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Revolution 4.0 as a Factor of Change in the Labour Market

Abstract

Objectives: The aim of the deliberations is to show how the exogenous factors, in this case the subsequent Industrial Revolutions, affected the structural changes of the labour market and how they were perceived by the economists.

Research Design & Methods: The research area is limited to the theory that explains the functions of the labour market in the historical perspective. The study is a theoretical study that combines the elements of analysis in the field of economic history and the development of economic thought. The justification of the presented theses was made using the induction method and the comparative method, both of which enable the presentation of the labour market evolution process in a relatively long-time horizon.

Findings: The structure of the study reflects the changes that have taken place in the economic theory under the influence of the Industrial Revolutions. The last of them, the Revolution 4.0, is a reference point to form the key questions regarding the automation and redistribution of income that the contemporary labour market researchers are concerned with.

Implications / Recommendations: In the theoretical dimension, the attention was drawn to the usefulness of the comparative analysis method for understanding the profound changes in the labour market. The practical aspect of the research is to identify the potential threats that arose as a consequence of the Revolution 4.0. Understanding them makes it possible to take action in the field of social, economic, and educational policies that aim at reducing social tensions resulting from dynamic changes taking place in the labour market.

Contribution / Value Added: The technological progress is most often treated as a key factor that affects the supply side of the economy. It enables an increase of the productive potential of highly developed societies. The presented considerations reveal the analogies that arise in connection with the functioning of the labour market in the context of subsequent technological revolutions. Particular attention was paid to the influence of technological progress on the demand side of the economy and the consequences related to the distribution of income. The article is an attempt to supplement the reflection on the impact of the latest advancements in information technology with the context of historical changes that have taken place in the labour market.

Article classification: theoretical article, conceptual article

Keywords: Revolution 4.0, labour market, technological progress, classical political economy, neoclassical economics

JEL classification: O31, O33, B30, J31

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Introduction

Every revolution is associated with deep transformations that cause the discontinuation of the existing processes. In response to the transformations taking place in the socioeconomic sphere, the economic theory usually develops bold proposals for the conceptualisation of such processes. According to T. S. Kuhn (1962), they can be defined as a search for a new scientific paradigm. That was the case with the classical political economy, which developed in the period of the First Industrial Revolution of the second half of the 18th century. Another paradigm – neoclassical economics – developed in late 19th century, when the giant corporations were created and the free market capitalism became monopolistic.

The Third Industrial Revolution of the 1960s was overshadowed by the development of information technologies. The economists focused their attention on the significance of knowledge and information, and incorporated them in the economic theory. Currently, we are witnessing a revolution that has been named 'the Revolution 4.0'. It is hard to answer the question about how this revolution will change the production methods and also how it will affect the directions of the economic theory development. One can only assume that this time there will also be attempts to thoroughly reorient the economic theory, as was the case in the past.

Although the considerations presented in this research paper are placed in the broad context of the Revolution 4.0, they mainly focus on analysing the labour market modernisation process. The essence of every revolution, either social or industrial[1], is a dynamic process of changes that redefines institutional conditions, both formal and informal. The main research questions formulated in this study are:

1. How did the First Industrial Revolution shape the relations on the labour market, where work was the basic production factor and its remuneration determined the distribution of income in the society?
2. What new challenges has the Revolution 4.0 created to understand the ways of the functioning of the labour market?

This article is an attempt to supplement the reflection on the impact of the latest advancements in information technology with the context of historical changes that have taken place in the labour market. The authors believe that the profound changes in the socio-economic dimension can be explained through adaptation processes related to the implementation of new technologies.

The subject of research and the research method

The subject of this research is the process of labour market evolution resulting from the technological changes caused by the successive Industrial Revolutions. The study also takes into account the way of conceptualising these changes on the basis of economic theory.

