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DIGITIZATION AND ROBOTIZATION OF THE WORLD ECONOMY AS A KEY DETERMINANT OF THE INTERNATIONAL LABOR MARKET TRANSFORMATION

ABSTRACT

Today a lot of research is devoted to migration issues, primarily because of its scale. Previously, this problem attracted economists, sociologists, lawyers, today it is a focus of attention of political scientists and researchers of international relations. Modern globalization processes are affecting the international labor market, creating free space for the movement of labor around the world. The steadily increasing trend of labor migration is accounts for the need to study it in its social, economic and political aspects. Virtual migration refers to a new form of transnational economic integration that does not require workers to literally move in physical space. The main purposes of the article are to analyze the reasons and background of virtual of highly skilled workers. The positive and negative aspects of robotization on employment of highly qualified persons in the conditions of globalized world are determined. The aim of the study is also to find the opportunities that the globalized information space offers today to attract labor to international exchange and to justify on this basis the expediency of new migration orientations and new types of migration. Considering the global problems of labor migration, we note that the process of migration is the so-called indicator of the population's response to changes in the life of any society that happen almost every day.

Keywords: intellectual migrant, international migration, digitization, classification of virtual migrants, robotization, blockchain technology

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1. INTRODUCTION

Today the information revolution is making significant adjustments to the formation of a new world economy, where the competition of intellectual potentials through telecommunication systems is even tighter. Unprecedented global IT infrastructure, which amounts to a technological foundation for the future deeper transformations in the daily lives of people and societies, creates unprecedented opportunities to increase the material well-being of humanity. Such information integration lays the groundwork for a new direction of migration orientations of the population. Thus, a systemic transformation opens up the unprecedented range of opportunities to access the global labor market, which generates new demands for the workforce. It creates alternative forms of employment and new labour resources are being formed by increasing the number of people employed in information / intellectually-oriented types of work. Thanks to the global Internet network, states are actively involved in the formation of new transnational communities and identities.

Labor migration has always taken place, but it turned out that it may be virtual, and this circumstance changed not only the idea of labor migration, but also societies at large. Digital globalization has also changed the concept of globalization and society itself. Migration significantly contributes to globalization because the former transcends social and economic boundaries set by the authorities. The nation-state acts as a mechanism of social closure, creating mutual alienation between all social territories. That is why migration is becoming a problem, since national-state borders make a clear selection of “them” and migrants.

2. LITERATURE REVIEW

This study was based primarily on an analysis of available documents, analytical and statistical data. They were mainly obtained from the United Nations (UN), the State Statistics Service of Ukraine, the International Organization for Migration (IOM), the International Labor Organization (ILO), International Federation of Robotics (IFR) and others. On the basis of the studies of the literature and web sources, the authors obtained information on the classification of the migration, modern information technologies and machines that are driven by artificial intelligence, blockchain technology.

The study and analysis of international migration of highly skilled workers has received a great deal of attention from foreign scientists, including Aneesh A. (Aneesh, 2006), McCarthy J. (McCarthy, 2011), Xiang B. (Xiang, 2014). Aneesh – a sociologist at the University of Madison – Milwaukee – offers a highly thought-provoking and stimulating rumination on unfolding nature of these dynamics, which he encapsulated in the notion of “virtual migration”.

Migration, as a cross-border practice, conceptually challenges domestic and foreign research and theories. As Xiang argued, the subject of the study of the term “migrant” is largely the invention of modern researchers, designed to understand migration from the perspective of states, especially from the point of view of host countries (Xiang, 2014).

The possibilities of migration, including virtual ones, the availability of information about the demand for certain sectors of knowledge in specific societies give the modern person a much wider spectrum of choices than the one confined to his own society. This means, for example, that with a high level of competence in any field in a particular social space and

the increased demand for such specialists in another society, a person has a chance to take a higher status position (Muhaylova, 2008, p.13).

Digitization has dramatically changed the spatial constitution and economic geography of modern capitalism from ways of buying, selling, and consuming goods and services to global circulatory systems. The digital computing has revolutionized and accelerated the logistics industry in a way that can be compared to the impact of the “world container revolution” in the 1960s (Nahorny, Naumov, & Viter, 2010, p.86). Delivery software, Enterprise Resource Planning (ERP) systems, Global Positioning System (GPS), Radio Frequency Identification (RFID) and other digital technologies that organize, capture and control the flow of goods, finances and people are at the heart of modern logistics.

