

The idea of formation of such an organization was later expanded in the works of T. Boydell, N. Dixon and P. Senge, who defined eleven of its characteristics: understanding the dynamics of strategy and business planning; the company's employees participate in the formation and development of the company's strategy; information openness, when information is perceived for decision-making and does not serve as a source or measure of remuneration or punishment of employees; accounting and control of the organization, focused on the contribution and responsibility of each employee; internal exchange of services; development of the optimal model of rewards; opportunities for employees to have a free and creative process within the company; monitoring of the external business environment and market changes; cooperation of the organization and related groups (suppliers, consumers: joint training or projects); opportunities for employees to self-improvement, budget calculation for education and training within the company; climate that promotes learning and self-improvement, mentoring system[54, 55]].

The main idea of formation of such a system is not only to respond to changes in the external environment, but also to actively participate in these changes, their promotion and formation. Such companies are the driving force behind

52 Senge P., Kleiner A., Roberts C., Ross R., Smith B. The Fifth Disciplines Fieldbook: Tools and Strategies for Building a Learning Organization, New York: Doubleday/Currency, 1994.

53 Самообучающиеся организации. Business Process Improvement Group. URL: https://bpi-group.com.ua/services/samoobuchayushhiesya-organizatsii.

54 Boydell T. et al. Developing the Developers, AMED. London: Departament for Employment, Sheffield, 1991.

55 Dixon N. Dialogue at Work. London: Lemon & Crane, 1998.

changes in market structure, supply or forms of doing business. Knowledge and information become a source of proactivity of such a company and that is why we can consider such a company an intellectual leader who provokes changes in the market and is an active participant.

Some studies have attempted to expand the understanding of intellectual leadership by expanding the system of subjects. However, in general, such studies do not go beyond groups of individuals. The formation of a leadership model under the new economic conditions required the study not only individual leadership, but also the ability of the intellect to change depending on the number and quality of participants in interaction or cooperation.

In the works of a number of scientists[56];[57];[58] there is the idea of social management (3S), based on the intellectual interaction of people and the phenomenon of group intelligence. This happens in the process of synthlectics, synarchy and synergy. Synthelectics is defined as a model of creation of a social intelligence as a result of intellectual interaction and cooperation of individuals within a group and the development of group knowledge[59]. Synarchy (from the Greek συναρχία (syn) — together, (archie) — power) is understood as "a harmonized, organic system of human coexistence, based on natural laws and principles, according to which everyone has their place and purpose and serve as the foundation of harmony - Accord"[60] or a combination of human efforts to achieve a common result[61]. Synergy (from the Greek συνεργία (syn) — together; (ergos) — action) provides for the predominance of the result of group activities over the simple sum of the results of individual activities (in this case it is the interaction of intellects and groups of intellects)[62].

56 Варцаба В. І. Конкурентоспроможність регіональних суспільних систем як наслідок використання інтелектоінтегруючої 3S технології управління. «Теорія і практика стратегічного управління розвитком галузевих і регіональних суспільних систем». Збірн. тез доповідей V-ї Всеукраїнської наук.-практ. конференції (м. Івано-Франківськ, 21-22 травня, 2015 року). Івано-Франківськ: ПП Курилюк, 2015. С. 51-53. 35.

57 Варцаба В. І. Синергетична парадигма гармонізованого управління людськими ресурсами соціально-економічних систем. Проблеми економіки. 2015. №2. С. 247 – 252.

58 Петренко В.П., Варцаба В.І. До удосконалення технологій стратегічного управління соціально-економічним розвитком регіональних суспільних систем України. «Управління соціально-економічним розвитком держави, регіону, підприємства». Матер. 2-ї Міжнар. наук.-практ. інтернет-конф. 01.11.-01.12. 2014 р. м. Полтава. Ч.1. Полтава: видавець ФОП Мирон І.А., 2014. С. 3 – 5.

59 Каныгин Ю. М. Основы когнитивного обществознания (Информационная теория социальных систем). К.: Украинская Академия Информатики, 1993. 236 с.

60 Бебешко Т. Синархія: пошук шляхів гармонійного впорядкування світу. Демократична Київщина. URL: http://sogdk.blogspot.com/2014/04/blog-post.html.

61 Еремин В. И. Закон синархии – гносеологическая основа человековедения. Дельфис. URL: http://www.delphis.ru/journal/article/zakon-sinarkhii-gnoseologicheskaya-osnovachelovekovedeniya.

62 Каныгин Ю. М. Основы когнитивного обществознания (Информационная теория социальных систем). К.: Украинская Академия Информатики, 1993. 236 с.

These three elements are closely linked and form a specific chain of control. Thus, "synarchy ... is also a demonstration or consequence of synthlectics, as the latter ... is a necessary condition and technological basis for the emergence of collective intelligence needs and motives for participation in co-management"[63]. In some works, we find a refinement of this chain of management "… efforts should be directed not to manage the system, but to create the conditions under which the system may create a "miracle"[64]. In most works, these processes occur one after another and form a chain, although some researchers define this spatial model differently (Fig. 3).

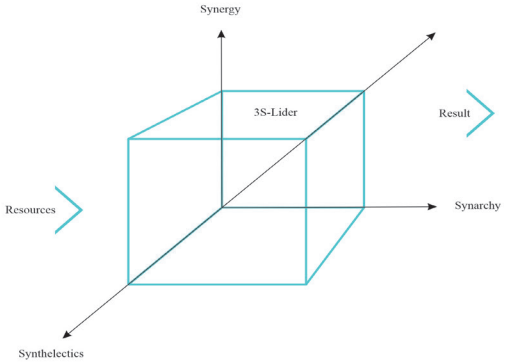


FIGURE 3. Spatial model of intelligent 3S-leadership[65]

According to the authors[66], such a model allows all group members to make their intellectual contribution to the formation of ideas, generation of knowledge, solving complex problems. In addition, the authors believe that such synergy effects ensure not only the active participation of each group member in the formation of group intelligence, but also the formation of a team of "co-leaders", where the responsibility falls on each member of the group.

In parallel with the term "synarchy" synonymous terms "team", "relationship", "complicity", "influence", "community" are used. Synarchy can be understood as tasks, actions, efficiency, and ability. Synthelectics is defined

63 Данилюк-Черних І. М., Петренко В.П. Управління використанням інтелектуального потенціалу людських ресурсів на засадах сінтелектики і синергізму. Регіональна економіка. 2011. № 1. С. 148-155.

64 Пугачева Е., Соловьенко Б. Синергетический менеджмент - новая парадигма управления, направленная на устойчивость компании. «Синергетик». URL: http://synergist.kiev.ua/publ.php?lang=ru&rubr=8&publ=32.

65 Дзвінчук Д. І., Лютий М.О., Петренко В.П. Економіка знань і необхідні зміни в моделях лідерства. Гуманітарний вісник ЗДІА. 2016. № 64. С. 44-59. URL: Bwww.zgia.zp.ua/gazeta/gvzdia_64_44.pdf.– ISSN 2072-7941

66 Ibid

as experience, wisdom, idea, imagination, courage[67].

However, these researchers view intellectual leadership as a process within a group that does not go beyond that group, but is expressed only in the results of its activities. Intellectual leadership within this group is seen primarily as a psychological process. At the same time, as already noted, in modern conditions, only the psychological aspects of intellectual leadership are not enough to explain economic processes and new conditions of competition. Intellectual leadership, which is occurred at the organizational and global levels, acquires new forms and characteristics.

According to Ihnatieva I. and Mykytenko V., world intellectual leadership has certain characteristics, in particular:

- Expanded export of patents, licenses, know-how (intellectual property in any form);
- Increase of the export of high-tech products and products that require the use of the latest intellectual products;
- Provision of scientific and technical assistance to other countries free of charge;
- High level of intellectual potential of the national economy[68].

Intellectual leadership is very common in the issue of competitiveness, which is defined as the ability to act in market relations and make a profit sufficient for scientific and technological improvement of production, employee incentives and maintenance of high quality of products or the ability of the economy of one state to compete with the economies of other states in the level of efficient use of national resources, economic productivity and ensuring a high standard of living of the population on this basis[69]. Prerequisites for international competitiveness are determined by a strong economic potential, a developed system of market institutions, significant intellectual capital, the ability to respond flexibly to changes in the world market[70].

Thus, intellectual leadership is the achievement of high positions in competition due to the high quality and intensity of the implementation of intellectual resources. Intellectual leadership is seen not as an ultimate goal, but as a key tool in achievement of global leadership, which allows for the accumulation of intellectual resources to increase competitiveness and economic efficiency. The subjects of intellectual leadership can be individuals, organizations, regions,

67 Ibid

68 Формування потенціалу соціально-економічних та організаційних змін: Монографія / За заг.ред. д.е.н. І.А.Ігнатьєвої, д.е.н. В.В.Микитенко. Київ, РВПС України НАН України і КНУТД МОН України, вид-во ПП Вишемирський В.С., 2010. 694с. С.561-562.

69 Економічний енциклопедичний словник / [С.В. Мочерний, Я.С. Ларіна, О.А. Устенко, С.І. Юрій]. Львів: Світ, 2006. 568с. ISBN 966-603-426-3.

70 Антонюк Л. Л. Міжнародна конкурентоспроможність і регіональний аспект. Міжнародна економічна політика: Наук. журн. Вип. 2 (1). К.: КНЕУ, 2005. С. 44-68.

countries. In turn, each of these entities can exercise leadership among other subjects at its own level and at higher levels: organizational, regional, national, global.

Individual leadership can be realized at any level within a group of individuals or a company, the national economy or on a global scale. For example, Steve Jobs, by realizing himself within his own company, led it to global leadership. For several years in a row, Apple remained the most expensive company in the world and is a model of leadership. The regional level of leadership determines the prevalence of the economy in a particular region and can be manifested both in general economic processes and in individual areas of activity. The most significant are the national and global levels, where the positions of individual countries are expressed.

Internationalization of the economy as a key prerequisite for the actualization of intellectual leadership

The development of opportunities and the achievement of intellectual leadership are influenced by a huge number of factors, each of which are not decisive, but together provides the economy with its place in the world economic arena. The greatest influence on the formation of these factors is exerted by the state and its institutions, as well as large corporations as key market players. In this case, different factors have different effects on the final result. Thus, the state has the greatest influence on resource and environmental factors (creation of conditions for the development of non-profit sector of economy, infrastructure, education, science, culture, guaranteeing access to them for the population), while business significantly affects the achievement of intellectual activity (patent activity, formation of license duties and royalties, high-tech production, etc.) and their practical implementation.

There is occurred with the growing role of intellectual factors of development the general intellectualization of the economy, the key factors of which are education and science. However, now their influence is significantly increasing: both directly and through action on other factors and driving forces of society[71]. In this situation, intellectual leadership is beginning to be perceived as a factor in assurance of competitiveness in the knowledge economy. There is an expansion of its understanding - as a management of change of business environment[72]. In general, all these changes become the basis for the formation of a global intellectual space of new quality, which acquires the characteristics of a common market, the rules of which are determined by key innovators and countries with a high level of intellectualization of production.

The intensification of transformational tendencies in the development of the

71 What role will education play in the Fourth Industrial Revolution? WEF. 2016. URL: https://www.weforum.org/agenda/2016/01/what-role-will-education-play-in-the-fourth-industrial-revolution/.
72 Blinder A. Education for the Third Industrial. CEPS Working Paper No. 163. 2008. URL: https://www.princeton.edu/ceps/workingpapers/163blinder.pdf, p.16.

world economy, globalization, networkization, and technologization contribute to the formation and development of the global intellectual space. At the global level, new players are emerging (new countries, companies, universities and other institutions), the range of objects of international exchange is expanding (not only goods and services, but also tangible results of intellectual activity in the form of patents, know-how, licenses), new financial flows and new systems of economic relations among subjects of different levels are formed. These dynamic processes require a thorough analysis and identification of general trends in the formation of a global innovation space.

The formation of a global intellectual space is a complex process that accompanies the current stage of development of the global economy. The key feature of the current stage of development of the world economy is the reorientation to innovative development, which is the basis of the Fourth Industrial Revolution. The Fourth Industrial Revolution determines the further orientation of production development on the basis of the use of robotics, the expansion of the use of network and ICT technologies, and so on. The characteristics of the modern market are "offshorization" of the labor market, change in the structure of production, development of opportunities through technology and network technologies, active export of services, the formation of global flows of knowledge, information, patents and more.

Increased competition at the present stage of civilization causes the emergence of new factors and mechanisms of market struggle. These include the growing importance of intellectual resources and creative products as a key factor in competitiveness. One of the important tasks of economic activity of countries in the global environment is the accumulation and implementation of intellectual resources, which can determine the pace of development of the country and form global parameters of world economic development in general. In fact, the intellectualization of society is becoming one of the most important conditions for intensive development, expansion of spheres of influence and realization of national interests. The concept of "intellectualization of the economy" is understood as a type of economic development of the world economy, characterized by increasing the role of knowledge and education as key factors in its provision[73].

The strengthening of the intellectual component in all sectors of economic activity is due to the need to solve urgent problems of society, to produce the latest development strategies. This is due both to our own innovative intellectually capacious products and by borrowing existing ones in other countries. The question is that under modern conditions the existing concept of intellectualization of the economy acquires new features and forms. This is

73 Іщук С.О. Інтелектуалізація як світова тенденція економічного розвитку. Вісник Університету банківської справи Національного банку України. 2011 № 2(11). С. 91-95.

reflected in the constant production of key innovations and the improvement of existing products and processes. Constant attention to increase of the intellectualization of the economy at all levels has allowed USA, EU, Japan, China to take the position of world leaders in scientific, technological and economic aspects[74].

The intellectualization of the economy is becoming the main trend of development in the transition to a new type of society that changes the relationship between market participants. Note that these processes are most pronounced in countries close to post-industrial society. In the economies of countries with a rustic structure, these processes are quite insignificant, due to limited development opportunities. There is a point of view that in the modern world there is not just a "transformation of the former order", but a restructuring of the world order, which "is the formation of a new social order"[75]. Accordingly, a new theory is formed, based on knowledge-value, characterized by Sakai T. From his point of view, "…we are entering a new stage of civilization, in which the driving force is the values created by knowledge"[76].

In the process of globalization of economic activity, new leaders appear on the world stage. The transition to the sixth technological mode occurs together with the identification of new factors of competitiveness of a company or country. These factors are not just related to human resources; they are based on intellectual activity, its results in the form of the latest achievements and technologies and their application.

The growing role of intelligence in the knowledge economy is justified by key trends:

• The economy is dominated by scientific and information technologies based on intellectual property and knowledge;

• Accordingly, the domestic demand for innovative products (technologies, business schemes, models, products) is formed (increased);

• Understanding the growing role of man and knowledge in the processes of innovative development and the transition to a knowledge economy;

• Changing the principles of competitiveness and means of competition, this is dominated by knowledge and information in all its manifestations;

• Strengthening the interdependence of economies, which deepens the gaps between poor and rich countries, increases the dependence of the poor and the

74 Лях В.В., Удовік С.Л. Фінська модель інформаційного суспільства: приклад для наслідування (передмова) // Кастельс М., Хіманен П. Інформаційне суспільство та держава добробуту. Фінська модель / Пер. з англ. К.: Вид-во "Ваклер" у формі ТОВ, 2006. С.15–22.

75 Воронкова В.Г. Філософія глобалізації: соціантропологічні, соціоекономічні та соціокультурні виміри: Наукова монографія. Запоріжжя: РВВ ЗДІА, 2009. 272с. С.34.

76 Сакайя Т. Стоимость, создаваемая знаниями, или история будущего. Новая индустриальная волна на Западе: Антология / Под ред. В.Л.Иноземцева. М.: Academia, 1999. С.337-371.

use of their raw materials, including cheap labor[77].

One of the key reasons for the changing dominance of global development is the depletion of natural resources and the need to find new opportunities for competitive dominance. The search for new solutions involves two key factors of development in production processes - technology and knowledge.

The geography of innovation is constantly changing, moving to the global plane, forming common open and dependent markets. Intellectual activity develops in different directions: on the one hand, there is an increase in activity in global processes, and on the other hand, there is an attempt to maintain localization and independence. All this contributes to the variety and diversification of the global innovation space based on intelligent products. The global intellectual space is formed at the expense of the sum of individual country policies of intellectualization and the synergetic global effect generated by joint activities.

Under the new economic conditions that are forming during the Fourth Industrial Revolution, new relationships and preconditions for global competitiveness are emerging. Leadership acts both as an objective precondition (process) and as a result of achievement of the global goals of the subject. However, in most scientific papers, leadership is seen purely as a manifestation of the activities of an individual or group of individuals, although the structure of subjects and understanding of leadership have changed significantly in the transition to new forms of business.

The intellectualization of economic development of the modern stage of management is beyond doubt. Redistribution of intellectual resources, their implementation, accumulation of knowledge are becoming a necessary prerequisite for the development of a country, formation of zones of its influence and determination of its place in the international arena. However, under such conditions it is important not only to produce knowledge, but also to be able to comprehend, apply and implement it in the global space. This requires an analysis of the system of subjects, determination of their role and participation in these processes. Under the conditions of the formation of the knowledge economy, it was the nonlinear development of the national economy that enabled the leading players (both national economies and multinational enterprises) to take the leading positions on the global map of the world[78].

Subjective market identification is an important prerequisite for the functioning of any market. The formation of the knowledge economy leads to

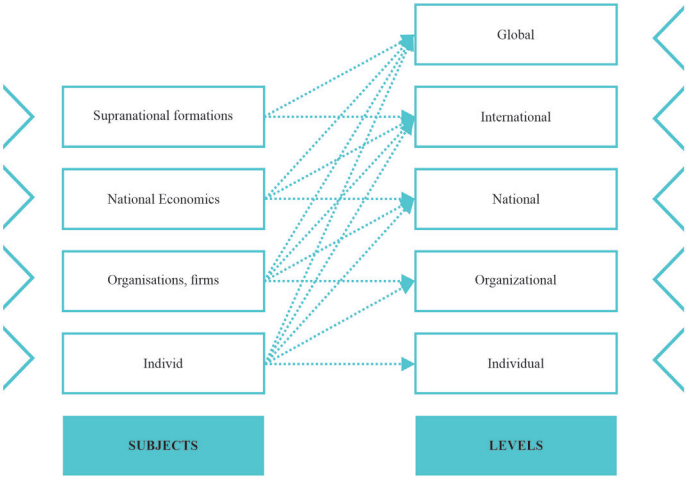
77 Інтелектуальний потенціал: соціальні виміри використання та розвитку: колективна монографія // М.В.Семикіна, В.І.Гунько, С.Р.Пасєка / за ред.. М.В.Семикіної. Черкаси: видавництво ТОВ «МАКЛАУТ», 2012. 336 с.

78 Лях В.В., Удовік С.Л. Фінська модель інформаційного суспільства: приклад для наслідування (передмова) // Кастельс М., Хіманен П. Інформаційне суспільство та держава добробуту. Фінська модель / Пер. з англ. К.: Вид-во “Ваклер” у формі ТОВ, 2006. С.15–22.

the formation and development of specific relationships in the market, which, in turn, requires a definition of the role of intellectual leadership. The understanding of intellectual leadership in modern science remains understudied, although the growing role of intellectual capital in economic development is undeniable.

Classically, leadership subjects are defined as individuals or groups of individuals. This view is shared by a number of researchers in the psychology of leadership (Downton L.[79], Gibb S.[80]; Katz D., Owen H.). However, with the change of the global economic system, the understanding of leadership, which acquires the ability to be realized at the global level, also changes. The subjects of global leadership are now countries, organizations, multinational enterprises, and regions. (MacFarland A., Lukianenko D.[81], Peters T.[82], Senge P.).

With the formation of the knowledge economy, the role of classical subjects of intellectual leadership changes, leadership ceases to be the focus of management only within the organization. The individual as a subject progress to the new levels of realization of opportunities, including: individual, organizational, national, regional, global levels. At the same time, the forms of intellectual leadership change for each subject at different levels (Fig. 4).



79 Downton L., Rebel Jr. Leadership Commitment and Charisma in the Revolutionary Process. N.Y. London: [s. n.], 1973. 220 p.

80 Gibb C. An Interactional View of the Emergence of Leadership. Australian Journal of Psychology. 1958. Vol.10. P 101-110. URL: http://onlinelibrary.wiley.com/doi/10.1080/00049535808255958/abstract.

81 Лук'яненко Д.Г., Кальченко Т.В. Стратегії глобального управління. Міжнародна економічна політика. 2008. №8-9.

82 Питерс Т., Уотерман Р. В поисках совершенства. Уроки самых успешных компаний Америки. М.: Изд-во Альпина, 2010. 528 с.

FIGURE 4. Interaction of subjects of intellectual leadership at different levels

** Systematized by the authors*

Each of the stated levels is represented by entities that interact with each other in a rather specific way. Thus, the individual level is formed at the expense of individuals who realize their leadership qualities and have the opportunity to show them at all the stated levels. At the organizational level, leadership potential is realized by companies of various organizational forms (small and medium-sized enterprises, multinational enterprises, multinational banks, metacorporations, network corporate structures, etc.). At the national level, intellectual leadership is implemented by all lower-level subjects and national-level entities (regions, clusters, dominant industries). Clusters or individual companies can be organized internationally, when several countries are involved in its creation. In this case, they represent the international level. In addition, at this level, intellectual leadership is shown by leading cities. Intellectual leadership at the global level is represented by lower-level subjects and blocks of countries or international organizations.

The specificity of the interaction of these subjects and the forms of realization of their leadership qualities is that at lower levels they only form the general conditions of the market or the basis for the formation of the economic environment. Influence is indirect, but it changes the structure of the market or the rules of the game. It should be noted that intellectual leadership is manifested at different levels very specifically: the leadership of the subjects is practically not detected at lower levels. Intellectual leadership becomes the basis for the competitiveness of different market participants. Competitiveness is understood here as "the possession of a subject by certain properties that enable it to develop on an innovative basis and win the competition"[83].

Even in the key index that studies innovation (Global Innovation Index - GII), an important component is a group of indicators for intellectual activity: human development, funding and level of research development, efficiency of universities, patent applications, international cooperation, etc. According to experts, there is investment in research, not only by countries that are key innovators, but also those that are currently not active in the innovation market at the heart of the innovation process (which is one of the key drivers of economic development at the present stage). In general, it contributes to the growth of both the global innovation market and the R&D market. Intellectual activity in the form of scientific work cannot be temporarily suspended due to lack of funds, as its restoration will require much more effort and excessive additional costs, and will be impossible at all, given the rapid pace of development of this market.

In addition, the development of the global market can be both a source of

83 Антонюк Л.Л. Міжнародна конкурентоспроможність і регіональний аспект. Міжнародна економічна політика: Наук. журн. Вип. 2 (1). К.: КНЕУ, 2005. С. 44-68.

monopolies and a source of global innovation at the local level. That is, large companies that enter the country, at the same time bring the latest products or technologies to the economy, invest in local research companies, register patents, and obtain licenses and more.

To minimize the negative effects of globalization, most countries apply protection policies that create barriers to entry for large companies. Nevertheless, there is a need to maximize the positive effects of globalization to attract untapped potential, which can be reflected in enhanced cross-cultural cooperation in research and development, supply chain management and value added, talent development, innovation clusters or hubs. Such geographical formations contribute to the attraction of talents and the formation of intellectual capital on a national and regional scale, which is made possible by the development of infrastructure and institutions. Researchers of the Global Innovation Index argue that the mere availability of highly qualified staff is not a guarantee of innovative development, but successful combinations of infrastructure, creative critical thinking, and entrepreneurial activity can be key prerequisites for intellectualization. In their opinion, "establishment of a proper environment that will promote the development, stimulation and development of the human factor of business and social innovation is a difficult but critical task"[84].

