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The impact of the digital revolution on the substitution of labour with capital

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Subject. Throughout human history, the development of new technologies has led to an increase in the efficiency of labour, changed its nature and influenced the socio-economic life of people. Currently, the process of the digitalisation of the economy, as well as the distribution of robotics and artificial intelligence technologies, increase interest in scientific research aimed at assessing the impact of these technologies on labour and productivity.
Purposes. The purpose of this article was the analysis of the impact of modern technological innovation on labour demand at the macroeconomic level. To achieve these, we considered two key issues: what is the impact of the introduction of new technologies on overall demand and what impact does the integration of new technologies have on the economy.
Methodology. In order to achieve the objectives, an analysis of domestic and foreign research in this area was carried out, and approaches to statistical testing of the hypotheses were discussed. General scientific methods were used: analysis, synthesis, comparison, systematisation.
Conclusions. Two main approaches to forecasting the impact of new technologies on the labour market have been identified: the capital-labour hypothesis (techno-optimists) and an increase of the technological demand hypothesis (techno-sceptics). It was revealed that statistical testing of the impact of new technologies on aggregate labour demand is not available due to data limitations. It was also noted that these two approaches apply to different time perspectives and are not mutually exclusive. It was found that there are conflicting views on the expected consequences of new technologies for the labour market. Some people believe that technologies will increase skill and income inequality, while others predict that it will reduce inequality and make the digital economy accessible to people with different skills.

Key words: nature of labour, content of work, technological unemployment, influence of technologies on the content of work, capital-labour hypothesis, increase of the technological demand hypothesis.

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Introduction

The development and distribution of modern computerisation technologies and, in particular, artificial intelligence have the potential to completely change the organisation of the social and economic life of people around the world and it determines the relevance of the topic.

Many domestic and foreign researchers have been analysing the impact of technologies on the economy and labour. They assessed the impact of new technologies on unemployment, changes in the structure of the labour market and its polarisation at the macroeconomic level, using statistical methods. Authors such as D. Autor (2013. P. 1553–1597), M. Dillender (2022. P. 1553–1597), W. Dauth (2017. P. 1–63), and G. Graetz (2018. P. 753–768), in their studies noted an increase in the overall demand for labour after the introduction of technologies in various sectors of the economy and in different time periods.

Acemoglu & Resterpo (2019. P. 1–45) introduced a "labour-task approach" to analyse the impact of new technologies on work. It allows assessing which tasks can be automated and which new tasks arise when new technologies are introduced. Their study confirmed that robotization in industrial enterprises reduces the overall demand for labour in the economy (Acemoglu & Restrepo, 2020. P. 1–92).

B. Martens (2018. P. 5–33) was one of the first to systematize methods for assessing the impact of technologies on work. Various researchers such as C. Frey (2017. P. 254–280), E. Brynjolfsson (2014. P. 89–249), J. Bessen (2019. P. 5–55), M. Arntz (2017. P. 157–160), R. I. Kapeliushnikov (2018. P. 32–36), E. V. Ustyuzhanina (2017. P. 1788–1804) and N. G. Yakovleva (2022. P. 30–47), conducted research on the impact of new technologies on the future socio-economic structure.

There are also studies on segmenting work tasks according to the degree of their vulnerability to automation. In the study of V. Marinoudi (2021. P. 3–18) segmentation of labour tasks in agriculture was carried out based on the characteristics of routine and creative activity, as well as physical and mental labour. The authors also forecast the impact of the introduction of robotics on these tasks and the professions associated with their implementation.

Studies related to changes in the structure of the labour force and the share of informal employment were conducted by V. E. Gimpelson, A. A. Zudina, and R. I. Kapeliushnikov (2017. P. 1–148).

