

## An Old Problem in the New Era: Effects of Artificial Intelligence to Unemployment on the Way to Industry 5.0

### Yeni Çağda Eski Bir Sorun: Endüstri 5.0 Yolunda Yapay Zekanın İşsizliğe Etkileri

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*Abstract: Unemployment is one of the most important and unfinished debates in the economic literature and every decade witnessed a crisis that created unemployment. Especially youth and long-term unemployment rates of the countries are very high and policymakers are focusing their interest on the unemployment problems. On the other hand, the impact of digitalisation is the most cited issue of the last decade in economic discussions. Especially, due to the impact of technological advancements, automation and artificial intelligence (AI) became the main keyword of future discussions. Advances in automation by using the increasing capability of AI changed the direction of the labor market by changing the quantity and type of jobs. The increasing capability of automation with AI turned the robots to cobots and leads to Industry 5.0 as a new industrial revolution. This study aims to explore the effects of AI in Industry 5.0 concept on unemployment.*

*Keywords: Artificial Intelligence, Unemployment, Industry 5.0, Technological Change, Cobot*

*JEL Classifications: E24, J21, O14*

*Öz: İşsizlik, ekonomi literatüründeki en önemli ve bitmemiş tartışmalardan biridir ve her on yılda bir işsizliği yaratan bir krize tanık olunmuştur. Ülkelerin özellikle gençlik ve uzun vadeli işsizlik oranları çok yüksek ve politika yapıcılar ilgilerini işsizlik sorunlarına odaklamaktadır. Öte yandan, dijitalleşmenin etkisi, ekonomik tartışmalarda son on yılın en çok atıf yapılan konusudur. Özellikle teknolojik gelişmelerin etkisiyle otomasyon ve yapay zekâ (AI) gelecekteki tartışmaların anahtar kelimesi haline gelmiştir. Yapay zekânın artan kabiliyetini kullanarak otomasyondaki gelişmeler, işlerin sayısını ve türünü değiştirerek işgücü piyasasının yönünü değiştirmiştir. Yapay zekâ ile artan otomasyon yeteneği, robotları kobotlara dönüştürmüş ve yeni bir sanayi devrimi olarak Sanayi 5.0'a yol açmıştır. Bu çalışma, Sanayi 5.0 kavramı çerçevesinde yapay zekânın işsizlik üzerindeki etkilerini araştırmayı amaçlamaktadır.*

*Anahtar Kelimeler: Yapay Zekâ, İşsizlik, Sanayi 5.0, Teknolojik Değişim, Kobot*

*JEL Sınıflandırması: E24, J21, O14*

## 1. Introduction

Every decade has a crucial and different debate matter but the world economy dealt with the same macroeconomic problems and ended with a single result: Unemployment. Besides being a macro-economic problem, unemployment is very important because it causes both social and political problems. Because of the high importance for the economies, it has been the core debate of many studies and became an indicator of welfare especially since the Great Depression. Unemployment rates of the many developed, developing and emerging countries are approximating to 10 percent. More than that, rates are worsening for long-term unemployment and youth unemployment (OECD, 2020). Therefore, policymakers became very sensitive to an unemployment problem that will trigger inequality and poverty. Besides, there

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are three sustainable development goals of the United Nations about these macroeconomic problems. The first sustainable development goal is “No Poverty” which is closely related to unemployment. Additionally, the eighth sustainable development goal is “Decent Work and Economic Growth” which is directly related to unemployment. The tenth sustainable development goal is “Reduced Inequalities” which is also much related to unemployment. Growing labor force while the number of jobs is decreasing and slower economic growth is the main reason for widening inequalities and the main threat to economic, social, and political stability. Due to this importance, the reasons behind unemployment is always on the agenda of the policy-makers.

On the other hand, the most famous debate of the last two decades in the economic literature is the impact of Industry 4.0 and technological change on the global economy. Many studies discussed the impact of Industry 4.0 on the global economy and asserted that Industry 4.0 based information and communication technologies (ICT) promoted economic growth by increasing productivity as well as the total production of goods and services. Especially, the first decade of the 21st century witnessed substantial growth in both developed, developing, and emerging economies, and most of them doubled the per capita income with a significant productivity increase. Additionally, most of the studies in the literature discussed the positive impacts of the technological advancement on the global economy and human prosperity but many concerns emerged for the future with the macroeconomic instabilities at various times.

These two debates intersected at an old problem called as “*technological unemployment*” that Keynes stated in his seminal paper. Keynes pointed out the “*discovery of means of economising the use of labour*” that caused productivity gain based reduction in employment (Keynes, 1930). Besides, Simon (1965) expressed that “*machines will be capable, within twenty years, of doing any work a man can do*” in his seminal book named as “The Shape of Automation for Men and Management” (Simon, 1965). Following these ideas, technological unemployment became one of the main debate topics between macroeconomists and revived in the second decade of the 21st century. There are many debates in the literature about the presence, causes, or impacts of technological unemployment, and researchers have had different results and conclusions.