There is the formation of a "joint" workforce, which is based on the processes of transnationalization in the process of globalization. Thus, local multinational corporations attract labor from abroad, and companies from other countries take away part of the country's labor market. Some companies are recruiting and assimilating talent, which is made possible by the development of communication networks and the Internet. In this way, the company can attract higher quality human capital. The growth of intellectual capital within the country occurs through the formation of equity and foreign investment. The formation of own national intellectual capital is due to the building of infrastructure (schools, colleges, academic institutions, research institutions), which allows to form knowledge capital of its own population or attract foreign capital by stimulating companies or institutions. The formation of a specific ecosystem helps to accumulate intelligence and ensure leadership on the world stage through its implementation or the realization of the results of intellectual activity. For example, USA has made significant efforts to attract the world's most prominent people (including Nobel laureates) to teach at universities, at the same time stimulating the creation of a favorable environment for doing business, which contributed to the establishment of the world's largest companies, which, in turn, began to create their own favorable for innovation and intellectual activity ecosystems.

84 The Global Innovation Index 2014. The Human Factor in Innovation. URL: http://english.gov.cn/r/Pub/GOV/ReceivedContent/Other/2016-08-12/GII-2014-v5.pdf, p.5.

The basis of the formation of intellectual capital is education aimed at the development of individual qualities and talents. However, only education is not able to ensure their implementation, it is possible only in cooperation with the business system and with the necessary infrastructure. With the active use of capital, goods, talent and knowledge on a global scale, global markets become "unified", forming global chains with the best built-in resources of the world. This is especially actively used by multinational corporations, because the integration of the world's leading resources into corporate value chains turns the latter into global innovation platforms, giving companies from around the world the fastest access to innovative products and innovations[85].

As for the role of human capital in the formation of value added or production of goods and services, it is statistically a difficult task given the possibility of replacing human resources and the role of talent in these processes. Another problem is the lack of a quick link between financing and supporting human capital and macroeconomic indicators. Sustainable global development may be interrupted by reduction of funding for R&D, but this link may be delayed. Globalization processes lead to a gradual reformatting of the market and the entry of new players, most often the leading countries with high incomes and development, but gradually this group is joined by middle-income countries, concentrated mainly in Asia, African countries improve their position. Countries with a high level of development and a high level of income have a higher share of the population with higher education, the total number of students, researchers, and the cost of R&D.

The low level of human and intellectual capital partially offsets and reduces the cost-effectiveness of research. Thus, certain interdependence is formed - a low level of development makes it impossible to form an adequate infrastructure, while the lack of infrastructure makes it impossible to actively develop human capital and intensify intellectual activity. These principles are also specific for the training of highly qualified workers. In this case, the low level of development affects the level of migration and outflow of personnel from the country.

In general, the role of intellectual resources is quite ambiguous, as its impact is delayed. Countries with a high level of research development may have low macroeconomic indicators, and conversely, high macroeconomic indicators are not always accompanied by significant attention to research. In general, income in modern conditions is the result of innovation, which is the result of the realization of intellectual potential. Updates of knowledge, their accumulation, generation, production become the basis of competitiveness. After all, "the value added created by human capital prevailed over that created by tangible assets such as machines"[86]. Wealth becomes the result of the realization of intellectual

85 Ibid, p.11.

86 Chen, H. and Lin, K. The role of human capital cost in accounting. Journal of Intellectual Capital,

potential and knowledge[87]. This becomes more effective and efficient with the development of the main transformational technologies - transport and communications[88].

In general, globalization effects are manifested in two areas: characteristics of the international space and transformational processes of interaction among the subjects of economic relations. In both areas, unidirectional processes are underway - the formation of a single market, which can be expressed at the regional level as intellectual hubs. Intellectual resources are transformed into capital in these conditions and acquire new characteristics. Intellectual centers are formed, which cover higher educational institutions, innovative enterprises, infrastructure, etc.[89]. With the development of technology, the time to transfer innovation, obtain new solutions is reduced, borders are opened, and competition becomes global[90]. This leads to an increase in the interdependence of economies and processes, including innovation[91];[92];[93];[94].

The globalization of intellectual activity is manifested through a change in the basic functions of higher educational institutions and the principles of their functioning. First, there is a transition of higher educational institutions in the market area and the formation of the market of educational services on a global scale[95];[96];[97]. Competition between higher educational institutions for money and human resources is intensifying[98]. Thus, competition deepens and extends to all

5(1), 116-130, 2004. 116p.

87 Stewart T.A. Intellectual Capital: The new wealth of organizations. N.Y. I., 1997. P.X., 67p.

88 Mitchell D., Nielsen S. Internationalization and Globalization in Higher Education. Education and Management Agendas. 2012. C.3–22. URL: https://pdfs.semanticscholar.org/3e6c/1173f21907959cd4d1fe47ab4109795f50d9.pdf

89 Suarez-Orozco, M. and Qin-Hillard, D.B. Globalization: Culture and education in the new millennium. University of California Press. 2004.

90 Carnoy M. Globalization, educational trends and the open society. Paper presented at Open Society Institute Education Conference: Education and Open Society: A Critical Look at New Perspectives and Demands. Budapest, Hungary. 2005.

91 Armstrong L. Competing in the Global Higher Education Marketplace. New Directions for Higher Education. Wiley Productions, Inc. 2007.

92 Morrow R. A., Torres C. A. The State, globalization and educational policy. In N. C. Burbules & C. A. Torres (Eds.) Globalization and education: Critical perspectives. New York, NY. Routledge. 2000

93 Rizvi F. Debating globalization and education after September 11. In Comparative Education, 2004. Vol. 40(2) 157-171.

94 Spring J. Research on Globalization and Education. Review of Educational Research. 2008. Vol 78, No. 2, pp 330-363.

95 Altbach P.G. Globalization and the university: Myths and realities in an unequal world. In Tertiary education and management. 2004. No.1

96 Marginson S., Considine M. The Enterprise university. UK: CambridgeUniversity Press. 2000.

97 Цимбал Л. І. Передумови формування світового ринку освітніх послуг. Економічний вісник університету. Збірник наукових праць учених та аспірантів. 2007. №1. С. 54–60.

98 Slaughter S., Rhoades G. Academic capitalism and the new economy: Markets, state and higher education. Baltimore, MD: JohnsHopkinsUniversity Press. 2004.

levels and subjects of economic activity. There is a redistribution of resources on a global scale, but a side effect of these processes is also to facilitate the outflow of resources through access to global networks.

The globalization of the higher educational system as a tool for increase of intellectual potential is manifested not only through technology, but also through increased mobility of students and teachers. This mobility is ensured both by obtainment of a full education abroad and by completion of short-term courses or programs. Globalization and networking are manifested in the possibility of obtainment of diplomas or certificates as a result of distance learning[99]. However, there is a need for a certain unification of software, equipment, standards, and these problems cannot be solved without international cooperation. This, in turn, creates problems with the enforcement of intellectual property rights and the search for a balance between national and global. Scholars claim that a new social environment is being formed[100] on the basis of "expansion, deepening and acceleration of the global relationship in all aspects of modern social life"[101].

Armstrong considers higher educational institutions as centers of participation in global processes[102], which expand their concept at the global level, do work on the principles of partnership between different educational institutions. This partnership involves joint research activities, the formation of a common environment for student learning[103];[104] (not only in the classical format, but also through the Internet and digitalization). Altbach considers internationalization as a probable mechanism for responding to globalization processes[105]. Internationalization involves cooperation within certain regions and the convergence of economies with each other. In the field of intellectual activity, this can be embodied in joint projects, patents, training, which allow providing "niche" needs.

Internationalization is manifested in the sector of formation and in the sector of attraction of intellectual capital. Academic mobility is becoming one of the key features of the level of internationalization of training systems. A similar indicator at the stage of attraction of intellectual resources is the corporate workforce. Both of these processes require the unification or adaptation of the

99 Heylin M. Globalization of science rolls on. In Science & Technology. 2006. 84(48). P.26-31.
100 Kellner D. Theorizing globalization. In Sociological Theory. 2002. Vol 20(3). P.285-305.
101 Held D., McGrew A., Goldblatt D., Perraton J. Global transformations. Oxford. Polity Press. 1999. p.2.
102 Armstrong L. Competing in the Global Higher Education Marketplace. New Directions for Higher Education. Wiley Productions, Inc. 2007.
103 Altbach P.G., Knight J. The Internationalization of Higher Education: Motivations and Realities. Journal of Studies in International Education. 2007. Vol 11. No ¾. p.290-305
104 Beerkens E. Globalisation and Higher Education Research. Journal of Studies in International Education. 2003. Vol 7. No. 2. P. 128-148.
105 Altbach P. G. Universities and globalization: Critical perspectives the globalization of higher education. In Journal of Higher Education. 2001. №72. P.254-256.

key rules of such activities.

In addition, the formation of a global market for intellectual property rights or intellectual property results continues. In the scientific field, it is a question of formation of joint or global bases of citation of scientific works, in the field of intellectual property rights - about joint patent offices or cooperation between them on formation of a uniform base of property titles.

The internationalization of intellectual activity can move from the regional to the global level, as exemplified by the joint study of space, the functioning of the Hadron Collider, multinational research teams, a large number of grants, and international financial support.

Globalization is also manifested by unification — parts and components are produced in many countries; they no longer have a national identity. The product ceases to be owned by one country, and the time of monopoly leadership in innovation is significantly reduced. Thus, there is a theory of "spatialization"[106], which characterizes products that do not belong to one country and are not geographically linked.

The formation of centers of intellectualization (including around educational institutions or research institutions) creates competition on a global scale, promotes the growth of specialized knowledge and control over market share, accumulates information and intellectual resources, and controls the flow of information. Information capital moves, but does not disappear in the centers of intellectualization[107].

In accordance with new trends, the formation of a specific state policy, aimed at spread and expansion of the boundaries of research, becomes relevant[108]. Commercialization of scientific developments, including those carried out in higher educational institutions can be considered as the result of economic globalization. Knowledge is becoming both the result of intellectual activity and a product suitable for sale or purchase that satisfies the newly formed demand.

Uneven primary development of countries and the level of its transition to an innovative model of development can be an obstacle to development. The higher the level of innovation-oriented companies, the greater the total number of innovations produced in the economy, which, in turn, becomes a new basis for technological development. The economy of developed countries is constantly undergoing modernization of education and research to ensure the development

106 Wallace M., Brady D. The next long swing. In I. Berg & A. Kalleberg (Eds.), Sourcebook for labor markets, evolving structures and processes. New York, NY: Plenum Publishers. 2001. P.101-129.

107 Szyszlo P. Internationalization Strategies for the Global Knowledge Society. 2016. URL: https://cbie.ca/wp-content/uploads/2016/05/CBIE-research-Szyszlo-PhD-E.pdf

108 Mitchell D., Nielsen S. Internationalization and Globalization in Higher Education. Globalization – Education and Management Agendas. 2012. P. 3–22. URL: https://pdfs.semanticscholar.org/3e6c/1173f21907959cd4d1fe47ab4109795f50d9.pdf

of knowledge, innovative skills and conditions for the development of personal qualities of employees. The harmonious combination of human, financial and technological capital forms a unique innovation environment based on intellectual activity.

Methodical principles of estimation of intellectual leadership of the global economy actors

The phenomenon of intellectual leadership is quite complex in terms of definition and structure; thus, its evaluation requires a systematic approach, based on the consideration of peculiarities of intellectual activity. The author's approach is that intellectual leadership in the modern environment needs to be determined by levels that characterize certain stages of intellectual activity and have their own peculiarities. Such stages are represented by three levels: the level of resources, the level of results of intellectual activity, and the level of final results. As for the subject, in this study, we will consider, for the simplicity of analysis, only a country or a national economy among the whole variety of entities (country, region, industry, institution, corporation, etc.).

The level of resources is in fact characterized by the presence of basic intellectual resources. Their presence and potential characterizes in general the ability of the country (or any other subject) to intellectual activity. At the same time, the availability of intellectual resources is an important precondition for leadership, but does not yet mean actual leadership. More realistically, it can manifest itself at the next level, which characterizes the results obtained by this subject. The level of results of intellectual activity involves evaluating specific results: patents, licenses, know-how, publications, etc. The final results should be those that relate not only to purely intellectual activity but also to the whole economy or society as a whole. The next step in the assessment should be the determination of key indicators at each of these levels (Fig. 5).

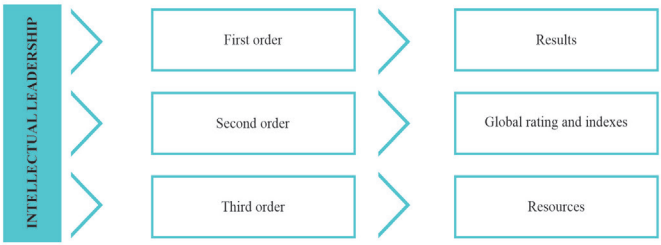


FIGURE 5. Levels of Intellectual Leadership Implementation *

**systematized by the authors*

In our view, only such a systematic approach to assessing each of these levels with a variety of indicators you to characterize intellectual activity and evaluate the overall competitive position of different parties. All indicators of the assessment of intellectual leadership, thus, take into account either the potential of intellectual resources or the results of the implementation of intellectual activity.

Leadership of the first order can be defined as resourceful. At this level, the country's ability to achieve intellectual leadership is determined through the formation of intellectual potential and mechanisms for its growth. The key development resources are divided into financial, human and, in fact, intellectual.

An assessment of the intellectual potential of human resources can be carried out using indicators such as: the number (proportion) of people with higher education (according to different age estimates); number of students (at different levels of training); the share of the population covered by education; level of literacy of the population; the share of the population employed in the high-tech sectors of the economy; the share of workers who increased their qualification. The ability of countries to actively participate in the development of knowledge economy is estimated through the definition: the number of Internet users; number of users by mobile phones; the level of export of high-tech products; information transfer rate, Kb / s per user; readiness for change.

In addition, at the national level, state participation in the development of intellectual potential is manifested through:

- the level of R & D expenditures;
- the cost of education and higher education, in particular;
- level (share) of education expenses per student;
- The share of enterprises introducing innovations.

In addition to the above indicators, leadership should be considered depending on the sector of its implementation. It may be productive, factor, trade, financial, socio-economic, informational, scientific and technical, technological

leadership, etc.

Thus, the development of a comprehensive system of indicators for intellectual leadership of countries still has a considerable scope for revision, to take into account all potential components and reserves of this type of leadership. The intellectualization of the economy in the transition to a "knowledge economy" becomes an objective necessity, which necessitates the development of a system of indicators and development benchmarks. This allows us to assess the current state of accumulation of intellectual resources, the dynamics of their development, the prospects of implementation; to highlight the main directions of increasing the efficiency of their implementation and further intellectualization of the economic system.

The following diagram illustrates the whole set of indicators characterizing intellectual resources. With such a set of indicators, one can estimate the potential of each country or any other entity (Fig. 6.):

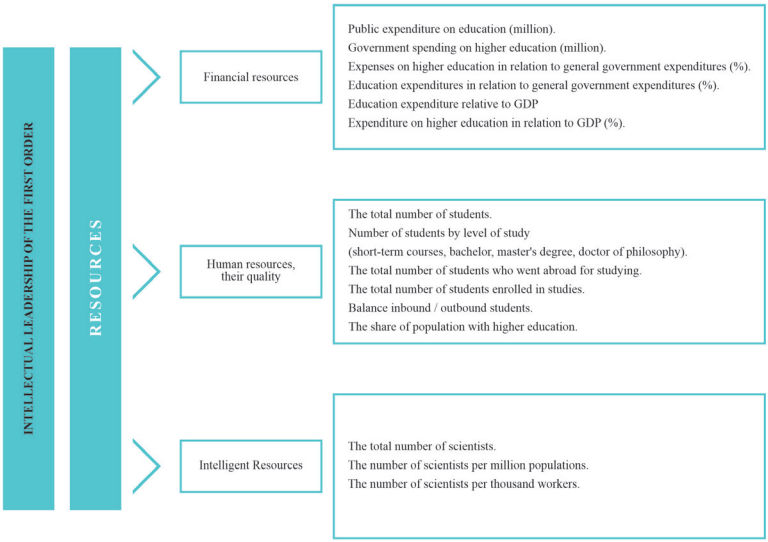


FIGURE 6. First-order Intellectual Leadership System*

** systematized by the authors*

An assessment of the intellectual potential of human resources can be carried out using indicators such as: the number (proportion) of people with higher education (according to different age estimates); number of students (at different attainment levels); the share of the population in education; level of literacy of

the population; the share of the population employed in the high-tech sectors of the economy; the share of workers who increased their qualifications[109].

The financial resources allocated by the country to increase intellectual potential should also be characterized by the following system of indicators: public expenditures on education (million); government expenditure on higher education (million); higher education expenditure as a share of general government expenditures (%); education expenses relative as a share of total public expenditures (%); education expenditures relative to GDP (%); higher education expenditure relative to GDP (%); the level of education expenses per student in absolute terms and in relation to GDP per capita; share of enterprises implementing innovations.

Actually, intellectual resources are a set of resources that can professionally carry out intellectual activity: the total number of scientists; number of scientists per million populations; number of scientists per thousand workers.

In general, the development of a comprehensive system of indicators for intellectual leadership of countries still has a significant scope for further elaboration, to take into account all potential components and reserves of this type of leadership. The intellectualization of the economy in the transition to a "knowledge economy" becomes an objective necessity, which necessitates the development of a system of indicators and development benchmarks. This allows assessing the current state of accumulation of intellectual resources, the dynamics of their development, the prospects of implementation; to highlight the main directions of increasing the efficiency of their implementation and further intellectualization of the economic system.

Assessment of resource potential is only the first stage, because further, intellectual leadership is also manifested through the results of activities. Second-order intellectual leadership is formed on the basis of the results of intellectual activity and includes indicators that reflect the infrastructure, educational, scientific and technological readiness for the implementation of innovations and the implementation of intellectual potential. In part, these indicators may indicate both the results of intellectual activity and in turn serve as a resource or a necessary basis for the formation of new results of intellectual activity.

Educational and scientific indicators at the same time serve both resources and results, but as resources based on results. These include the number of world-class universities, the number of scientific publications in general and in science-editions, the number of Nobel laureates. Infrastructure indicators primarily include opportunities for using technologies for innovation development, in

109 Sedlyar D.O. Intellectual capital of the national economy: methodical principles of measurement. [Седляр Д. Інтелектуальний капітал національної економіки: методичні засади вимірювання. Глобальні та національні проблеми економіки. №2. 2014. С.17-22.]. URL: http://www.global-national.in.ua/archive/2-2014/03.pdf.

particular: the number of Internet users (% of population); number of mobile telephony users (persons); number of mobile telephony users (per 100 people); number of fixed telephone users (persons); secured Internet servers (per million of population). The last group of indicators includes technological indicators, in particular: the number of technical staff in R&D; technical staff in R&D (per 1 million of population); registration of trademarks (residents, non-residents and total number); high-tech exports (in millions of dollars and as a percentage of exports); ICT products and services (export and import); applications for industrial designs (residents and non-residents); patent applications (residents and non-residents).

In addition to resource potential, intellectual leadership is also manifested through the results of activities. In the system of structural and functional characteristics of the global intellectual space it becomes an expression as a second-order leadership. Second-order intellectual leadership is formed on the basis of the results of intellectual activity and includes indicators that reflect the infrastructure, educational, scientific and technological readiness for the implementation of innovations and the implementation of intellectual potential. In part, these indicators may indicate both the results of intellectual activity and in turn serve as a resource or a necessary basis for the formation of new results of intellectual activity.

Educational and scientific indicators at the same time serve both resources and results, but as a resource based on results. These include the number of world-class universities, the number of scientific and technical publications, the number of Nobel laureates. Infrastructure indicators primarily include opportunities for using technologies for innovation development, in particular: the number of Internet users (% of population); number of mobile telephony users (persons); number of mobile telephony users (per 100 people); number of fixed telephone users (persons); number of fixed telephone users (per 100 people); secured Internet servers; secured Internet servers (per million). The last group of indicators includes technological indicators, in particular: the number of technical staff in R & D; technical staff in R & D (1 million USD); registration of trademarks (residents, non-residents and total number); high-tech exports ($,% of exports); IKT products and services (export and import); applications for industrial designs (residents and non-residents); Patent applications (residents and non-residents) (Fig. 7.).

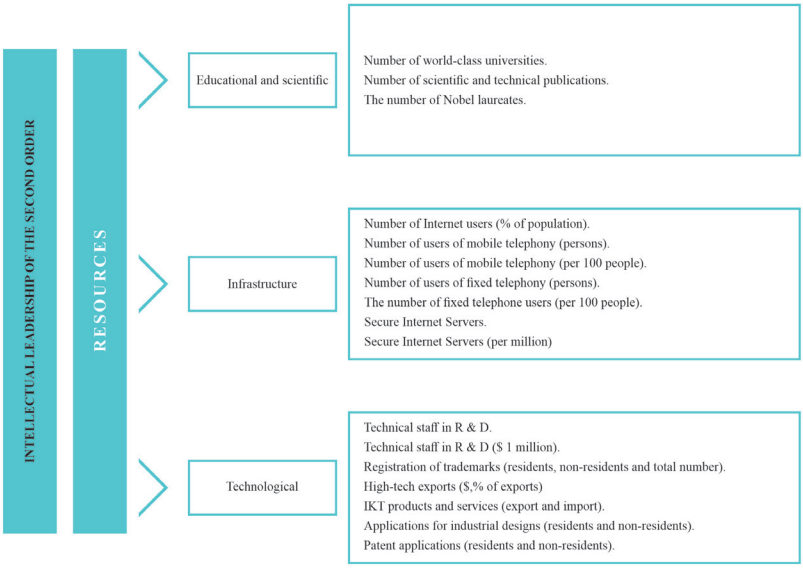


FIGURE 7. The system of indicators of intellectual leadership of the second order*

** systematized by the authors*

As stated above, the third level of intellectual leadership is the level of final results, which are manifested not only by themselves, but also in relation to general economic indicators. Most often, this is manifested in a variety of indexes, rankings, and so on. At the global level, partial assessment of individual leadership in its generalized format and confirmation of its necessity for growth of the economy are found in the well-known world indices. In particular, the Global Innovation Index contains an analysis of the role of human capital in the growth of economic performance, in particular, indicators of innovation. Another index that takes into account the individual component of leadership is the Global Talent Competitiveness Index, which is based entirely on the study of the state of human capital in the country[110].Of course; these indices only generalize the existing trends, rather than consider individual leadership as a separate element of the economic system.

The problem of leadership becomes relevant not only for business organizations. The intensification of competition on a global scale raises the issue of reaching leadership positions and in other areas of activities, which specifics require their own leaders and professionals. One of such spheres is the sphere of intellectual activity - the system of education and science. There are

110 INSEAD. URL: http://global-indices.insead.edu/index.cfm.

numerous university rankings, ratings and indices of innovation, which become tools for ranking and identifying leaders in a highly competitive intellectual environment. The emergence of leadership issues in its modern sense to a higher level makes it possible to assert the existence of new leadership formations in the geopolitical environment and understanding of the international economy.

In recent years, the issue of leadership of countries and regions, its objective basis in the framework of global trends, is intensifying. For example, at the World Economic Forum in Latin America in 2017, the preconditions for regional leadership and its key criteria were identified. These include labor productivity and migration policy, which is based on the development of education and skills; security; competitiveness. Competitiveness for a given region is determined by the need to develop leadership in renewable energy sources[111].

Confirmation of the importance of intellectual factors in achieving leadership at the global level can be the discovery of this component in the world ranking. Table 2 summarizes the main world rankings and analyzes the share of indicators that characterize intellectual activity, the components of human capital in manifestations (Table 2).

TABLE 2. Global ratings and indexes

	Global ratings and indexes	**Organization that calculates the indicator**	**Indicator**	**Weight**
Intellectual component of human resources	Human Development Index, HDI	UN	• Literacy level indicator	1 subindex from 3 5 indicator from 21
	Index of education level in the world	UN	• Literacy level indicator • The share of those who study	2/3 1/3 in total weight
	The Social Progress Index	Project The Social Progress Imperative	• Availability of basic knowledge and literacy of the population • Duration of women training • Duration of studies at university • Global University Ranking • Inequality in the availability of education	5 indicator from 48
	The Global Innovation Index	WIPO	• Human capital and research in the subindex of innovation costs	1 indicator from 6
	The Bloomberg Innovation Index	Bloomberg Rankings	• Tertiary efficiency (5%) (coverage rate for all subjects for students)	1 indicator from 7

111 Thomson St. 1,000 global leaders just met in Buenos Aires. Here are the highlights. URL: https://www.weforum.org/agenda/2017/04/latin-america-highlights-day-two.