The introduction and spread of modern technologies such as automation and artificial intelligence have given rise to a variety of approaches regarding their impact on the economy. These divergent views attempt to develop new methods and approaches to assess the economic impact of technologies, overcoming the limitations and perceptions formed in the past. Due to this uncertainty, there is an important research gap evident in two key areas: the lack of consensus and common understanding of the impact of new technologies on the labour and the economy, and the limited number of studies on the integration of new ideas and approaches into existing methods of assessment of technologies on labour.

The main purpose of this article was to determine the impact of new technologies on the economy. To achieve this goal, two key questions need to be answered: first, how does the introduction of new technologies affect the overall demand for labour at the macroeconomic level, and second, how does this introduction of technologies affect the economy as a whole.

Research methodology

This article is based on an analysis of a large amount of domestic and foreign material on the research topic. The results of the analysis were synthesized into a single block of argumentation. The following criteria (factors) were used for selection of articles for the analysis:

1) the authority of the scientific journal where the article was published: whether the journal included in the list of referenced scholarly journals recommended by the State Commission for Academic Degrees and Titles of the Russian Federation, Web of Science, Scopus (mainly for Russian publications); international publication source (International Labour Organisation, World Bank, OECD, etc.), Google Scholar ranking for journals of the Economics and Economic Theory category;

2) the authority of the author of the publication: the presence of publications in reputable journals, frequent mention of different authors in publications; the affiliation of authors with leading research institutes.

Results and discussion

Research into the impact of new technologies on overall labour demand shows varied and conflicting results. In particular, there are differences in the opinions and assessments of researchers regarding the process of replacing labour with capital and its possible consequences for the medium and long term.

There are two general hypotheses that can be distinguished in this context. The first, supported by techno-optimists, is that the substitution of labour with capital will occur faster than the ability of people to adapt to new technological conditions. The second hypothesis, supported by techno-sceptics, states that employees will be provided sufficient time to successfully adapt to change. Let's consider the arguments of both sides.

Argumentation of Techno-Optimists

Techno-optimists argue their position based on the assumption that automation, and especially robotization, allows almost completely eliminating humans from the production process. At the same time, new jobs that appear due to automation have two main characteristics: (1) they remain small in number compared to the number of jobs being replaced within one company; (2) and require a completely different level of qualifications and skills (Acemoglu & Restrepo, 2019).

In the past, employees were required to perform simple, routine tasks. However, with the advancement of technologies and automation, employees must perform more complex tasks, such as the supervision and monitoring of complex technological systems, which require completely different skills and competencies. These skills cannot be learned in a short period of time.

Techno-optimists also point out that employees substituted by automation often find opportunities to reskill and adapt to new technological demands. They move to other industries and companies where there is a demand for their skills or where they can quickly learn new competencies. However, as techno-optimists point out, this transfer is usually limited by moving to less technologically advanced companies within the same industry or moving into the service sector, where technological adaptation is slower (Гимпельсон et al., 2017).

Techno-optimists justify their position by pointing to the increasing share of robots in manufacturing across various industries. However, to support their arguments, it is necessary that the increase in automation be accompanied by an increase in unemployment. Data showing that in industries where the share of robots (capital) is growing, the share of employees (labour) is decreasing were presented in such studies as the study of Acemoglu & Restrepo (2020). Other researchers have also used similar methodologies and confirmed that the increase in robotization is accompanied by a decline in the share of labour (Arntz et al., 2017; Dauth et al., 2017; Graetz & Michaels, 2018). For example, one study states that robotics in developed countries may reduce employment in developing countries where companies previously relied on cheap labour (Faber, 2020). However, it is important to note that these studies generally indicate that the decline in demand occurs only at the company and industry levels, and the impact on the economy and unemployment in general are either absent or positive (Martens & Tolan, 2018). This happens because labour displaced from robot-prone industries moves to other areas where robotization is less common or where technological adaptation is slower.

It is important to note that the movement of labour is possible because the process of technological adaptation occurs unevenly and takes a lot of time (Dun et al., 2020).