United Nations Development Program (UNDP) emphasized the increase in inequality between nations and pointed out the technical change as the driver of this inequality. Especially, the UNDP report stated that this technological change affected the functional distribution of income and increase primary income inequality with increasing returns to capital and productivity (UNDP, 2013). Besides, many of the workers are substituting by automation in

many industries even in the health sector that affected income inequality. As a stunning example, Nawrocki et. al. (2018) and Thrall et. al. (2018) stated that AI is providing a new set of tools in radiology for interrogating image data and may increase the productivity. This foresight for the use of AI in radiology brings debates about the job market of the radiologists. Similarly, the situation may be the same for the physiotherapist because of AI-assisted rehabilitation and has the potential to affect job markets. There are many similar examples. These effects have the potential to limit the wage growth and decline the share of labor in income that will cause a decline in prosperity eventually.

Moreover, within the third decade of the 21st century, technological advancements switched to a new phase and changed the direction of the economic analysis. It is very essential to understand the way of change, characteristics of the new concept, and its potential impacts. This shift in the paradigm is the new industrial revolution that is becoming the core of debates. Digitalisation with AI-assisted technologies is shaping the future of the work and Big Data (BD) seems as an accelerator. Due to the importance and complexity of the impacts on the global economy and unemployment is increasing the need for new researches that are highlighting the new concepts. In this framework, the main aim of this study is to analyze the effect of Industry 5.0 and AI with BD on unemployment as a disrupter to the labor market. Besides, the secondary aim is to define Industry 5.0 in the AI with BD framework.

## **2. Background**

Ernst et. al (2019) expressed the change of everything very nicely: *“Values, norms, and language have evolved over the last six decades. What has remained the same, however, is the fear of the machine”* (Ernst et. al, 2019). This is a completely true and unique idea that summarizes the main problem and they stated that drop-in computer costs, widespread adoption of digital communication, and drop in capital costs of digital technologies have promoted AI-assisted learning machines. These technological advancements have triggered this old fear again for the future. The main reason behind this fear is the disruption to the labor markets as well as the displacement effect of the robots and cobots. Especially for the next few decades researchers emphasized the risk of job losses and polarization that will widen the income and wealth in recent studies. The question is whether there will be more jobs destroyed than jobs created and the core of the debate is this question.

According to many studies of the researchers and international organizations, the main problems of the global economy are poverty and inequality. Among the many factors that contribute to poverty and inequality, unemployment is the most important one and different kinds of unemployment rates are reflecting the size and depth of the unemployment problem.

The unemployment rate for the world is about %5 and higher than %6 for upper-middle-income countries. Unemployment became a crisis issue for almost every decade with a different reason after the Great Recession and policy-makers focused on the solution to the unemployment problem. Especially developed and developing countries suffered from many political or economic factors that contribute to the unemployment problem. From financial or energy crises to political turmoil increased the unemployment rate but 2001-2007 world economic expansion decreased the unemployment rates. Among these incidents, continuous advancements in technology like BD and AI-assisted learning machines started the technological unemployment debate in this decade.

Many studies emphasized the potential impacts of technological changes on future work and some of the irreversible damage to the labor market. These changes affected the wages and share of labor income as a percent of GDP is decreasing that will increase inequality. Additionally, labor force participation rates are decreasing over time especially for the lower educational level groups in most advanced economies (Furman and Seamans, 2019). These can be recognized as the precursor indicators of the unemployment problem that Keynes (1930) pointed out as technological unemployment. Frey and Osborne (2017) claimed that 47% of the jobs in the US economy will be replaced by AI in the future and found that jobs making less than \$20 per hour 83 percent probability of automation. These jobs are usually easier to substitute with the new type of AI-assisted machines with the BD. According to Korinek and Stiglitz (2017), these AI-related innovations will likely to be complementary to some jobs.

The impact of Industry 4.0 is the most important debate of the last decade and many of the articles mentioned positive impacts of it. Impact of automation and computerization are well-known issues in the economic literature and most of the studies presented the positive impacts on labor markets especially for the jobs of low-income groups but ongoing technological advancements went beyond the standard automation tasks.

This is the new case for this decade because within the Industry 5.0 cognitive jobs will be automated and will affect the middle-income group. Substitution of the cognitive jobs with AI-assisted learning machines will increase unemployment and depending on this problem the share of the middle-income group in labor income will decrease which leads to poverty. There are many studies about the technological changes that created unemployment in the labor market but for this decade there must be in-depth analysis about technological unemployment within Industry 5.0 that is including the new concept of technologies that may affect the middle-income group.

### 3. An Overview Of The Unemployment Problem

Unemployment is still the basic problem of the world economy because of the significant effect on poverty and socio-economic problems. Although the unemployment rate seems to be decreasing in recent years, it is still considered as an important macroeconomic problem. The average unemployment rate for OECD, Euro Area, EU are respectively, 5.2%, 7.5%, 6.3%, and policymakers cannot decrease the rate below the 4% level (OECD, 2020). According to the International Labor Organization Statistical Database, labor income share as a percent of GDP is decreasing while unemployment rates are still high especially for middle-income countries. This is directly affecting income distribution and increasing inequality. Besides, continuous unemployment will restrain the social progress of countries and the world. Figure 1 is reflecting the unemployment rates of the various countries and showed that some of the countries have relatively high rates and still an important problem for the economies.