	The Global Competitiveness Index, GCI	WEF	• Health and elementary education • Higher education and vocational education	2 groups of indicators from 12
	The Legatum Prosperity Index	Legatum Institute	• Indicator of quality of education	1 subindex from 8
	Satisfaction with Life Index, SWL	OECD	• Indicator of accessibility of education	in 1 subindex
	Academic Ranking of World Universities (ARWU)	Higher Education Institution of Shanghai Jiaotong University	• Takes into account the activities of leading universities and their scale	100%
	Webometrics ranking of world's universities	Cybermetrics Lab Spanish National Research Council, CSIC	• Takes into account the activities of leading universities in the Internet and their scale	100%
	Report of the World Trade Organization	WTO	• Includes primary and secondary education coverage	2 indicators from 8
Results of intellectual activity	The Global Innovation Index	WIPO	• Sub-index of innovation costs • Sub-index of innovative results	100%
	The Bloomberg Innovation Index	Bloomberg Rankings	• Intensity in research and development (20%) • High-tech density (20%) • Concentration of researchers (20%) • Patent activity (5%) • Technological opportunities (10%)	5 indicators from 7
	Country rating by number of patents	WIPO	• Takes into account the specific indicators of the results of intellectual activity	100%
	Country ranking by number of Internet users	It is based on statistics	• Takes into account the specific indicators of the results of intellectual activity	100%
	Country rating by number of users by mobile phones	It is based on statistics	• Takes into account the specific indicators of the results of intellectual activity	100%
	Ranking of countries by level of export of high-tech products	It is based on statistics	• Takes into account the specific indicators of the results of intellectual activity	100%

	The Global Competitiveness Index, GCI	WEF	• The level of technological development • Innovation potential	2 groups of indicators from 12

** systematized by autors*

Of course, the list provided above is not exhaustive, but it represents the most weighty and popular world rankings. All of them reflect the processes of increasing the role of the human factor and its transition to a new level of leadership. The world's leading countries are demonstrating a creative transformation, which becomes a platform for the formation of a successful society and a prosperous nation. This is confirmed in the Human Development Index study, which examines three components: health and longevity; education and access to it; living standard, estimated through GNI per capita based on purchasing power parity in US dollars.

Even such generalizing rating systems as the Global Competitiveness Index, the Social Progress Index, the Prosperity Index, the World Trade Organization report, etc., in different ways, include indicators that characterize the performance of the country's intellectual activity. For instance, one of the important indicators that is defined in the World Development Indicators study, is the export rating of high-tech products. According to generally accepted standards, high-tech products include products in which the share of research and development works is not less than 3.5%. The volumes of trade in high-tech products thus serve as an indicative effective indicator of the level of intellectual activity of each country.

Trends in the sales of high-tech products show the potential accumulated in countries and the future trends of further development. Thus, not only the structure of trade, but also the internal reserves of the state play a significant role in determining the place of the state in the world arena, in order to maintain leadership in the future among the countries that trade high-tech goods. This is reflected in the World Intellectual Property Organization report, which analyzes the patent activity of countries and the number of patent applications from both residents and non-residents. Thus, both internal capabilities and external sources of intellectualization of the economy are studied.

The levels of implementation of the potential of countries, their structure of trade, the direction of development are reflected in global rankings that take into account the above indicators. For example, they are reflected in the definition of the Global Intellectual Property Indicators, which explores the innovative costs of the world and their innovative efficiency.

A consolidated analysis of the indicators of various world rankings allows concluding that the countries with the highest indicators of development of

human potential, financing of research works, trade in high-tech products and services become, respectively, the world's engines of development. It the new technologies, the effectiveness of their implementation, human potential that determine pace and results of development, the country's place on the world stage. With it, the relationship between the general level of country's development, the level of efficiency of intellectual activity and social development of countries is identified. The leaders in ratings of education or social progress are countries that are in a group of key innovators[112].

The presented method allows confirming and analyzing the dynamics of the key trend of modern world economic development - the broad intellectualization of production and trade, the priority development of science, the spread of complex mental labor[113]. That is what forms the centers of development of world civilization and becomes a prerequisite for the formation of a knowledge-based society.

The leading countries of the world form a rather harmonious policy of supporting the intellectual component of the economy and ensuring its innovation. At the same time, the analysis of these indicators by regions shows a rather significant gap. For instance, in the countries of Africa, Latin America and Western Asia, the indicators of innovation are rather low. However, in order to increase the effectiveness of such activities, it is necessary to adhere to the basic principles: innovation policy should be aimed at maximizing innovations in all branches of industry; innovation policy should support all types and stages of innovation; creative destruction; low prices for import of information and communication technologies; support for the creation of key innovations; development of a national innovation strategy and organizations of its support[114].

In recent decades, the state policy of the leading countries of the world is aimed at a significant increase in the level of intellectual component of economic activity. Most government programs are aimed at stimulating innovation through increased funding, investor engagement, patent promotion, increase of population's education levels, and the return of scientists who have migrated. Intellectualization of the economy is the basis of the major state programs of a large number of countries. The success of such a program is beyond doubt, and experience requires further study of all methods and tools used in its implementation.

In general, the assessment of intellectual leadership can be done on the basis

112 World ranking of the world in terms of social progress. 2015. URL: http://gtmarket.ru/news/2015/04/10/7126.

113 Lukyanenko D., Kolesov V., Kolot A. Global economic development: trends, asymmetries, regulation: a monograph [Лукьяненко Д., Колесов В., Колот А. Глобальное экономическое развитие: тенденции, асимметрии, регулирование: монография. 2013. К.: КНЭУ, 466р.].

114 Global Innovation index. 2015. URL: https://www.globalinnovationindex.org/content/page/gii-full-report-2015/.

of a system of indicators, which are summarized in three key levels: resource, results and final results. Each of these levels involves taking into account its subsystem of indicators that detail the resources, results of intellectual activity and their combined impact on the final results of the country's economy.

In the vast majority of scientific works, intellectual leadership is understood only as part of the activity of educational institutions or is implemented on an individual level. However, in our opinion, in today's conditions, intelligence-led leadership becomes a prerequisite for ensuring the competitiveness of any economic entity: the individual, enterprises, the economy, the region, etc. The approach taken to the assessment of intellectual leadership in our work can mainly be used to determine the prerequisites for leadership in countries and regions, assess their competitiveness and development prospects.

Assessment of intellectual leadership under global competition

The availability of intellectual resources is a prerequisite for achieving intellectual leadership of the country, expanding its capabilities in a globalized world in a knowledge economy. The development of the intellectual potential (resources) of the country takes place through two main approaches: the formation of own resources and their attraction from external sources. Own potential is formed primarily by the system of education in general and higher education, in particular. When analyzing the indicators of individual countries regarding the number of students, it should be noted that they tend to continuously grow (Table 3)

TABLE 3. TOP-10 countries by increase in number of students, 2005-2018[115]

	Total numbers				%
	2005	**2006**	**2015**	**2018**	**2018/2005 or the most relevant years**
Turkey	2 106 351	2 342 898	6 062 886	7 560 371	358,9
India	11 777 296	12 852 684	32 107 419	34 337 594	291,6
Luxemburg	..	2 692	6 896		256,17
China	20 601 219	23 360 535	43 367 394	44 935 169	218,1
Hong Kong (China)	152 294	155 324	298 643		196,1
Colombia	1 223 594	1 314 972	2 293 550	2 408 041	196,8
Chili	663 694	661 142	1 221 774	1 254 839	189,1
Brazil	4 572 297	..	8 285 475	8 741 996	191,2
Mexico	2 384 858	2 446 726	3 515 404	4 561 792	191,3

115 Systematized by the authors according to UNESCO Enrolment in tertiary education, total number. URL: http://data.uis.unesco.org/#

Netherlands	564 983	579 622	842 601	889 506	157,4
Switzerland	199 696	204 999	294 450		147,50
World	139 648 065	147 371 357	214 083 295	225 069 560	161,2

The majority of countries in the TOP-10 are developing countries, showing an increase at least at the level of the average global growth over a specified period. Absolute championship is held by Turkey, India and China, an increase in them of more than 200%. Of course, one of the reasons for such an increase in student contingent is the large population and the presence of significant potential for the expansion of higher education. It is noteworthy that the advanced countries of the world do not demonstrate the high dynamics of the number of students because of the high level of education of the entire population.

Thus, among the leaders there are 7 countries, the number of students in them exceeds one million. There are also more than one million students in countries such as China, India, the USA, Brazil, Russian Federation, Turkey, Japan, Mexico, Korea, Germany, France, Great Britain, Colombia, Spain, Australia, Ukraine, Poland and Chile. These countries account for 68.65% of the total number of graduates.

In general, countries have rather significant differences not only in the number of students, but also in the total number of people with higher education. For instance, despite the high growth of number of students, in China, less than 10% of the populations have higher education, which is one of the lowest rates among the countries under investigation. A similar situation can be noted for India, Colombia and Argentina. In general, according to the OECD, the proportion of people with higher education varies greatly (Fig. 7).

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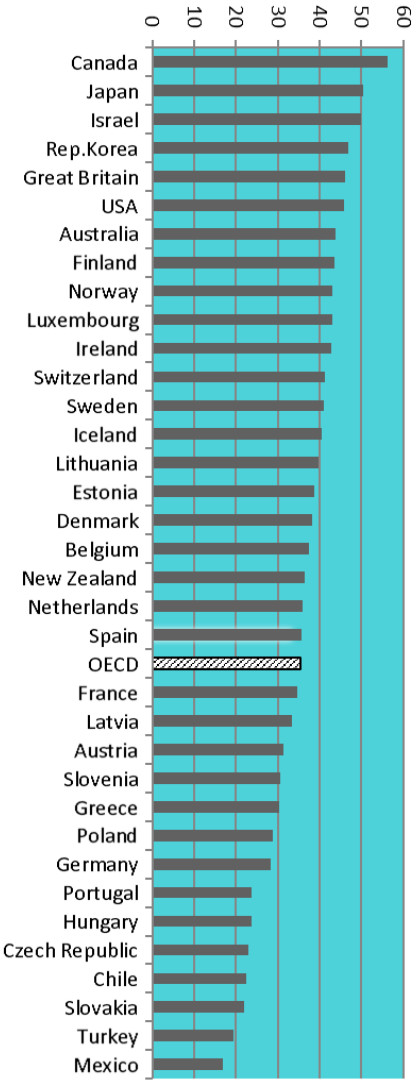

FIGURE 8. Share of people with higher education in OECD countries, 2016, %[116]

As can be seen from the figure, the difference between the highest and the lowest level is more than 40%, i.e. 3.5 times. The group of countries with a high proportion of people with higher education includes countries with the highest GDP figures. In general, among the OECD and G-20 countries, the proportion of people with higher education is above 30%, while in countries that are world leaders by the level of GDP and development, this proportion is much higher.

In order to evaluate the intellectual leadership of the first level, students' performance at different levels of training (short-term courses, bachelors, masters, doctors of philosophy) is also important. This indicator reflects to the country's potential for increasing the scientific potential of its development. In general, the level of baccalaureate accounts for almost 70% of the total number of students in the world. At the same time, analysis by country shows a rather uneven distribution: while in the world, proportion of students in short-term courses is 20%, in the United States, this number exceeds the global level almost twice, and in Germany, it is only 0.01%. The highest rates are expected at the bachelor level, even in the country analysis. Master's degree level is the most widespread in France, Germany, Poland and Italy, where it is generally not much lower than a bachelor's degree. At that time, only about 10% of all students study at the master's level in Turkey, Mexico, Japan, the USA and China. The highest level of postgraduate education is demonstrated by Canada, Great Britain and Germany, exceeding the world level three times. At the same time, in Mexico and China, this proportion is less than 1%, which is 0.33% lower than the global figure.

In addition to developing their own intellectual potential, the mechanisms of attracting human potential from the environment are very actively used by countries. The most attractive for students are the educational systems of the United States, Great Britain, Australia, Russia, France, Canada, Germany and Japan, where the number of students from abroad exceeds the number of those who left the country by more than 100,000 people (Table 4):

TABLE 4. Countries with the largest share of foreign students[117]

	2005	2008	2011	2015	2016	2018
Australia	167 407	220 671	251 603	282 374	323 181	444 514
Canada	25 646.	47 801	74 837	121 990	139 063	224 548
China						201 177

116 Educational attainment and labour-force status. URL: https://stats.oecd.org/Index.aspx?DataSetCode=EDU_ENRL_MOBILE#

117 Systematized by the authors according to UNESCO. URL: http://uis.unesco.org/en/uis-student-flow

France	187 154	197 133	207 879	153 168	..	229 623
Germany	..	..	..	112 856	..	311 738
Italy						106 611
Japan	61 352	75 398	115 243	101 489	..	182 748
Netherlands	16 145	21 746	24 832	71 036	74 382	104 015
Russia	50 763	91 760	113 695	169 099	186 865	262 416
Turkey						125 138
Great Britain	295 089	319 922	392 501	399 254	..	452 079
USA	536 898	568 690	648 813	839 895	..	987 314

At the same time, volatility in attractive countries is much lower and demonstrates a steady tendency to increase of the balance. Australia, Canada, the USA, the Russian Federation and the Netherlands have the highest growth, with rates of 68%, 375%, 56% and 233%, respectively. It should be noted that the growth of the number of foreign students in Russia is due to the involvement of students from Asia, while European countries have a broader geography of students.

The rapid increase in the number of foreign students in the world in turn means the formation of a global market for educational services. The number of foreign students grew slowly from 0.8 million in 1975 to 1.7 million in 1995, and from the beginning of the 21st century it is gaining momentum: in 2005 - 3.0 million, in 2010 – 4.2 mln, 2011 - 4.4 mln., 2014 - 4.6 mln, in 2018 – 5.6 mln people.

Between the countries of the world there is a sharp competition for their share in this market, for attracting foreign students, which minimizes the cost of their initial training. In recent years, the turbulence of the global educational environment has undergone rapid changes, which rapidly change the balance of forces and cause the emergence of new processes and phenomena. This is reflected in the decline in OECD market share (from 76.4% to 70.0% during 2007-2018), the emergence of new active actors (China, Saudi Arabia, Russia), weakening the position of traditional leaders in the educational services market (US, Great Britain, Australia, Germany, etc.).

Changes are also taking place among importing countries (Table 5). Among the main leaders of the importing countries, we see quite different countries: China, USA, Saudi Arabia, Turkey, Japan, Vietnam, Russia, etc. It is characteristic that for some countries such a tendency is to build capacity by attracting new knowledge, and for others, the loss of intellectual resources. The increase in the flow of those who go abroad for education is far from always due to the unfavorable situation in the country. Thus, China has developed a

clear strategy for funding its own students abroad, who worked out the criteria and incentives for their return to their homeland after graduation[118] (Choudaha, 2014). As a result, we can see both emerging and developed countries among the leaders of the importing countries.

TABLE 5. Number of students studying abroad by origin country[119]

	1998	2000	2005	2010	2015	2017	%, 2017/1998
China	151 055	165 348	407 520	570 449	818 803	847 259	561
USA	38 208	43 482	52 699	57 506	67 356	68 580	180
Saudi Arabia	9 941	10 626	12 398	42 651	86 223	85 277	858
Vietnam	7 858	9 148	20 801	47 268	68 038	70 328	895
Russia	26 096	28 634	39 508	50 403	57 332	56 915	218
Ukraine	13 064	20 891	26 698	36 203	68 279	76 181	583
Greece	62 059	63 676	41 687	29 226	37 092	37 484	60
Latvia	2 875	3 005	3 486	5 064	5 804	5 737	200
Japan	57 088	59 302	69 273	40 330	30 491	30 850	54
Brazil	15 596	17 274	19 424	27 753	42 645	43 438	279
UK	28 142	22 328	23 053	24 600	31 433	33 109	118
Mexico	13 149	14 230	23 048	26 072	30 194	30 646	233
Thailand	21 553	21 007	25 618	28 304	28 672	29 768	138
Sweden	12 819	12 601	13 350	15 540	17 378	17 567	137
Azerbaijan	4 882	4 862	4 125	14 302	39 970	41 762	855
Tajikistan	1 292	1 396	3 022	8 342	15 677	20 623	1596

Thus, the multiple increase in student migration confirms the thesis of the concentration of human and intellectual capital in developed countries and its outflow in developing countries. An analysis of the migration patterns of students from China and the United States confirms the concentration of the European direction in Germany, Britain, France and Austria in particular. As a result of the research it was revealed that in the process of formation of the global innovation space, the dominant factors are intellectualization processes, namely human capital, creative and technological results.

118 Choudaha R., Wit, H. Challenges and Opportunities for Global Student Mobility in the Future: a comparative and critical analysis, In B. Streitwieser (Ed.), Internationalisation of Higher Education and Global Mobility . Oxford: Symposium Books. 2014. P.19-33. doi: https://doi.org/10.15730/books.87

119 Systematized by the authors according to UNESCO. URL: http://uis.unesco.org/en/uis-student-flow

The next set of indicators includes financial resources allocated by the country for the formation of intellectual capital. Absolute and relative indicators of financing of education and science are important indicators in assessing the country's basic intellectual resources. They include government spending on education (higher education) and science in general, as a percentage of total public spending and relative to GDP. Such a structure makes it possible to analyze not only quantitative but also qualitative parameters of financing and state's attention to systems of education and science.

Public spending on education as a share of GDP is a rather informative indicator reflecting the state's participation in the processes of formation of primary intellectual potential. In general, in developed countries, spending on education is in average 5.26% of GDP, but some countries show significantly higher rates (Table 6)

TABLE 6. Government expenditure on education and on tertiary education as a percentage of GDP, 2005-2017, (%)[120]

	2005		2008		2011		2017	
	on education	on tertiary education	on education	on tertiary education	on education	on tertiary education	on education	on tertiary education
Denmark	8.09	2.32	7.48	2.12	8.48	2.37	7.8	2.5
Finland	6.04	1.92	5.85	1.81	6.48	2.08	6.4	1.7
Norway	6.87	2.22	6.28	2.01	6.45	1.93	7.9	2.1
Sweden	6.56	1.80	6.39	1.73	6.49	1.89	7.6	1.8
Belgium	5.77	1.25	6.29	1.34	6.38	1.40	6.4	1.5
New Zealand	6.28	1.45	5.51	1.59	6.94	1.90	6.3	1.5
Israel	5.76	0.95	5.54	0.89	5.56	0.90	6.1	0.9
Brazil	4.48	0.85	5.27	0.84	5.74	0.96	6.3	1.5
Austria	5.25	1.43	5.26	1.43	5.59	1.50	5.4	1.7
Australia	4.91	1.09	4.63	1.04	5.10	1.18	5.1	1.3
Estonia	4.84	0.92	5.52	1.10	5.02	1.26	5.0	1.1
France	5.50	1.16	5.44	1.21	5.52	1.26	5.5	1.2
Latvia	..	..	5.41	0.94	4.94	1.01	4.4	0.7
Slovenia	5.58	1.23	5.11	1.19	5.57	1.35	4.8	0.9
Switzerland	5.20	1.35	4.87	1.17	4.97	1.29	5.1	1.4

120 Systematized by the authors according to UNESCO and World Bank. URL: http://data.uis.unesco.org/#; http://databank.worldbank.org/data/reports.aspx?source=Education%20Statistics

Great Britain	4.98	1.11	4.94	0.78	5.67	1.25	5.4	1.4
Portugal	5.07	0.92	4.70	0.91	5.12	1.01	5.0	0.8
Mexico	4.91	0.86	4.86	0.92	5.15	0.93	4.5	0.9
Netherlands	5.16	1.38	5.09	1.41	5.53	1.61	5.2	1.6
Ukraine	6.06	1.79	6.43	2.03	6.16	2.12	5.4	1.4
Canada	4.78	..	4.64	1.60	5.27	1.88	5.3	1.7

As the data in table shows, Denmark, Norway and Sweden spend more than 7% of GDP on education. Accordingly, these countries have the highest costs of higher education, exceeding the average rate of 1.28% almost two times. In general, it can be noted that if education costs are high enough in all countries, while in developed countries, the cost of higher education is exceeds the average, while in countries with lower levels of development, the cost of higher education is much below the average.

However, the costs of education and higher education in monetary terms are analyzed, the situation changes significantly, which is due to the actual size of GDP in the designated countries. World leaders are undoubtedly the United States ($ 832.8 billion in 2014), Germany ($ 191.1 billion), Japan ($ 185.1 billion), France ($ 157.2 billion), and Great Britain ($156 billion)[121].

At the same time, the sum of TOP-15 countries by the level of education financing is $2 198 575.91 million and almost 40% of this amount falls on the US. The largest increase in education expenditure is demonstrated by Brazil - 365.8% over the period indicated, indicating an extremely active country's policy on education and the economy as a whole, given that in % of GDP this figure increased by only 1.5%. On average, the growth of education costs in a given group of countries is fairly stable and is at a level above 50%.

The country structure is almost unchanged in the analysis of countries with the highest costs of higher education. The top five leaders in 2014 are the United States ($229 billion), Germany ($51 billion), Japan ($38.4 billion), the United Kingdom ($38 billion), and France ($35.5 billion).

The undisputed leader is the United States, although the percentage of GDP for higher education is even lower than the average for a given sample of countries. The total cost of TOP-15 countries for higher education is $ 580,327.9 million and again almost 39.5% of this sum falls solely on the USA, ahead of Germany 4.5 times. In general, the costs of higher education for the chosen period are characterized by higher volatility and lower rates of growth, even for countries with high growth rates at the general cost of education.

An important indicator characterizing the financial resources allocated by the country to the formation of intellectual potential and achievement of

121 Government expenditure on education in US$. 2017. URL: http://data.uis.unesco.org/#

intellectual leadership of the first level is the share of education and higher education expenditure in the total public expenditure. On average, across countries, spending ranges from 8 to 20% on education in general and from 1.2 to more than 5% on higher education. Moreover, quite a small number of countries spend on education more than 15% of the total public expenditures.

At the same time, Norway, Mexico, Turkey and the USA spend the most on the higher education. The fluctuations of these indicators are insignificant and during this period costs are held at one level, increasing in monetary terms.

In addition to the above, the indicator of financing of science in the countries is important. This is the highest level of intellectual capital formation in the country, and, accordingly, the most informational. The distribution of research spending in the world points to the obvious leading centers with the highest spending on science. The largest share of research and development costs is in South and East Asia with 37.6% of global spending. The second position in terms of costs is held by countries of North America with an index of almost 28% and third position includes European countries with 21.6% of global spending. All other regions of the world spend on scientific research no more than 3% per region, or 12.8% of world expenses. In general, in 2017, $1,733.9 billion was spent on research. The most informative indicator is the level of expenditure on scientific and research work as a share of the gross domestic product (Table 7).

TABLE 7. TOP-10 countries by expenditures on R&D, % GDP, 2005-2018

	2005	**2008**	**2011**	**2015**	**2016**	**2017**	**2018**
Israel	4,05	4,35	4,01	4,27	4,25	4.82	4.95
Republic of Korea	2,63	3,12	3,74	4,22	4,24	4.55	4.81
Switzerland	..	2,72	..	3,37	..	3.37	…
Japan	3,18	3,34	3,24	3,29	3,15	3.21	3.26
Sweden	3,39	3,50	3,25	3,27	3,26	3.40	3.34
Austria	2,37	2,57	2,67	3,05	3,09	3.05	3.17
Denmark	2,39	2,77	2,95	2,96	2,87	3,05	3,06
Germany	2,42	2,60	2,80	2,92	2,94	3,04	3,09
Finland	3,33	3,55	3,64	2,90	2,75	2.76	2.77
USA	2,51	2,77	2,77	2,74	2,74	2,82	2,84
World	1,53	1,60362	1,64	1,69	1.69	1.72	-

Israel has the highest level of R&D spending in the world with an indicator of 4.95%, South Korea's is the second (4.81%). In general, more than 4% of GDP is spent on science only by these countries. The next block of countries, which also has an extremely high level of spending on science, is Japan,

Switzerland, Sweden and Austria with indicators of over 3%. In general, all countries included in the TOP-10 have cost level that approximately 2 times higher than the global rate.