Currently, robotization is actively used in secondary sector manufacturing, where tasks and work processes can be described as a sequence of actions and, therefore, can be automated relatively easily.

However, in the service sector, tasks are more difficult to automate due to the high degree of

uncertainty associated with their performance. Despite this, forecasts indicate that in the future artificial intelligence will be able to automate most tasks even in the service sector (Autor & Dorn, 2013; Marinoudi et al., 2021). With the development of more advanced machine learning and robotics algorithms, we can expect an expansion in the field of automation in the service sector.

Many researchers emphasize the special importance of artificial intelligence (AI) technologies in modern development. They have a significant advantage over traditional robots, which specialize in specific tasks and often require large investments for their implementation. After training AI algorithms are capable of solving a wide range of different problems in different fields. For example.

1. Search algorithms, such as those used by Yandex, can find relevant information in different areas, taking into account many factors to provide the best search results.

2. Recommendation systems in on-line stores and streaming platforms can provide personalized recommendations in different categories of products, movies, music and other content, taking into account user preferences.

3. Technologies such as ChatGPT or DeepAI are capable of generating text, creating simple computer programs, and answering a variety of questions with a wide range of knowledge and skills.

This versatility and adaptability of AI algorithms makes them powerful tools in many industries that require data science, decision making, and task automation. In addition, facial recognition algorithms can be trained and then used an unlimited number of times in different parts of the world. These technologies and their potential raise doubts about the continued high demand for unskilled labour (Brynjolfsson & McAfee, 2014; Martens & Tolan, 2018).

If we imagine a future in which technological adaptation is highly developed and uniform across all industries (where tasks performed by robots completely substitute manual labour), and there is no significant lag in technological adaptation between different sectors of the economy, then it will be difficult for employees to find new jobs. If their jobs are substituted by robots in one area, then it will be extremely difficult for them to find similar jobs that require the same skills. This means that there will be a significant discrepancy between current skills of employees and the minimum skills required to move to a new job. The speed at which employees can learn the new technologies needed to participate in the new technological order may not correspond to the speed at which these technologies develop and are adopted. In this situation, the rapid mobility of labour between industries will become impossible, and the risks discussed by proponents of the idea of labour substitution with capital will become relevant. The situation is aggravated by the fact that existing education systems around the world are not ready to effectively adapt people to the new technological order (Яковлева, 2022).

This argument of techno-optimists partly continues the ideas of Karl Marx about the growth of the organic composition of capital. Marx predicted that new technologies would lead to the gradual automation of production and the substitution of manual labour. Marx believed that with the development of new technologies and increased productivity, capitalists will try to automate and optimize production to reduce labour costs (Marx, 1996). This will lead to the fact that the share of constant capital (including technologies and machinery) will increase, and the share of variable capital (labour) will decrease.

However, from the point of view of modern researchers, Marx's approach has its limitations, since he did not foresee the emergence of new innovative goods and services. With the development of new technologies, new tasks that may be difficult to automate appear. Some tasks in service industries, for example, require direct contact and interaction between people, making them less suitable for automation (Acemoglu & Restrepo, 2019).

It should also be taken into account that the movement of labour between industries depends on the development of technologies and

their adaptation. At the moment, automation is being actively implemented in manufacturing industries, where tasks can be described as a sequence of actions. However, tasks in service industries are often more complex and less predictable, making them less suitable for automation. However, the future may bring new innovations in artificial intelligence and automation, potentially changing the situation (Martens & Tolan, 2018).

The second argument of supporters of the substitution of labour with capital is that new technologies allow multiplying the productivity of a worker without a significant increase in their salary. To support this argument, it is necessary to prove that the increases rate of worker productivity exceeds the increased rate of salaries. Acemoglu & Restrepo pay attention to such dynamics (2020). They conducted research in industrial sectors (where robotization was most active) and found that with an increase in the productivity of companies, there was simultaneously a decrease in employment and the share of labour in the additional product.