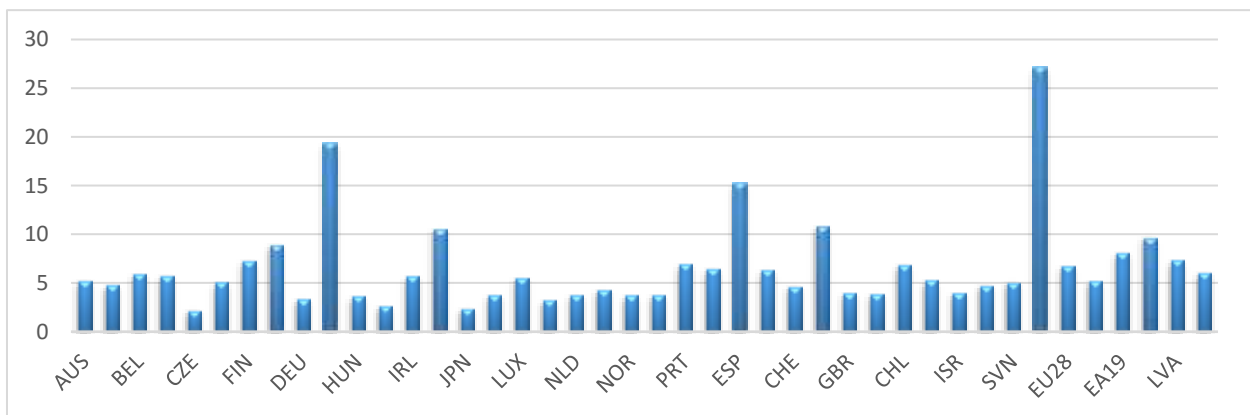


Figure 1. Unemployment Rate (Total, % of the labor force, 2018)

Source: <https://data.oecd.org/chart/5SIF>

Besides, youth unemployment is a main threat to the global economy, especially for middle-income countries. According to recent studies, youth unemployment is getting higher after the 2008 financial crisis and is having more complex effects on unemployment rates. The most important asset of the economy are the youth and employment of the youth is essential for economic development with social stability.

Figure 2 showed the youth unemployment rate of the middle-income countries for 2018 that is over 20% and this may be a signal for the decreasing job creation. OECD stated that for most of the countries labor market conditions deteriorated for young people because of a fall in the share of middle-skilled occupations (OECD, 2019). Additionally, in the same report, OECD stated that especially in advanced economies due to the impact of globalization and automation there will be fewer jobs in the future. In this framework, higher youth unemployment may lead to long term unemployment for most economies. In parallel with this report, Acemoğlu and

Restrepo (2017) pointed out the countries that have aging populations are also robotizing their industrial production process.

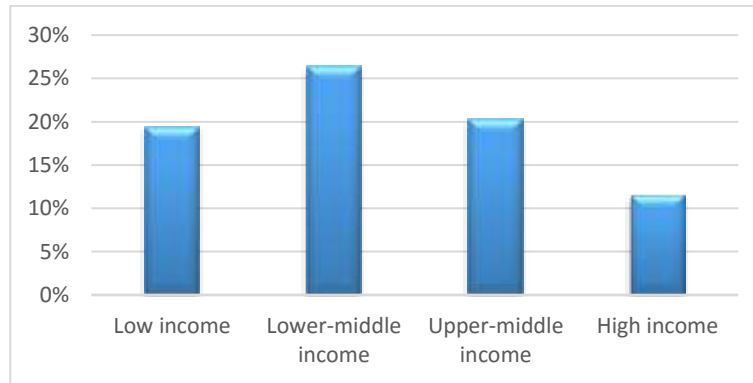


Figure 2. The proportion of Youth (aged 15-24 years) not in education, employment or training (%) 2018

Source: ILOSTAT Database SDG Indicator 8.6.1

On the other hand, poverty is closely related to the unemployment rates and the share of the labor income in GDP is decreasing that will lead to inequality. All of the developed and developing countries showed the same tendency and it is much related to the decline of manufacturing sector employment. Employment rates of the manufacturing sector for selected OECD countries are declining and this may be the basic reason behind the fall of labor income share (OECD, 2019).

Many studies emphasized this decline in various countries especially after the 2000s and for the last decade, the problem has become more apparent. Both OECD and ILO have similar views and emphasized in their reports. Besides, this may be seen if the wage growth is slower than productivity growth and the case is the same for most of the economies. The gap between labor productivity and real wage index may cause to decline in the share of labor income. Technological advancements may cause this decoupling but both technological, institutional, and economical changes shifted the employment structure. This decline is very important for income inequality and to differentiate and analyze the shares of the low, medium and high-class workers is very essential.

