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Global Trends in the Use of Human Capital in the Digital Economy

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Abstract

The exponential growth in the use of information and communication technologies (ICT) in all aspects of our lives, combined with the growing need to acquire digital skills to the same extent as literacy, are major changes that create new challenges in the modern world.

The paper examines the evolution of human capital and its impact on the development of the digital economy, as well as the trends inherent in countries with a high level of the human capital index. In modern conditions, the quality of education and skills determine the efficiency of the economy in terms of increasing the use of ICT, increasing the volume of GNP, and exporting ICT. It is the availability of knowledge, as an integral part of human capital that determines the amount of created new knowledge and technologies, their export, and the production of products with high added value. Research shows that the high quality of education contributes to the wider use of digital technologies both in practice and in everyday life.

The modern methodology for assessing human capital requires significant adjustments due to the need to assess the impact of human capital on macro - and microeconomic processes, the need for qualitative changes in some components of human capital.

Keywords: Human capital, Digital technologies, Social sphere, Digital development index, Efficiency of using digital technologies.

Introduction

Human capital is a macroeconomic category and affects directly the functioning of the economy, including the digital one. Over the past 60 years, this economic category has evolved significantly. An information base for the assessment of human capital has been created, and methodologies and methods for the assessment of human capital have been developed. This, in

turn, made it possible to identify new components of human capital. It became necessary to measure them. More modern definitions of the category "human capital" were formulated, which include not only investments in a person, but above all investments in knowledge, their quality, which is possessed by a particular individual and the state as a whole [18-25].

The level of human capital development, ultimately, is one of the components of the effective functioning of the economy of any country in the world. It allows creating new technologies; new world-class knowledge, exporting new technologies and products obtained using these technologies, including digital ones. Modern trends in the functioning of the economies of developed countries of the world indicate the need for investment in human capital, namely in the quality of individual knowledge [26-33].

Materials And Methods

The research materials are based on the study of trends in the use of human capital in the digital economy. For this purpose, such indicators as the human capital index, the graduation of specialists with higher and secondary education in the developed countries of the world in the field of digital technologies, the digitalization index and the intensity of the use of digital technologies, digital competitiveness, human capital indicators in DESI, indicators characterizing the creation of new knowledge, and others were studied. The information base of the study was the data of the UN FAO, the World Bank, published works of scientists from Russia and other countries of the world, and statistical materials.

The research uses the following research methods: monographic, dialectical, abstract-logical, deductive, synthesis, analysis, economic-statistical. The research methodology involves a consistent study of trends affecting the development of human potential, as well as factors affecting it in the context of the functioning of the digital economy in some countries of the world [34-37].

Results

Ever since the theory of human capital was officially founded in 1960, economists have used it to make the connection between skills, education, and personal income. In the beginning, economists viewed investing in education as analogous to buying any fixed capital using a simple cost-benefit analysis that compared the cost of education with the long-term distribution of income [12].

Modern concepts of human capital have significantly expanded and include not only investments in knowledge, but also the availability of competencies, professionalism, the ability to lifelong learning, bring their knowledge to the benefit of the modern community, and even psychometric assessment. Currently, the level of human capital development is increasingly linked to the level of development of engineering and technology, to the level of development of the country, various country ratings, etc. And this opinion is not unfounded, as investments in human capital, ultimately, determine its quality, and subsequently the dynamics of economic development, its place in the world.

Human capital plays a crucial role in the development of new technologies and is an important factor in their effective use. The development of technologies, especially telecommunications and information technologies, requires their creators and users to have an appropriate level of qualification. It plays a crucial role in the development of new technologies

and is an important factor in their effective use. Today, the ability to adapt to rapid changes is of great importance. From the very beginning of human civilization, human existence depended on the possession of knowledge and the skills to use it. Nowadays, when knowledge has reached the status of the highest factor of development, it is reasonable to want to transfer it to the level of a region or country [4].

