

Yapay Zekâ ve Otomasyonun İstihdama Etkisi: Emek ve Robotlaşma Ekseninde Türkiye Analizi

The Impact of Artificial Intelligence and Automation on Employment: An Analysis of Turkey in the Axis of Labor and Robotization

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Araştırma Makalesi/Research Article		DOI: 10.5281/zenodo.12599863
Gönderi Tarihi/Received 27/05/2024	Kabul Tarihi/Accepted 20/06/2024	Online Yayın Tarihi/Published 30/06/2024
Atf/Cited in: Aydın, A. (2024), The Impact of Artificial Intelligence and Automation on Employment: An Analysis of Turkey in the Axis of Labor and Robotization, <i>Sosyal Bilimler Akademik Gelişim Dergisi (SOBAG)</i> , 2(1), 1-9.		

ABSTRACT

We are facing the biggest revolution since the invention of the steam engine and electricity. This 21st century revolution is based on artificial intelligence and automation technologies. With the development of productive artificial intelligence, both social and economic transformations of countries have begun. At this point, especially developed countries are carrying out many activities to become leaders in artificial intelligence and automation technologies. But this situation does not only concern developed countries. It is also important for underdeveloped and developing countries to develop and reach the levels of developed countries. Artificial and intelligence automation technologies, along with various positive assumptions, have raised concerns that people may lose their jobs and that robots and human labor may be replaced. At this point, it is important for countries to establish a labor policy integrated with artificial intelligence and automation technologies. In this study, the development of industrial robots, one of the important computational data of artificial intelligence and automation, is discussed. In particular, Turkey has been examined and the displacement effect of labor has been observed. As a result of the study, policy recommendations have been developed for Turkey.

Key Words: Employment, Artificial Intelligence, Automation

ÖZET

Buhar makinesinin ve elektriğin icadından bu yana en büyük devrimle karşı karşıyayız. Bu 21. yüzyıl devrimi yapay zeka ve otomasyon teknolojilerine dayanmaktadır. Üretken yapay zekanın gelişmesiyle birlikte ülkelerin hem sosyal hem de ekonomik dönüşümleri başladı. Bu noktada özellikle gelişmiş ülkeler yapay zeka ve otomasyon teknolojilerinde lider olmak için birçok faaliyet yürütüyor. Ancak bu durum sadece gelişmiş ülkeleri ilgilendirmiyor. Az gelişmiş ve gelişmekte olan ülkelerin de gelişip gelişmiş ülke seviyelerine ulaşması önemlidir. Yapay ve zekalı otomasyon teknolojileri, çeşitli olumlu varsayımların yanı sıra insanların işlerini kaybedebileceği, yerini robotların ve insan emeğinin alabileceği endişelerini artırdı. Bu noktada ülkelerin yapay zeka ve otomasyon teknolojileriyle entegre bir işgücü politikası oluşturması önem taşıyor. Bu çalışmada yapay zeka ve otomasyonun önemli hesaplama verilerinden biri olan endüstriyel robotların geliştirilmesi ele alınmaktadır. Özellikle Türkiye incelenmiş ve emeğin yerinden edilme etkisi gözlemlenmiştir. Çalışma sonucunda Türkiye'ye yönelik politika önerileri geliştirilmiştir.

Anahtar Kelimeler: İstihdam, Yapay Zeka, Otomasyon

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1. INTRODUCTION

Technology plays an undeniable role in the economic, political and sociological development of societies. Developing technologies have the potential to reshape all human activities such as daily life activities, trade, production, health, education, belief structure, education, belief structure and transform societies by taking the capacities of machines to superhuman levels with many developments such as deep learning, machine learning, big data, natural language processing (Brynjolfsson et al., 2018). The automation and artificial intelligence technologies brought about by technological breakthroughs can affect human life both positively and negatively, raising certain concerns. Indeed, one of the most important concerns of the 21st century is whether technology will take away our jobs. Based on this concern, economists in particular focus on the effect of replacing labor with capital (Acemoglu & Autor, 2011). On this issue, scientists are divided into optimists and pessimists. Optimists argue that the replacement of labor with capital is possible, but that it will open up new jobs, just as it did in the industrial revolution. The machines that will be used instead of human labor will create a productivity effect due to cheaper, error-free production. By automating tasks in routine and non-routine sectors, costs will decrease and the economy will expand, causing an increase in labor demand in non-automated sectors (Acemoglu & Autor, 2011).