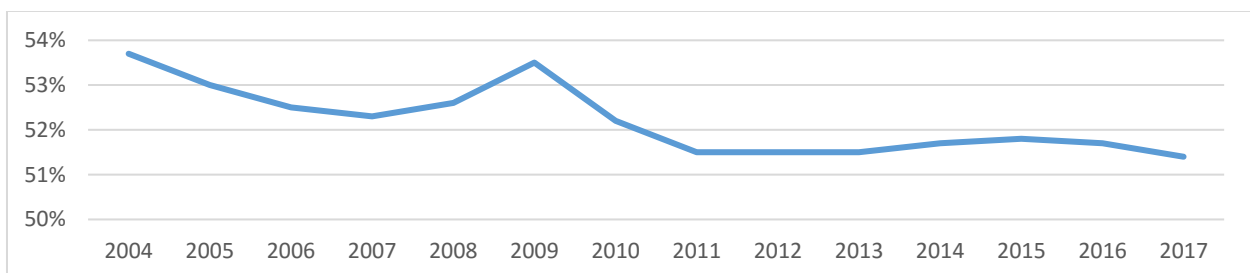


Figure 3. Labor income share as a percentage of GDP – World (%)

Source: ILOSTAT Database SDG Indicator 10.4.1

The long-term unemployment rate shows the proportion of these long-term unemployed among all unemployed (OECD, 2019). Unemployment is the basic problem for the economy and economic stability but long-term unemployment rates create more economic and social problems. In some economies, there may be relatively low unemployment rates but this long-term one is quite an important one to analyze for macroeconomists. Despite the relatively low unemployment rate, high long-term unemployment should be seen as an important problem. Figure 4 pointed out the long term unemployment rate of the selected OECD countries and the average of OECD. As seen in figure most of the countries have relatively higher long term unemployment rates because of economic crises hat decreases job creation. Even some countries' long-term unemployment rates are more than 40% and decreasing employment in the manufacturing sector may be the main promoter. It is very important to understand the reasons behind the long term unemployment and have substantial socio-economic effects. Long-term unemployment is dangerous as it will create permanent unemployment that is depreciating the human capital and person’s social capital (Bejaković & Mrnjavac, 2018).

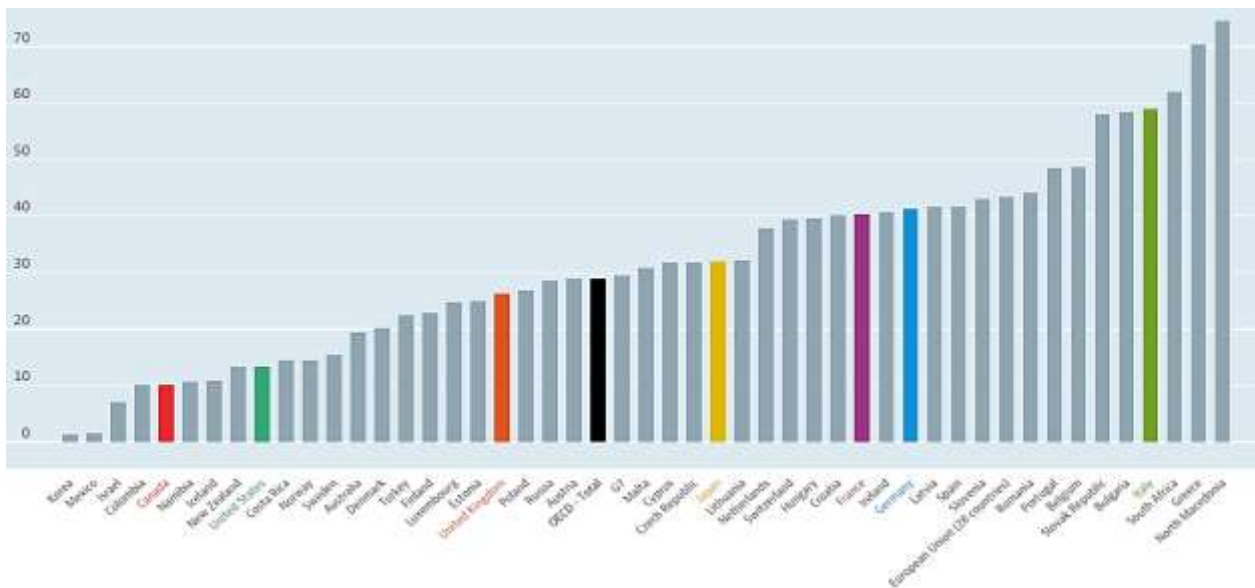


Figure 4. Long Term Unemployment Rate for 2018 (% of unemployed)  
 Source: OECD (2020), Long-term unemployment rate. doi: 10.1787/76471ad5-en

#### 4. Emergence Of The Industry 5.0 And Role Of Artificial Intelligence

Industry 4.0 and Web 3.0 are well-known issues in the literature but Industry 5.0 with Web 4.0 will be the centre of the debates in this decade. Industry 5.0 may be defined as the fifth industrial revolution that is including AI-assisted learning machines with the BD and “cobots” in the core. All four industrial revolutions are mainly about technological advancements and digitalisation to provide automation for production to increase productivity and total production. Differently, Industry 5.0 includes “Smart Everything”, that is referring to “Internet

of Everything” (IoT), cloud computing with storage, BD, and the collaboration of humans with AI-assisted machines (Johansson, 2017). Besides, cloud and cognitive computing with AI-assisted machine learning that is collaborating with the human called as “cobot” is in the base of this fifth industrial revolution.