In this research article, a descriptive method has been applied. It allows one to capture the essence of changes taking place in the labour market over a long period of time (defined by A. Marshall as "secular" (1920, p. 379)). This method refers to the evolutionary approach proposed by T. B. Veblen (1898) and is currently used by some representatives of institutional economics. It enables the reconstruction of the process of the development of economic theory, taking into account the socioeconomic factors that had a significant impact on the directions of its

[1] The 'social revolution' term can be applied, e.g., to the French Revolution of 1789–1799 or the Russian Revolution of 1917. When it comes to Industrial revolutions, one can speak of: (1) the First Industrial Revolution of the mid-18th century; (2) the Second Industrial revolution of the turn of the 19th and 20th centuries; (3) the Third Revolution of the 1960s; and (4) the Fourth Revolution that started in the first decade of the 21st century. Although the exact dates remain disputable, these periods roughly cover the time of the most important technological inventions that led in subsequent years to an economic growth and the development of complementary industries that made use of the innovations.

evolution. The proposed research approach combines the elements of economic history with an analysis of the development of economic theory understood retrospectively.

The labour market in the classical view of political economy

The development of economic thought is inherently linked to the major socioeconomic transformations that not only changed the existing dominant means of production, but also redefined social relations. When British economic historian Arnold Toynbee (1884, pp. 27–32) used the term 'Industrial Revolution' for the first time, he meant the period from 1760 to 1840. In 1760, in the Scottish town of Carron, when the first metallurgical furnaces were lit, new perspectives for the metallurgical industry opened. The inventions applied in the weaving industry increased productivity. As an example of increased productivity in the British weaving industry, Gregory Clark (2014) quoted data on the labour required to transform a pound of cotton into cloth. In the 1760, the process took 18 person-hours, while one hundred years later this was done in just 1.5 person-hours. The process would not have been possible without implementing in the production process inventions such as: John Kay's flying shuttle (1733), James Hargreaves' spinning jenny (1769), Samuel Crompton's enhanced spinning mule (1779), or Richard Roberts' self-acting mule (1830) (Clark, 2014, p. 255). James Watt's steam engine became a new source of energy that replaced the human and animal muscle power. Privately, Watt knew Adam Smith, who is recognised as the father of modern economics. All these inventions enabled rapid growth in production. They also permanently changed the picture of the society. Labour, along with capital and land, became the key factor of production and the permanent element of economic balance sheet. In the period before the Industrial Revolution, work had been done mostly by slaves, as was the case in Antiquity, or as feudal duty, as was the case in Medieval Europe. A milestone that enabled the creation of the labour market was the process of enclosing communal pastures in England. Rural dwellers who had lost their source of income migrated to the suburbs of cities such as Manchester or Liverpool, and increased the numbers of the new wage-earner forces – the so-called proletariat. They found employment in manufactories that developed as a consequence of the Industrial Revolution. The process was accompanied by social resistance. The expression of the utopian thinker, Thomas Morus (Doyle, 2014, pp. 166–179) – 'Sheep eat man' – became the symbol of this phenomenon.

Together with the Industrial Revolution, the market economy institutions developed. Among them, the labour market gained special significance. In the first paragraph of his book titled *The Wealth of Nations*, Adam Smith wrote: "The annual labour of every nation is the fund that basically supplies it with all the necessities and conveniences of life it annually consumes" (1981 [1776], p. 10). Smith's claim that labour creates value became the subject of numerous polemics and interpretations in the area of the economic theory of value.

Recognising labour as the fundamental factor of production also gained significance in the broader context of the social stratification mechanism. In the traditional societies of Antiquity and the Middle Ages, and even that of the 16th and the 17th centuries, the place of an individual in a society was determined by customs and traditions. The social position was inherited together with the social privileges associated with a given class. Traditional societies were hierarchical. Once the market was recognised as the basic mechanism defining social relations, any free citizen could climb the social ladder, provided they could gather the necessary material resources. Success in the economic dimension guaranteed advancement to a higher social rank. The economic factors, in particular the labour market regulations, became the subject of an extensive debate, which surpassed the limits of economic theory.

The labour theory of value propagated by A. Smith and his successors was not only an

attempt to explain how the market evaluated respective goods. It became more than that, namely a claim that led to the greatest polarisation in the 19th-century economy, which reached far beyond the academic discourse and stepped into the institutional dimension of the socioeconomic system of capitalism. On the one hand, the classicists of economy – A. Smith, D. Ricardo, J. B. Say, and, to some extent, J. S. Mill – advocated liberally-oriented market economy. On the other hand, K. Marx criticised it severely and prophesied its prompt end as a consequence of a contradiction that was deeply rooted in it. This dispute had a broader dimension; it concerned two major theoretical narratives: pro- and anti-market-oriented.