According to the logic of our study, the following group of indicators refers to the intellectual resources: the total number of scientists, their number per one million of population and the share of employees. These indicators characterize the intellectual component of human resources. The analysis of the structure of leading countries in terms of the total number of scientific personnel and their number per one thousand of employees indicates significant differences in the list of leaders (Table 8):

TABLE 8. Countries with biggest number R&D personnel (in Full-time equivalents and Headcounts), 2005-2018[122]

Country	2005	2008	2011	2015	2016	2017	2018
China	1364799.0	1965357.0	2882903.0	3758847.6	3878056.8	4033597.2	4381443.7
Japan	896855.0	882739.0	869825.0	875005.0	872340.0	890749.0	896901.0
Russian Federation	919716.0	869772.0	839183.0	833654.0	802317.0	778155.0	758462.0
Germany	475278.0	523504.7	575099.5	640516.0	656727.0	686348.7	706557.0
India	391149.0	..	..	528219.0	..		552969.0
Republic of Korea	215345.2	294439.6	361374.2	442027.1	447408.2	471201.2	501174.5
France	349681.3	382652.8	402491.7	428642.9	432245.0	441509.0	451423.0
United Kingdom	324916.5	342085.5	356258.3	413860.0	419898.0		
Italy	175247.6	221115.0	228094.0	259167.0	258585.0	317628.0	311734.0
Canada				244879.0	228590.0	229170.0	-
Spain	174772.9	215676.4	215078.8	200866.0	205873.0	215744.5	225696.0
Netherlands	93599.0	93432.0	117435.5	129060.0	133214.0	135626.0	157389.0
Turkey	49251.4	67244.1	92801.1	122288.4	122288.4	136953.0	153552.0
Poland	76761.0	74595.8	85218.7	109249.0	111789.0	144103.0	161993.0
Sweden	77557.0	79549.0	78445.0	83551.0	90690.0	88928.0	92011.0
Switzerland	..	62065.7	..	81451.0	..	81751.4	-
Belgium	53517.1	58475.7	62894.7	77520.0	79766.0	82686.2	88749.0
Austria	47625.1	58014.4	61170.5	71396.0	73643.0	76010	81534
Czechia	43370.4	50807.9	55696.9	66433.4	65783.0	69735.7	74969.0
Ukraine	..	127345.7	110917.8	81854.4	71071.2	67806.0	65594.3
Denmark	43498.6	58588.8	57585.0	59532.0	60290.0	63243.0	64591.0

122 Systematized by the authors according to UNESCO. URL: http://data.uis.unesco.org/#

For instance, the largest number of scientists in general falls on China, Japan, Russia, South Korea, Germany, India, France and the United Kingdom. At the same time, all countries show a steady tendency of the growth of total number of scientists. We can see Ukraine in this list as well, although it unfortunately shows a steady tendency of decline of the number of researchers. The presence of a contingent of scientists of 65,594.3 people in 2018 so far allows our country to be in the list of TOP-20, but soon enough we can lose it, provided that it does not overcome the pace of decline (by a total of 48.5% from 2008 to 2018). If we analyze the number of scientists per one thousand of employees, the structure of leaders significantly changes (Table 9):

TABLE 9. TOP-20 countries: Total R&D personnel per thousand total employments (in Full-time equivalents), 2005-2018[123].

Country	2005	2008	2013	2014	2015	2016	2017	2018
Denmark	15.7	20.5	21.4	21.4	21.9	22.2	22.6	22.7
Luxembourg	22.5	22.4	20.1	20.4	19.9	20.1	20.1	19.8
Finland	23.8	22.2	21.5	21.2	20.6	19.3	19.8	19.7
Sweden	17.7	17.3	17.2	17.6	17.5	18.7	18.1	18.5
Switzerland	..	14.6	..	..	17.7	..	17.4	
Ireland	8.3	9.4	16.4	16.9	16.9	16.4	16.6	16.1
Austria	12.5	14.3	15.8	16.7	16.9	17.3	17.6	18.5
Belgium	12.6	13.1	15.0	16.0	16.9	17.1	17.6	18.5
Republic of Korea	9.1	12.1	15.7	16.5	16.7	16.8	17.5	18.6
Norway	12.9	14.0	14.8	15.3	16.0	16.6	17.4	17.3
France	13.6	14.4	15.9	16.2	16.4	16.4	16.6	16.8
Iceland	19.0	17.3	14.8	..	15.1	16.2	15.9	
Germany	13.1	13.7	14.7	15.0	15.7	16.0	16.5	16.7
Netherlands	11.4	10.7	14.7	14.9	15.3	15.7	15.7	17.9
Slovenia	9.5	11.7	16.7	16.1	15.4	15.6	15.2	15.9
Japan	14.0	13.6	13.6	13.9	13.6	13.4	13.5	13.4
Czechia	9.0	10.2	12.4	12.8	13.0	12.6	13.2	14.0
Italy	7.7	9.5	11.2	11.2	11.5	12.7	13.7	13.3
Portugal	5.0	9.2	10.5	10.4	10.5	10.9	11.5	11.7
Greece	7.2	..	12.1	12.4	13.9	11.5	12.8	13.4

As the tables show, the geographic structure of the leaders by the share of scientists per thousand employment has changed fundamentally. Thus, China, the

123 Systematized by the author according to UNESCO. URL: http://data.uis.unesco.org/#

Russian Federation, and India generally fell out of the list of leading countries, in which only the highly developed countries of Europe and Asia remained, showing stable rates of economic growth and innovative development. This indicator in the first place indicates the qualitative parameters of the labor market and the intellectual component of all employed persons. In Ukraine, over the past 10 years, it has lost its place in a cohort of countries with a significant number of scientific personnel per 1,000 employments, reducing the indicator from 7 to 3.7 in 2018, which is much lower than in Turkey or China.

We can conclude that intellectual leadership is a complex phenomenon, which can only be assessed with the help of a complex of indicators. The above data confirms that countries can be leaders in some absolute indicators, may lose leadership positions by relative indicators. But if it is such powerful economies as the US and China, their leadership is undeniably confirmed by further in-depth analysis based on other indicators (second and third order). Also, further analysis can confirm some problems and lagging behind countries that have separate good positions on individual indicators.

The resource potential assessment is an important and necessary step in the overall analysis of intellectual leadership. The set of indicators can be significantly expanded, as well as modified for other entities (corporations, universities, regions, etc.). In general, it is a basic set that characterizes the initial conditions for intellectual activity and intellectual leadership of multilevel entities. These indicators are key to understanding the country's capabilities, expanding its competitiveness, and increasing the prerequisites for achieving intellectual leadership on a global scale.

However, the availability of resources is not always a decisive factor in achieving leadership at the global level. That is why, perspective, we consider further, more in-depth studies of factors of indicators and mechanisms for achieving intellectual leadership.

Actualization of the problem of leadership in the modern global environment is connected both with the aggravation of competition, and with the complication of the structure of the global economy and the factors of its development. The separation of intellectual leadership is due, on the one hand, to increasing the role of intellectual resources in achieving leadership positions in a variety of criteria for economic and innovative development, and on the other, it becomes an independent sphere of global competition.

The methodological approaches to the assessment of intellectual leadership are a multi-stage system of analysis of multi-level indicators of intellectual activity at the levels of resources, results and outcomes. The scale of the analysis made it possible to present only the results of the conducted research at the first level - an analysis of the resource component of intellectual leadership. It is equally important and interesting to study the following levels, as well as

to find correlation between source resources and the end results of multilevel entities in the global economy. Undoubtedly, the scientific interest is represented by the implementation of the presented methodology to assess the intellectual leadership of other actors, such as corporations and regions.

We consider that analyzing and evaluating the intellectual leadership of different actors is important not only in order to ascertain the disposition of different actors, but first and foremost - to identify key trends in the development of the global economy, the key aspects that are important for their breakthrough development and competitiveness in the global space. Thus, the problem of the manifestation of intellectual leadership still leaves a great deal of space for further research both in terms of identifying quantitative dependencies and the role of intellectual factors, and in the context of in-depth analysis of factors and leadership mechanisms through the accumulation and active use of intellectual resources.

Intellectual component of global leadership

In the context of the formation of the knowledge economy, the role of intelligence becomes key; it forms the basic preconditions and determines the nature and dynamics of global economic development. Achievement of leadership positions of various subjects in the modern complex world is possible only on the basis of intellectual factors. Taking into account the modern trends of informatization, digitalization, networking, and the growth of the mobility of the world countries, the development of intellectual potential in their national development strategies and the priority directions of building a knowledge economy are among them. The achievement of intellectual leadership depends not only on the development and spread of technology, but also on the ability of countries to cooperate in these new environments, taking into account the formation of global production chains and innovation space. Accordingly, the global landscape of intellectual leadership changes and transforms, and new players are emerging, and in their turn, continue this transformation and form new ties.

In general, intellectual leadership is understood as the achievement of high positions in the competition due to the high quality and intensity of the implementation of intellectual resources. The author's methodology for evaluating intellectual leadership involves: resources and final results levels. The availability of diversified intellectual resources is the first step in achieving intellectual leadership and, accordingly, the assessment of resource potential is the first step in identifying leadership positions in countries around the world. At the same time, it is important to assess not only the availability of a certain resource potential, but also the results of its implementation. Therefore, the next important step is to evaluate the results of intellectual activity. In the system of structural and functional characteristics of the global intellectual space, it is expressed as a second-level leadership.

Intellectual leadership is formed on the basis of the results of intellectual activity and includes indicators reflecting educational, scientific, infrastructural

and technological readiness for introduction of innovations and realization of intellectual potential. These indicators show both the results of intellectual activity and, in turn, can act as a resource or a necessary basis for the formation of new results of intellectual activity.

Educational-scientific indicators serve as both resources and results, but as a resource of a higher level, which is already a certain result. The group of educational-scientific indicators includes the number of world-class universities, the number of scientific and technical publications, the number of Nobel laureates. Infrastructure indicators primarily include opportunities for using technology for innovation development, in particular, the number of Internet users (percentage of population); number of users of mobile telephony (persons); number of mobile telephony users (per 100 people); number of fixed telephone users (persons); number of fixed telephone users (per 100 people); secured Internet servers; Secured Internet Servers (per million us.). The last group of indicators includes technological indicators, which include, in particular: the number of technical staff in R&D; technical staff in R&D (per 1 million of population); registration of trademarks (residents, non-residents and total number); high-tech exports ($ and % of total exports); ICT products and services (export and import); applications for industrial designs (residents and non-residents); patent applications (residents and non-residents).

The presence of world-class universities also shows the country's ability to build and develop its own intellectual potential, and, at the same time, shows the high efficiency of their intellectual activity. The assessment methodology of the universities is rather exact and includes a significant number of effective indicators, in particular, the quality of staff (the number of Nobel laureates working at the university), the quality of training (the number of graduates who received the Nobel Prizes), the level of quotations of researchers and academic efficiency. Key ratings for university performance indicate that the vast majority of these universities are concentrated in the United States and Europe. Thus, according to the Shanghai Academic Ranking of World Universities (ARWU), 16 of the top 20 universities are located in the United States of America[124].

The United States, Great Britain and Switzerland completely fill the TOP-20 list of universities in the world. This confirms the unconditional intellectual prevalence of these countries on the world stage. If we analyze the same indicators according to The Times Higher Education World University Rankings, we can note that the situation is not very different[125]. In both ratings, the US leads by the number of world-class universities and this leadership is indisputable. However,

124 Academic Ranking of World Universities. 2017. URL: http://www.shanghairanking.com/ARWU-Statistics-2017.html

125 World University Rankings. 2018. URL: https://www.timeshighereducation.com/world-university-rankings/2018/world-ranking#!/page/0/length/-1/sort_by/rank/sort_order/asc/cols/stats

Germany, Australia, the Netherlands and Canada are also ranked as leaders in this ranking. The gap between the first and second position is quite significant. In the leader country (USA), the number of world-class universities is more than four times higher than the number of such universities in Germany and the UK (they share the second position).

The next indicator is the number of Nobel laureates in the country, as this indicator is taken into account in many university rankings. Analyzing the number of Nobel laureates in countries around the world, it should be noted that this indicator is also significantly higher in the United States (Fig. 9):

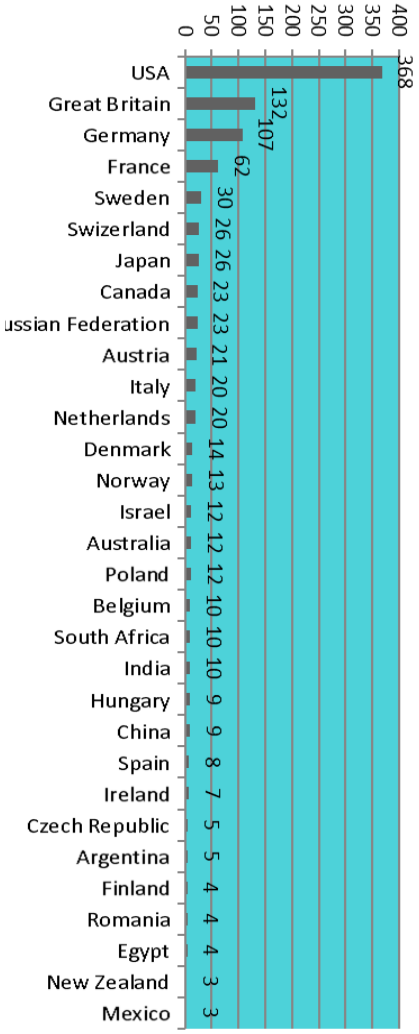

FIGURE 9. The ranking of countries by the total number of Nobel laureates, 2017[126]

The leadership of the United States is absolute and the number of Nobel laureates exceeds their number in Germany by 3 times. For instance, only in Harvard, 157 Nobel laureates work, which is more than in the whole Great Britain, which is in second position. And 116 of the 132 British laureates work in Cambridge[127]. In total, 75 countries of the world have Nobel laureates and in 43 of them the number does not exceed 2 (including in Ukraine). The vast majority of Nobel laureates are concentrated in the United States and Europe.

The next important indicator is the number of scientific publications in the cited publications. Statistics shows that countries with a lower level of development in recent years have been actively increasing the number of publications in cited publications, which in turn affects the position of universities in global rankings. The highest number of publications per year in the world is in China. The Government of China adopted a focused strategy for innovation development, and one of the key indicators that were determined was to enter the TOP-5 countries by the number of publications by 2020. In general, over the period from 2005 to 2019, the number of publications scientists from China shows an increase of 394%, India by 445%, Chile by 375%, Colombia by 853%, Latvia by 354%, Luxemburg by 723%. The smallest gain is shown by the USA, only 130%[128].

Thus, the leading China and the United States show a rather different dynamics. While the US keeps on a relatively stable level, China has significantly increased its performance since 2005. In 2019, China came out on top for the first time and was ahead of the United States. The third place is occupied by the United Kingdom, but it is gradually catching up with India. At the same time, Japan, which occupied the third position in 2005, even reduced its performance and moved to the fifth position in 2019. It is worth noting that the gaps even in the top ten leaders are extremely high. The USA and China have figures of more than 600,000, Germany, India the United Kingdom - more than 167,000, Japan, France, Italy and Canada - more than 105,000. The values between the first and the tenth position by this indicator vary by more than 6 times.

Important indicators for supporting leadership are a group of infrastructure indicators that characterize the economy's readiness to expand ICT and access to communications. The growth in the number of mobile communication subscribers per 100 populations is at an extremely high pace in developing countries. The highest growth rates with a colossal increase are shown by India

126 TOP-30 countries with Nobel prize winners. 2017. URL: https://www.worldatlas.com/articles/top-30-countries-with-nobel-prize-winners.html

127 List of Nobel laureates by university affiliation. 2017. URL: https://www.nobelprize.org/prizes/lists/all-nobel-prizes/

128 Scimago Country Rankings. URL: https://www.scimagojr.com/countryrank.php

- 12771% since 2005, Colombia (3034%), China (444%), Mexico (259%), Brazil (234%), Ukraine (183%), Chile (237%), Hong Kong (251%), and Poland (166%). In general, the growth rate in the world is quite significant and amounts to 370% in the period from 2005 to 2019. For comparison, developed countries have an average growth rate of 49% (OECD indicator), while some of them have extremely low growth rates for a given period[129].

Similar trends in growth can be noted when analyzing the growth of personal Internet users, which from 2005 to 2019 increased to 361% of the global population. According to the World Bank, more than 90% of Internet users are in UAE (99%), Denmark (98%), South Korea (96%), Sweden (96%), Switzerland (96%), United Kingdom (96%), Netherlands (95%), Canada (94%), Saudi Arabia (993%), Germany (93%), New Zealand (93%), Japan (92%), Hong Kong (91%), Spain (91%), and Belgium (90%)[130]. The highest growth is observed in Ukraine, where the number of individual users increased by 1299%, India (1137%), China (524%), Colombia (428%), Russia (380%), Turkey (277%), Mexico (249 %), Israel (216%), Brazil (189%). The lowest growth was observed in Iceland (13%), Norway (18%), Denmark (17%), the Netherlands (11%), Sweden (6%), Finland (18%) and the United States (12%) with the overall increase among OECD countries by 45% for the specified period.

The number of reliable Internet servers has a large growth rate, due to the development of Internet technologies in general and mobile communication technologies. The average growth in the world since 2010 is 1777%, and in developed countries of OECD - 1593%. The highest growth rates are demonstrated by such countries: more than 10,000% growth is observed in Singapore (10,939%), Chile (15,872%), China (17,340%), Russia (20,614%), and Ukraine (31 841%). Less than 1,000% of the increase is demonstrated by Austria (975%), New Zealand (978%), Norway (834%), Japan (981%), and South Korea (582%). However, an increasing in the number of secure Internet services over the period since 2010 is extremely active, indicating the spread of technologies and opportunities for their use.

Patent activity is one of the most prominent indicators, since the number of patents indicates the results of scientific and research activities. The absolute leaders of 2016 were China, the USA, Japan, South Korea, Germany, India, Russia, Canada, Australia and Brazil. The unconditional leader is China, exceeding the US index of almost 1 million patents, while demonstrating an increase of 1189% of registered by residents patents for the period from 2005 to 2016. The highest growth rates are seen in the countries of Asia and Latin America, in particular, India (179% increase), Singapore (181%), Mexico (124%), Colombia (450%), Turkey (571%), which proves the activation of

129 Statistics. URL: https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
130 Global Digital Report 2020. URL: https://datareportal.com

residents in innovation activities (Patent applications…,2016). During this period, most countries show a decline in non-resident activity. There are countries in which the activity of non-residents significantly exceeds the activity of residents, in particular, India, Brazil, Canada, Australia, Singapore, Mexico, Israel, New Zealand, Columbia, Chile, Hong Kong. Consistent leaders over the past decade have been the United States, Japan, and South Korea, by the number of patents registered both residents and non-residents, which. However, they were surpassed by China in 2011 (Fig. 10).

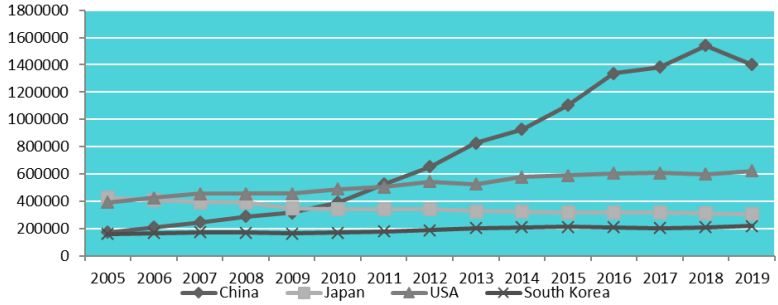

FIGURE 10. Dynamics of the total number of patents of the leading countries, 2005-2019[131]

In Japan, since 2005, the number of patents is gradually decreasing, while China is showing a sharp rise. The United States and South Korea are more moderate, but still the key trend is the growth of patent activity. The absolute outsiders by the number of patents are Estonia, Iceland, Slovakia, Ireland, Lithuania and Latvia, in the above countries the total number of patents does not exceed 300 and tends to decline.

The next indicator in this group is the number of applications for industrial designs submitted by both residents and non-residents. Industrial designs receive a patent for protection and may even act as patents for industrial designs. Leading by the number of applications for industrial designs is kept by China, South Korea, Germany, and others[132].

One more indicator of this group is registration of trademarks. Its dynamics indicates the activation of industrial activity in the country and can serve as an indicator of the development of the global market. Similarly to previous figures reflecting the state of the market for intellectual property rights and its geographic structure, China is far ahead of all other countries in the world. There

131 Patents by country. 2019. URL: http://databank.worldbank.org/data/source/world-development-indicators#

132 Industrial design applications, resident, by count. 2016. URL: http://databank.worldbank.org/data/source/world-development-indicators#

is a number of countries that have significantly reduced their quantifiable rates for this indicator between 2005 and 2019, in particular, Germany, Spain, Italy, Chile, Belgium, Poland, Sweden, Czech Republic, Austria, Greece, Hungary, Finland, Slovakia, Denmark, Lithuania, Iceland, Ireland, Latvia and Estonia. In turn, among the countries that show positive dynamics, the leaders' group is emerging, and it is represented by China with a growth rate of 420%, the United States with a rate of 150%, India with a significant 345%, Mexico (201%), Great Britain (188%), and Turkey (181%). In general, not all of these countries are included in the TOP-10 by the total number of trademark registration[133].

One of the most important indicators of the effectiveness of intellectual activity is the actual realization of patent activity in practice, which is expressed with the volumes of high-tech products (production, export, import, ICT products and services). According to the reports of global organizations, it should be noted that the share of Asian countries in high-tech exports is constantly increasing and declined only in 2009 (Fig. 11).

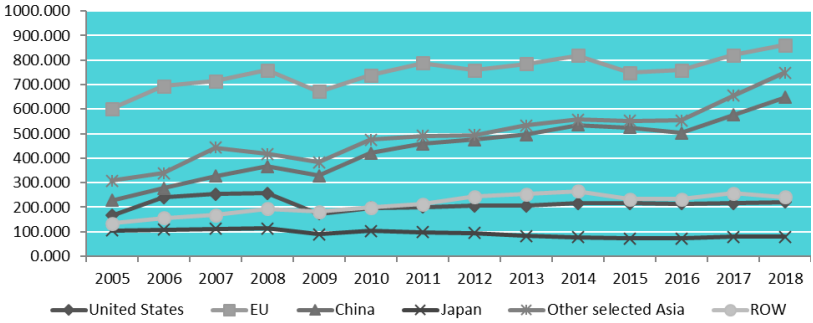

FIGURE 11. Exports of high-tech products by selected regions, countries, 2005-2018, mln.[134]

Only Japan has cut exports of high-tech goods for the selected period, and generally there is a gradual increase. Almost all selected countries reduced exports in 2009, due to the economic crisis of 2008, but quickly regained the exports level. Leaders are China, the countries of Asia and the EU. Among the countries studied in our sample, the highest level of exports of high-tech goods when converted to exports is general is demonstrated by Singapore, Ireland, Switzerland[135].

133 Trademark applications. 2017. URL: http://databank.worldbank.org/data/source/world-development-indicators#

134 Science and Engineering Indicators. 2020. URL: https://ncses.nsf.gov/pubs/nsb20205/global-trade-in-high-and-medium-high-r-d-intensive-products

135 High-technology exports (% of manufactured exports), selected countries. 2016. URL: http://databank.worldbank.org/data/source/world-development-indicators#

The share of exports in the vast majority of leading countries is gradually shrinking, which is explained not by the nominal decline in the export of high-tech goods, but by the growth of exports as a whole. The growth of exports of high-tech products in the above-mentioned TOP-10 is demonstrated only by Switzerland, France and Norway. The growth of this indicator is characteristic mainly for countries that had not very high figures in 2005 and, accordingly, have significant potential for building up. Those countries are Turkey, Chile, Slovenia, Poland, Colombia, Slovakia, Russia, Greece, Lithuania, Latvia, Belgium, Ukraine, but all these countries had less than 10% of exports of high-tech products in 2005. Thus, the maximum 223% growth in Poland provides only 8.7% of exports of high-tech products of total exports in 2016.