The analysis of the consequences of technological development, performed by some researchers have drawn attention to the tendency toward worker polarisation that may arise as a result of this process. This trend involves the identification of two opposing classes of employees (Ustyuzhanina et al., 2017):

1. Innovators: This class will consist of those employees who actively contribute to the creation and implementation of new technologies and approaches to solve both new and existing problems. Innovators will play a key role in driving the development of the economy and society. They will represent the creative minority (according to Toynbee) who will make significant contributions to innovation.

2. Operators: This class will include employees involved in performing routine tasks and maintaining automated systems and machines. Their main function will be related to operational activities and maintaining the functionality of existing technologies, but they will not be sources of innovation.

Over time, the gap between these two groups of employees will be wider. The creation of innovations will require a high level of skills, and the innovators will be at the forefront of development. In addition, even employees who were previously considered innovators may lose this status in the future, since maintaining this status will require continuous improvement of skills and knowledge. This process of polarisation can create a number of social and economic challenges, including increasing income inequality and access to opportunities. It will also be necessary to ensure the re-training of employees that they can successfully adapt to the changing demands of the labour market.

The progressive spread and automation of routine tasks performed by "operators" has the potential to lead to a phenomenon called the de-intellectualisation of work (Ustyuzhanina et al., 2017). This means that employees may perform the role of operators whose activities are reduced to mechanically following prescribed algorithms and sequences of actions, reminiscent of pressing buttons on a machine. This state is reminiscent of the Industrial Revolution, when many tasks were automated and employees performed monotonous and routine tasks.

However, we should not forget that automation affects different professions and areas of activity in different ways. For example, professions related to management, engineering, and science can benefit from automation. For these professionals, automating routine tasks such as monitoring, measurement, control and calculations provides an opportunity to more effectively use their skills and resources for creative solutions and higher-level tasks.

Some researchers propose the idea of "labour creativity" (Dun et al., 2020). This means that in addition to de-intellectualisation, when routine tasks become less intellectual, the opposite process, an increased requirement for creative solutions, may also occur. This means that some industries will require new and creative approaches to solve problems that cannot be automated. Thus, we can observe not just de-

intellectualisation, but also the simultaneous creativity of labour (Ibid.).

It should be noted that there is a gradation between these two phenomena, de-intellectualisation and creativity, and their impact on different areas of work and professions will be different. These two processes can be observed with different intensities and in different areas of the economy.

The arguments of techno-optimists, proposing positive scenarios for the impact of robotization on the labour market have a common drawback, the limited amount of available data to reliably assess the consequences of automation. Even in the sector considered most susceptible to automation, namely the secondary sector (Acemoglu & Restrepo, 2019), the adoption of new technologies and robots remains limited. At the same time, the observed positive effects, although significant, have a limited impact and do not allow us to draw clear conclusions about the impact of automation.

Argumentation of techno-sceptics

The second group of researchers, who can be described as techno-sceptics, believe that the probability that mass unemployment will arise as a result of robotization, automation and digitalisation is low, citing historical examples of technological revolutions.

These researchers point to professions that were supposed to disappear under the pressure of new technologies. However, in practice, such professions either increased in numbers (such as tellers and bank operators) or disappeared relatively slowly. This suggests that the rate of adaptation and adoption of new technologies matches the rate of decline in demand for old skills (Bessen, 2019; Kapeliushnikov, 2018).

Techno-sceptics also consider the current statistics to support their point. For example, they note a slowdown in GDP growth rate and even negative total factor productivity. This indicates the slow adoption and use of new technologies, as well as the limited impact of these technologies on overall labour productivity.

An example in this context is data from Acemoglu & Restrepo (2019), which shows that the number of automated jobs in the US is only about 600,000, which represents a small share of the total workforce of about 120 million (Kapeliushnikov, 2018).