The robots have been used in production since the late 1960s with the use of electronics and became a primary component for many industries today (Østergaard, 2016). General Motors used the first robot called as “Unimate” in 1961 that was invented by George Devol in the 1950s. In the third and fourth industrial revolution advancements in electronics, software, and hardware technologies, computers, and information technologies increased the usage of the robots for repeated tasks while decreasing the costs of them.

Industry 5.0 is a challenging revolution that is changing the ways of using these robots by combining with human creativity and ability from now. This collaboration of robots and humans is called as Cyber-Physical Systems (CPS) that combines physical and software components within high-speed internet (Pathak et. al., 2019) for a smart and connected world. Besides, this fifth revolution is transforming the nature of production by bringing the machines, AI, and BD together in high-speed internet as cobots that collaborate with humans. There will be an interaction between humans and these cobots to increase the productivity and production capacity of the industries. Especially, wide usage of sensing, computation, control, and networking technologies will boost the interaction for industries that will allow them to be smart everything and also to promote sustainability. This is the main difference of Industry 5.0 from the other industrial revolutions that are changing the role and impact of machines in the global economy and also leading to Society 5.0. The difference of this industrial revolution from others is that Industry 5.0 also brings new other concepts with it. Society 5.0 is an important example that is introduced by the Government of Japan.

Society 5.0 is a new definition that is presented by the Government of Japan instead of Industry 5.0 to create a super-smart society for social challenges by incorporating the innovations of the Industry 4.0 (Fukuyama, 2018). The main aim of Society 5.0 is to combine economic growth and technological development for the prosperity of citizens as a whole. This exemplary approach shows us how different this new industrial revolution is in understanding from others.

Furthermore, Industry 5.0 offers personalization instead of mass production that manufacturers can offer unique solutions to customers and that can be only enabled by “*human touch*”. Industry 4.0 can’t respond to this kind of manufacturing process because automation is the barrier to that “*human touch*”. The unique difference of Industry 5.0 is this human-robot



engagement and this is the decisive characteristic to personalize goods and services and increase the satisfaction of the customers. Therefore, collaborative robots –cobots- are going to rise to bring the human touch to mass production and this became a key characteristic for Industry 5.0. Haleem and Javaid (2019) gave an example of how personalization can be used in the health sector by using mass personalization and cited to the article of Özdemir and Hekim (2018) that is analyzing the concept of Industry 5.0 within the AI, Big Data and IoT and also they stated that Industry 5.0 is an evolutionary advancement that builds on Industry 4.0 (Özdemir and Hekim, 2018).

As seen in many articles, this fifth revolution is not only the progression of Industry 4.0 as a technological advancement but a paradigm shift that is integrating many components of technology in a new understanding about interaction of humans and machines and can be called as intelligent automation with AI-assisted learning machines. Technological advancements and increasing the speed of networking and microprocessors that makes the machine even smarter promotes Industry 5.0. There will be an interaction between the human and robots and between these new cobots with the existing technologies in the digital factories and this interaction moved the production structure to a new phase.

These are the new factories of the future and aimed to benefit from the human workforce that is assisting from cobots. The most important characteristic of these new technological factories is the empowered human workforce with AI-assisted learning machines. These engagements will provide better standards for the workforce and the production process will be more “*workforce-friendly*” while enhancing productivity with total production. Besides, another main difference in Industry 5.0 is using BD in the production process with AI-assisted learning machines and these machines can decide on tasks. This ability will bring the human touch that enables the mass personalization. Moreover, these new factories started to use new technologies like Augmented Reality (AR) and these technologies became a production technology. In this framework, this fifth industrial revolution is a shift of paradigm that is using the same inventions in different ways.

Dark factories are examples of this new kind of factories and in the future, some researchers are expecting the wide usage for producing goods. In these kinds of future factories, all of the workforce that used for production will be cobots, and using the AR human workforce will control all of the production processes. Besides, 3D-printing technology, autonomous vehicles, wearable technologies, nano-technology, infinite processing power with cloud storage, and AI that can make cognitive decisions based on BD will be the indispensable factor for the production process.

The human factor is the absolute requirement in designing, manufacturing, and selling the products but Industry 5.0 is the revolution that changes this absolute requirement. However, instead of removing the human workforce, changing them to a workforce who are capable and able to talk with the machine who are well-educated and open to development is always more efficient and logical. Industry 5.0 will be about controlling all of the robots, machines, or vehicles with chips in our brains in the future. This may be the clearest and also futurist definition of the Industry 5.0.

There are only a few debates and studies about Industry 5.0 in the literature but these studies are intersecting on the same basis: AI-assisted learning machines with BD. The definition of the industrial robot is evolving with a new paradigm to the industrial cobots and the effect of this evolution on the global economy must be widely discussed.