Exports of high-tech products are a rather powerful trade flow, which is formed predominantly by highly developed countries. However, even highly developed countries have significant volumes of imports of high-tech products, which indicate the formation of certain centers of gravity. The US and the EU, despite a significant share of exports, are also leaders in terms of imports of high-tech products, which in turn indicates the specialization and the creation of global flows of such products and, accordingly, global markets.

Export-import flows are quite significant in all regions of the world, although the countries of Asia prevail. Asian preeminence is indisputable, followed by the countries of North America and the European Union. In general, Asian countries account for more than 60% of exports of high-tech goods. The world is divided between the key regions that ensure the formation of export flows. Asian countries generally import more than 10% than export, while in the countries of North America and the European Union, the foreign trade turnover of high-tech goods has a negative balance. Country analysis shows not only Asia's leadership in the global export of high-tech goods, but also China's leadership in particular[136]. Vietnam, China, Switzerland, Israel, Taiwan and Russia show the highest growth rates. The average growth rate for the sample of countries is 175% except of Vietnam, which shows a whopping 4167% since 2005.

Significant growth can be observed in the import of high-tech goods[137]. The average growth rate of imports of high-tech goods is 167%, but China, South Korea, Mexico, India, Brazil and Turkey significantly exceed average growth rates. China and the United States show significant gap, which is at least 3 times higher than Japan's third position. Accordingly, the fourth position can be attributed to Germany, South Korea and Singapore, as their indicators are quite close to each other and they generally have similar dynamics. Mexico,

136 Patterns and trends of knowledge and technology intensive industries. 2018. URL: https://www.nsf.gov/statistics/2018/nsb20181/report/sections/industry-technology-and-the-global-marketplace/patterns-and-trends-of-knowledge--and-technology-intensive-industries

137 Ibid.

France and the United Kingdom form the following group with indicators from $55 billion to $61 billion. The difference between leaders and followers is quite significant, and itself membership with the TOP-10 leading countries in this case does not indicate extremely high rates.

In addition to high-tech products, an important aspect of the country's activity is medium-high-tech products. According to this indicator, countries of Asia also lead. The growth here is much smaller than in high-tech products. Thus, the growth rate of exports in all countries of the world is 182%, in North America the export growth rate is 157%, the EU shows similar trends with an indicator of 152%. The countries with the Middle East (289%) and Africa (243%) show the highest growth of exports of medium-high-tech products. Asian countries generally have indicators of growth of exports higher than the world and show 204%, which means the actual doubling of exports of medium-high-tech goods. As for imports, the Middle East has a high growth rate, but much lower than exports (about 219%). The highest growth rates of imports of medium-high-tech goods are shown by the countries of Africa, with an index of 230%. Not very low indicator is in Central and South America - 196%, the European Union and North America are at the bottom, with roughly the same rates - 157% and 156%, respectively[138].

In general, in all regions of the world, export-import operations of medium-high-tech products grew, due to increased trade volumes in general and the growth of the role of high value-added products in the processes of globalization and the gradual transition to the dominant technology in the new economy. If we analyze the dynamics of exports of medium-high-tech goods, we can note that in 2009, it significantly decreased in all countries (Fig. 12):

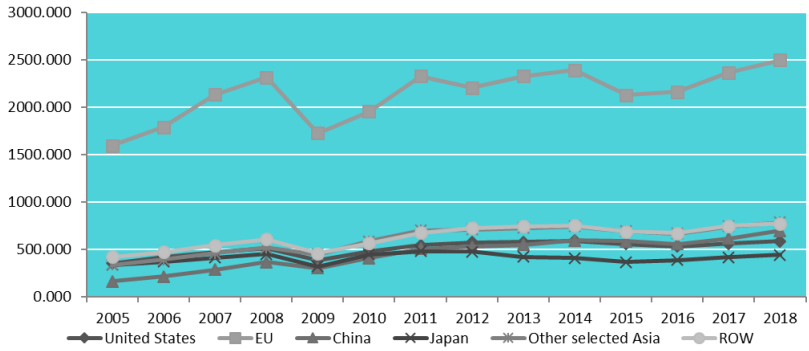

FIGURE 12. Export of medium-high-tech product, by selected regions, countries, economies: 2005-18, billion dollars.

138 Ibid.

The total volume of medium-high-tech products in global trade flows is steadily increasing and while in 2005, the global export volume of this kind of production was almost $2 trillion, then in 2016, it was more than $3 trillion. At the same time, China in terms of exports showed a 25% lag of the United States in 2005 and twice as high as the US in 2016. As for imports, the United States retains global leadership and focuses on the accumulation of intellectual capital and the tangible results of intellectual activity.

On the whole, there is a steady increase in trade in knowledgeable products and services: high-tech products, medium-high-tech products, knowledge-intensive services. Growth is not only natural indicators, but also relative ones: as a share of overall trade, which indicates the growth of their role in production, and, accordingly, reorientation of production to other technologies (Fig. 13):

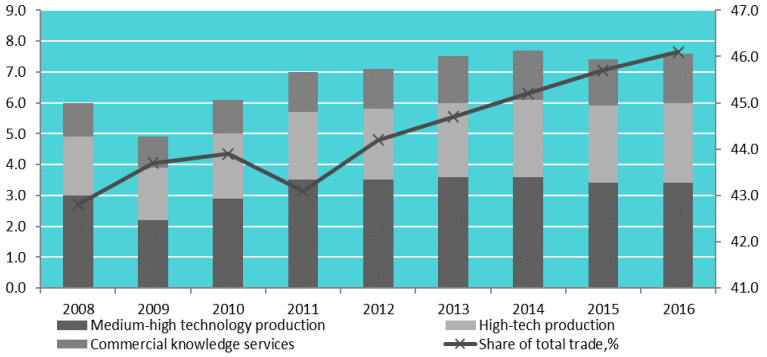

FIGURE 13. Global export of commercial knowledge of high-volume products and services: 2008-16 trillion dollars[139]

As can be seen from Figure 12, we can note the gradual increase in the share of commercial knowledgeable services, which often accompany high-tech products. There is certain redistribution between the designated groups of goods, as well as the commodity modification of the market structure of high-tech goods in general. In general, high-tech exporting countries also have a high level of R&D spending, which is sometimes ten times higher than the costs of competitors. At the same time, developed countries allocate financing mainly for improvement of existing technologies and the development of breakthrough innovations. At the same time, less developed countries should focus on the initial stages of development.

The cost of labor is lower than that of highly developed countries, which can

139 Patterns and trends of knowledge and technology intensive industries. 2018. URL: https://www.nsf.gov/statistics/2018/nsb20181/report/sections/industry-technology-and-the-global-marketplace/patterns-and-trends-of-knowledge--and-technology-intensive-industries

serve as a competitive advantage and facilitate the transfer of productions from developed countries to developing countries. For example, China is actively promoting its own outsourcing on the market of high-tech products[140]. Each of the leading countries specializes in own production of goods[141]. Finland specializes in biotechnology, energy and environmental sciences. China is developing robotics, semiconductors, high-speed trains, supercomputers, automobiles and genetic engineering. Canada focuses on biotechnology, wireless interactive machines, supersonic technologies and chips. The United Kingdom is actively developing military technology and unmanned aerial vehicles. Military projects are also being developed by Russia. Germany is developing biotechnology, automotive and mechanical engineering. Israel is one of the five countries focused on the development of space technology. South Korea specializes in robotics. The United States has a wide range of scientific interests: the space industry, nuclear technology, pharmaceuticals, defense systems, telecommunications, and internet technologies. Japan also has a broad specialization: robotics, automotive, electronics, mechanical engineering, space engineering, optics, industrial robotics, biotechnology, metals and semiconductors[142].

An important trend in modern development is the formation of a global innovation space, evidenced by the growing volume of scientific cooperation between parties from different countries. The data in the following table characterizes the dynamics of patents obtained as a result of cooperation between countries in conducting innovation activities (Table 10):

TABLE 10. Patents in co-operation with foreign companies, 2005-2017[143]

		2005	2010	2015	2017
Japan	Total Patents	23 758,0	20 974,0	20 940,0	19 475,0
	General cooperation with foreign countries	754,0	618,0	641,0	650,0
	Japan	..	..	..	..
	USA	374,0	234,0	273,0	198,0
	EU-27	249,0	3262,0	206,0	210,0

140 Global High Tech Exports By Country. 2016. URL: https://www.worldatlas.com/articles/countries-with-the-most-high-tech-exports.html

141 Achieng Vivian. Top 15 Most High-Tech Countries In The World. 2017. URL: https://www.therichest.com/technologies/top-15-most-high-tech-countries-in-the-world/

142 Allouche D. Top 10 of the Most High Tech Countries in the World. 2017. URL: https://www.young-diplomats.com/top-10-high-tech-countries-world/

143 International co-operation in patents. 2019. URL: https://stats.oecd.org/Index.aspx?DataSetCode=PATS_COOP

USA	Total Patents	39 052,0	34 652,0	39 011,0	37 982,0
	General cooperation with foreign countries	5 151,0	4 992,0	5 849,0	5 175,0
	Japan	374,0	234,0	273,0	198,0
	USA	..	..	..	..
	EU-27	2 397,0	2 113,0	2 443,0	2 248,0
EU-27	Total Patents	53 653,0	55 198,0	56 483,0	55 784,0
	General cooperation with foreign countries	5 087,0	5 136,0	5 682,0	5 297,0
	Japan	249,0	262,0	206,0	210,0
	USA	2 397,0	2 133,0	2 443,0	2 248,0
	EU-27	2 512,0	2 888,0	2 821,0	2 875,0
World	Total Patents	134 117,0	134 044,0	144 438,0	142 932,0
	General cooperation with foreign countries	10 488,0	11 201,0	12 277,0	11 484,0
	Japan	754,0	618,0	641,0	650,0
	USA	5 151,0	4 992,0	5 849,0	5 175,0
	EU-27	7 090,0	7 497,0	7 983,0	7 598,0

Among the leading patent countries, the United States alone shows the growth of the total number of patents by 1%, while the number of patents in cooperation increased by 4%. In contrast, the EU has contracted by 1%, but the number of patents has grown significantly, which is the result of cooperation between EU countries.

In general, analyzing performance indicators, we can note that the list of leader countries is not constant; it is constantly changing, which is a sign of fierce competition both between key players and new persistent outsider countries. The results of the analysis show that the United States remain the absolute leader in most of the indicators (9 indicators). Japan and Germany are the leaders in six indices, South Korea, the United Kingdom, China and France – in five, Switzerland and Canada – in four. At the same time, advanced countries show quite different rates and trends in the dynamics of change in key indicators of their intellectual activity, which is reflected in the high volatility of countries' positions. All this gives grounds for predicting further transformations in the list of global intellectual leaders.

The processes of innovation development in the global economy have long ago become an important subject of scientific research, i.e. their factors, mechanisms, tools, dynamics, etc. A key feature of the current stage of development of the world economy is the actualization of innovation processes, which serves as

the basis of the Fourth Industrial Revolution. The Fourth Industrial Revolution determines the further orientation of the development of production on the basis of the use of robotics, the emergence of new opportunities through technology, network and ICT technologies, changes in the sectoral structure of the economy, «offshoring» labor market, etc.

In these conditions, the role of intellectual development factors is growing dramatically. There is a general intellectualization of the economy, the key factors of which are education and science. However, in today's conditions, their influence is substantially increased: both directly and through influence on other factors and driving forces of development of society[144]. What matters are not only is the growth of intellectual factors, but also the achievement of intellectual leadership that begins to be perceived as a factor in ensuring competitiveness in the knowledge economy. There is an expansion of the scope of understanding of intellectual leadership - how to manage the change in the business environment[145]. In general, all these changes form the basis of the formation of a global innovation space as a new phenomenon that acquires characteristics of the common market, the rules of which are determined by key innovators.

The formation of a global innovation space (GIS) is a dynamic process that is characterized by activation of innovational process and factors of economic development, the spread of global forms of interaction between different subjects of innovation, the intensification of competition for leadership positions at the global level[146]. First of all, the evidence of this should be the emergence of numerous global ratings and indexes that assess the various aspects (potential, process and results) of the innovation activities of the world. In order to achieve high positions in the ratings, both resources and results are important: inputs are institutions, human capital and research, infrastructure and complexity of the market; the results are patents, scientific articles and creative results[147]. Thus, innovations are gaining weight for all countries, as they become the basis for the formation of competitive advantages in various spheres. Fierce competition in the innovation space is accompanied by constant changes of disposition among the countries of the world, including among the most innovative countries. Top-20 most innovative countries mostly include high-income countries, although

144 AbuMezied A. What role will education play in the Fourth Industrial Revolution? 2016. URL: https://www.weforum.org/agenda/2016/01/what-role-will-education-play-in-the-fourth-industrial-revolution/

145 Blinder A. Education for the Third Industrial Revolution. CEPS Working Paper. 2008. No. 163. P. 1-19. URL: https://www.princeton.edu/ceps/workingpapers/163blinder.pdf.

146 Kubik G.H. Limitless: becoming remarkable in the borderless economy. On the Horizon. 2013. Vol. 21(2). P.114-126. URL: https://doi.org/10.1108/10748121311323012 [13 08 2018]

147 Kulkarni A. Index shows the global innovation gap is growing. 2017. URL: http://www.universityworldnews.com/article.php?story=2017080106484882

relatively new leaders are beginning to pour out new outsiders.

In particular, China shifted at once from 25 in 2016, to 22 places in 2017. These countries consistently demonstrate broad innovative capabilities: powerful scientific and engineering systems, active cooperation between education, science and business. Over the past ten years, the map of innovative economies has changed significantly (Table 11):

TABLE 11. The dynamics of economies according to the Global Innovation Index, 2007-2020[148];[149]

Country	GII, 2007	GII, 2020	Change position	Country	GII, 2007	GII, 2020	Change position
Ireland	21	15	+6	Singapore	7	8	-1
Sweden	12	2	+10	Luxembourg	10	18	-8
South Korea	19	10	+7	Britain	3	4	-1
Iceland	20	21	-1	USA	1	3	-2
Netherlands	9	5	+4	Hong Kong	10	11	-1
Norway	25	20	+5	Germany	2	9	-7
Switzerland	6	1	+5	Canada	8	17	-9
Denmark	11	6	+5	France	5	12	-7
Finland	13	7	+6	Japan	4	16	-12
Austria	22	19	+3	Belgium	15	22	-7
Israel	18	13	+5	UAE	14	34	-20

Switzerland is the global leader in terms of innovation, which has improved its position by 5 points over the past 15 years. In general, almost all countries showing a positive growth (except for Norway and Austria) were among the top 20 countries in the ranking in 2007. The United Arab Emirates, which have lost 21 positions from 2007 and Belgium with a loss of 7 positions, losing their place in the TOP-20 in the ranking, show the highest rates of decline. The US has lost its leading position during this time, while remaining in high positions. At the same time, Global innovation index includes a lot of indicators, which characterizing different aspects of innovation activity. Countries are showing significant gaps between the values of individual indicators. (Table 12):

TABLE 12. Ranking of Top-10 countries by indicators, position in the ranking, 2020[150]

148 Global innovative index 2007. URL: https://www.globalinnovationindex.org/userfiles/file/GII-2007-Report.pdf

149 Global innovative index 2020. URL: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf

150 Ibid.

Place in rating	Economy	Institutions	Human capital	Infrastructure	The complexity of the market	The complexity of business	Knowledge and technological results	Creative outputs
1	Switzerland	13	6	3	6	2	1	2
2	Sweden	11	3	2	12	1	2	7
3	USA	9	12	24	2	5	3	11
4	UK	16	10	6	5	19	9	5
5	Netherlands	7	14	18	23	4	8	6
6	Denmark	12	2	4	8	11	12	10
7	Finland	2	4	9	33	8	6	16
8	Singapore	1	8	13	4	6	14	18
9	Germany	18	5	12	24	12	10	9
10	Republic of Korea	29	1	14	11	7	11	14

For example, Singapore shows the largest gap in its ranking having first position in terms of the level of activity of institutions and institutional support in general, but it has only 18 position by the level of creative activity results. In general, the global leaders in terms of innovation show the highest positions in terms of knowledge, technology products and performance. This group of indicators includes following indices: creation of knowledge, the number of patents by origin, patent applications, utility models by origin, scientific and technical articles, index of scientific papers citing, influence of knowledge, rate of growth of employees, new enterprises, expenses on computer software, ISO 9001 certificates of quality, high-tech production (high and medium technology), knowledge dissemination, etc. The role of the creative component for an innovative economy is undeniable, as evidenced by research[151];[152]. A significant gap between individual indicators explains the focus of individual countries' activities on particular segments of economic activities.

In GIS, a unique landscape of innovation activity is formed, and it forms standard approaches to assess its effectiveness. Extremely high performance is demonstrated by highly developed countries. At the same time, some developing countries, in particular, Malaysia, Thailand, Vietnam, the Philippines, Indonesia and Cambodia, are substantially improving their performance. The assessment

151 Baculakova, K. Harakalova, L. Creative industries in the EU: factors influencing employment. Economic Annals-XXI. 2017. Vol.164(3-4). P.40-44. URL: https://doi.org/10.21003/ea.V164-09

152 Baculakova K., Gress M. Cluster analysis of creative industries in the EU. Economic Annals-XXI. 2015. Vol.9-10. P.15-18. URL: http://soskin.info/ en/ea/2015/9-10/contents_3.html

of efficiency takes into account the ability to make significant investments in education and research with to obtain a social and commercial effect; number of engineering graduates and employees in the field of science and technology; opportunities of talents realization in business structures; the high proportion of exports of creative goods, the cost of world companies, cooperation business and science, the number of patent applications (Table 13):

TABLE 13. Key indicators of innovation activities of global key innovators[153]

Country	The average cost of the three leading world companies to the R&D, 2020		Collaboration between universities and business, 2020		Knowledge-intensive emploment, %, 2020		Patent applications by origin, amount per billion GDP, 2020	
	Value, mln.	Grade rank	Value,	Grade rank	Value	Grade rank	Value	Grade rank
Switzerland	91,3	5	77,5	2	53,8	3	16,7	1
Sweden	79,0	10	71,0	7	53,5	4	10,7	9
USA	100,0	1	75,7	4	48,0	9	13,9	1
UK	84,8	8	69,0	11	49,2	7	6,1	15
Netherlands	83,0	9	74,4	5	47,7	11	9,5	10
Denmark	71,3	15	61,1	10	47,0	13	12,1	8
Finland	76,0	12	75,8	3	47,8	10	12,1	7
Singapore	48,6	30	71,3	6	56,9	2	2,8	32
Germany	95,6	2	70,7	8	45,2	17	16,9	17
Republic of Korea	91,4	4	57,4	28	39,5	29	72,7	1

At the same time, the gaps in these indicators are also quite significant. For instance, Switzerland ranks first in terms of cooperation between universities and business, but is significantly lower by the number of researchers in the business. The role of university in modern world is one of the majors[154]. The United States is leading the research and development (R&D) cost of three large companies, outpacing almost 30% its successor, Germany. In general, the US is among Top-10 innovative economies in the world by almost all indicators. As the analysis shows, all key innovation countries have quite high level of effective indicators of scientific activity.

The analysis of the results of innovation activities suggests that the intellectual

153 Global innovative index 2020. URL: https://www.globalinnovationindex.org/analysis-economy

154 Paleari S., Donina D., Meoli M. The Role of the University in Twenty-first Century European Society. Journal of Technology Transfer. 2015. Vol. 40. Issue 3. P.369–379. URL: https://doi.org/10.1007/s10961-014-9348-9

leadership of the TOP-10 most innovative countries is backed up by a very active position and policy of the state. Thus, by some indicators, only some of the selected countries are not included in the TOP-10, but this may be due to their orientation towards other types of innovation activity. However, some countries that are not among the top-10 most innovative economies are leading by some indicators. For example, Israel ranks first in the world by the number of researchers per thousand of population, which is the result of a state policy on the formation of an innovation technology hub, with a simplified taxation for companies that open their research centers in Israel. China leads the number of patent applications as a result of a state long-term strategy focused on very clear, definite indicators and goals. The strategy from simulation to innovation is foremost manifested at the level of certain indicators and in the long run can provide world leadership by the level of innovation.

In general, in the modern world, the formation of open innovation networks occurs. Their main goal is the formation of incoming flows of innovation or key factors that can promote the development of innovation. The spread of ICT creates new opportunities for cooperation, information seeking and the exchange of results between the various levels of global economy[155]. The possibilities of information exchange enable accelerating all economic and innovative processes in the global space, reducing transaction costs, creating powerful network accounting systems, trading, business communications, joint innovations, etc.[156].

Innovation process in the present conditions inevitably becomes international in nature, as at any stage (R&D, development and release of new products) it becomes impossible without taking into account the requirements of the environment. Thus, ICT, on the one hand, brings impulses of the environment to individual subjects of innovation activity, and, on the other hand, allows them to quickly interact with him and other actors. Such global information environment becomes an integral part of the global innovation space. Evidence of the great importance of information technology is data on the growth of traffic, the growth of trade, exports of ICT goods and services.

It can be stated that the formation of a global innovation space is a dynamic process characterized by processes of increasing the influence of intellectual factors on the dynamics of world economic development, the formation of global innovation networks, acceleration of human resources movement, creation of global systems of measurement, indication and evaluation of innovative

155 Jaehan Ch. Knowledge transfer to foreign affiliates of multinationals through expatriation. Journal of International Economics. 2018. Vol. 113. P. 106-117. URL: https://doi.org/10.1016/j.jinteco.2018.04.006

156 Hvizdova E., Mokrisova V., Polacko J. Changes in research and development after crisis in selected countries. Economic Annals-XXI. 2016. Vol.160(7-8). P.31-34. URL: https://doi.org/10.21003/ea.V160-06

development for both individual entities and general trends, aggravating competition for leadership positions at the global level.

An integral feature of the innovation of any subject is the achievement of high positions in numerous ratings or global-level indices that assess the various aspects (potential, process and results) of innovation activities in the world. Under the influence of fierce competition, there are constant changes in the country's disposition: new outsiders are emerging, and the gap between global leaders and their followers is shrinking. Over the past ten years, the map of innovative economies has changed significantly. Top-20 most innovative countries mostly include high-income countries, although relatively new leaders are beginning to pour out new outsiders. Some developing countries are substantially improving their performance. In the international space of innovation, China's role is growing substantially, as it increases the speed of innovation development, the export of high-tech products, etc.

The dynamic development of the global innovation space brings to its orbit and the movement of human resources, the evidence of which is the rapid growth of the global market of educational services. Acute competition between the countries for its share in this market, for attracting foreign students leads to changes in the disposition, the emergence of new actors and new turbulent processes. There are sharp increasing of the number of foreign students in the world (from 3.0 million in 2005 to 5.6 mln people in 2018), decreasing the share of OECD countries, the emergence of new active actors (China, Saudi Arabia, Russia), weakening the position of traditional leaders in the educational services market (US, Great Britain, Australia, Germany, etc.) in the global market of educational services.

Promotion of innovation is becoming a priority task of any country in the context of providing sustainable competitive advantages in global innovation space. A highly competitive environment requires from governments working out of a separate strategy for innovation development aimed at comprehensive support for priority sectors focused on the development of knowledge economy. The results of intellectual and creative activity become dominant in these conditions.

The impact of intellectual factors in economic development of a country: a cluster analysis

Accelerated and active intellectualization is a common trend of modern world economic development. The axiom is that the accumulation and use of intellectual resources is the driving force (engine) for the countries' development. It is the intellectual factors that underpin the countries' breakthrough development and their high competitiveness basis. At the same time, a considerable scientific interest is raised by the question of what intellectual factors are important for different countries.

A cluster analysis of the countries characterized by decisive development trends was made in order to identify and summarize existing dependencies. In total, 44 countries were selected for the study, which are rather heterogeneous in terms of their socio-economic development and geopolitical position.

The purpose of the analysis is to identify the relations between resource and performance indicators for a country's intellectualization and GDP dynamics. The resource indicators include: human (total number of students; number of students by level of study such as short courses, bachelor, master, doctor of philosophy, etc.; total number of students who went to study abroad; total number of students who went to study to the country; balance of inbound / outbound students; proportion of the population with higher education); financial (government expenditure on education (in mln. units of the national currency); government expenditure on higher education (in mln. units of the national currency); expenditure on higher education relative to general government expenditure (in %); education expenditure as a percentage of general government expenditure; education expenditure relative to GDP expenditure on higher education (% of GDP); intellectual (total number of scientists; number of scientists per 1 million of population; number of scientists per 1 thousand employees). The indicators mentioned above characterize the potential for intellectual activity.