3. METHODOLOGY

We used in the paper the list of theoretical and empirical methods of research; in article was provided the analysis of recent research publications subject under the discussion, compared the results obtaining with statistical data, suggested the practical recommendations that were received on the base of survey results. The author’s methodology uses a systematic approach, methods of observation, comparison, abstraction, idealization and grouping. Graphical method was used to visualize the research results.

4. RESULTS AND DISCUSSIONS

Migration is a phenomenon that attracts more and more attention of researchers and the general public. If labor migration is actively discussed in the media and scientific literature, intellectual migration or the migration of highly professional personnel becomes the subject of discussion exclusively as the plot of the “brain drain”. Actually, the problem is more complicated.

The issue of population migration and changes in its orientation in a globalized world is the subject of research by scientists (economists, demographers, sociologists) and is the focus of attention of representatives of state institutions and non-governmental organizations. Scientific achievements of domestic and foreign specialists are devoted to the study of problems of social and economic nature related to employment. However, a significant number of scientific publications are not paying enough attention to the opportunities brought about by the information society. We are talking about moving the migration process to cyberspace, since the use of electronic databases and electronic labor exchanges significantly expands the range of opportunities for economically developed countries in their respective search for much demanded specialists.

The definition of migration depends on the methodology and methods of the sciences that study it. From one or another point of view, economics, demography, ethnography, geography, history, anthropology, sociology, political science, law, management, etc are studying population migration. There are various understandings of the term, but for the purpose of this article we will use this one – migration is the relocation of the able-bodied population from one state to another for economic and non-economic reasons (political, social, religious, national, racial, etc.), it is one of the determining factors that characterizes the development of social and labor relations. Also in the article we will mention the migration of highly

skilled workers (it is migration of persons who have a higher education, or a master's degree, or obtain a scientific degree, have significant experience in a particular field, able to perform highly qualified work).

International migration is complex demographic and social phenomenon, the patterns of which are manifested in a constant increase of the scale, involved in the world migration of almost all countries. At the same time, international labour migration acquires new structural characteristics, becoming more and more differentiated according to classification, professional, educational and other features. International migration of highly qualified personnel is a type of international migration and is called intellectual migration, or "brain drain". It is a process where scientists, professionals and skilled workers emigrate from a country or region

Tab. 1. Migrants' classification

Classification	Labour migrants	Virtual migrants
Sphere of labor effort	all areas where physical and mental work is required, filling vacancies in non-prestigious areas and sectors of the economy	mostly spheres that require intellectual and creative work
Territory	physical movement across borders is obligatory	lack of binding to a specific territory due to the opportunities brought about by the Internet space
Duration	permanent, temporary, periodic and seasonal character	permanent and temporary character, depending on the volume of work
Direction of migration flows	the largest centers attracting labor, usually in economically developed countries	a global labor market that opens up a wide range of opportunities to attract skilled personnel regardless of socio-economic status in the host country
Form of organization of employment	legal and non-legal employment	disorganized virtual movements that are not officially documented and organized
The degree of adaptation to new conditions	the difficulty of adapting to living and working conditions with foreign employers	do not need much adaptation as they work under usual conditions
The level of mobility	flexibility and mobility of specializations and professions	freedom of movement on the global labor market
Requirements for labor functions and the quality of the workforce	ability to respond quickly to employers' requests	ability of abstract thinking, high reaction speed, ability to communicate with a virtual colleague and to make decisions, etc.
Movement entities	Everyone who has ability to work	persons of different ages (from student to retirement) and social status, they can be, for example, citizens with disabilities, etc.

Source: (Huk, 2012, p.90).

for economic, political, religious or other reasons. Highly qualified specialists are the basis of economics, based on the education. Despite the widespread contention that different types of migration are mixed and therefore cannot be clearly categorized, the number of criteria does not make it very difficult to classify some of them. Of course, as migration processes evolve, new types emerge and, accordingly, the classification needs to be supplemented and improved. In order to facilitate the study of both long-existing and new types of migration, it is important to clearly identify a wide range of these types and to classify them according to specific criteria (Table 1).