Paul James McNulty admitted that Adam Smith could be rightly called the first economist of the labour market who approached labourers with understanding and this way changed the attitude represented by his predecessors, i.e. by William Petty and mercantilists (McNulty, 1966, pp. 539–540). The classicists viewed labour as the basic factor of production, whose value was not determined in accordance with the contemporary standards of the demand–supply analysis based on A. Marshall's views (1920). This resulted from the fact that the classical political economy was strongly inclined towards supply. However, it lacked the analytical tools to understand the idea of demand. Owing to the marginal revolution of the 1870s, the economists understood the importance of the demand factors in the process of the development of consumer goods' prices, followed by production factors. However, before that happened in classical political economy, a crucial role in explaining the wages had been played by the wage-fund doctrine enriched with the Malthusian interpretation of population pressure. This concept can be described by means of a simple formula:

$$W = \frac{WF}{QL},$$

where: W – wage rate; WF – wage fund; QL – quantity of labourers.

According to the wage-fund doctrine, in a short period, the wage rates (W) constitute the quotient of the wage fund (WF) and the quantity of labourers (which is constant in a short period). The wage fund is part of the capital accumulated by owners. It is paid in advance to labourers so that it can cover the time gap between the input of production factors and the results achieved, i.e. the end product. Such schemes might be interpreted as some kind of a demand-supply approach. The demand for labour is communicated by employers, which is based on the wage fund (WF). It resulted from the abstinence (capital owners' resignation from the ongoing consumption). The supply of labour (QL) is determined by the size of the population ready to begin employment. However, the representatives of the classical political economy were interested not only in the static approach. The most important question was how wage rates would change with the development of capitalist economy. At first, the empirical data was pessimistic. Despite the introduction of technological inventions that increased labour productivity, the wages remained on the subsistence level, understandably triggering defiance of the pauperised parts of societies[2]. F. W. Botham and E. H. Hunt, who analysed the dynamics of wages in the early period of the Industrial Revolution, demonstrated the fluctuation of the real wage index as well as its relatively limited growth in the years from 1751 to 1792, based on the example of the Staffordshire County (real wage index of general labourers in north Staffordshire). With the index value for the year 1790=100, in 1751 it amounted to 101.1, reached the peak in 1779=141.2, after which it dropped to 111.4 in the year 1792 (Botham & Hunt, 1987, p. 390). Some explanation for this phenomenon is offered in a study on the low rate of economic growth in the early period of the Industrial Revolution (Williamson, 1984).

[2] A broader interpretation of the wage-fund doctrine embedded in the historical context is provided in the study titled "The Wages Fund in Historical Context" (Phillips, 1967).

Having analysed the above facts, the classical-economy representatives finally matured in conviction that poverty and destitution were natural attributes of human existence. The fullest justification for this view was famously presented at the turn of the 19th century by Reverend Thomas Robert Malthus (1798). The principle of population presented in his essay allowed for a modification of the short-term doctrine of the wage fund in such a way that it justified the empirically-observed tendency of the wage rates to remain on the subsistence level. The logic behind it was simple: if, as a result of the development of market economy, the wage fund (WF) grows, it exerts pressure for wage rates (W) to grow. This is the place where Malthus' principle of population is implemented. According to it, an increase in wage rates (W) is followed by the population growth, which, in turn, increases labour force supply (QL). As a result, wages drop to the physical subsistence level. This line of thought provided justification for the thesis that – on the same basis that poverty and destitution are an insurmountable attribute of human life – also wages will remain on the subsistence level in the long term. Accordingly, no institutional solutions can change this state of affairs. This belief was abolished by empirical evidence which demonstrated that in the second half of the 19th century wage-earners also started benefitting from the technological advancement. The wage-fund doctrine came to be perceived not only as erroneous but also as harmful, as it justified a set of views that the capital owners benefitted from. As such, it fuelled the revolutionary moods among those who felt marginalised.