The following set of indicators relates to the results of intellectual activity already obtained. These results should be divided into educational and scientific ones (number of world-class universities; number of scientific and technical publications; number of Nobel laureates); infrastructure (number of Internet users (in % of total population); number of mobile telephony users (in persons); number of mobile telephony users (per 100 persons); number of fixed telephone communication users; number of fixed telephone communication users (per 100 persons); Secured Internet Servers; Secured Internet Servers (per 1 million of population); technological (technical staff in R&D; technical staff in R&D (per 1 million of population); trademark registration (residents, non-residents, and total population); high-tech exports (in $ or in % of total exports); ICT products and services (exports and imports); applications for industrial designs (from residents and non-residents); patent applications (from residents and non-residents); innovative activity of enterprises).

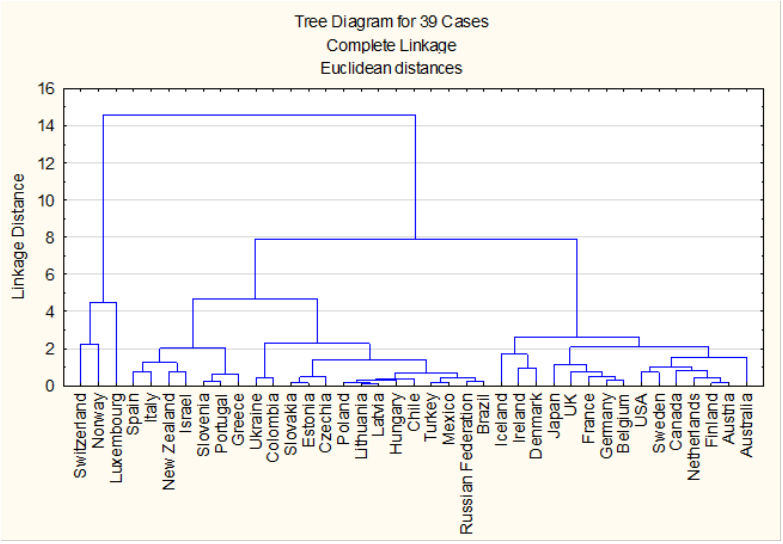

FIGURE 14. Dendrogram of hierarchical clustering of countries by GDP per capita in 2005-2015

Source: Drawn by the authors

The methodology for identifying clusters that integrate characteristic countries is based on the results of a hierarchical agglomerative cluster analysis procedure. The process of clustering is presented in the form of a dendrogram. Figure 14 shows the dendrogram of clustering countries by GDP per capita by full-scale method, and the Euclidean distance between countries is chosen as a measure of distance. In addition, a hierarchical clustering of countries by

resource and output level was conducted.

Based on clustering results, we have identified 3 groups of countries characterized by high (cluster 1), medium (cluster 2) and low (cluster 3) GDP per capita values during 2005-2015. Cluster 4 includes emerging Asian emerging countries identified above - China, Hong Kong, Singapore, India, and the Republic of Korea. The composition of each cluster is given in Table 14:

TABLE 14. The list of countries in each cluster

Cluster 1	Cluster 2
Australia; Austria; Belgium; Canada; Dania; Finland; France; Germany; Iceland; Ireland; Japan Luxembourg; Netherlands; Norway; Sweden; Switzerland; Great Britain; USA	The Czech Republic; Greece; Israel; Italy; New Zealand; Portugal; Slovenia; Spain
Cluster 3	**Cluster 4**
Brazil; Chile; Colombia; Estonia; Hungary; Latvia; Lithuania; Mexico; Poland; Russian Federation; Slovakia; Turkey; Ukraine	China; Hong Kong; India; Republic of Korea; Singapore

The dynamics of average GDP values by clusters is presented in Fig. 15:

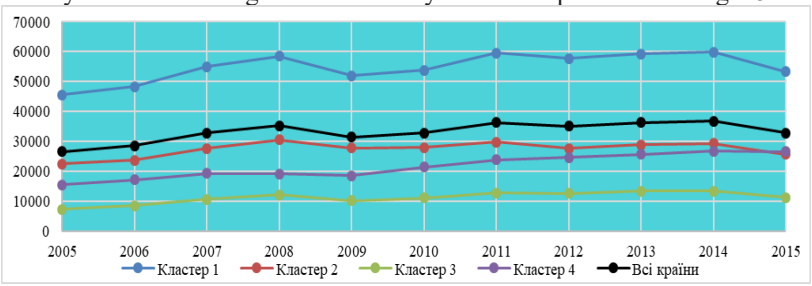

FIGURE 15. Average GDP values by clusters, $US in 2005-2015

Source: Drawn by the authors

We will analyze cluster averages of resource and resulting indicators.

TABLE 15. Cluster averages of resource and resulting indicators

Indicators	1 cluster	2 cluster	3 cluster	4 cluster
total_mobil	2443	1312	1414	2365
inbound_mobil.s	3870	2463	748	2444
gov_tertiary	796	336	126	205
gov_educ	3103	1361	558	715

tertiary_gov_exp	3.136	2.608	3.086	5.495
educ_gov_exp	12.611	11.573	13.625	17.880
gov_tertiary_GDP	1.422	1.119	1.117	1.152
gov_educ_GDP	5.665	4.946	4.840	3.834
Enrol_tert	45992	45471	46802	36764
Enrol_PhD	1677	1548	837	750
Enrol_short	6977	8367	9150	12960
R&D_ per thousand	15	12	6	8
R&D_per million	7515	5124	2480	3947
R&D pers	7517	5100	2482	3963

Source: Calculated by the authors

For almost all indicators, the cluster averages differ significantly, with the exception for the number of enrolled students per 1 million of population. The highest values are observed in countries of the 1st cluster, the lowest - mostly in the countries of the 3rd cluster. Particularly noticeable differentiation between clusters exists in terms of public expenditures on education and the number of R&D staff. These indicators, by the results of modelling the impact of resource factors on the level of economic development, had a significant positive effect on GDP growth.

TABLE 16. Cluster averages of resulting indicators

Indicators	1 cluster	2 cluster	3 cluster	4 cluster
mobile_sub	112	117	112	108
intern_users	81	60	50	53
hi-tech_exp_share	18	9	9	26
hi-tech_exp	1977	564	353	10260
ICT_exp	5.6	4.9	6.7	22.3
ICT_imp	8.6	7.4	9.2	15.7
design_nres	214	120	45	222
design_res	143	171	67	372
patent_nres	265	249	49	900
patent_res	371	143	53	668
trademark_nres	1111	671	491	1000
trademark_res	959	924	604	1039
research_exp	1259	460	95	513
tech_RD	4772	3511	1601	2811

Articles	1553	1243	419	684
Innov	51.7	41.8	29.2	36

Source: Calculated by the authors

In terms of scientific potential (R&D expenditures, number of R&D researchers, publishing activity) and shares of innovatively active enterprises, countries in the 1st cluster occupy leading positions. Countries in the 4th cluster are expected to have the highest levels of high-tech exports and exports / imports of ICT goods. Similarly, the lowest values of indicators are seen for the countries of the 3rd cluster.

Next, we will perform econometric modelling of the impact of resource and resulting indicators on the level of economic development separately for each cluster. The dummy variables characterizing the level of innovation activity of enterprises in the country - Innov_quart2, Innov_quart3, Innov_quart4 - were not used separately for modelling the impact of resulting indicators on the level of economic development for each cluster. This is due to the fact that the countries from the same cluster mainly belong to the same quartile by the level of innovation activity, thus, the introduction of dummy variables makes no sense.

TABLE 17. Resource Factors Influencing GDP- Econometric Modelling for 1-st Cluster Countries.

Indicators	**OLS**	**FE**	**RE**
total_mobil	0.0305***	-0.0282	**0.0340*** **
	(0.00691)	(0.0453)	**(0.00937)**
RD_persons	0.139***	0.132*	0.138***
	(0.0297)	(0.0708)	(0.0388)
gov_educ	0.862***	0.707***	0.816***
	(0.0276)	(0.0451)	(0.0323)
enrol_short	**0.00581** **	0.00469	**0.00608***
	(0.00269)	(0.00959)	**(0.00366)**
educ_gov_exp	**0.00646***	0.00652	**0.00787***
	(0.00381)	(0.00866)	**(0.00477)**
enrol_PhD	-0.0371***	-0.0336	**-0.0373*** **
	(0.0108)	(0.0285)	**(0.0144)**
gov_educ_GDP	-0.170***	-0.126***	-0.162***
	(0.00735)	(0.0183)	(0.00948)
enrol_tert	**-0.0405** **	-0.0288	**-0.0466** **
	(0.0166)	(0.0243)	**(0.0188)**

Constant	4.083***	5.401***	4.428***
	(0.326)	(0.596)	(0.386)
Observations	198	198	198
R-squared	0.923	0.659	
Wald chi2:			1251,52***
Number of country		18	18

Source: Calculated by the authors

Econometric models equation (OLS-model, FE-model, RE-model

$$GDP_{it} = \underset{(0,326***)}{4,083} + \underset{(0,007***)}{0,031}\, total\_mobi1_{it} + \underset{(0,050***)}{0,139}\, RD\_persons_{it} + \underset{(0,028***)}{0,862}\, gov\_educ_{it} + \underset{(0,003**)}{0,006}\, enrol\_short_{it} + \underset{(0,004*)}{0,006}\, educ\_gov\_exp_{it} - \underset{(0,011***)}{0,037}\, enrol\_PhD_{it} - \underset{(0,007***)}{0,170}\, gov\_educ\_GDP_{it},$$

$$GDP_{it} = \underset{(0,596***)}{5,401} - \underset{(0,043)}{0,028}\, total\_mobi1_{it} + \underset{(0,071*)}{0,132}\, RD\_persons_{it} + \underset{(0,045***)}{0,707}\, gov\_educ_{it} + \underset{(0,010)}{0,005}\, enrol\_short_{it} + \underset{(0,009)}{0,007}\, educ\_gov\_exp_{it} - \underset{(0,029)}{0,034}\, enrol\_PhD_{it} - \underset{(0,018***)}{0,126}\, gov\_educ\_GDP_{it},$$

$$GDP_{it} = \underset{(0,386***)}{4,428} + \underset{(0,009***)}{0,0341}\, total\_mobi1_{it} + \underset{(0,059***)}{0,138}\, RD\_persons_{it} + \underset{(0,032***)}{0,816}\, gov\_educ_{it} + \underset{(0,004)}{0,006}\, enrol\_short_{it} + \underset{(0,005*)}{0,008}\, educ\_gov\_exp_{it} - \underset{(0,014**)}{0,037}\, enrol\_PhD_{it} - \underset{(0,010***)}{0,162}\, gov\_educ\_GDP_{it},$$

For countries that have formed the first cluster, government expenditures on education has the most significant impact on GDP growth. At the same time, the share of education expenditures in the overall GDP structure should be reduced. A significant positive impact of the number of R&D employees on GDP growth was identified. The quantity of students enrolled in universities and postgraduate studies have no positive effect on the GDP. Exception is that the only slight positive effect on GDP dynamics is the increase in the quantity of students enrolled in short-term courses. Increasing student mobility has a positive effect on GDP for cluster 1 countries, if we consider the overall trend over 11 years of study (OLS model).

The values of the determination coefficients (R2 = 0.923 for the OLS model and R2within = 0.659 for the FE model) and the statistically significant Wald test for the RE model suggest that all three models are of satisfactory quality.

Test results to determine the best specification of the model testify to the model with fixed effects:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 2,94***	$\chi 2$ = 23,12***	$\chi 2$ = 3,51**

TABLE 18. Resource Factors Influencing GDP- Econometric Modelling for 2-nd Cluster Countries

Indicators	OLS	FE	RE
total_mobil	-0.0828**	-0.216***	-0.115**
	(0.0328)	(0.0671)	(0.0555)
gov_tertiary	0.208***	-0.136*	-0.0294
	(0.0435)	(0.0685)	(0.0646)
gov_educ	0.449***	0.959***	0.781***
	(0.0526)	(0.0897)	(0.0789)
Enrol_PhD	-0.0723**	-0.0176	0.00446
	(0.0325)	(0.0354)	(0.0345)
Constant	6.890***	5.750***	5.542***
	(0.473)	(0.606)	(0.588)
Observations	88	88	88
R-squared	0.771	0.700	
Wald chi2:			165,1***
Number of country		8	8

Source: Calculated by the authors

Econometric models equation (OLS-model, FE-model, RE-model

$$GDP_{it} = \underset{(0,473***)}{6,890} \underset{(0,035**)}{-0,083}\, total\_mobil_{it} + \underset{(0,043***)}{0,208}\, gov\_tertiary_{it} + \underset{(0,053***)}{0,449}\, gov\_educ_{it} - \underset{(0,033**)}{0,072}\, enrol\_PhD_{it},$$

$$GDP_{it} = \underset{(0,606***)}{5,750} \underset{(0,067***)}{-0,216}\, total\_mobil_{it} - \underset{(0,069*)}{0,136}\, gov\_tertiary_{it} + \underset{(0,090***)}{0,959}\, gov\_educ_{it} - \underset{(0,035)}{0,018}\, enrol\_PhD_{it},$$

$$GDP_{it} = \underset{(0,588***)}{5,542} \underset{(0,056**)}{-0,115}\, total\_mobil_{it} - \underset{(0,065)}{0,029}\, gov\_tertiary_{it} + \underset{(0,079***)}{0,781}\, gov\_educ_{it} - \underset{(0,035)}{0,004}\, enrol\_PhD_{it},$$

The highest stimulating effect on GDP growth is provided by government expenditures on education: a 1% increase in it leads to almost 1% GDP growth. Instead, the increase in government expenditures on education, given the panel data structure (fixed effects model), has no positive effect on GDP. The simultaneous inclusion of gov_tertiary and gov_educ into the model is possible, since no close correlation is found between the indicators for 2-nd cluster countries.

The increase in the quantity of students leaving for study abroad has a negative impact on the level of economic growth. The reduction in the quantity of students enrolled in doctorate has a small positive effect on GDP.

According to the determination coefficients (R2 = 0.771 for OLS model and R2within = 0.700 for FE model) and Wald criterion for RE model, we can conclude on the quality and adequacy of the models built.

Model with fixed effects is preferred:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 17,95***	$\chi 2$ = 22,44***	$\chi 2$ = 54,26***

TABLE 19. Resource Factors Influencing GDP- Econometric Modelling for 3-rd Cluster Countries

Indicators	OLS	FE	RE
total_mobil	**0.0290****	-0.0866	0.0175
	(0.0119)	(0.0602)	(0.0182)
gov_educ_GDP	-0.0964***	-0.0923**	-0.0886***
	(0.0298)	(0.0454)	(0.0337)
gov_tertiary	0.400***	0.413***	0.442***
	(0.124)	(0.132)	(0.123)
gov_educ	0.459***	0.417***	0.396***
	(0.135)	(0.134)	(0.132)
Enrol_PhD	0.0343*	0.162***	0.0616***
	(0.0179)	(0.0461)	(0.0234)
educ_gov_exp	**0.0108****	0.0146	**0.0146****
	(0.00478)	(0.0116)	**(0.00658)**
gov_tertiary_GDP	-0.476***	-0.486***	-0.522***
	(0.110)	(0.158)	(0.116)
Constant	4.911***	5.022***	4.975***
	(0.257)	(0.450)	(0.273)
Observations	143	143	143
R-squared	0.950	0.807	
Wald chi2:			1307,80***
Number of country		13	13

Source: Calculated by the authors

Econometric models equation (OLS-model, FE-model, RE-model):

$$GDP_i = \underset{(0,257***)}{4,911} + \underset{(0,012**)}{0,029}\, total\_mobil_i - \underset{(0,030***)}{0,096}\, gov\_educ\_GDP_i + \underset{(0,124***)}{0,400}\, gov\_tertiary_i + \underset{(0,135***)}{0,459}\, gov\_educ_i + \underset{(0,018*)}{0,034}\, enrol\_PhD_i + 0,011\, \underset{(0,005**)}{educ\_gov\_exp_i} - \underset{(0,116***)}{0,476}\, gov\_tertiary\_GDP_i;$$

$$GDP_i = \underset{(0,450***)}{5,022} - \underset{(0,060)}{0,087}\, total\_mobil_i - \underset{(0,045**)}{0,092}\, gov\_educ\_GDP_i + \underset{(0,132***)}{0,413}\, gov\_tertiary_i + \underset{(0,134***)}{0,417}\, gov\_educ_i + \underset{(0,046***)}{0,162}\, enrol\_PhD_i + 0,015\, \underset{(0,012)}{educ\_gov\_exp_i} - \underset{(0,158***)}{0,486}\, gov\_tertiary\_GDP_i;$$

$$GDP_i = \underset{(0,273***)}{4,975} + \underset{(0,018)}{0,018}\, total\_mobil_i - \underset{(0,034***)}{0,089}\, gov\_educ\_GDP_i + \underset{(0,123***)}{0,442}\, gov\_tertiary_i + \underset{(0,132***)}{0,396}\, gov\_educ_i + \underset{(0,023***)}{0,062}\, enrol\_PhD_i + 0,015\, \underset{(0,007**)}{educ\_gov\_exp_i} - \underset{(0,116***)}{0,522}\, gov\_tertiary\_GDP_i;$$

As for cluster 3-rd countries, government expenditures on education and public expenditures on higher education have almost the same positive impact on GDP growth. At the same time, the share of the expenditure on education in the overall GDP structure should be reduced. This applies to both educations in general and higher education in particular.

An increase in the quantity of students leaving for study abroad has a small positive effect on GDP dynamics (as for the models with individual effects, the factor total_mobil was statistically insignificant, thus, reasonable conclusions can be drawn only for the unified model). Increasing the number of postgraduate students has a positive effect on GDP.

The high quality of the developed models is indicated by the high values of the determination coefficients (where R2 = 0.950 for the OLS model, and R2within = 0.8007 for the FE model), and the statistical significance of the Wald test for the RE model.

The test results for selecting the best model are as follows:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 3,12***	$\chi 2$ = 5,88	$\chi 2$ = 3,96**

The Wald and Breusch-Pagan tests indicated the need for a panel data structure, and the Hausman test should give preference to the random effects models. However, as already noted, the fixed effects model is more appropriate for econometric modelling of our data.

TABLE 20. Resource Factors Influencing GDP, Econometric Modelling for 4-th cluster countries.

Indicators	OLS	FE	RE
total_mobil	0.378***	0.0162	0.378***
	(0.0612)	(0.111)	(0.0612)
Enrol_tert	0.270***	0.368***	0.270***
	(0.0830)	(0.0842)	(0.0830)
gov_tertiary	0.222***	0.247***	0.222***
	(0.0418)	(0.0497)	(0.0418)
RD_per_thous	0.412***	0.811***	0.412***
	(0.0488)	(0.0920)	(0.0488)
educ_gov_exp	0.0282***	0.0142*	0.0282***
	(0.00899)	(0.00739)	(0.00899)
gov_tertiary_GDP	0.171***	0.0378	0.171***
	(0.0639)	(0.0492)	(0.0639)

gov_educ_GDP	-0.155***	-0.261***	-0.155***
	(0.0307)	(0.0399)	(0.0307)
Constant	2.041**	3.647***	2.041**
	(0.876)	(0.940)	(0.876)
Observations	55	55	55
R-squared	0.996	0.962	
Wald chi2:			11118,79***
Number of country		5	5

The reference: Calculated by the authors

Econometric model equation (OLS model, FE model, RE model):

$$GDP_t = \underset{(0,876^{**})}{2,041} + \underset{(0,061^{***})}{0,378}\, total\_mobi1_t + \underset{(0,083^{***})}{0,270}\, enrol\_tert_t + \underset{(0,042^{***})}{0,222}\, gov\_tert_t + \underset{(0,049^{***})}{0,412}\, RD\_per\_thous_t + \underset{(0,005^{***})}{0,028}\, educ\_gov\_exp_t + \underset{(0,064^{***})}{0,171}\, gov\_tertiary\_GDP_t - \underset{(0,031^{***})}{0,155}\, gov\_educ\_GDP_t$$

$$GDP_t = \underset{(0,940^{**})}{3,647} + \underset{(0,111)}{0,016}\, total\_mobi1_t + \underset{(0,084^{***})}{0,368}\, enrol\_tert_t + \underset{(0,050^{***})}{0,247}\, gov\_tert_t + \underset{(0,052^{***})}{0,811}\, RD\_per\_thous_t + \underset{(0,007^{***})}{0,014}\, educ\_gov\_exp_t + \underset{(0,049)}{0,038}\, gov\_tertiary\_GDP_t - \underset{(0,040^{***})}{0,261}\, gov\_educ\_GDP_t$$

For 4-th cluster countries, the most significant impact on GDP growth is the increase in the quantity of R&D employees. Public expenditure on higher education has a significant positive impact on GDP growth. The negative factor with the variable gov_educ_GDP means that GDP growth is accompanied by a reduction in the share of education expenditures in the overall GDP structure. The quantity of students enrolled in universities also has a significant impact on GDP growth.

The high quality of the developed models is indicated by the high values of the determination coefficients (where R2 = 0.9996 for the OLS model, and R2within = 0.962 for the FE model), and the statistical significance of the Wald test for the RE model.

Test results for the best model selection indicate in favour of the fixed effects model:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 18,12***	$\chi 2 = 105,61$***	$\chi 2 = 0$

Zero value for the Breusch-Pagan test means that the combined model and the random effects model both have given exactly the same results for estimating the model coefficients, so it is senseless to use the random effects model.

TABLE 21. Resulting Factors Influencing GDP, Econometric Modelling for 1-st cluster countries

Indicators	OLS	FE	RE
mobile_sub	0.327***	0.0941*	0.128**
	(0.0845)	(0.0552)	(0.0559)
trademark_res	-0.214***	0.0535	0.00991
	(0.0334)	(0.0452)	(0.0430)
hi-tech_exp	0.0519***	-0.0651***	-0.0370*
	(0.0197)	(0.0230)	(0.0210)
trademark_nres	0.0288**	0.0837***	0.0780***
	(0.0132)	(0.0234)	(0.0208)
research_exp	0.493***	0.734***	0.681***
	(0.0453)	(0.0433)	(0.0413)
design_nres	0.0270***	-0.0133	-0.0109
	(0.00851)	(0.0128)	(0.0119)
design_res	-0.0265**	-0.0416***	-0.0420***
	(0.0120)	(0.0114)	(0.0113)
patent_nres	0.0704***	-0.0130	-0.0124
	(0.0129)	(0.00964)	(0.00956)
patent_res	-0.140***	0.0372	0.0146
	(0.0188)	(0.0225)	(0.0216)
Constant	7.172***	4.916***	5.369***
	(0.519)	(0.424)	(0.416)
Observations	198	198	198
R-squared	0.721	0.785	
Wald chi2:			579,59***
Number of country		18	18

The reference: Calculated by the authors

Econometric model equation (OLS model, FE model, RE model):

$$GDP_{it} = \underset{(0,519***)}{7,172} + \underset{(0,089***)}{0,327}\, mobile\_sub_{it} - \underset{(0,033***)}{0,214}\, trademark\_res_{it} + \underset{(0,020***)}{0,052}\, hi-tech\_exp_{it} + \underset{(0,013***)}{0,029}\, trademark\_nres_{it} + \underset{(0,045***)}{0,493}\, research\_exp_{it} + \underset{(0,005***)}{0,027}\, design\_nres_{it} - \underset{(0,012**)}{0,027}\, design\_res_{it} + \underset{(0,013***)}{0,071}\, patent\_nres_{it} - \underset{(0,019***)}{0,140}\, patent\_res_{it}$$

$$GDP_{it} = \underset{(0,424***)}{4,916} + \underset{(0,055*)}{0,094}\, mobile\_sub_{it} + \underset{(0,045)}{0,054}\, trademark\_res_{it} - \underset{(0,023***)}{0,065}\, hi-tech\_exp_{it} + \underset{(0,023***)}{0,084}\, trademark\_nres_{it} + \underset{(0,043***)}{0,734}\, research\_exp_{it} - \underset{(0,013)}{0,013}\, design\_nres_{it} - \underset{(0,011***)}{0,042}\, design\_res_{it} - \underset{(0,010)}{0,013}\, patent\_nres_{it} + \underset{(0,023)}{0,037}\, patent\_res_{it}$$

$$GDP_{it} = \underset{(0,416***)}{5,369} + \underset{(0,056**)}{0,128}\, mobile\_sub_{it} + \underset{(0,043)}{0,010}\, trademark\_res_{it} - \underset{(0,021*)}{0,037}\, hi-tech\_exp_{it} + \underset{(0,021***)}{0,078}\, trademark\_nres_{it} + \underset{(0,041***)}{0,681}\, research\_exp_{it} - \underset{(0,012)}{0,011}\, design\_nres_{it} - \underset{(0,011***)}{0,042}\, design\_res_{it} - \underset{(0,010)}{0,012}\, patent\_nres_{it} + \underset{(0,022)}{0,015}\, patent\_res_{it}$$

For 1-st cluster countries, R&D expenditure has a key positive effect on

economic development. It has been found that the growth of high-tech exports under the integrated model has a positive effect on economic development level, and, in the same time, it has a negative effect on the models that take into account individual effects. Therefore, as a rule, higher high-tech exports' value corresponds to higher GDP value, but if we consider each country as a separate entity, the growth of high-tech exports has a negative impact on the country's economic development level. Improving the information infrastructure has a little positive impact on the economic development level. Increase in non-resident intellectual property assets has a positive impact on GDP.