### **5. The Impact Of Artificial Intelligence On The Labor Market**

Digitalisation is the most important disrupter for the labor markets and changing the characteristics of many jobs. Automation is the basic reason behind this disruption and these changes in jobs and skills will affect the demand and structure of different jobs. Many innovations throughout the 19th and 20th century automated the jobs but created many new jobs with an increasing demand for goods and services. However, this is not the case for Industry 5.0 because the ability of AI-assisted learning machines became a threat to many of the jobs. In this framework, new studies in the literature asserted that within the wide usage of AI-assisted learning machines, labor replacing technologies will lead to global change.

In fact, in 1930s Keynes stated the technological unemployment in his seminal paper and brought macroeconomics a new debate topic. Technological advancements have a significant potential to replace the worker. There many examples like driverless cars, workerless smart factories, AI-assisted crop harvesting, and also automated shopping. Many of the sectors in the economy quickly adopted the digitalization and automation in their production process and this reshaped the employment structure as well as unemployment structure.

However, in Industry 5.0 these changes have different characteristics from past technological advancements and will have different effects on sectors and the nature of work along with employment. Previous industrial revolutions brought the technologies that increased the supply and demand simultaneously and technological unemployment did not rise to the top of the agenda but Industry 5.0 changed the direction of technological advancements that are reshaping the employment structure. Conventional automation robots are only doing the standard tasks like welding, carrying, or assembling but for now, AI-assisted learning machines that are called as cobots started to collaborate with humans to assist to the complicated financial

tasks, diagnosis of illness, optimization of production or mass personalization. These changes seem as challenging and have positive effects at first sight but this will be also challenging for approximately half of the jobs for developing and developed countries.

This rapid globalization and automation will change the structure of the jobs that will decrease the labor demand or create new AI-assisted jobs. Figure 5 is reflecting the percentage of jobs at risk by the degree of risk and pointed out the challenge for the nature of works in the future.

Based on many studies, Industry 5.0 will cause primarily stagnant wages that decline share of labor in income as we see above in figure 3. Acemoğlu and Restrepo (2017) stated the situation more clearly and found that automation reduced the wages as well as employment. The primary cause of this change may be the technological advancements that replaced the high-skilled workers with AI-assisted learning machines. The increasing ability of these learning machines has the potential to get more jobs from humans and innovations may destroy many jobs. Besides, new job creations may be lower than job destruction. Due to the greater abilities of these innovations may decrease the demand for labor and wages may stagnate.

Acemoğlu and Restrepo (2018) in their other paper presented a framework that AI and robotics replace workers and called as “*displacement effect*” that will reduce the demand for labor, wages, and employment. They consider that there will be an increase in output per worker but the share of income of the labor will fall due to this displacement effect (Acemoğlu & Restrepo, 2018).

Moreover, Acemoğlu and Restrepo (2019) emphasized that the displacement effect will also reduce the labor share of value-added while white-collar workers in accounting, sales, logistics, trading, and managerial occupations are replaced by AI-assisted learning machines (Acemoğlu & Restrepo, 2019). This is the main rationale behind the stagnating wages and figure 5 pointed out the risk of stagnation is growing.