Techno-sceptics also focus on institutional and market factors that contribute to the slow adoption of technologies. Institutional and market barriers can weaken the impact of new technologies on the economy and labour market, which, in turn, supports the thesis of techno-sceptics about the slow adaptation and limited impact of new technologies.

These factors include:

1. Duration of legislative registration of new technologies. The process of developing and approving legislation for new technologies, such as self-driving cars or delivery drones, usually takes a significant amount of time.

2. Established forms of management at enterprises. Many businesses rely on traditional management methods and work processes, which can make it difficult to implement new technologies.

3. The high cost of introducing and maintaining new technologies. Often, introducing and maintaining new technologies requires significant investments compared to low labour costs.

4. Limited supply of highly qualified specialists. The lack of specialists capable of introducing innovations in a short time can slow down the process of adapting new technologies.

5. The complexity and duration of training for such specialists. Training qualified professionals can take time and effort.

All these factors together influence the slow penetration and application of new technologies in the market (Kapeliushnikov, 2018).

Techno-sceptics also point out that new technologies not only reduce aggregate labour demand, but also change its structure. They argue that certain professions are becoming obsolete while others are emerging. New technologies usually place higher demands on the qualifications and education of employees. Companies which do not invest in innovation may face lay-offs and even closure, while innovative

companies expand and create new jobs. This leads to a flow of employees from the first group of companies to the second, stimulating changes in the structure of not only the industry (it becomes more technologically advanced), but also the labour market (people also begin to learn more technologically advanced skills).

To support this point of view, researchers refer to statistical data. For example, from 2000 to 2015, the sectoral structure of the Russian economy underwent significant changes, but the active redistribution of labour between sectors was not accompanied by a sharp increase in unemployment. Labour resources that were released from industries subjected to changes were absorbed by other industries (Gimpelson et al., 2017). Similar dynamics were also shown by the research of other authors (Gogoleva et al., 2022).

Techno-sceptics, commenting on the claims of techno-optimists regarding the features of artificial intelligence (AI), have a different point of view. They emphasize that the unique characteristics of new technologies, such as the ability to be used in a variety of tasks and the low cost of replication, can contribute to the improvement of the composition of the labour force and reduce polarisation in the labour market (Dun et al., 2020).

At the moment, new technologies open the way for wider access of people to the digital economy. This access is not limited only to the ability to work on platforms and fulfil orders from different parts of the world. Today, everyone has the ability to create their own platforms, websites, and mobile applications, even without the need to have relevant qualifications (Ibid.). This phenomenon is especially relevant for developing countries, where the digital services market is not yet subject to monopolization by large corporations.

In developed countries, new technologies can also help narrow skills or education gaps among employees while widening the gap in creativity and creative thinking. If technologies reduce the requirements for specific skills to create digital products or services, then acquiring the ability to be creative and differentiate in the market becomes more important. This process can expand access to the digital economy and provide new opportunities for entrepreneurs and creative people (Ibid.).

Modern technologies also influence the work patterns of existing staff. Let's consider the previously mentioned example: artificial intelligence that can perform facial recognition of customers and collect important data about them. However, analysing problems and developing appropriate solutions requires a high level of empathy and a thorough understanding of the context of a particular situation and such qualities are difficult to automate. This principle is also confirmed by the results of a study conducted by M. Dillender et al. (2022), where the impact of new software on office administrative employees was analysed. The results of this study revealed that the number of employees in administrative positions decreased, but their salaries increased. In addition, the nature and requirements of job skills have changed significantly. Administrative staff are now expected to perform more analytical and creative tasks related to internal interactions within companies, and there is a need for a higher level of education and understanding of new technologies. It is important to note that the unemployment rate in the studied region did not increase, which indicates that employees moved to other companies or retrained to work in other positions (Dun et al., 2020).