The high quality of the developed models is indicated by the high values of the determination coefficients (where R2 = 0.721 for the OLS model, and R2within = 0.785 for the FE model), and the statistical significance of the Wald test for the RE model.

Test results for the best model selection indicate in favour of the fixed effects model:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 64,23***	$\chi 2$ = 363,03***	$\chi 2$ = 424,07***

TABLE 22. Resulting Factors Influencing GDP, Econometric Modelling for 2-nd cluster countries

Indicators	OLS	FE	RE
mobile_sub	0.855***	0.945***	0.855***
	(0.178)	(0.184)	(0.178)
intern_users	0.00258**	0.00257**	0.00258**
	(0.00127)	(0.00128)	(0.00127)
hi-tech_exp	-0.152***	-0.147***	-0.152***
	(0.0300)	(0.0303)	(0.0300)
ICT_exp	-0.0285***	-0.0316***	-0.0285***
	(0.0104)	(0.0108)	(0.0104)
ICT_imp	0.0433***	0.0467***	0.0433***
	(0.0116)	(0.0121)	(0.0116)
design_nres	0.0902***	0.0937***	0.0902***
	(0.0208)	(0.0214)	(0.0208)
patent_res	-0.101*	-0.125**	-0.101*
	(0.0537)	(0.0567)	(0.0537)
research_exp	0.340***	0.350***	0.340***
	(0.0474)	(0.0493)	(0.0474)

Constant	5.197***	4.728***	5.197***
	(0.834)	(0.866)	(0.834)
Observations	88	88	88
R-squared	0.724	0.738	
Wald chi2:			204,62***
Number of country		8	8

The reference: Calculated by the authors

Econometric model equation (OLS model, FE model, RE model):

$$GDP_i = \underset{(0,834***)}{5,197} + \underset{(0,178***)}{0,855}\, mobile\_sub_i + \underset{(0,001**)}{0,003}\, internet\_users_i - \underset{(0,030***)}{0,152}\, hi\text{-}tech\_exp_i - \underset{(0,010***)}{0,029}\, ITC\_exp_i + \underset{(0,012***)}{0,043}\, ITC\_imp_i + \underset{(0,021***)}{0,090}\, design\_nres_i - \underset{(0,054*)}{0,101}\, patent\_res_i + \underset{(0,049***)}{0,340}\, research\_exp_i$$

$$GDP_i = \underset{(0,866***)}{4,728} + \underset{(0,184***)}{0,945}\, mobile\_sub_i + \underset{(0,001**)}{0,003}\, internet\_users_i - \underset{(0,030***)}{0,147}\, hi\text{-}tech\_exp_i - \underset{(0,011***)}{0,032}\, ITC\_exp_i + \underset{(0,012***)}{0,047}\, ITC\_imp_i + \underset{(0,021***)}{0,094}\, design\_nres_i - \underset{(0,057***)}{0,125}\, patent\_res_i + \underset{(0,049***)}{0,350}\, research\_exp_i$$

The amount of expenditures invested in research and development have a positive impact on GDP. Improving the information infrastructure also has a little positive impact on the economic development level. The rise in high-tech exports and ICT exports is undesirable and leads to a slowdown in economic development, while an increase in the ICT goods' share imports in the overall import structure has a positive effect on GDP growth. The increase in quantity of non-residents providing industrial design services has a positive impact on the economic development level.

The high quality of the developed models is indicated by high values of the determination coefficients (where R2 = 0,724 for the OLS model, and R2within =0,738 for the FE model), and the statistical significance of the Wald test for the RE model.

The tests' results for choosing the best model refute the hypothesis of a panel structure's presence in the data:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 0,85	$\chi 2 = 4,71$	$\chi 2 = 0$

When modelling the resulting indicators influencing GDP, the same coefficients for the OLS and RE models and the very similar coefficients in the FE model also indicate the absence of unobserved individual characteristics in the 2-nd cluster countries. Thus, a unified cross-regression model is modelling the real data most adequately.

TABLE 23. Resulting Factors Influencing GDP, Econometric Modelling for 3-rd cluster countries.

Indicators	OLS	FE	RE
research_exp	0.370***	0.507***	0.504***
	(0.0356)	(0.0389)	(0.0395)
intern_users	0.00928***	0.00345***	0.00376***
	(0.00144)	(0.00103)	(0.00105)
trademark_nres	0.109***	0.297***	0.213***
	(0.0332)	(0.0452)	(0.0398)
hi-tech_exp	-0.0844***	0.0626*	0.00624
	(0.0237)	(0.0368)	(0.0324)
trademark_res	0.212***	-0.0670	0.00189
	(0.0412)	(0.0744)	(0.0702)
ICT_imp	**0.0332****	-0.00905	-0.00335
	(0.00547)	(0.00561)	(0.00575)
design_nres	**-0.0675****	0.00249	0.00396
	(0.0147)	(0.0108)	(0.0111)
Constant	5.524***	5.359***	5.625***
	(0.257)	(0.442)	(0.423)
Observations	143	143	143
R-squared	0.831	0.852	
Wald chi2:			633,35***
Number of country		13	13

The reference: Calculated by the authors.

Econometric model equation (OLS model, FE model, RE model):

$$GDP_t = \underset{(0,257***)}{5,524} + \underset{(0,039***)}{0,370}\, research\_exp_t + \underset{(0,001***)}{0,009}\, intern\_users_t + \underset{(0,033***)}{0,109}\, trademark\_nres_t - \underset{(0,024***)}{0,084}\, hi-tech\_exp_t + \underset{(0,041***)}{0,212}\, trademark\_res_t + \underset{(0,009***)}{0,033}\, ITC\_imp_t - \underset{(0,015***)}{0,068}\, design\_nres_t$$

$$GDP_t = \underset{(0,442***)}{5,359} + \underset{(0,039***)}{0,507}\, research\_exp_t + \underset{(0,001***)}{0,003}\, intern\_users_t + \underset{(0,043***)}{0,297}\, trademark\_nres_t + \underset{(0,037*)}{0,063}\, hi-tech\_exp_t - \underset{(0,074)}{0,067}\, trademark\_res_t - \underset{(0,005)}{0,009}\, ITC\_imp_t + \underset{(0,011)}{0,002}\, design\_nres_t$$

$$GDP_t = \underset{(0,423***)}{5,625} + \underset{(0,040***)}{0,504}\, research\_exp_t + \underset{(0,001***)}{0,004}\, intern\_users_t + \underset{(0,040***)}{0,213}\, trademark\_nres_t + \underset{(0,032)}{0,062}\, hi-tech\_exp_t - \underset{(0,070)}{0,002}\, trademark\_res_t - \underset{(0,008)}{0,003}\, ITC\_imp_t + \underset{(0,011)}{0,004}\, design\_nres_t$$

For 3-rd cluster countries, the most significant impact on GDP growth is provided by the increase in R&D expenditure. Registration of new trademarks for both residents and non-residents contributes to economic growth. There is a small but statistically significant correlation between the quantity of Internet users and GDP growth. Growth in high-tech exports in the unified model is found to have a negative impact on economic development, but, in the same time, it has a positive impact on GDP by the models that take into account the

individual features of each country. That is, if we consider each country as a separate entity, the growth of high-tech export volumes has a positive impact on the country's economic development level.

The high quality of the developed models is indicated by the high values of the determination coefficients (where R2 = 0.831 for the OLS model, and R2within = 0.852 for the FE model), and the statistical significance of the Wald test for the RE model.

Test results for the best model selection indicate in favour of the fixed effects model:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 48.55***	$\chi 2$ = 117.33***	$\chi 2$ = 180.26***

TABLE 24. Resulting Factors Influencing GDP, Econometric Modelling for 4-th cluster countries

Indicators	OLS	FE	RE
research_exp	0.441***	0.499***	0.441***
	(0.0426)	(0.0607)	(0.0426)
trademark_nres	**0.0784*** **	0.0625	0.0784***
	(0.0291)	(0.0395)	(0.0291)
intern_users	0.00763***	0.00686***	0.00763***
	(0.00190)	(0.00246)	(0.00190)
hi-tech_exp	0.00002***	0.000002	0.00002***
	(0.000002)	(0.000006)	(0.000002)
mobile_sub	0.126***	0.119***	0.126***
	(0.0277)	(0.0327)	(0.0277)
ICT_imp	**0.00551*** **	0.00401	0.00551***
	(0.00187)	(0.00315)	(0.00187)
Constant	5.292***	5.330***	5.292***
	(0.122)	(0.324)	(0.122)
Observations	55	55	55
R-squared	0.998	0.963	
Wald chi2:			1204,22***
Number of country		5	5

The reference: Calculated by the authors.

Econometric model equation (OLS model, FE model, RE model):

$$GDP_t = \underset{(0,122^{***})}{5,292} + \underset{(0,043^{***})}{0,441}\, research\_exp_t + \underset{(0,030^{***})}{0,078}\, trademark\_nres_t + \underset{(0,001^{***})}{0,008}\, intern\_users_t + \underset{(0,000002^{***})}{0,00002}\, hi-tech\_exp_t + \underset{(0,028^{***})}{0,126}\, mobile\_sub_t + \underset{(0,002^{***})}{0,006}\, ITC\_imp_t +$$

$$GDP_t = \underset{(0,324^{***})}{5,330} + \underset{(0,061^{***})}{0,449}\, research\_exp_t + \underset{(0,040)}{0,063}\, trademark\_nres_t + \underset{(0,002^{***})}{0,007}\, intern\_users_t + \underset{(0,000008)}{0,000002}\, hi-tech\_exp_t + \underset{(0,033^{***})}{0,119}\, mobile\_sub_t + \underset{(0,003^{***})}{0,004}\, ITC\_imp_t +$$

The research-and-development expenditure has a leading positive impact on GDP growth in 4-th cluster countries. The information infrastructure development has a positive impact on GDP. According to the coefficients, such factors as the increase in high-tech exports, the share of ICT goods' imports, and the quantity of non-residents providing industrial design services have a small positive effect on GDP.

The high quality of the developed models is indicated by the high values of the determination coefficients (where R2 = 0.996 for the OLS model, and R2within = 0.962 for the FE model), and the statistical significance of the Wald test for the RE model.

The test results for the best model selection indicate in favour of the fixed effects model:

Wald test (OLS/FE)	Hausman test (FE/RE)	Breusch-Pagan test (OLS/RE)
F = 3.41**	$\chi 2 = 47.46$*	$\chi 2 = 0$

Basing on the system of indicators for use and reproduction of intellectual capital, the countries were stratified by the level of intellectualization success. A clear topography for innovative development of forty-four most developed countries has been formed. The whole set of countries differentiated according to the key intellectualization factors into four clusters with common development features in both static and dynamic plane.

The key factors influencing GDP of the countries for each group were identified, and the intellectual models for perspective development of the countries positioned in the clusters were characterized. This makes it possible to make realistic prognostic scenarios for their development, taking into account both changes in individual model components and the efficiency of different economic measures and instruments. Correlation-and-regression analysis has revealed 4 key clusters for the countries with common development features.

As a result of the simulations, the following regularities were revealed for each cluster. For first cluster countries the most significant impact on GDP growth is exerted by the government's expenditures on education and the research staff growth. For the second cluster countries growth in expenditures on education by 1% leads to a 1% increase in GDP. The third cluster countries are experiencing a significant positive impact from rising expenditures on education in general and

on higher education in particular. The fourth cluster countries are experiencing a significant positive impact from the increase in research staff and the increase in public expenditures on higher education.

The most influential performance indicators of intellectual activity were also identified. The research-and-development expenditure has the biggest positive impact on GDP growth for the first cluster countries. For second cluster countries these indicators are complemented by the information infrastructure available. For the third cluster countries the most significant impact is the increase in the R&D expenditure and raising capital from abroad, which gives a rather rapid economic effect. For fourth cluster countries, in addition to the classical factors of influence, the share of high-tech goods exports has a positive effect.

Overall, a close linear relationship between GDP per capita and R&D expenditures, the quantity of scientific and technical publications, the quantity of researchers in the R&D industry and the share of the population using the Internet was confirmed. A moderate correlation exists between the GDP value and industrial design of non-resident applications.

The results of modelling the impact of resource level factors indicate that public expenditure on education has the most positive impact on the country's economic development level: if this indicator increases by 1%, it leads to an increase in GDP by 0.8% and increase in the quantity of employees engaged in the R&D implementation by 1%, which allows for an increase in GDP by 0.15%.

The simulation results showed that R&D expenditure has a leading stimulating effect on the GDP growth. Increasing R&D expenditure by 1% enables GDP to increase by 0.55% approximately. The increase in the innovative enterprises' share in the country is also a significant factor in GDP growth.

The intellectual potential of the development of Ukrainian economy in the global environment

The position of Ukraine on first-order leadership indicators (resource indicators) is generally good (Table 25). Government expenditures on education as % of GDP increased from 4% in 2005 to 5,4% in 2016. The share of government expenditures from GDP on higher education increased from 1,3% in 2005 to1,5% in 2016. Government expenditures on higher education as a share of total government expenditures increased by 2% from 2005 to 2010, from 2010 they decreased to 3,7% compared to 2017. Given that GDP of Ukraine grew during this period, this decrease is evidence of negative trends in the economy.

TABLE 25. Dynamics of financial resources of intellectualization of the economy of Ukraine[157]

Indicators	2000	2005	2010	2015	2016	2017
Government expenditures on education, million dollars	7085,5	26801,8	79826,0	114193,5	129437,7	177755,7
Government expenditures on higher education, million dollars	2285,5	7934,1	24998,4	30981,8	35233,6	38681,1
Government expenditures on education, % GDP	4,2	6,1	7,4	5,7	5,4	-
Government expenditures on higher education, % GDP	1,3	1,8	2,3	1,6	1,5	-
Government expenditures on education, % government expenditures	14,7	18,1	21,1	16,8	15,5	16,8

157 Вища освіта в Україні у 2017 р. Статистичний збірник. Київ, 2018. 298 с.

Government expenditures on higher education, % government expenditures	4,7	5,7	6,6	4,6	4,2	3,7

In general, the level of government expenditures (as a share of GDP) on education remains at the level of the world average and is higher than, for example, in Great Britain, Turkey, USA, Switzerland, Spain, Slovakia, Singapore, Poland, Lithuania, Japan, Italy, Ireland and Germany[158]. In terms of expenditures on higher education as a share of GDP, in general, Ukraine's indicator comparing with countries such as the USA, Great Britain, Australia, Austria, Belgium, Brazil, Canada, France, Germany, Portugal, Spain, South Korea and other analyzed countries. In general, only Norway, Denmark and Sweden have higher indicators than in Ukraine[159].

Almost an analogous situation is observed in terms of the education share expenditures from total public expenditures. Ukraine has some of the highest education expenditures within the public expenditure structure, higher education expenditures, in general, observed only in Australia, Brazil, Chile, Colombia, Estonia, Ireland, Israel, New Zealand, Norway, Sweden, Turkey, USA and Great Britain, but higher than in Austria, Canada, Denmark, Japan, Singapore, Spain, Netherlands, and Luxembourg[160].

Government expenditure of Ukraine on higher education is also at a level that corresponds to the leading countries. The median value is set at 3.21%, while Ukraine shows the indicator of 4.2-3,7% of national expenditures and is in the same group as countries such as Turkey, Norway, New Zealand, Mexico, China, Chile, Canada, Denmark[161].

Only countries with low level of population, for example, Estonia, Hungary, Latvia, Lithuania, Luxembourg, Slovenia, and Slovakia, spend less than Ukraine[162]. They spend USD 2,472 million on higher education, which is only 6% of expenditures of Great Britain and 17% of expenditures of Turkey. In the case of comparison of Ukraine with countries with a population close in number to the population of Ukraine, it is lagging far behind - Ukrainian expenditure is 67% of expenditure of Colombia and 38% of expenditure of Poland on

158 Government expenditure on education as a percentage of GDP, selected countries. URL: http://data.uis.unesco.org/#

159 Government expenditure on tertiary education as a percentage of GDP, selected countries. URL: http://data.uis.unesco.org/#

160 Government expenditure on education as a percentage of total government expenditure, selected countries. URL: http://data.uis.unesco.org/

161 Government expenditure on tertiary education as a percentage of total government expenditure, selected countries. URL: http://data.uis.unesco.org/

162 Government expenditure on education in US$ (millions), selected countries. URL: http://data.uis.unesco.org/

higher education[163]. In general, expenditures on education and higher education in particular are not characterized by homogeneity and Ukraine has a stable position only in relative indicators, but their absolute expression indicates the weak position of Ukraine, which is caused by the weakness of the Ukrainian economy as a whole.

The second group of resources includes human resources and their quality, including the number and mobility of students. As the analysis shows, the number of students in Ukraine is quite significant (Table 26):

TABLE 26. Dynamics of change of separate indicators characterizing human resources and their quality[164];[165]

Indicators	2005	2010	2015	2016	2017	2018
Number of students, ISCED 5	548466	566194	427471	408732	398721	383710
Number of students, ISCED 6	..	1433590	855683	800450	774076	746330
Number of students, ISCED 7	..	491504	322116	377572	365768	392210
Number of students, ISCED 8	29683	36214	30308	27755	26432	23974
Number of students studying abroad	26704	36194	68209	77421	77878	72063
Number of foreign students	23259	38166	53493	52147	48991	54566
Student migration balance	-3445	1972	-14716	-25274	-28887	-17497

In general, Ukraine demonstrates various tendencies in this group of indicators, in particular, in terms of student numbers, declining trends are observed at almost all levels. Thus, the number of students at ISCED 5 (short-term courses) has decreased by more than 32% since 2010, as well as at ISCED 6 (bachelor) - a decrease of 48% compared to 2010. At the level of ISCED7 (Master), a decrease was almost 20% compared to 2010. However, the number of students at ISCED 8 (PhD) level decreased by 34% compared to 2010. Ukraine is gradually losing its position in the market of higher education services and is giving way to both highly developed and countries with similar number of population.

163 Government expenditure on tertiary education in US$ (millions), selected countries URL: http://data.uis.unesco.org/

164 Вища освіта в Україні у 2019 році. URL: http://www.ukrstat.gov.ua/.

165 Total outbond internationally mobile tertiary students studying abroad. URL: http://data.uis.unesco.org/#

In terms of participation of Ukraine in global flows of academic mobility, it should be noted that 1.2% of the global flow of foreign students was recorded in our country in 2018. Switzerland, New Zealand, Belgium, and Austria had the same level[166]. In terms of student outflows, Ukraine represents 1.6% of the global flow and is at the same level as Canada, China, Italy, Russia, USA and Turkey.

In general, the net inflow of foreign students to Ukraine is quite volatile (Fig. 16).

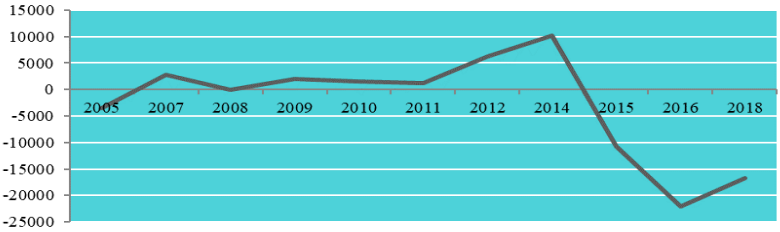

FIGURE 16. Dynamics of student migration balance, persons, 2005–2018

In recent years, there has been a steady tendency to reduce the attractiveness of Ukraine and reduce the number of students coming to Ukraine. In general, place of Ukraine in the global market of educational services is quite ambiguous, due to significant fluctuations in the attractiveness of the country for students. The similar situation is observed in Turkey, Ireland and Poland. In Poland, the positive balance has been observed only in recent years, but the increase is quite significant, it is around 10 thousand students on average every year.

Analyzing the geographical structure of academic student migration, we note that most foreign students come to Ukraine from India (Table 27):

TABLE 27. Geographical structure of Ukraine's participation in the processes of academic migration (TOP-20), persons, 2018[167]

Country of origin	Number of students	Country of destination	Numer of students
Total	55 333	Total	72 063
India	10 698	Poland	26 864
Azerbaijan	5474	Germany	6 481
Moroco	4723	Czechia	3 233

166 Inbound internationally mobile students by continent of origin, selected countries. URL: http://data.uis.unesco.org/#

167 Global flow of teriary-level students. URL: http://uis.unesco.org/en/uis-student-flow

Turkmenistan	3817	Italy	2 950
Nigeria	2882	Slovakia	1 965
Egypt	2632	USA	1 911
Izrael	2013	Austria	1 426
Jordan	1895	Canada	1 230
Georgia	1851	Hungary	1 168
China	1816	France	1 075
Turkey	1593	Bulgaria	850
Ghana	1522	United Kingdom	845
Uzbekistan	1498	Turkey	612
Iran	1403	Netherlands	502
Lebanon	803	Romania	435
Poland	695	Spain	418
Russia	657	Belarus	363
Moldova	648	Switzerland	355
Iraq	630	Lithuania	323
Palestine	527	Greece	270

Consequently, the structure of students entering Ukraine is more homogeneous than the structure of leaving students. The vast majority of students go to Poland (almost 32.3%) and Germany (almost 9% of the total number). Third place is shared by the Czechia and Italy with indicators of 4.5% and 4.1% respectively that indicates significant disproportion in the distribution of students among the destination countries. Up to 2% of the total flows of migrants are heading to the United States (2.7%), Austria (2.0%), Canada (1.7%), Hungary (1.6%), France (1.5%), Bulgary (1.2%) and United Kingdom (1.2%). Less than one percent of the top 20 leading countries account for Turkey, Netherlands, Romania, Spain, Belarus, Switzerland, etc all.

Students coming to Ukraine are distributed more evenly. The leader is India and it provides 19.6% of the total students, Azerbaijan – 10%, Moroco – 8.7%, Turkmenistan — 7.0%. Fifrth place is occupied by Nigeria with a margin of more than 5.3%. Egypt has 4.8%, Israel – 3.7%, Jordan — 3.5%, Georgia — 3.4%, China — 3.3%, Turkey — 2.9%, Ghana — 2.8%, Uzbekistan — 2.8%, Iran — 2.6%, Lebanon — 1.5%, Poland — 1.3%, Russia — 1.2%, Moldova — 1.2%, Iraq – 1.2%.

Participation of Ukraine in global migration flows of students during this period has significantly intensified and the number of Ukrainian students studying abroad has almost tripled since 2005, generally showing an increase of 185% if compared to the basic indicators. As for the involvement of foreign

students in the system of higher educational of Ukraine, the trends are quite close — the indicators of 2018 are 235% compared to 2005. At the same time, the migration balance of students was almost the entire period in a positive plane, which indicates the attractiveness of Ukrainian education for foreign students, but in 2015 and 2018 the balance showed a steady decline and gained negative values.