Automation and artificial intelligence gradually reduce the share of labor in national income as capital plays a greater role in production stages. Autor & Salomons (2018) argue that job losses from automation are often offset by job creation in other sectors, leading to an overall positive impact on employment in the long run. He found that employment at the sectoral level tends to decrease as productivity increases, but employment at the country level generally increases as aggregate productivity increases. This finding is consistent with the stylized fact that the relationship between productivity gains and employment is negative in individual industries but presumably positive for the economy as a whole. Graetz & Michaels (2018), they analyzed new panel data on the adoption of robots in industries for 17 countries from 1993 to 2007 and new instrumental variables based on the comparative advantage of robots in specific tasks. Industrial robots were found to increase both labor productivity and value added. Additional increases in the choice to use robots contribute almost 0.36 percentage points to labor productivity (annual) growth. They calculated that the increased use of robots increased countries' average growth rates by about 0.37 percentage points. They find that robots increase both wages and total factor productivity (Vermeulen et al., 2018).

The study examines the projected impact of automation on employment over the next decade, both at the macro level and on the actual sector (types). The study finds support for “business as usual structural change” rather than “end of work” in the set of “technology-impacted” sectors. Our expert-based estimate of the automatizability of jobs in the applicant sectors turned out to be limited, and the shift of employment to “making” sectors (especially engineering, software and scientific services) was evident. We found significant job creation in both existing and emerging occupations in the “making” sectors as well as in complementary enabling and disabling sectors (e.g. big data and information systems, service robotics and a range of their applications). Earnst et al. (2018) aims to address this knowledge gap in order to better understand the economic and social consequences of AI. To do so, the study begins with a detailed analysis of how previous waves of automation have changed occupations and employment opportunities in the past. In particular, the study looks at the experience of developed and emerging economies with the automation of physical tasks through increased robotization. This approach can shed light on the likely impact that the development and widespread diffusion of AI could have on employment, incomes and inequality through the automation of mental tasks (as per the distinction between AI and robots/mechanization above). The study finds moderately optimistic conclusions that new, AI-based digital technologies could enable broader segments of the labor market to increase their productivity and access better-paid occupations, and thus help support (inclusive) growth.

Pessimists, on the other hand, emphasize that automation and artificial intelligence technologies will increasingly become more intense and that technology will replace labor. In today's world,

skill-based differences between high-skilled workers and low-skilled workers will become even sharper with automation, reducing the demand for low-skilled workers, leading to decreased wages and employment losses (McKinsey & Company, 2017). Another important point is the development of production stages against labor due to the substitution of labor by capital due to automation technologies, the decrease in the share of labor in value added and the demand for labor (Lu & Zhou, 2021).

Especially in developed countries, the proliferation of dark factory models and the minimization of human labor are leading to a change in the class structure by eliminating the concept of working class. These phenomena push societies to transform both sociologically and economically. Technological developments are creating a new gap in the class structure as well as in the level of development between countries. According to Norton, rapid developments in artificial intelligence and automation technologies may prevent developing and underdeveloped countries from reaching the level of developed countries even more than in the past (Norton, 2017). Because, although access to information and the use of automation technologies are similar between developed and developing countries, developing countries struggle with problems such as agricultural employment, high levels of unregistered workers, and insufficient human resources to integrate high-tech production tools (Carbonero et al., 2018). With the change in the structure of production and the ability to produce more efficiently with fewer people, capital, which was transferred to developing countries in the past to provide access to cheap labor, is turning more towards locations that facilitate access to the final consumer in areas such as the manufacturing sector (Norton, 2017). This shows that capital will shift its investments to developed countries. Despite this negative impact, the cheapening of information technologies and their accessibility in almost every country in the world offers a leapfrog effect for developing countries (Hallward-Driemeier & Nayyar, 2017).