Techno-sceptics, despite the generally optimistic prospectives, acknowledge the negative effects of automation, especially in the short term. In the medium term, technological unemployment may be a real phenomenon, and the important question is how much it will exceed standard levels of frictional unemployment. However, techno-sceptics also argue that, in the long term, new technologies can help create new jobs and reallocate labour, which can mitigate the negative effects of short-term technological unemployment.

Measurements and Metrics

To confirm their hypotheses and arguments, both techno-sceptics and techno-optimists monitor changes of the similar set of indicators.

The main object of analysis is the aggregate demand for labour in the economy. It is expected that the development of new technologies can either reduce aggregate labour demand (according to techno-optimists) or not change it (according to techno-sceptics). Since the impact of new technologies on labour demand is not immediately apparent, researchers also consider other indicators that can predict future changes in demand.

These leading indicators can be divided into two main categories: (1) indicators of employee adaptation and (2) indicators of technological adaptation of companies:

1) growing inequality between high-skilled and low-skilled employees. According to technology optimists, we will see an increase in the number of employees with high and low skills, while the share of employees with average skills will decrease. This will lead to deep polarisation not only in skill levels, but also in income. This is probably will create challenges for social justice and labour market regulation;

2) low skill levels and decreasing motivation of people to learn and improve their skills. Optimists argue that we will see an increase in the number of students ready to adapt to new requirements. However, techno-optimists worry that the pace of technological development and sophistication may exceed the ability of people to retrain. This could result in the proportions of trainees remaining low or will have little impact on employment and salary increases.

Indicators of the technological adaptation of companies and the economy as a whole include:

1) the degree of automation and robotization in the economy, determined, for example, through the number of robots per 10,000 employees, taking into account industry characteristics;

2) changes in the share of the salary budget in the overall cost structure of companies. A decline in this share while productivity remains the same or increases may indicate the potential negative impact of technologies on the workforce, such as labour displacement or lower salaries;

3) productivity increase compared to salary increase. If productivity increases significantly faster and salaries do not rise accordingly, this could signal the impact of technologies on the labour market, including possible labour displacement and lower salaries.

Table 1 provides information on the various indicators and metrics used to assess the impact of technologies on the labour market. For each indicator, a brief description is provided, methods of measurements, as well as an interpretation of changes, as techno-sceptics and techno-optimists perceive it.

It is important to note that time horizons (short-term and long-term) are used in the literature to indicate the chronological order of events and changes associated with the impact of technologies on the labour market. The exact numbers defining the length of each of these terms are not fixed and may vary from industry to industry.

As a result, four conditional scenarios can be distinguished, taking into account both time horizons (medium and long term) and different points of view of groups of researchers (techno-optimists and techno-sceptics). For each of these scenarios, it is possible to predict expected changes in the considered indicators, namely, whether the indicator will increase, decrease or remain unchanged. The qualitative state of the labour market, such as the degree of robotization of the economy also can be assessed. Table 2 contains information on changes in indicators for each scenario.

It is important to emphasize that in the long term, assessing the impact of new technologies on the labour market will become more accurate and the key metric here will be the level of labour demand. This demand can be measured by various indicators, such as the unemployment rate or the share of the employed population in the economy. Other indicators characterizing the state of the labour market may lose their significance and become less informative. Research and monitoring of labour demand and its long-term dynamics will be important tools for assessing how technological change affects the labour market and what adjustments may be needed to maintain the workforce and reduce inequality.

However, decisions and recommendations on necessary government interventions for the support of economic growth and mitigation of the risks of automation need to be developed and applied in the short to medium term. During these time, the forecasts and measurements presented by both techno-sceptics and techno-optimists may either be the same or have slight differences. It is therefore important to make decisions taking into account both the potential challenges and opportunities that may arise due to automation and new technologies in the labour market.

Based on the scenario analysis, it can be seen that both groups of researchers assume the development and distribution of new technologies, but differ in some key assumptions.