Table 1 Interpretation of the "human capital" category

Year	Author	Definition
1966, 1975, 1981	Becker, G. S. Schultz, T. W	The term "human capital" has become increasingly popular, among other things, due to the works of Becker (1975) and Schultz (1981). The authors conducted research in which it was possible to show that the thriving development of the regions cannot be explained solely by investment in real estate. Rather, it is possible to establish a positive correlation between well-being and the level of education [3, 15].
2003	Menzies, M.	Human capital demonstrates an innate talent that can both change and modernize itself and other resources. This characteristic leads to a constant dynamism of the economy [13].
2003	Weatherly, L. A.	Human capital is the sum of the characteristics, life cycle, knowledge, creativity, innovation, and energy that people put into their work [16].
2004	Burund, S., &Tumolo, S.	Human capital is an investment in human resources in order to increase their efficiency. In fact, the value of this investment is provided for future use. Consequently, the learning organization chooses to invest in individuals, because people represent valuable human capital with different qualities [5].
2005	Best, R.J.	Human capital is primarily a carrier of technological knowledge that underlies scientific and technological progress [4].
2005	Joseph A. DiVanna and Jay Rogers	Human capital and its associated value can be defined simply as "the implicit knowledge stored in people's minds" [10].
2006	Namasivayam, K., &Denizci, B	Human capital refers to knowledge, education, work competence, and psychometric assessments [14].
2009	Kumar,V. & Shah, D.	Professional competence should be considered as an important corporate asset that allows the organization to gain a long-term competitive advantage. The competence of employees is determined by the company's ability to perform the tasks assigned to it, including the ability to perform the work. The instability of economic conditions requires constant changes to adapt the competence to the current situation. This can be considered as the development of human capital in the company, contributing to an increase in its value [11].

Over the past 60 years, the category of "human capital" has evolved significantly. If Becker, G.S. Schultz, T.W. in their theory understood human capital to mean the contribution of a person, or rather his education to the well-being of the nation, then in the modern economy education is not the only component of human capital. At the same time, human capital itself has a significant impact not only on the well-being of society, but also on individual production processes, an increase in value added, an increase in GDP, etc. The category of "human capital" has a measurement methodology, but the evolution of this category is likely to lead in the near future to a change in the methodology and method for assessing human capital. It is obvious that structurally, the human capital index will consist of at least a dozen indicators related to both the development of a person as a person and the impact of human development on the economic processes taking place in society.

On the other hand, society is increasingly interested in the question of a person's contribution to the economy, the measurability of this contribution. And as part of the digital revolution, many scientists are interested in the question - what share in the structure of the assigned value will be live labor, and what will be reified labor. All this leads to certain reflections on the impact of human capital on the effectiveness of the digital economy.

In itself, the term "human capital" is far-fetched and unfounded from a practical point of view. In addition, very often in the scientific literature they can find controversy regarding the use of the term "human capital". Moreover, in the scientific literature there are quite a lot of author's definitions of this term, and quite often the authors equate the term "human capital" and "human potential", without understanding their essence and differences.

However, there are not only author's definitions of this economic category, but also a harmonized international concept of "human capital". Human capital refers to the knowledge, skills, and health that people accumulate over the course of their lives, which allows them to realize their potential as useful members of society. Investing in people through improved nutrition, health care, quality education, job creation and skills training contributes to the development of human capital, which is the main condition for ending extreme poverty and creating a more socially cohesive society [8].

At its core, investments in improving nutrition and health care are not, in our view, components of human capital. They are the socio-economic components of the life of any person. This is a separate group of indicators that characterize the food security of any country, if we are talking about nutrition. And if we are talking about health care, about the health of the nation, then there is a group of indicators that characterize the health of the nation and life expectancy. Thus, the main components of human capital are the acquired knowledge and skills, the desire to acquire new knowledge and skills and apply them in practice.

Regarding the definition of the category of "human capital", this is the opinion of the World Bank, which is essentially a structural unit of the United Nations. The World Bank defines human potential as the measurement of human development indicators – high life expectancy and healthy lifestyle, high level of awareness and a decent standard of living [8]. That is, human capital, in contrast to human potential, requires knowledge, skills and health. Although in our opinion, the elements of health are also present in the concept of human potential. The only difference is that human capital is the presence of a certain individual's knowledge and skills. And, of course, in the digital economy, it should be knowledge and skills in the use of tools and technologies of the digital economy. Everything else is obviously of little interest to the modern economic system. For example, we are not interested in the moral

foundations of modern society, the moral foundations of raising children and the institution of marriage, etc. For the modern economy, it is important to have knowledge and skills, the ability to use them to create products with high added value and then assign profits. In turn, the production of products with high added value requires not only investment in fixed assets, but also modern knowledge and skills, that is, components of human capital.