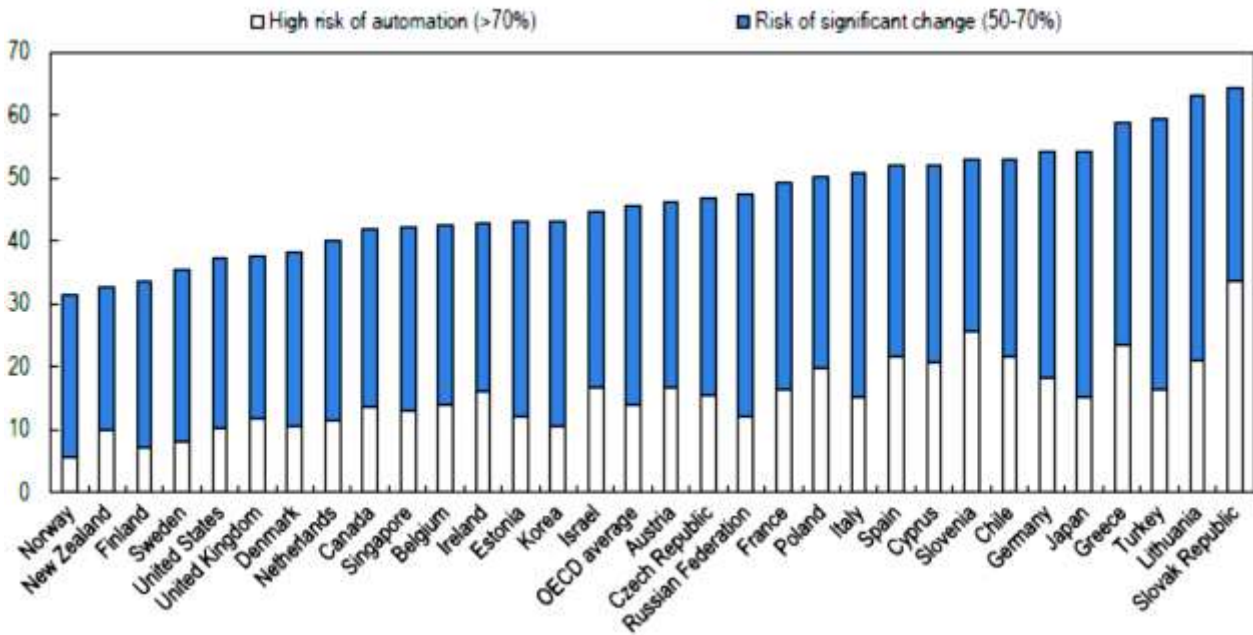


Figure 5. Percentage of Jobs at Risk by Degree of Risk

Source: OECD (2018), "Putting faces to the jobs at risk automation", Policy Brief on the Future of Work, OECD Publishing, Paris, <http://www.oecd.org/future-of-work/Automation-policy-brief-2018.pdf>

On the other hand, Korinek and Stiglitz (2017) emphasized inequality as an important result of AI-based workers replacing technologies. Stagnation of wages may decrease the share of labor income that will lead to poverty. Besides, a higher long-term unemployment rate may promote poverty and figure 4 reflecting the danger of increasing poverty.

Industry 5.0 will affect both workers for the next two decades and skill or education will not be important whether high or low. AI-assisted learning machines with BD will replace most of the known jobs, working habits, and labor demand. There may be many reasons and innovations for this change but the main driver is the costs that increase the competitiveness of the firm as well as increasing productivity. Technological advancements are decreasing the cost of the automation and AI-assisted learning machines as well as accessibility. Besides, reliability, flexibility and accuracy are increasing and becoming the main advantages of these new technologies and jobs or tasks that contain the decision-making process can be performed by AI-assisted learning machines. These may affect the employment rates negatively for both blue-collar and white-collar workers and due to this wages will stagnate.

On the other hand, there is and will be changes in the forms of employment as well as the working time within the Industry 5.0. The standard form of employment is changing to a flexible and on-demand form for the new decade. Their many new forms and have significant effects on the unemployment rate as well as long term unemployment. The main challenge is about the working times of employers like job sharing, employee sharing, and on-call work.

Digitalisation and automation are decreasing the working time for the employers and this is leading to a decrease in income. Many of the firms in different countries are offering lower working time to employees by the impact of technological advancements in Industry 4.0. These changes in the working time will continue for the next decades by the impact of AI-assisted learning machines.

Flexible working time will be the new framework for the employees and labor demand will change within this framework. Flexible working time can be seen as a positive change for the workers but the problem is twofold. The first problem is about the income of flexible workers because decreasing working times may decrease the income of workers. Regular income may be the second problem and have the potential to increase poverty with social security problems that will be a threat to wealth.

Another problem that starts with Industry 5.0 is the decoupling of hourly wages that are depending on skill levels may cause wage polarization and volatility of the hourly wages. Wage polarization is an important threat for the future that may raise with Industry 5.0. There are many side effects of the differentiation of the hourly wages based on job sharing, employee sharing, and on-call work. These new forms of employment have different wage payment methods that are depending on per hour, per performance or per pieces. This flexibility of the working time brought the volatility of the income and technological advancements will likely increase the volatility.

Digitalisation and automation with the AI-assisted learning machines are challenging the job market because these are changing both the tasks and jobs. AI and ICT are changing the number of workers because of destroying the jobs as well as the tasks. Especially declining costs of the AI with increasing the ability is getting more of the tasks from the workers or the same number of workers do more tasks. Therefore, Industry 5.0 is recognized as a disrupter for the labor market and two problems have the potential to rise. Wages will stagnate due to the decreasing demand and there will be no increase in employment.

These problems are very related to inequality and will have different impacts on jobs and sectors in different economies. Korinek and Stiglitz (2017) stated the problem in their paper that AI-automation will worsen the income distribution for two reasons. One is the fact that only small numbers of companies (or economies) can get the benefits of the AI-assisted learning machines and the second one is about the decrease in demand for labor. There will be a change in relative wages and this will lead to income inequality with poverty. This seems like the dark side of the future work and international economic organizations are continuously preparing the new documents to inform the policymakers.

For instance, the World Trade Organization (WTO) stated in their report that innovation and technological progress have caused disruption and workers become anxious about the impact of innovations. According to WTO, the future of the world of work is uncertain and governments should rethink their policies to encourage employment (WTO, 2018). However, WTO draws an optimistic framework and claimed that technology is creating more jobs than destroyed by itself. Innovation and automation created new sectors, new jobs, and new tasks with increased productivity that will affect prosperity.

There are controversial views about the impacts of Industry 5.0 but every study is expecting an impact on labor market. There is no consensus about the impact of productivity, employment, working time, and new forms of working issues. The mainstream of the literature has doubts about the disruption of labor markets and expectations are pessimistic. Many of the researchers agreed that groundbreaking technological advancements may induce unemployment that will lead to inequality and poverty but there are only a few studies established AI-based economical models and there doubts about the unemployment rates because of stagnating wages (Gries & Naudé, 2018).