In response to the criticism presented by Marx in *Das Kapital. Kritik der politischen Oekonomie* (1867), the representatives of the marginal revolution formulated an alternative theory that explained both the formation of wages on the labour market and the principles determining the functional distribution of income in the society. This approach was reconstructed by G. J. Stigler (1994). The ambition of the supporters of the theory of marginal productivity of production factors was to identify one universal principle to evaluate every single production factor. According to this theory, labour, land, and capital were to be remunerated in accordance with the value of their marginal product. Such an approach was supposed to ensure fair distribution which was postulated by American economist J. B. Clark. He claimed that in perfect competition, each factor would receive a reward adequate to its contribution to the product-creation process, which would make a fair solution (Clark, 1908, p. 7). The interpretation of this claim was accompanied by an academic dispute that concerned the exhaustion of a product, which, in fact, boiled down to formalised analyses of production functions. As a result, it was noted that a product gets exhausted only in the case of constant economies of scale. This means that once a factor of production is rewarded in accordance with the principle of the marginal product value, the whole product has been distributed between the owners of those factors. If there are increasing economies of scale, an extra product remains after the distribution and as such it should be distributed among the members of the society based on the distribution principles other than market forces.

The theory of distribution based on the marginal productivity of the factors of production has remained the nucleus of contemporary microeconomics to this day. However, it is of limited use in answering the questions arising in association with the Second Industrial Revolution of 1870–1914 (Mokyr & Strotz, 2000). In technical terms, the steam engine was replaced with the electrical engine and combustion engine, and the achievements of science were incorporated into the industrial production. The society became much more mobile owing to the air transport and popularity of the car. In order to absorb the technological achievements predominant in the 19th century, the enterprise of an individual owner was replaced by joint stock companies and limited liability companies. Monopolistic capitalism and mass production was born. This type of production is best embodied by the assembly line applied by

the car manufacturer, Henry Ford. The genius entrepreneur was very well aware of the fact that mass production required mass consumption. Accordingly, on 5 January, 1914, he offered to his employees a daily pay of 5 dollars, which was high by the standards of those times. For a large group of labourers, work in the car industry became the dream road to improve their financial status. On the hundredth anniversary of those events, Tom Mackaman quoted two opposite opinions that were published back then in the *New York Times* and *Wall Street Journal*, respectively. The first one said: "What marvels might not Mr. Ford's example work if only other capitalists would do the same". Meanwhile, the *Wall Street Journal* criticised him for what he had done, calling him the "class traitor" (Mackaman, 2014).

The First Industrial Revolution gave birth to the labour market founded on voluntary contracts between the demand party represented by employers and the supply party defining the employee behaviour. In the neoclassical economy analysis, there is a clear polarisation between the world of capital and the world of labour. The Second Industrial Revolution resulted in strong monopolisation processes. Those processes were also reflected in the labour market. They consisted in the growing importance of trade unions throughout the 19th century. The labourers who expressed their demands concerning the amount of wages and the conditions of production had less bargaining power when they were confronted with enterprise owners who gradually increased the scale of their operations and monopolised the market. The scattered British associations of farmers and craftsmen started consolidating under the Grand National Consolidated Trades Union, established by Robert Owen in 1834. The union was a country-wide association of British workers who decided to fight for fair working conditions and satisfactory wages. The origin, evolution, and significance of trade unions is presented in the classical study by Beatrice Webb and Sidney Webb (1920). The authors believed that the implementation of the socialist postulates had been a chance not only to improve the financial situation of the labourers, but also to create a more just socioeconomic system in England. In order to implement the ideas they propagated, the Webbs, Graham Wallas, and George Bernard Shaw founded the London School of Economics and Political Science in 1895. When analysing the history of trade unions, one might think that they constituted an important element of industrial relations founded on mass production, which was mainly the consequence of the Second Industrial Revolution. Contemporary changes in the production process which resulted from the Fourth Industrial Revolution changed the functions that they were supposed to perform, and whose interests they should protect.