The last block of first-order leadership indicators includes indicators of the own intellectual component (Table 28):

TABLE 28. Dynamic of R&D staff number of Ukraine and Latvia, persons[168]

	2006	2010	2015	2016	2017	2018
Ukraine						
Numder R&D staff	136244,7	116320,8	81854,4	71071,2	67806	65594.3
Numder R&D staff on millions population	2922,7	2540,2	1914,3	1668,7	1598.6	1553.8
Number of R&D staff per thousand employees	6,7	5,9	4,5	4	3.8	3.7
Latvia						
Numder R&D staff	5396	5739.0	5570.0	5120.0	5378.0	5806
Numder R&D staff on millions population	2638.7	2839.4	2788.2	2593.4	2756.4	3010.7
Number of R&D staff per thousand employees	5.9	6.3	6.1	5.6	5.8	6.3

As for intellectual indicators, place of Ukraine is gradually going down, and since 2005 the reduction in all indicators has occurred by more than 40%. Thus, the total number of scientific personnel decreased by almost 52%, the decrease was 47% in the recalculation per one million populations, and the number of research staff per thousand employed people decreased by 45%. Although in general, Ukraine remains in the context of key global trends not at the last place, however, negative trends indicate the deterioration of the situation as a whole. Ukraine is in the same group with Finland, Hungary, and Norway[169] according to the indicators of the total number of research personnel. Analyzing the indicators of the number of scientific personnel per million inhabitants, it

168 Science,technology and innovation:Total R&D personnel per thousand total employment, selected countries URL: http://data.uis.unesco.org/; Science,technology and innovation:Total R&D personnel per million inhabitants (Full-time equivalents - FTE) selected countries URL: http://data.uis.unesco.org/

169 Science,technology and innovation:Total R&D personnel, selected countries. URL: http://data.uis.unesco.org/

should be noted that Ukraine occupies one of the last places among the selected countries. For comparison, the table 28 also shows data for Latvia. Although the absolute indicators are much lower than in Ukraine, in terms of relative indicators, Latvia has an advantage. And, besides, there is an obvious positive dynamics of all indicators.

Having the same original positions as Ukraine, Slovakia and Hungary show different trends, because Slovakia and Hungary are gradually increasing the indicators. Poland is showing a gradual increase in indicators, overtaking Ukraine in 2012 and it is ahead of Ukraine by 30%. Latvia is demonstrating increasing these indicators: the total number of research personnel increase from 5396 in 2013 to 5806 in 2018 (on 7.6%), the number of scientific personnel per million inhabitants increased from 2638.7 to 3010.7 (on 14.1%), the number of research staff per thousand employed people increased from 5.9 to 6.3 (on 6.8%) over the same years.

In general, Ukraine has quite good positions in the presence and financing of the resource component, but with the increase in the level of resource intelligence, the indicators are gradually going down. This indicates the low efficiency of intellectual potential realization and the need to develop new innovative tools for its implementation and commercialization.

Educational and scientific indicators include the number of world-class universities, scientific and technical publications and Nobel laureates. According to these indicators, Ukraine has a rather weak position. As for world-class universities, Ukrainian higher educational institutions have been represented in the ranking of the 1000 best universities in the world; in different periods - from 1 to 5 universities.

There are stable positive trends in the growth of the number of scientific articles in cited and peer-reviewed publications; since 2005, growth has taken place by almost 208.3%. By the way, in Latvia, although the number of publications is six times less, the growth was 360.2%. That is, despite the rather high position of Ukraine in terms of the number of research staff, its efficiency and effectiveness in publishing the results of the study are quite low. At the same time, countries close to Ukraine in terms of the number of R&D staff have much higher rates in terms of the number of publications in the cited publications. Austria, Denmark, Portugal and Belgium show at least twice the number of publications with relatively equal scientific staff (Table 29):

TABLE 29. Dynamics of educational and scientific indicators of Ukraine and Latvia[170]

170 Scimango Jourmnal&Country Rank. URL: https://www.scimagojr.com/countryrank.php

	2005	2010	2015	2016	2017	2018	2019	% 2019/ 2005
Scientific articles in cited publications in Ukraine	7576	7809	10765	11281	12615	14115	15783	208.3
Scientific articles in cited publications in Latvia	669	1093	2057	2085	2472	2400	2410	360.2

The number of Nobel laureates in Ukraine during the analyzed period is static and includes, according to various estimates, from 2 to 5 people (taken into account Soviet times, the last prize in 1992). Among all the countries of the world in terms of the number of Nobel laureates, Ukraine belongs to the most represented bloc of countries. The undisputed leader is the United States of America with 368 winners; Luxembourg, Bosnia and Herzegovina, Belarus, Turkey and others are in the same group with Ukraine[171].

Second-order intellectual leadership includes infrastructure indicators that are crucial for the formation of innovation ecosystems (Table 30).

TABLE 30. Dynamics of infrastructural indicators of development of intellectual leadership of the second order for Ukraine

Indicators	2005	2010	2015	2016	2019
Individual using the Internet (% population)	3,75	23,30	48,88	52,48	59
Secure Internet servers	..	567	6 403	85 755	349 187
Secure Internet servers (per 1 million population)	..	12,36	141,80	1 905,47	7 867
Mobile subcriptions	30013.5	53 928.8	60 720.0	56 717.9	54 842.9
Mobile subcriptions (per 100 people)	64,01	117,7	143,9	135,2	131
Fixed line users, mln	11 666,6	12 941,3	9 113,0	8 451,2	4 183,00
Fixed line users (per 100 people)	24,88	28,26	21,60	20,14	10

Considering the infrastructure indicators, on the one hand, the number of fixed line users is steadily declining, with an average reduction of 1.5% per 100 people per year, almost 20% during the analyzed period. On the other hand, the number of users of the latest means of communication increases sharply

171 Nobel prize winners by country. URL: https://www.worldatlas.com/articles/top-30-countries-with-nobel-prize-winners.html

during the analyzed period, for example, secure Internet servers increased by almost 3000% (both in total and per 1 million of people). The share of individual Internet users also increased to 52%, which is 1397% of the 2005 level. The smallest increase is observed in the number of mobile users, in general their number increased by almost 89%, in terms of 100 people the increase is 214% (i.e. since 2005 the share of users has increased by 114%; by the way, there are 135 users of mobile communication per 100 people.

The table 31 shows the world average and data for seperate countries. In general, both Ukraine and Latvia are in line with world trends: the number of Internet users, mobile users are increasing, the use of fixed telephony is decreasing.

TABLE 31. ICT indicators in selected countries and the worldwide[172]

Indicators	Australia	Denmark	Latvia	Netherlands	United Kingdom	United States	World
Individual using Internet (% population)	87	98	86	93	87	86	50.8*
Secure Internet services	931399	1612517	38004	2259681	2405337	40706384	-
Secure Internet services (per 1 million people)	36721	277134	19868	130370	35990	124014	10049.6
Mobile subscriptions	27880	7243.5	2071.8	21762	78924.3	404577	8196
Mobile subscriptions (per 100 population)	111	125	109	127	118	124	104.1*
Fixed line users	8705.5	2536.5	508.9	7459	25586.1	114093	1134
Fixed line users (per 100 population)	31	17	12	33	48	33	12.6*

172 World Development Indicators. URL: hhtp://data.worldbank.org.indicators/

In general, the number of individual Internet users in Ukraine, despite the positive trend, is lags far behind world leaders and remains at the level of average global level. The highest indicators have UAE (99%), Denmark (98%), South Korea (96%), Sweden (96%), Swtzerland (96%), United Kingdom (96%), Netherlands (95%), Canada (94%), Saudi Arabia (93%), Germany (93%), New Zealand (93%), Japan (92%), Hong Kong (91%), and Spain (91%)[173].

A positive phenomenon is the presence and dynamics of secure Internet servers. In terms of the number of mobile telephony users per 100 people, Ukraine has a high level this indicator (131). However, its highest values are in countries such as Macao (345%), Hong Kong (289%), UAE (201%), Seychells and British Virgin Islands (198%), Antigua and Barbuda (193%), and Thailand (186%)[174].

Regarding the last block of this group of indicators (including intellectual property rights), Ukraine does not show significant changes and we even see a certain decrease in, for example the total number of patent applications, both residents and non-residents. Ukraine's indicators are close to those of Poland, but the dynamics is completely different - Poland shows a gradual increase, like the vast majority of OECD countries[175].

The third group of indicators of intellectual leadership of the second order includes indicators of manufacturability, which reflect the results of intellectual activity, mainly demonstrated in patents and licenses (Table 32).

TABLE 32. Dynamics of technological indicators of intellectual leadership of the second order for Ukraine[176]

2018	…	…	5,8	1,0	8 165	5,6	1247555874	3 968	38 031
2017	19,4	2 760	5,1	0,9	8 347	6,4	1267145051	4 047	36 834

173 Global Digital Report 2020. URL: http:// datareportal.com

174 World Development Indicators. URL: hhtp://data.worldbank.org.indicators/

175 Patent applications, residents and nonresidents. URL: http://databank.worldbank.org/data/source/world-development-indicators#

176 World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators#

Позиції	2005	2010	2015	2016
ICT-export of services (% total export of services)	1,5	3,9	16,9	18,6
ICT-export of services (mln dol.)	157	719	2 105	2 310
ICT-goods import (% total import goods)	4,0	3,2	4,0	4,9
ICT-goods export (% total export goods)	0,5	1,1	0,8	0,9
Applications for industrial design (industrial designs)	…	5 818	7 783	9 014
High-tech export (% total export)	…	…	8,7	7,4
High-tech export, $	…	…	1626367 584	1245921696
Number of patent applications, residents and non-residents	5 592	5 312	4 497	4 095
Trademark applications	23 553	28 307	31 003	36 090

In general, according to this group of indicators, Ukraine shows steady growth in almost all of these indicators. The decrease occurred only in the share of information and communication goods in the structure of imports (which may indicate import substitution) and in the number of patent applications, where the decrease was 27%. Among the applications for intellectual property rights, applications for trademark registration increased by 16%, and for industrial designs - by 387%, but the latter have heterogeneous structure: until 2009, the number of applications from residents significantly exceeded applications from non-residents, but in the last 8 years, the number of applications from non-residents has significantly exceeded.

Regarding the trends in the export of knowledge-intensive services as a share of total exports of services, it should be noted that growth is almost 5 times, and Ukraine's place among developed countries is quite stable in terms of growth and size. Among the analyzed countries, the largest share of exports of ICT services belongs to Israel, India, Ireland and Brazil, where their share exceeds

50%, and in the leading Israel it is almost 70%, which is twice the indicator of Ukraine[177]. Ukraine has close indicators to Austria, Great Britain, Germany, France, Hungary, Singapore, Slovakia, the Netherlands, Norway, Poland, Colombia, Russia and Canada. However, among these countries, Ukraine has the highest growth rates (Fig. 17).

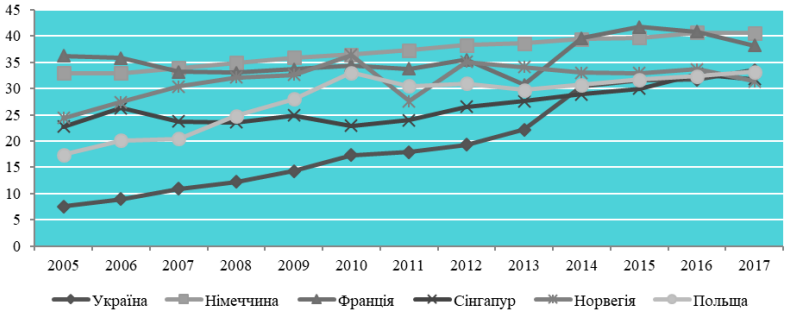

FIGURE 17. Dynamics of export ICT-services, separate countries, % total export services[178]

Analyzing the indicators of exports of services in natural indicators, we see other situation. In terms of value, exports of services in Ukraine account for only 8% of the indicators of Netherlands, 22% of Austria, 9% of Singapore, 24% of Poland and 27% of Russia exports of services. The share of the Czech Republic is lower - 52%, Norway - 40% and Hungary - 60%[179]. For example: the experience of Singapore is impressive, which, despite its small size and lack of natural resources, has implemented a strategy for the development of the information and communication sector, as a result of becoming one of the TOP-10 countries in terms of the cost of ICT services provided. Given the difference in GDP between world leaders and Singapore, the value indicators of export of high-tech services are extraordinary.

However, among the selected countries, Ukraine does not have the last position and exceeds the indicators of Colombia (by 247%), Lithuania (by 232%), Latvia (by 228%), Slovenia (by 138%). Because of the fact that most of these countries are much smaller in terms of both population and economic activity, such an excess is not evidence of a high level of economic development

177 ICT service exports (% of service exports, BoP), selected countries. URL: http://databank.worldbank.org/data/source/world-development-indicators#

178 ICT service exports (% of service exports, BoP), selected countries. URL: http://databank.worldbank.org/data/source/world-development-indicators#

179 ICT service exports (BoP, current US$) Selected countries. URL: http://databank.worldbank.org/data/source/world-development-indicators#

of Ukraine. The positive for this indicator is its unconditional six-fold growth over the period.

According to the indicator of imports of ICT goods in the structure of total imports. Ukraine shows a constant indicator at the level of 4% of total imports of goods; in general, this level is lower than the average for the selected group of countries - 10.2%. These indicators are approximately at the same level as Greece, Spain, Slovenia, Switzerland, Luxembourg and Portugal; the lower indicators than in Ukraine, among selected countries, only in Belgium[180]. The low indicators are a rather positive fact, as they indicate the country's low involvement in global value added chains. For example, South Korea has one of the highest levels of exports of high-tech goods, but the share of imports of ICT goods is almost 15%. South Korea actively imports parts and components for Samsung products from Japan, thus forming product chains and sharing equal stages of production with several countries, although the final product belongs to South Korea. This is confirmed by the indicators of exports of ICT goods, which in South Korea already account for 22%.

Almost all countries during the analyzed period show a decrease in exports of ICT goods in the structure of total exports. However, Ukraine is gradually increasing this figure, which indicates a gradual strengthening of its place in the Fourth Industrial Revolution and increase of technological potential in the world. Overall, growth was almost 100%, but even with this growth, the share of ICT goods is less than 1% of total exports. Only Israel, Singapore, Slovakia, Latvia and Poland showed significant growth during this time. At the same time, Israel shows growth by 90%, Singapore - by 110%, Slovakia - by 76%, Latvia - by 500%, Poland - by 107%. Despite extraordinary growth rate of Latvia, the share of ICT goods in its exports is only 11%; this is at least three times lower than the indicators of the leading countries - Singapore with a share of 33%, China with a share of 26% and South Korea with 22%. An important issue is the visible trade of balance of ICT goods. Thus, in Ukraine, imports exceed exports by almost 4%, which proves that Ukraine is a consumer in this market; at the same time, South Korea shows a positive balance (7%), China - 3%, Singapore - 5%.

The share of high-tech exports of Ukraine is 7% of total exports in 2015, and this is one of the lowest indicators among the analyzed countries, the leader among which is Singapore with a record 48%. In general, more than 20% of high-tech products from exports in 2016 are demonstrated by Ireland (29%), Switzerland (27%), France (26%), South Korea (26%), China (25%), Iceland (23%), Great Britain (22%), USA (20%)[181]. Among the analyzed countries,

180 ICT goods imports (% total goods imports) selected countries. URL: http://databank.worldbank.org/data/source/world-development-indicators#

181 High-technology exports (% of manufactured exports), selected countries. URL: http://

only Luxembourg (6.8%), Italy (7.2%), Slovenia (6.4%), Chile (6%), Portugal (4.3%) and Turkey (2.1%) have lower values than the level of Ukraine.

Among the positive trends is the increase in the value of high-tech exports by 56%, which, given the significant growth of the US dollar exchange rate over the period, indicates the presence of positive trends in the structure of the economy of Ukraine. However, after the growth of the average annual US dollar exchange rate in 2014, the total value of exports decreased significantly compared to previous years. Thus, the increase in 2012 to 2005 was 196%, i.e. 25% on average annually, but in 2013 the value gradually decreased and in 2016 it was only 52% of the value of exports in 2013 (Fig. 18).

As can be seen from the figure, the share of high-tech exports is quite volatile, but has a relatively stable upward trend.

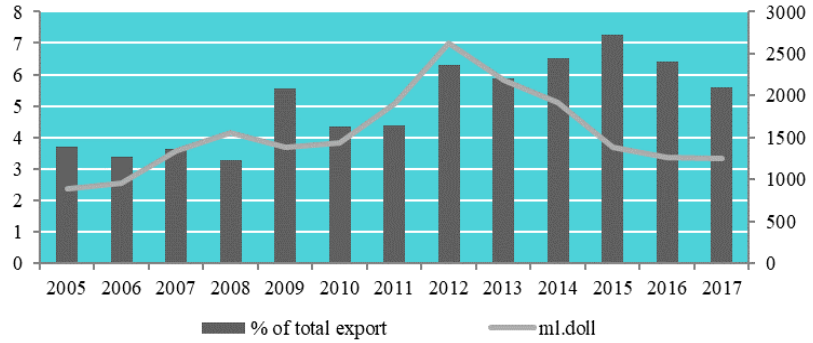

FIGURE 18. High-tech export of Ukraine, 2005–2017, ml. doll., % total export

A very small number of countries show an increase in the share of high-tech exports. Moreover, countries with a lower level of development show higher growth rates of the share of high-tech exports relative to highly developed ones, but world leaders in general show a decrease in this indicator.

Thus, the analysis of key indicators of intellectual leadership of different order gives grounds to claim that most values in Ukraine are negative and need significant adjustment. Analysis of global trends indicates the need to increase intellectual potential and its effectiveness. Potential of Ukraine to integrate knowledge into the economy and achieve intellectual leadership is quite significant, but requires adjustment of state participation in these processes.

Ukrainian rich potential in the field of higher education and the reduction in the number of Ukrainian students have made available many places in higher educational institutions, for example, for foreign students. Thus, in terms of

databank.worldbank.org/data/source/world-development-indicators#

the number of foreign students, Ukraine has one of the leading positions in the world with a share of 1.5% of the world market of educational services. The formation of a global educational space contributes to the integration of individual economies into the global space. However, under modern conditions, a significant increase in the number of students from abroad is possible only with the participation of the state to develop an active position.

State support can be seen in the privilege of higher educational institutions that accept foreign students. This can be expressed in the possibility of using the funds raised at the discretion of the educational institution, in supporting the creation of the material and technical base of universities, in additional financing of foreign language courses. In addition, state support can be implemented in the formation of a state strategy for cooperation with certain countries, which may be the focus of universities to attract students. It is important to develop a mechanism for opening university branches abroad, which will facilitate the attraction of foreign students. These opportunities are already quite actively used by foreign universities in Ukraine, creating additional competition in the domestic market of educational services.

Under these conditions, it is important to preserve national identity and culture. On the one hand, this issue is complicated in the process of globalization, but on the other, it can be used as a competitive advantage. In this context, the issue of obtainment of synergetic effects of the globalization of the education system and the internationalization of its individual components is important. The state development strategy should be aimed at finding the optimal balance between the country's inclusion in the global space and support for national forms of manifestation of this type of activity (national-specific forms of the educational system).

It is worrying that the capacity of the scientific sector in Ukraine is declining, which over the past 10 years has not only lost its place in the top 10 countries in terms of scientific potential, but also is lagging far behind developing countries. This is primarily due to the weak links between business and the scientific component, as science is mainly concentrated in universities, and business has no real incentive to take advantage of these opportunities. This, in turn, is caused by the low level of manufacturability of Ukrainian production, as the vast majority of enterprises are concentrated in the field of agriculture, retail and sales.

To stimulate this sector, we need incentives for the development of intellectual work of scientists, taking into account its complexity and intensity, the dynamics of competitiveness of higher educational institutions in general in the market of educational services, stimulating the growth of research staff and development of a system of incentives depending on the results of their activities.

Under the condition of global intellectualization, competitive advantages

are provided by the production of complex and knowledge-intensive products, devices, industrial equipment or the provision of intelligent services. The prerequisite for this is, first of all, the availability of highly qualified personnel capable of producing information resources and working with them. Ukraine has the greatest opportunities in provision of technical support for the development of the IT sector, which is in line with global trends in the formation of this market. However, Ukraine weakly uses these opportunities for its own development. Foreign companies that employ Ukrainian specialists on the basis of hiring or outsourcing are active in this market.

The appliance of tax incentives for individual enterprises, for example, tax holidays for innovative enterprises, can be implemented both for the entire activity of the enterprise and for its innovative component. Analysis of world experience shows the active use of tax credits for new enterprises that are created in strategic sectors of economic activity or form production with a high level of value added and the share of manufacturability.

It is necessary to differentiate enterprises of different formats in order to choose the methods of incentives. Thus, if large enterprises can receive benefits or tax compensation for the production of innovative products, the stimulation of small enterprises can take the form of local centers or clusters with favorable conditions for the implementation of all stages of production of innovative products and innovation process. This process may include the creation of technopolises, innovation incubators, and innovation centers for scientific and technical development. Such centers can contribute to the intellectualization of business and commercialization of innovative developments or results of intellectual activity, that is, such intellectual results that will serve as a breakthrough in the development of intellectual business.

In addition, foreign companies that introduce innovative technologies on the territory of Ukraine or open their own research centers need incentives. This can also take the form of tax benefits or compensation. With the aim to avoid formalities in opening such centers, it is necessary to determine the minimum size of such centers, the term or duration of their operation, their location, and so on. In particular, the minimum period of operation for such centers can be defined as 4 years, which is sufficient to set up the whole operation; on the other hand, this may depend on the type of production, since different areas of production provide for scientific research of different formats and duration. All these measures are aimed at reduction of the chances of manipulation of such benefits, avoidance of cases when such centers are opened formally only for the sake of obtainment of financial benefits, and real functioning does not occur.

For example, in Israel, such a restriction is introduced at the level of 100 employees, but the number of employees may vary depending on the sector of activity and territorial location. For depressed regions, the number of scientific

staff may be reduced so that compensation covers a larger share of costs. In addition, it is possible to implement compensation for a share of salaries to companies that implement innovative or scientific projects, especially in depressed regions. This compensation can be at the level of the minimum salary, the minimum unemployment benefit, or a fixed share of salary.

Business incentives are also possible by reduction of tax rates on profits obtained as a result of commercialization of scientific developments. For this type of incentive, a different tax rate can also be introduced for regions with different levels of social and economic development. For underdeveloped regions, an additional rate of 2.5–5% of such compensation can be implemented, as this type of activity stimulates the development of entrepreneurship in depressed regions and, accordingly, intensifies the search for new solutions for doing business within these territories.

The next type of incentive is partial compensation of enterprises' research and development costs. According to world experience, such compensation can reach up to 55% of the cost of such work in depressed regions and up to 45% - in regions with a high level of social and economic development. Compensation can be formed at the expense of state funds or facilitating access to international grants, when the state acts as a guarantor of scientific projects or developments or their customer. This is most relevant for enterprises in the military-industrial, information and communication, pharmaceutical, energy and other sectors that become the foundation of national security or are strategic for the development of the national economy in the conditions of the formation of the knowledge economy. Most developments aimed at ensuring national security are strategic and usually have a high efficiency, as evidenced by the experience of developed countries. These developments are transferred to other sectors of the economy and are implemented for peaceful purposes. Thus, the military-industrial complex actively develops information and communication technologies, communication networks, technologies for the development of space and air forces, energy technologies, etc.

State support may involve a state order for the training of specific specialists for innovative enterprises or the licensing of state higher educational institutions to conduct advance training and retraining courses for innovatively active enterprises. The state may also reimburse the expenditures of company on personnel training fully or partially.

Intensification of production in the field of knowledge-intensive products and services should become a priority for the development of the national economy. Encouragement of entrepreneurs and business owners to develop and implement innovations will saturate the domestic market with goods and services, meet consumer needs, strengthen the export potential of the economy, formation of the budget at the national and

regional levels, reduction of unemployment, population income growth.