On the contrary, few studies pointed out that there will be no change in the labor market and technological advancements will support employment. For instance, Borland and Coelli (2017) in their paper analyzed the effect of computer-based technologies on employment in Australia and found that there is no relationship between technologies and jobs (Borland & Coelli, 2017).

Generally, many of the jobs or tasks even professions like lawyers, accountants, auditors, journalists, and marketing specialists, started to be affected by technological advancements in Industry 5.0. AI-assisted learning machines are a significant threat to these professions as experienced in routine jobs in the last two decades.

However, this displacement of the professions with AI-assisted learning machines will have deeper effects on income and its distribution. Furthermore, AI-assisted learning machines and BD brought new economic and social issues like market concentration, social security, digital capital taxation, and spreading ownership of the capital.

Finally, this decade is very important to understand the future of the work as well as the nature of the work. Technological change has a significant potential to affect the current unemployment indicators and an increase in the ability of the AI-assisted learning machines with BD will promote this potential when the abilities of these robots and cobots exceed over a cognition level.

## **6. Future Research Directions**

The current progression of technological change affects the whole world and Industry 5.0, Web 5.0, and Society 5.0 will be the key elements for the progression of the world economy. Therefore, it is very important to understand the impacts of these revolutions on the global economy. Besides, digitalisation and automating of the global production in the sectors are evolving many of the jobs and demand of the high-skilled worker is changing day by day. There are two main question arises for the future in this framework and these two questions should be examined in future studies. The first one is about the future of jobs. Which jobs will disappear in the next two decades? Along with this question, future professions that will be suitable for Industry 5.0 need to be explored. The second key question will be about the new skills. What new skills will the new jobs demand? These two questions have a high priority for the future to understand challenges arising in the new digital global economy. In economic literature, few studies analyze these two questions. Additionally, an important topic for future research is to determine key priorities for the skill policies of the governments. Understanding these priorities is very important for the future to promote sustainable growth. In particular, the skills and features required to increase youth employment should be explored in depth. Additionally, these studies will be the basis for understanding the reasons for long-term unemployment. Besides, the impact of Industry 5.0 on working time and new forms of employment will be the most debated topic for the next decades. There is a potential to increase productivity and disrupt the workforce, for this reason, in-depth analysis becomes essential for future policies, and the results of these studies will drive the policies. Furthermore, there is an unknown potential of these new AI-assisted learning machines, and understanding these potential will promote the new labor policies.

## **7. Conclusion**

Unemployment indicators are getting worsen for those developed, developing, and emerging countries. Acemoğlu and Restrepo (2019) emphasized the negative impacts of the automation on labor demand. In the literature, there are many doubts about the economic impacts of technological progression. As a result, technological unemployment will be the main problem for the global economy. First of all, policymakers must understand the kind of technological progression, difference, and characteristics of Industry 5.0. This issue is very important to understand the disruption of labor markets. It is very essential to understand the impacts on the global economy for today and the future. The high speed of technological advancements and the decreasing cost of technological innovations is bringing “*technological unemployment*” on the agenda again. These advancements and wide-usage of the AI-assisted learning machines

with BD that have cognitive decision-making ability caused a reduction in employment of low-skill workers as well as medium-skilled workers. However, this will also affect high-skilled employees in the long run because of the increasing ability of the cobots.

Therefore, all of the policy-makers in those developed, developing and emerging countries should design employment policies in the Industry 5.0 framework. These advancements will shift the workers to new jobs and new policies should contain new kinds of approaches for workers at every age. There should be two phases of policies. The first one is re-educating unemployed workers to adapting them to new kinds of jobs. This will be important for the aged workers that are unemployed now and a high rate of long term unemployment may be an indicator of this problem. Re-employment will be the basic problem for the policymakers and policies must promote the re-education of the aged workers. The second one is changing the education style and polices for the new generation to increase youth employment. Youth employment is another basic problem for now and will be more complex for the next decades. Especially, robots and cobots will replace low-skilled and medium-skilled jobs and new generations will need more sophisticated jobs than today. Education policies also should change in parallel with the employment policies to prevent high rates of youth unemployment by increasing their skills. These parallel policies will be the key for the next decades because it seems that many of the blue and white-collar jobs will be replaced by digitalisation and automation. Every country should have a different plan about this issue for preventing long-term unemployment with youth unemployment because of the different employment and production structure. Besides, technology is already gearing up and this is threatening many jobs while employment opportunities are decreasing.

On the other hand, the structure of the working is changing with the effect of Industry 5.0 and new forms of employment brought different drawbacks to the workers. Industry 5.0 has impacts on working time and employment forms and these impacts must be well-understood by the policymakers. Especially, law-makers must recognize the changing relations between employers and employees because it is very important to adapt the laws to these changes.

In summary, Industry 5.0 will make very important changes in working life and therefore more study is needed.



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