The indicator that characterizes human capital is the human capital index, calculated using three components. The calculation is done by multiplying these components.

Component 1: Survival rate. This component of the Index reflects the sad reality that not all children born today will reach the age when the process of accumulating human capital begins within the framework of the formal education system. Component 2: Learning at school. This component of the Index represents the aggregate quantitative and qualitative data on education. Component 3: Health status. There is no single, universally accepted, directly measurable, and accessible total health indicator like the number of years of schooling as a standard measure of educational achievement.

Table 2 shows the leading countries in the human capital index. Further, some of these countries will appear as objects of analysis. This in itself is not surprising, as such an integral part of human capital as knowledge has a direct impact on the development, including the digital economy.

Table 2 Human capital index in some developed countries of the world, 2018.

Place	Country	Lower limit	Indicator	Upper limit
1	Singapore	0.87	0.88	0.90
2	Republic of Korea	0.83	0.84	0.86
3	Japan	0.83	0.84	0.85
4	Hong Kong	0.81	0.82	0.83
5	Finland	0.80	0.81	0.82
6	Ireland	0.79	0.81	0.82
7	Australia	0.79	0.80	0.81
8	Sweden	0.79	0.80	0.81
9	Netherlands	0.79	0.80	0.81
10	Canada	0.79	0.80	0.81
34	Russia	0.68	0.73	0.77

The ranking of countries on the human capital index is led by Singapore with a value of 0.88, followed by the Republic of Korea-0.84, Japan -0.84, Hong Kong -0.82, Finland and Ireland-0.81. Then there is a group of countries with a dense human capital index of 0.80, with the upper and lower limit of the indicator also not different: Australia, Sweden, the Netherlands and Canada.

As it is known, according to the World Bank methodology, Component 2 consists of two indicators: the quantity of education and the quality of education. The amount of education is measured by the number of years a child can expect to be in school by the time they reach the age of 18. The quality of education reflects the work carried out by the World Bank to integrate the test results of the largest international assessment programs into the indicator of unified educational achievements.

However, this approach to assessing the human capital index takes into account only the basic knowledge gained in school. The quality side of the training is also taken into account. Education in colleges and universities is not taken into account here, which distorts the real assessment of the human capital index. Getting a higher education, the educational component significantly increases the human capital index and its actual impact, including on the development of the digital economy.

The Deloitte report, which analyzes international trends in human capital in 2018, emphasizes that concerns about automation, an aging workforce, growing needs for new types of skills and shortages in labor markets pose an urgent task for modern companies to unite the efforts of senior management to increase the social role of business [1, 7].

The use of modern technologies increases the profitability of the business by reducing the share of live labor and increasing the share of materialized labor. At the same time, the materialized work requires constant control on the part of the person, which causes the need for specialists in the field of digital technologies. Negative demographic indicators of developed countries worry business owners about the prospects of a shortage of skilled labor. And they are forced to think about the social role of business, the possibility of its further development, while losing a certain share of profit.

Surely, the better the level of knowledge and skills of modern specialists, the greater their cost in the labor market. This knowledge and skills are formed in universities, colleges and even schools, determining the further development of the digital economy. The quality and prospects for further development of the digital economy of any country in the world depend on the level of education, on the number of specialists in the field of digital technologies.

Economists found that when countries actively invest in human capital, these investments ultimately contribute to the adoption of technology. As a result, more educated countries are more likely to adopt technologies that promote the development of a skilled workforce. Therefore, it is not surprising that countries with higher levels of education experienced a faster shift towards industries with intensive training [2].

Table 3 shows that the share of graduates with secondary and higher education, as well as postgraduate students, does not affect the country's digital development index. For example, Russia produces a significant proportion of specialists in the field of digital technologies, but the country ranks only 37th place in terms of digital development. Although theoretically, it is the availability of modern knowledge and skills obtained in schools and universities that should be the main factor in the successful development of the digital economy. There are other factors that influence the development of the digital economy in addition to human capital, such as a favorable investment and tax regime, favorable institutional conditions, political environment, etc. However, ultimately, it is the human factor that contributes to the formation of favorable conditions for the development of the economy as a whole, and for the digital technology industry.