The advent of the Internet is a technological revolution with consequences for all spheres of social life, so it is the Internet that has created such a social innovation as the virtual labor market, which allows more and more virtual migrants to work without leaving the country, regardless of geographical location their employers. Virtual migration does not cancel the physical migration of workers, they are both part of labor migration in the global economy. The phenomenon of virtual migration demonstrates that the essence of the global economy is that the world economy moves from physical to information space.

There are some difficulties in the study of virtual migration of highly skilled workers who have high educational and computer literacy skills. These include the lack of a clear statistical record of the virtual relocation of highly skilled labor. Typically, virtual migrants are service workers (scientists, educators, physicians, engineers, programmers, etc.). It is liberalization of the labor market leads to a greater polarization of the income of the citizens of developed countries and of the ones originating from impoverishment of the underdeveloped countries that generates a process of world migration, which is a part and parcel of the international labor market.

4.1. OFFLINE MIGRATION OF HIGHLY QUALIFIED WORKERS

These processes are changing both global geography and the division of labor, as well as the patterns of mobility and migration. Not only the mobility of things, but also the mobility of work, are undergoing major transformations, given the proliferation of digital technologies around the world. Workforce is a commodity and its mobility has special qualities. Digitization is an important factor in the modern transformation of labor and its mobility. Digital technologies and infrastructure have transformed existing jobs and created new ones, and these changes occur with spatial and temporal transformations affecting labor mobility.

Workers staying in their home country are programming, pursuing debtors through their credit cards, and selling cell phones, diet pills, and mortgages to companies based in other countries. Is it possible to call this phenomenon migration? We think that this is virtual migration because their skills and workforce are virtually migrating abroad, and, physically, workers remain in the country of their permanent residence and keep working there. Virtual migration is now subject to a fascinating and innovative study of how software flows are replacing real human migration.

Many corporations have developed the so-called 75–25 model, with a 75 percent office located in the employee's country and about 25 percent of employees working abroad. As a result, it is sometimes difficult to determine what really moves: data, work, or both? Aneesh called the process of the employee's work for a company outside of his country "migrate without migration" (Aneesh, 2006, p.2).

Nowadays, the global geography of virtual work continues to change dynamically. For example, the increasing importance of the digital workforce through work platforms and mobile phone applications is enabling rapid outsourcing of virtual workforce from around the world. Of course, the concept of migration is mutated when the movement of labor does not coincide with the amount of real movement of people across the border. From this understanding, it is necessary to take into account the heterogeneity of migration processes, it requires understanding of the border as not only a specific dividing line between the two countries.

In transnational virtual space, work and vast amounts of data cross national boundaries, but workers themselves do not. Analyzing the work of computer programmers in India working for the US software industry, Aneesh argues that a programming code that connects globally scattered employees across servers and computers is a key organizational system facing the growing virtual reality migration. He considers this “code rule” to be a crucial and unexplored aspect of globalization (Aneesh, 2006, pp.4–5). Virtual migration reflects the extension of a transnational space where globalization is done through computer programming code.

Globalization frees up migration of capital to a much greater extent than labor migration, the mobility of which, unlike the mobility of capital, is limited by the market although it is global. This is a particularly big problem for unskilled workers. So, for such workers from rich countries, it makes no sense to migrate in order to improve their financial situation since markets that are ready to accept them will provide them with even worse conditions than in their native country. Migrants from poor countries get a higher salary than in their original countries and create a migration of capital on the basis of their physical migration, with their labor thus “creating” capital which was not there before their migration.

The digital revolution has extended this logic of migration – capital growth through labor migration on the part of highly skilled workers in the highest sector of the global labor market, bringing human capital (highly skilled workers) accumulated in many poor countries into the migration movement. An unprecedented increase in capital migration and competition in the global labor market has occurred. This led to an explosive demand for knowledge. The demand for highly skilled workers has created a global situation, because, unlike unskilled workers, such workers compete in the global labor market, while there is no such competition between unskilled workers. Unskilled workers without competition massively migrate from poor countries to richer countries. They do not create a global economy but simply use its transparent state borders. So, highly skilled labor migrants mobilized by the digital revolution create the “knowledge economy”. Thus, the global economy, the digital revolution and the “knowledge economy” are closely interconnected and act as a single phenomenon.