The Revolution 4.0 vs. contemporary development trends in the labour market

The transformations of the late 20th and the early 21st centuries that we have been witnessing have a huge impact on the labour market. These transformations, mainly associated with fast technological development, are called the Fourth Industrial Revolution. Although this concept has not yet been uniformly defined in scientific research and it would be hard to find a consensus in such issues as, for example, the time frame of the Revolution or its precise characteristics, researchers and experts agree that no other period in the history of humanity saw such thorough socioeconomic changes. Schwab (2017, p. 3) lists three main characteristics of the Fourth Industrial Revolution: (1) *velocity* (the pace of the changes that we observe is exponential rather than linear); (2) *breadth and depth* (the complexity of – and relationships between – technologies change the entire economic, business, and social paradigm, and even who we are as individuals); (3) *systems impact* (involves the transformation of the entire system, both within and across entities). The progress triggers structural changes that enforce a modification of labour market institutions, understood in the context of both formal and less formal considerations. Even

though we are not able to predict the direction in which new technologies will develop, and their impact on the socioeconomic environment, we should observe and try to draw conclusions from the dominant trends. Noticing certain tendencies will enable, at least to some extent, a dialogue about the institutional environment, including the direction that the societies and economies should follow. To quote Daniel Susskind and Richard Susskind (2015, p. 155): "An unwillingness to try to determine overall interaction is akin to driving a car at night with no headlights. Making qualified predictions (…) is like having the headlights on". Thus, we should accept the fact that we are not able to notice many issues. Moreover, the issues that can have the largest impact on the socioeconomic environment might not have been uncovered yet.

Undoubtedly, it should be emphasised that the dynamic spread of ICTs, also in the context of the above-mentioned growing role of machines, leads to an exclusion of a part of society from the labour market, mainly due to their lack of relevant skills and because of their problems with learning such skills or retraining. It should be noted, however, that this aspect has two sides: old jobs are being eliminated, while new jobs are being created (Kubiczek, 2006 p. 127). The research results suggest that in a race of the force associated with the creation of new jobs owing to technological progress and the destruction associated with their replacement by automation, the former tendency has always won. Moreover, throughout the 19th and the 20th centuries, it was accompanied by gradual reduction of working hours that contributed to improve the quality of life and leisure time (Freeman & Soete, 1997; Dachs, 2018). Nonetheless, the discussion associated with the "end of work" concept and shift to the post-industrial era (Rifkin, 1995, 2016) – as well as progressing automation that will, to a large extent, replace human labour (Brynjolfsson & McAfee, 2011; Frey & Osborne, 2013; Ford, 2015) – is still relevant. It should be noted that, long-term, the creation of jobs has indeed always surpassed the level of their liquidation. This kind of compensation was not and is not an automatic, fast, or painless process for a large part of society. The need to adapt to the new reality as well as the time required to gain relevant skills means that, in the short run, new jobs do not compensate for the loss of the old ones (Kubiczek, 2006, p. 128), which poses a major challenge for the labour market institutions, understood both in the formal and the informal context. The negative impact of automation, associated with the progress in the field of artificial intelligence, is being extensively discussed in scholarly literature. C. Frey and M. Osborne (2013) analysed 702 different occupations in the American market and concluded that as many as 47% occupations are at risk of being entirely replaced by autonomous systems in the next 10 to 20 years. M. Ford (2015) highlights a very important and unprecedented contemporary phenomenon: machines not only increase productivity, but they also become workers themselves. What is also important is that the border between routine jobs (that are easy to replace by automation) and non-routine jobs is disappearing very fast, and the development of artificial intelligence algorithms can also affect workers with the highest skills. Accordingly, Ford proposes replacing the term 'routine' with 'predictable'. All jobs that fall into this group will be very easily replaced by machines and robots. One of the main reasons why artificial intelligence affects the labour market lies in its nature. Namely, as it develops, artificial intelligence not only complements occupations, but it also entirely replaces them and substitutes human labour (the so-called *worker-replacing technological change).* It is worth noting, however, that the technological change might bring two competitive effects. The first one concerns relocation of workforce and is directly linked to the aforementioned substitution of labour. The second one leads to increased employment and capitalisation in industries that have developed the most as a result of the technological change. Historically, the latter effect was usually dominant (Frey & Osborne, 2013). Meanwhile, the changes that are taking place in the 21st century make one wonder which of the two effects will prevail

this time. The studies show that the innovations known from the history of the previous Industrial Revolutions mainly replaced routine jobs, but now, for the first time in history, we can see that artificial intelligence causes replacement of non-routine jobs, too (Brynjolfsson & McAffee, 2011). Accordingly, the consequences for the labour market as well as for the demand-and-supply structure associated with the labour market (discussed in detail in the subsequent section of this paper) might prove to be not only huge, but also unlike anything that we have known so far.