One of the main factors in the education system is the quality of the acquired knowledge and skills, which are then demonstrated by graduates using the tools and technologies of the digital economy. It is obvious that the first 10 countries listed in table 3 have an education system that is adequate to the current macroeconomic relations, in particular, the effective development of the digital economy. As it can be seen from the above data, the principle of "the more, the better" does not apply here, rather, we can only talk about the quality of

education, the good material component of educational institutions, as well as good practical training of students. The share of graduates who possess digital technologies in the developed countries of the world is no more than 15-18% of the total number of graduates of all levels of education.

Table 3 Graduation of secondary professional education in secondary level training programs and higher education in the field of information and communication technologies in some countries of the world, 2017-2019 [17].

Country	Secondary vocational education in the programs of training of middle-level specialists (ISCED 5)	Higher education in Bachelor's, Specialist's, Master's degree programs (ISCED 6, 7)	Higher education in the programs of training of scientific and pedagogical personnel in postgraduate studies (ISCED 8)	Digital Development Index (in brackets there is the occupied place)
Norway	1.6	3.9	1.9	3.79 (1)
Sweden	11.7	3.2	5.2	3.79 (2)
Switzerland	-	2.4	3.4	3.74 (3)
Denmark	6.4	4.7	-	3.72 (4)
Finland	-	6.3	7.2	3.72 (5)
Singapore	no	no	no	3.69 (6)
Republic of Korea	4.7	7 4	3.3	3.68 (7)
Great Britain	4.6	3.6	3.9	3.67 (8)
Hong Kong	no	no	no	3.66 (9)
USA	3.5	4.3	2.8	3.61 (10)
Russia	6.1	4.8	8.1	2.49 (37)

The proof that the quality of knowledge and skills is the dominant factor determining the level of development of the digital economy is the business digitalization index (Table 4). From the above data, it can be seen that 5 out of 10 countries that pay significant attention to the quality of education in the field of digital technologies have also succeeded in the development of digital technologies themselves. That is, such components as high-quality knowledge and skills affect the development of digital technologies by at least 50%. The highest business digitalization index in Finland is 50. This country is ranked the 5th place in the world on the digital development index. Sweden ranks the 5th place in the digitalization index and the 2nd one in the Digital Development Index. Denmark ranks the 4th place in the Business Digitalization Index and 4th one in the Digital Development Index. The Republic of Korea ranks the 8th place in the Business Digitalization Index and 7th one in the Digital Development Index. Thus, one of the global trends in the development of human capital is the relationship between the quality of education and the level of development of the digital component of the national economy.

Table 4 shows that countries with a high business digitalization index actively use not only broadband Internet – 98-100%, but cloud services (17-65%), RFID technologies (9-43%), ERP systems (28-54%), and electronic sales (11-35%). The structure of the use of digital technologies is determined by national preferences and characteristics rather than technological

or other patterns.

Table 4 Digitalization index and intensity of use of digital technologies in business sector organizations by countries, 2018-2019 [17].

	Business Digitalization Index	Share of organizations using digital technologies in the total number of organizations, percentages				
		Broadband Internet	Cloud services	RFID-technologies	ERP-systems	Electronic sales
Finland	50	100	65	23	39	24
Belgium	49	98	40	21	54	30
Netherlands	48	100	48	18	48	27
Denmark	47	100	56	9	40	32
Sweden	46	97	57	12	31	32
Ireland	43	96	45	11	28	35
Norway	43	94	51	10	30	29
Republic of Korea	42	99	17	43	38	11
Austria	40	98	23	19	40	18
Spain	40	98	22	15	46	20
Russia	31	86	27	7	22	15

Another trend in the development and use of human capital in the developed countries of the world is the increase in the share of people employed in the information and communication technology sector (table 5). It is noteworthy that the top ten countries with a high level of employment in the ICT sector included exclusively European countries. They show an increase in the number of people employed in the field of digital technologies. In particular, in Sweden over the past 3 years, the share of people employed in this field increased by 2%, Finland by 3%, Luxembourg by 3%, the Netherlands by 2%, Estonia by 3%, Great Britain, Switzerland and Denmark by 1%, Ireland and Norway by 2%.