Therefore, workers with secondary or higher education have fewer chances of being laid off than less educated workers. Kupets examines the duration of unemployment and believes that higher education significantly increases the chances of finding a job, while other levels of education do not have a significant impact on this probability (Kupets, 2006, pp.228–247). Our findings are confirmed by the 2007 report of the European Education Foundation Transition from Education to Work in EU Neighboring Countries. The report states that on the example of Ukraine, 26% of graduates were unemployed two years after graduation. However, for university graduates this indicator was almost twice lower (14%).

Inside highly skilled labor migrants’ environment, a virtual migration regime was subordinated to the “code rule”. Virtual migration does not abolish the physical migration of

workers; both of them are part of labor migration in the global economy. At the same time, virtual migration not only “fills” the global economy, but directly builds its higher sectors, determining its quality of the “knowledge economy”. Virtual migration is a kind of test for national economies: it shows how they are “knowledge economies”. This is a test of the quality of labor migration to a given country. Firstly, if labor migration is not directed to the country, but from the country, this is evidence that the country is economically disadvantaged. Secondly, if the country in which labor migrants migrate massively has ignored highly skilled migrants, the quality of mass physical migrants is low in this country (Aneesh, 2006, p.64).

The development of modern means of communication, primarily the Internet, along with traditional forms of use of foreign labor in the host country, has fostered the emergence and remote forms of it, which allow residents of one state to work for employers located in other countries without leaving the former’s homes.

Digitization can increase job turnover and, thus, promote even more efficient division of labor within the economy. On the principle of substitution, professions that use new technologies (for example, graphic designers) can take on functions previously performed by other professions (such as printing houses). Technological changes may result in the complementarity of capital and the skills of employees, or the polarization of such skills (Krusell & Ohnian, 2002, pp.1029–1053). In the case of complementary capital and skills, the demand for highly skilled workers performing creative tasks will increase even more, while low skilled workers are more likely to lose their jobs (assuming the use of labor-intensive technological innovations). On the contrary, the polarization of skills hypothesis (Chinorackya & Corejová, 2019, pp.994–1001) involves more risks for middle-skilled workers, assuming that most standardized (“office”) tasks are at greater risk of digital substitution than low-skilled workers, especially if they do not perform routine tasks (the use of “conventional” technologies that proportionately reduce capital and labor costs).

The proliferation of online job search (including online employment) creates additional opportunities for a new generation of workers to learn, work and change their career paths in short steps without being tied to one of their chosen specialties. In the future, the adoption of such a trend will allow for the worker’s remuneration to be simply a function of his skills, but not merely of the actual position at work he would hold.

4.2. BLOCKCHAIN TECHNOLOGY

Temporary employment using blockchain technology can be a powerful tool for the future development of online employment. Temporary employment contracts play a crucial role in today’s global economic and social context. Increasing international competition, slow economic growth and high unemployment have led to greater flexibility in many countries and institutions. The proliferation of non-standard contractual agreements is also greatly facilitated by technological innovations that have been actively developed in recent years. Dynamic temporary online employment can be an important and flexible business tool for responding to market fluctuations caused by economic policies and seasonal factors. According to the ILO, contractual agreements are a feature of today’s global labor market.

At the same time, this type of activity requires a special form of protection for the labor market participants in the global labor market, taking into account all aspects and risks of online employment, for both employers and employees. A blockchain-based employment system can secure the rights of all temporary employees, providing them with fair legal

remuneration (including tax payments) and employer insolvency risk insurance. At the same time, such a system can assist the employer in the processing of contracts in a fully automated and swift procedure.

Blockchain technology is based on a decentralized technical database for efficient transaction management. It stores these transactions in a Peer-to-Peer network. This technology is also a public registry: transactions consist of encrypted data that is verified and validated by participating nodes and then added to the block and recorded in the blockchain. Blockchain technology is also expected to have a direct impact on the job market, most notably the brokers and managers who handle the workflow, which can be pushed out of the automated services market. In the long run, this also means a decrease in the demand for notaries, auditors, officials, administrators and more.