Interpretation of social inequalities in the context of the Revolution 4.0

The method of income redistribution between the individuals who participate in the process of its generation has attracted the interest of economists ever since economics became a scientific discipline. The ongoing Fourth Industrial Revolution and the growing production automation in many areas both add numerous new issues that require analysis and put into question some of the theoretical assumptions of the neoclassical theory of income distribution and the marginal productivity theory. A question that is extremely vital for the contemporary social policy is – who should become the beneficiary of an economic system in which products will be, to a large extent, manufactured by automatic processes? Moreover, how will the demand side of the economies be affected by the decreasing share of the human capital in the production process? The concept of the distribution of income, dominant in the economic theory, has two aspects: functional and personal. The functional distribution of income (previously discussed in this paper) involves rewarding a certain group proportionally to its contribution to the production process (i.e. marginal productivity). In the concept called the theory of distribution, the factors that take part in the production process receive a reward proportional to the impact that the unit of a given factor has on the entire product (Leszczyńska, 2006). Thus, it seems that the owner of a factor that is of major importance in the process receives a relatively high reward. However, the theory of distribution was subject to some criticism, especially after Alfred Marshall had suggested that the organisation was the fourth factor of production (1920, pp. 240–249). It is impossible to analyse soft factors – such as the organisation, entrepreneurship, or knowledge – from the perspective of the contribution of each unit of those factors to the marginal product (Giza, 2007). The concept of the functional distribution of income seems, in the light of contemporary transformations, to be even more limited, as added value in production processes is, to a large extent, created by automatic processes. Thus, the classical theory of distribution no longer answers the question about how income should be distributed. In the context of the role of production factors in creating wealth and generating economic growth, it is also worth acknowledging Robert Solow's milestone study titled "Technical Change and the Aggregate Production Function" (1957). Solow built a model to evaluate the share of production factors in the USA's economic growth in 1909–1949. The results showed that as much as 85% of the growth could not be explained by the model, which means that the growth was not stimulated by the traditional production factors, such as labour, capital, or land. Along with Solow's study, a very important term for the economic theory was coined, namely 'the total factor productivity', also referred to as the Solow 'residual'. It became a measure of ignorance about economic growth (Warsh, 2012), and technological progress started to be associated with a crucial role in the process. The domain of each Industrial Revolution is to transform the old processes into new ones by improving and automating certain tasks. In the past, technology replaced certain tasks performed by humans. Although each innovation characteristic of the subsequent Industrial Revolutions took work away from a part of the labour force, it gave unimaginable possibilities for economic development and increasing prosperity. However,