Table 1

Indicators of technological adaptation and the impact of technologies on labour

Index	Description	Method for measuring	Analysis and interpretation
Aggregate demand for labour in the economy	The main indicator for assessing the impact of technologies on labour	Unemployment and employment levels in the economy	Techno-sceptics: demand for labour increases with the spread of technologies. Techno-optimists: demand for labour decreases
Rate of employee adaptation to new technologies			
Level of inequality (polarisation) between high and low skilled employees	Determination of skill level: median salary in the profession. Assumption: the higher the salary, the higher the level of qualifications	Polarisation is characterized by an increase in the share of employees with medium and high qualifications (at the expense of average)	Techno-sceptics: moving labour resources to higher skill levels. Techno optimists: increased in the share of highly and low-skilled employees due to the decrease of the average level-polarisation
Declining proportion of people participating in advanced training programs	The transition to higher skill levels implies an increase in demand for advanced training courses	Percentage of the working-age population completing education. Share of educational services in the economy	Techno sceptics: increase in the proportion of people completing education; along with an increase in qualifications and income Techno optimists: increase in the share of people completing education; without an increase in income and employment
Rate of technological adaptation - how quickly economies/businesses adopt new technologies			
Robotization of the economy (the degree of its automation)	New technologies are expected to replace routine tasks everywhere, which means an increase in their share in the economy	Ratio of robots per 1000 workers. Technology investment growth rate	Techno-sceptics: the increase in robotization along with the growth of employment and salaries (labour demand). Techno-optimists: the increase in robotization, a decrease in employment and salaries
Share of payroll in the capital of the company	Robotization implies an increase in the share of fixed assets in the capital of the company	Share of payroll in the capital of the company (by industry)	Techno-sceptics: don't expect changes. Techno-optimists: decrease in share of payroll in all sectors of the economy
Ratio of productivity increase to salary increase	If technology is a labour enhancer, then the distribution of such technologies will accelerate salary increases	GDP growth to salary increase. Ratio of revenue per employee to average salary	Techno-sceptics: salary increases correlate with productivity gains. Techno-optimists: salary increases slow down; productivity increases faster

Source: compiled by the author based on an analysis of scientific literature.

Table 2

Measurements of the assessment of the impact of technologies on labour for each of the scenarios

Scenarios	Labour demand	Salary level	Polarisation (inequality) by qualifications	Proportion of people completing education (post-university)	Robotization (automation) of the economy	Share of payroll in the capital of companies	The relationship between productivity gains and salaries
Medium term							
Techno-optimists	Without changes	Without changes	Increases	Increases	Increases	Decreases	Increases
Techno-sceptics	Without changes	Without changes	Increases	Increases	Without changes	Without changes	Increases
Long term (changes refer to the previous period)							
Techno-optimists	Decreases	Decreases	Strong inequality	Without changes	High (work tasks involve a large amount of uncertainty and creativity)	Decreases	Increases
Techno-sceptics	Increases	Increases	Decreases (labour flows to higher skill levels)	Reaching some relatively high fixed level	Average (The proportion of routine tasks performed by humans is maintained)	Without changes	No change or decreases

Source: compiled by the author based on an analysis of scientific literature.

One of the key assumptions used by both groups of researchers is the rate and ability of people to adapt and acquire new skills. Techno-sceptics argue that employees have a historically proven ability to re-skill and upgrade their skills, making them resilient to technological changes in the economy.

It is important to note that techno-sceptics base their position on observations of historical trends where employees have successfully re-skilled and adapted to changing labour market demands.

Techno-optimists believe that in the future, the rate and intensity of technological change may exceed the ability of employees to quickly re-skill. These researchers suggest that rapid advances in technologies may create greater challenges for the workforce, requiring greater efforts for training and retraining.