However, to date, the potential for the application of this technology in the field of international labor migration regulation can be characterized as observation domain and is still significantly underestimated compared to its use as compared to other forms of international economic relations: disruptive domain) – international trade in goods and services, international finance; the evolution domain – international economic integration.

However, data acquisition and transmission systems, both traditional and blockchain and artificial intelligence, should be regarded as just one of the prerequisites for successful migration policy formulation and implementation. These innovations can only outline the potential benefits in the medium and long term, in terms of economy, transparency and accountability, in migration management, but they cannot replace the existing strategic vision in shaping regional migration policies, taking into account the system of migration interests of countries in the region.

4.3. ARTIFICIAL INTELLIGENCE

Modern information technologies and machines that are driven by artificial intelligence have a significant impact on the world labor market today. The information economy is developing exponentially and is finding active expression in manufacturing. We consider that artificial intelligence is one of the most promising directions of computer science that studies methods of solving problems for which there are no solutions. Artificial intelligence systems can operate on data and learn. The scope of such systems is unlimited – from the creation of robots that make their own decisions, to machines with autopilot or online translators in real time.

There are two types of artificial intelligence:

- Weak artificial intelligence: the computer is only a tool for the study of cognitive processes – the machine only simulates intelligence.
- Strong artificial intelligence: processes in the computer are intelligent, and the machine itself is capable of self-learning. Computers can use the right software to optimize their behavior based on their past behavior and experience ('Artificial intelligence and robotics and their impact on the workplace,' 2018).

When applied in the economic sphere of artificial intelligence, (Dettmer, Hesse, & Jung, 2016) distinguish five directions of its manifestation: deep learning, dematerialization, giant economy, autonomous driving and robotization.

Robotization is a growing trend in the global economy, characterized by the replacement of human labor by robots. Robotization is a higher level of development of machine

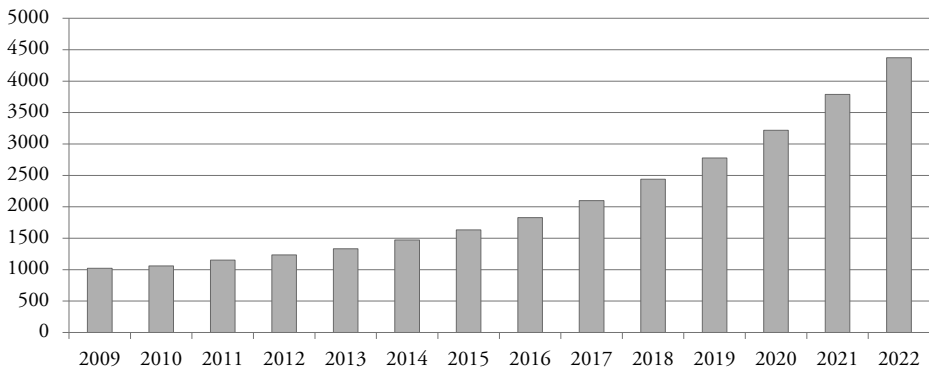
technology, when the regulation and management of production processes are carried out without human participation, but only under control. This process can be positive for international business by increasing labor productivity and reducing labor costs, increasing profits, filling scarce jobs in the enterprises.

Robotics use has increased significantly since 2009, when companies tried to balance cash flow by optimizing payroll costs. Thus, the automotive industry, which actively used robotics in the first phase of recovery after the Great Recession (2009–2011), increased the participation of robots in the production process by 55%. If Japan and South Korea are the traditional largest users of robotics, the United States, China and Germany are the most important drivers of their continued use. Advances in robotics, artificial intelligence make a new era of automation, as machines are capable of the same, and sometimes higher productivity in performing human work in a wide range of areas, including those requiring cognitive abilities. The pace and degree of automation are determined by technical, economic and social factors.

Digital technologies offer radical new ways of manufacturing, buying and selling and regulating, which in general has a direct impact on the state of the labor market (Freddi, 2018). To date, this focuses on the replacement of the lowest-skilled workers (one additional job is sufficient to replace six such workers) and the impact on the general payroll (one additional job per 1,000 workers results in a total reduction of between 0.25 and 0.5%) (Chinorackýa & Čorejová, 2019, pp.994–1001).