In modern conditions, knowledge as an integral part of human capital, technology as a process of knowledge realization and readiness for the future are components of the world ranking of digital competitiveness, i.e. the ability to compete in the field of digital technologies and tools of the digital economy. And judging by the data in Table 6, fierce battles take place every year in the field of digital competitiveness.

Table 5 People employed in professions related to the use of ICT (information and communication technologies) per 100 people employed in the economy by countries [17].

Countries	Years		
	2017	2018	2019
Sweden	5	7	7
Finland	4	7	7
Luxemburg	3	5	6
Netherlands	4	5	6
Estonia	3	6	6
Great Britain	4	5	5
Denmark	4	4	5
Ireland	3	4	5
Norway	3	6	5

Switzerland	4	5	5
Russia	2	2	2

The calculation of the digital competitiveness index involves the calculation of three sub-indices in the field of knowledge, technology and readiness for the future. The top ten countries in the competitiveness rating are exclusively developed countries in Asia, Europe and North America. Moreover, the first 6 places of the digital competitiveness index did not change their place in the ranking compared to 2018. This means that despite the fact that developed countries invest heavily in the development of digital technologies, in knowledge and technology, these 6 countries (USA, Singapore, Sweden, Denmark, Switzerland, the Netherlands) are making more efforts to develop the digital economy, as well as more investments in this area.

Thus, such a component of human capital as knowledge has a significant impact on the development of the digital economy in the developed countries of the world.

Developing the previous thesis about the importance of knowledge in the process of forming human capital, we should also focus on the process of creating knowledge, which includes conducting research and eventually publishing articles and patenting inventions. The developed countries of the world are making a lot of efforts to step up the process of acquiring new knowledge, transform it into technology and apply it in practice. In the developed countries of the world, there are motivational mechanisms to support the creation of new scientific knowledge and its application in practice. For example, in the United States, in order for an economic entity to receive state support, it must apply innovations. And this is done not formally, but with the provision of appropriate evidence. In Germany, when building houses in the private sector, the use of "smart home" technologies helps to reduce the mortgage rate, etc.

Table 6 World Digital Competitiveness Ranking by countries, 2019 [17].

Countries	**World Digital Competitiveness Ranking**	**Including sub-indices**		
		Knowledge	**Technology**	**Future Readiness**
	Rank (change from 2018)			
USA	1 (0)	1 (+3)	5 (-2)	1 (+1)
Singapore	2 (0)	3 (-2)	1 (0)	11 (+4)
Sweden	3 (0)	4 (+3)	7 (-2)	6 (-1)
Denmark	4 (0)	6 (+2)	11 (-1)	2 (-1)
Switzerland	5 (0)	2 (+4)	10 (-1)	10 (0)
Netherlands	6 (+3)	13 (-1)	6 (+2)	3 (+1)
Finland	7 (0)	9 (0)	8 (-4)	7 (+1)
Hong Kong	8 (+3)	7 (-2)	4 (+2)	15 (+9)
Norway	9 (-3)	16 (0)	3 (-1)	8 (-2)
Republic of Korea	10 (+4)	11 (0)	17 (0)	4 (+13)
Russia	38 (+2)	22 (+2)	43 (0)	42 (+9)

The essence of the following pattern of using human capital in the digital economy is to increase the concentration of research and development in the field of information and communication technologies.

The leader in the number of publications in 2019 is China – 28.22% of all publications in Scopus, the second place is the United States – 15.76%, the third is India – 9.51% (Table 7). The share of developed countries in the percentage of publications in the last 10 years tends to decrease. The reason for this trend is an increase in the share of publications by countries that previously had a small share in the global number of publications. For example, Russia increased the share of publications from 0.87% to 3.12%. But India made a significant contribution to the change in the share of publications in their global number, increasing the share of publications in Scopus by 6.5%.

In terms of purchasing power parity, India's GDP ranks third after China and the United States. At the same time, agriculture and industry are actively developing. It is obvious that, among other things, due to the formation of new knowledge and the use of new technologies, India shows good indicators of economic development.

It is noteworthy that the top ten countries with a high share in the global number of Scopus publications include 8 countries that occupy leading positions in the GDP rating by purchasing power parity. The exceptions were Italy – the 11th place and Canada – the 16th place. This once again confirms the dependence of the development of both the economy as a whole and its digital component on the level of human capital development, and in particular on the quality of knowledge.