the characteristic feature of the late 20th and the early 21st centuries is the polarisation of the labour market that leads to increasing inequalities (Autor & Dorn, 2013; Acemoglu & Autor, 2010). This trend involves growing employment rates in occupations that require both low and high skills, while the demand for middle-skill occupations is dropping. Acemoglu and Autor (2010) showed in their studies that the share of middle-skill occupations, i.e. sales, office and administration jobs, and production jobs in total employment dropped from 57.3% in 1979 to 48.6% in 2007 and 45.7% in 2009. This phenomenon is associated with the fact that automation mainly replaces routine and predictable work. The occupations that are in the highest demand are the ones that require creative problem-solving (information technologies are those complementary to such occupations (Autor, Levy, & Murnane, 2003)) as well as occupations that require manual labour (e.g. waiters, cleaning personnel, etc.), as these are very hard to replace by available technologies. In the light of the above deliberations – associated with income distribution challenges in the era of digital revolution and growing social inequalities – there emerge public policy reactions that are worth mentioning. One of the concepts is universal basic income, which has been broadly discussed in the social policy discourse in the recent years, including the possible consequences of this solution for the economy. Undoubtedly, it is an interesting research problem that introduces questions of not only economic but also social and behavioural nature, associated even with the philosophical approach to the concept of a human being and their role in the society. Harrop and Tait (2017) identified five prerequisites that lead to an increased interest in the basic income concept. The prerequisites include: more insecure work, stagnant payment, skills and job dislocation, rising inequality, and insufficient work. Even though the introduction of basic income might solve some of the contemporary problems, it should be noted that this is only a tool to distribute income, not to generate it, and, in the long term, it might lead to economic stagnation. The experiments show that basic income, intended to meet the basic human needs, might yield positive results in poorer communities (e.g. the Madhya Pradesh Unconditional Cash Transfers Project implemented in 20 Indian villages in 2010 (Bharat, 2014)). Another initiative that responds to the growing automation and that is supposed to reduce inequalities is the robot tax. According to research conducted by Joao, Rebelo and Teles (2017) based on the American economy data, further decrease of production automation costs will deepen income-related inequalities unless the current tax system changes. In order to keep their jobs, workers are required to be constantly reducing their wage expectations. Although a robot tax can become a major contribution to the state budget, offering additional funds for income redistribution, if such solutions are introduced only in a limited number of countries, those countries will lose their competitiveness compared to the countries that decide not to implement this solution. Another important kind of initiatives aimed at adapting societies to the requirements of the contemporary labour market includes all kinds of training programmes that teach the skills that are currently wanted on the labour market (e.g. knowledge of programming languages). They are supposed to increase the adaptive abilities of a society in the era of rapid digital changes. On the one hand, they promote further technological development. On the other hand, they stimulate active social participation in the process. To sum up, continual economic growth creates the need for fair distribution of income, which poses numerous challenges in the era of the Fourth Industrial Revolution. The neoclassical theory of distribution seems to have become irrelevant, which is proven by the new government initiatives based on the personal approach and focused on increasing the quality of life of the society, removing inequalities and adapting to the changing labour market.

Concluding remarks

To summarise the considerations, it is worth paying attention to the socio-economic consequences caused by successive industrial revolutions. They are listed in Table 1.

When answering the first research question formulated in the introduction, it can be stated that the labour market, understood as a network of relations that determines the way of using the production factor, namely labour, is the consequence of the First Industrial Revolution. On the one hand, the classicists of economics emphasised the value-creating role of work. On the other hand, they presented the unjustified scepticism about the possibility of an increase in wage rates in the long term.

The increase in wages in the second half of the 19th century not only ensured an increase in the welfare of employees, but also opened the path of social advancement for them. The Second Industrial Revolution gave birth to monopolistic tendencies. Their effect on the labour market came in the form of the emergence and inclusion of Trade Unions in the process of shaping modern institutions of the capitalist economy.

When the potential effects of the Revolution 4.0 are analysed, the possible threats to employees who can be replaced by machines and the positive effects in terms of increasing the production capacity of modern economies are frequently noticed. This appears to be nothing new, as this issue had been viewed in a similar way during the First Industrial Revolution. The key question

Table 1. Economic and social consequences of the Industrial Revolutions

Industrial Revolutions	The changes in the labour market and their social consequences
The First Industrial Revolution (mainly related to inventions in the weaving and metallurgical industries and the consequences of the invention of the steam engine).	• the creation of the labour market; • market based on allocation of work resources; • noticing the so-called social question; • the beginning of legislation which regulated the employee–employer relationship.
The Second Industrial Revolution (related to the chemical industry, the usage of electricity, internal combustion engine, and mass production after the introduction of a production line).	• the rise of monopoly capitalism; • monopolisation of the product market and the labour market (the growing role of Trade Unions in the process of wage negotiations); • the development of techniques for influencing consumer preferences and unifying their behaviour through advertising.
The Third Industrial Revolution (related to the invention of computers, the Internet, and the rapid increase in the possibility of storing information).	• strengthening the supply side of economies by applying more efficient technologies; • the growing importance of the middle class; • the increasing importance of knowledge and information (data) as production factors.
The Revolution 4.0 (related to the progress in the development of artificial intelligence, biotechnology, automation and robotics, and the transfer of an increasing part of everyday and professional life to the digital world).	• profound changes in the production process causing concerns about an increase in income inequality and employment stability in occupations dominating among middle-class representatives; • progressive automation of activities requiring advanced analytical and comprehensive skills; • blurring the boundaries between the functioning of the real world and the digital world.

Source: own elaboration.

is – what institutional solutions in terms of income distribution and employee remuneration will be adopted in the world where a machine will be able to replace human labour?

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