For the period from 2020 to 2022, the number of industrial robots to be installed in the industry is expected to grow by more than 2 million units (expected average growth of +10% annually, with an upward trend of up to 12% in 2022) (Fig. 1). The key sectors that are driving this growth are the automotive and electronics industries (including computers, communications, etc.).

Fig. 1. Number of industrial robots in the world in 2009–2022 (thousand units)



* 2020–2022 – forecast of the number of industrial robots in 2020–2022

Source: (International Federation of Robotics, 2019).

Up to 30% of all jobs in the world are theoretically able to be automated through the use of existing technology, which amounts to about 800 million full time workers. However, the proportion actually replaced by labor by 2030 may average about 15 percent (McKinsey Global Institute, 2017a). By the same year, 3 to 14% of the world's total workforce (75–375 million

workers) will be forced to change employment, and everyone else will have to adapt to the condition of working together with robotics. In particular, it will require increasing the level of education, social adaptability, creativity, development of cognitive abilities and more. Developed countries that are more likely to implement robotization will have higher labor replacement rates – an average of 33% (in Japan – up to 46%). Developing countries in the 2030s will be more moderate and may average up to 9% (China – up to 13%, Mexico – up to 10%, India – up to 6%). At the same time, by 2030, it can be expected that 8–9% of the demand for labor will be a request for those types of specialties that either do not exist at present or are just in their infancy.

According to the McKinsey Institute (McKinsey Global Institute, 2017b), robotic manufacturing processes can increase global labor productivity by 0.8–1.4% annually. The cost-savings potential of robotics can be up to 50% of the global payroll, which is around \$32 trillion per year and can affect 1.1 billion workers in the world economy (more than half of this figure is in 4 countries: US, China, Japan and India). Automation can occur in more than 2000 occupations and will cover 800 occupations by 2055. Although less than 5% of all professions can be fully automated at the current technology level, approximately 60% of all professions have at least 30% of processes that can be automated.

At the same time, the replacement of human labor by machine does not imply a systematic transition of the dismissed workers to the unemployed, but will be more characterized by their transfer to other sectors of services, as was the case with the change in the structure of employment in the transition to post-industrial society. At the same time, on the way to full robotization, some specializations may be partly automated at first, which may have different consequences for low- and highly-skilled workers. For low-skilled workers, this process will be accompanied by a reduction in wages, provided there is no proportionate increase in global demand, which is likely in the medium term. Instead, the demand for and income levels of highly skilled workers, which is first and foremost due to the introduction of new robotic technologies, will grow at an increasingly fast rate.

5. CONCLUSIONS

Digitization of the world economy, along with processes such as technologicalization, robotization of labour, standardization of education, etc., are key determinants that influence the transformation of the international labor market. The consequence of the digitization and robotization processes is the spread of industrialization 4.0, which is manifested in the accelerated robotization of the world economy and accelerated data exchange in global production processes, which include cyber-physical systems, the Internet, cloud technology and the development of other technologies.

The advent of the Internet has created such a social innovation as a virtual labor market that allows more and more virtual migrants to work, regardless of where their employers are literally located. Highly skilled migrant workers, mobilized by the digital revolution, build an environment for themselves – a global economy, a “knowledge economy”. Thus, the digital revolution and the “knowledge economy” are very closely interconnected.

Virtual migration does not abolish the physical migration of workers, they are both part of labor migration in the global economy. The phenomenon of virtual migration demonstrates

that the essence of the global economy lies not in transnational corporations and transparent borders, the global economy moves from the physical space to information space.

Robotization will be capable of replacing the traditional driver of economic growth starting from the mid-21st century. At the same time, if for advanced economies and the global economy as a whole, robotization appears to be a useful process, for some labor-intensive developing countries, large-scale automation can be a major shock in the local labor market.

The impact of digitization and robotization on employment can be both positive and negative. Companies that leverage the potential of digital technology will oust competitors who will not make full use of it. Robots can replace people in the workplace or perform certain tasks, but technological innovations create new opportunities for injured workers, driven by the increasing volume of newly created value-added work. The needs of mankind are endless, goods and services are not limited in their evolution, and digital technologies should be considered an advantage as they are an important source of future productivity gains. All this minimizes the risks of mass unemployment in the international labor market in the short and medium term, while the technological restructuring of the labor market under the dominant influence of digital technologies is realistic.

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