The situation is similar for patent applications for inventions in the field of ICT (Table 8). Its position in the field of intellectual property registration is significantly strengthened by China – an increase in the number of applications by more than 5 times and the United States – by 1.5 times. For the rest of the countries, there is a minor change. In this rating, we should also note the success of the Republic of Korea in terms of industrial development and digital technologies. The GDP of this state increases annually by 2.8-3.3%.

Table 7 Share of countries in the global number of publications indexed in Scopus [17].

Place	Country	2010	2019	Ranking of countries by GDP (by purchasing power parity)
1	China	28.22	25.80	1
2	USA	18.38	15.76	2
3	India	3.01	9.51	3
4	Germany	5.80	5.21	5
5	Great Britain	4.97	4.83	8
6	Japan	5.09	3.76	4
7	Italy	3.20	3.52	11
8	France	4.38	3.51	9
9	Russia	0.87	3.12	6
10	Canada	3.38	2.85	16

The COVID-19 pandemic and mandatory social distancing have made the need for digitalization in dealing with companies, human capital, and public services even more urgent.The current COVID-19 pandemic has shown how important digital assets are for the economies of the world, and in particular for the EU. Basic and advanced digital skills support the EU economy and society. And this is despite the fact that in 2019, 85% of citizens already

used the Internet, while before the COVID-19 crisis, only 58% had a minimum of basic digital skills. Obviously, an internet connection is not enough; this must be paired with the appropriate skills to take advantage of the digital society. Digital skills vary in level of complexity, ranging from basic skills that allow participating in a digital society and consuming digital goods, to advanced skills that allow developing new digital goods and services.

Table 8 Patent applications for ICT inventions by the applicant's country.

Place	Country	2010	2019	Ranking of countries by GDP (by purchasing power parity)
1	China	53962	279730	1
2	USA	108636	146508	2
3	Japan	135947	98942	4
4	Republic of Korea	59212	61755	14
5	Germany	17007	18025	5
6	France	13249	10770	9
7	Sweden	7750	9281	37
8	Great Britain	7187	6037	8
9	Netherlands	6236	5027	24
10	Israel	3203	3678	48
15	Russia	1696	2033	6

Table 9 Human capital indicators in DESI(Digital Economy and Society Index).

Indicators	2017	2019
Basic skills, %	57	58
Above basic skills, %	31	33
Basic software skills, %	60	61
ICT specialists, % of employed, in the economy as a whole	3.7	3.9
Women ICT professionals, % of employed women	1.3	1.4
ICT graduates, % of the total number of graduates	3.5	3.6

Table 10 Exports of ICT-related goods by major exporting countries and Russia.

Country	2016	2017	Human Capital Development Index (ranked), 2018
China	32.3	30.7	46
USA	9.7	7.3	24
Republic of Korea	7.6	7.1	2
Singapore	7.6	6.0	1
Germany	4.3	3.6	11
Malaysia	4.0	3.4	55
Mexico	4.2	3.3	64
Japan	3.7	2.9	3
Netherlands	3.6	2.8	9
Russia	0.1	0.1	34

The high level of human capital development has a positive impact not only on the development of the digital economy, but also on the export of goods related to ICT. As it can be seen from the data in the table 10 – 7 countries out of 10 that occupy leading positions in the export of ICT in the world have a human capital index value of more than 0.7.

The exceptions are China, Malaysia and Mexico. The leading position of these countries among the world's ICT exporters is due to cheap labor and the government's policy of increasing exports.

Conclusions

The modern methodology of human capital assessment requires significant adjustments related to the refinement of qualitative indicators of human capital assessment. In particular, knowledge and skills. The need for such changes is due to the evolution of the category of "human capital" and also taking into account the influence of knowledge and skills on the development of the economy as a whole, as well as individual economic processes and even technological operations.

Trends in the use of human capital in the digital economy are reduced to an increase in the volume of products with high added value, an increase in exports, GDP and other macroeconomic indicators. The modern economy is very sensitive to the use of new knowledge and skills. This primarily contributes to the creation of new technologies and equipment, as well as the need for its qualified maintenance and use. In addition, countries with a high human capital index provide a significant increase in knowledge and inventions. All this makes the development of the world economy dependent on the level of human capital development.

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