Conclusions

This article analyses the impact of new technologies on social and labour relations. To achieve this goal, two key perspectives have been identified regarding the impact of technological innovations on work. The first of them is represented by supporters of the hypothesis of the substitution of labour with capital, better known as "techno-optimists". The second view is associated with the hypothesis of increasing technological demand for labour, and its proponents are often called "techno-sceptics". Both concepts provide extensive research material that allows assessing exactly what consequences may arise from the introduction of modern technologies in the labour market, in particular in terms of changes in labour demand, required skills and employment dynamics. Techno-optimists focus on the potential benefits of increased productivity

and improved overall quality of life, while techno-sceptics are concerned about the potential challenges of adapting and sharing the benefits of technological change.

It was discovered that at the moment, the analysis of the influence of technologies on labour demand is complicated by the lack of required data, which makes it difficult to carry out direct assessments of the effects of new technologies on the labour market. Due to the difficulties in directly assessing the impact of technologies on the labour market, researchers are actively developing and applying a variety of methods to measure this impact. They use the analysis of indirect indicators and factors that may indicate trends in change. Analyses based on such data allow developing more detailed and accurate forecasts regarding the impact of technological innovation on the labour market.

After considering two approaches to forecasting the impact of new technologies on the labour market, we can conclude that they are not mutually exclusive, but rather are focused on different time horizons. In the short to medium term, it makes more sense to use the methods and assumptions proposed by techno-sceptics. In this context, we should not expect radical changes in the economy and labour market, since the distribution of the workforce across different sectors of the economy and the ability of employees to adapt and update their professional skills probably will mitigate most of the negative consequences associated with automation and increased demands for qualifications for vacancies.

However, over a longer time horizon, market mechanisms will be probably insufficient to solve emerging problems. It was noted that expectations regarding new technologies, including artificial intelligence and machine learning algorithms, are multidirectional. Some researchers predict increased polarisation of employees by skill level and salaries, while others predict a decrease in this polarisation and lower technological barriers to access the digital economy for those without the necessary qualifications.

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Conflict of Interest

The author declares the absence of obvious and potential conflicts of interest related to the publication of this article.

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Влияние цифровой революции на замещение труда капиталом

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Предмет. На протяжении всей истории человечества развитие новых технологий приводило к увеличению эффективности труда, изменяло его характер и оказывало влияние на социально-экономическую жизнь людей. В настоящее время процесс цифровизации экономики, а также распространение технологий роботизации и искусственного интеллекта вызывают повышенный интерес к научным исследованиям, посвященным оценке воздействия данных технологий на труд и производительность.
Цели. Цель настоящей статьи заключается в анализе воздействия современных технологических инноваций на спрос на труд на макроэкономическом уровне. Для достижения этой цели необходимо рассмотреть два ключевых вопроса: каковы последствия внедрения новых технологий для общего спроса и какое влияние оказывает интеграция новых технологий на экономику в целом.
Методология. Для достижения поставленных целей был проведен анализ отечественных и зарубежных исследований в данной области, а также обсуждены подходы к статистической проверке выдвинутых гипотез. Использовались общенаучные методы: анализ, синтез, сравнение, систематизация.
Выводы. Были выявлены два главных подхода к прогнозированию воздействия новых технологий на рынок труда: гипотеза о замещении труда капиталом (техно-оптимисты) и гипотеза о росте технологического спроса на труд (техно-скептики). Выявлено, что статистическая проверка влияния новых технологий на совокупный спрос на труд недоступна из-за ограниченности данных. Также было отмечено, что эти два подхода применимы к разным временным перспективам и не исключают друг друга. Обнаружено, что существуют противоречивые взгляды на ожидаемые последствия внедрения новых технологий для рынка труда. Одни считают, что технологии приведут к увеличению неравенства по уровню квалификации и доходам, в то время как другие предсказывают, что они снизят неравенство и сделают цифровую экономику доступной для лиц с разной квалификацией.

Ключевые слова: характер труда, содержание труда, технологическая безработица, влияние технологий на содержание труда, гипотеза замещения труда капиталом, гипотеза роста технологического спроса на труд.

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