Artificial intelligence and automation technologies, which progress within the framework of knowledge-based tasks, are developed by highly skilled engineers, mathematicians, software developers and people with creative thinking and analytical thinking capacity. In this respect, trained human resources play an important role in the development of societies (Buchanan, 2005, Kumar, 2016). However, especially in authoritarian regimes, legal problems, wrong education policies and restrictions on freedoms lead to the transfer of technologically qualified labor to developed countries. The migration policies of developed countries are also shaped towards the transfer of highly skilled educated individuals, accelerating the process (Huang & Arnold, 2020).

In our study, we examine artificial intelligence and automation technologies and analyze the effect of the replacement of labor with capital as a result of artificial intelligence and automation technologies, and in this context, we reveal how much of the sectors in Turkey can be transformed by technology. For economists, productivity is one of the key challenges worldwide. At this stage, companies aim to increase productivity and reduce costs. This effort leads to a focus on the impact of automation on employment. Many scientists, policymakers and research journalists are interested in the development of automation and artificial intelligence technologies (Brynjolfsson & McAfee, 2014; Ford, 2015; Frey & Osborne, 2017). One of the key reasons for this is that AI offers us the opportunity to grow and transform businesses of all sizes, and for the whole world to reap the benefits of the resulting innovation (UK Government Office for Science, 2024). The significant increase in wages and the gradual rise in cost items in developed countries since the 1980s have prompted firms to invest in and use automation equipment more and more. The resulting high costs in economies have encouraged manufacturers to use automation and artificial intelligence technologies and accelerated the process of replacement between workers and machines. Industrial robots and equipment using artificial intelligence (AI) - what we call 'automation equipment' - not only help human workers perform their tasks more efficiently, but also improve precision, accuracy and reliability. Manufacturers are therefore able to reduce their production costs, while at the same time increasing their overall productivity with higher quality output (Aswicahyono & Rafitrandi, 2020).

The global AI market is expected to reach USD 13.9 billion by 2025. In total, taking into account competitive effects and transition costs, AI could boost global GDP by 1.2% per year by 2030 (Bughin et al., 2018). Contrary to popular belief, AI and automation technologies are not only a topic that is being studied in developed countries. Although developed countries, especially the US and China, have taken the leading role in this field, studies in developing countries such as Turkey are also extremely important (Ghys et al., 2021). Automation has a higher potential to affect underdeveloped and developing countries. The poorer a country is, the greater the number of jobs that can, in principle, be automated because the types of jobs that are common in developing countries (such as routine jobs) are much more susceptible to automation than the jobs that dominate high-income economies (Stevenson, 2020).

Our study examines the industrial robot installations of the International Federation of Robotics (IFR) to observe the sensitivity of jobs to AI and automation. Industrial robot installations are important as they most clearly demonstrate the displacement effect of AI and automation. Emerging economies with young populations, such as India, Indonesia, Mexico and Turkey, are seeing the positive effects of a growing working-age population in maintaining and advancing GDP. However, in order to sustain their economic development, the mere labor of the young population is not enough, and in order to ensure a sustainable economic management in the globalizing world conjuncture, they need to follow developed countries in the fields of automation and artificial intelligence (McKinsey Global Institute, 2017).

Fundamental problems such as Turkey's geopolitical position, wars in neighboring countries, the dominance of the political agenda and the pace of structural reforms have a negative impact on investments. As Turkey improves in terms of political uncertainties and structural reforms, its favorable demographics could make it one of the most promising countries in the long term. According to PwC forecasts, Turkey is projected to grow by 3% on average over the next 34 years. 3% growth is the fastest growth rate compared to European countries. In the G7 countries, this figure is estimated to be 1.6% (PwC, 2017).

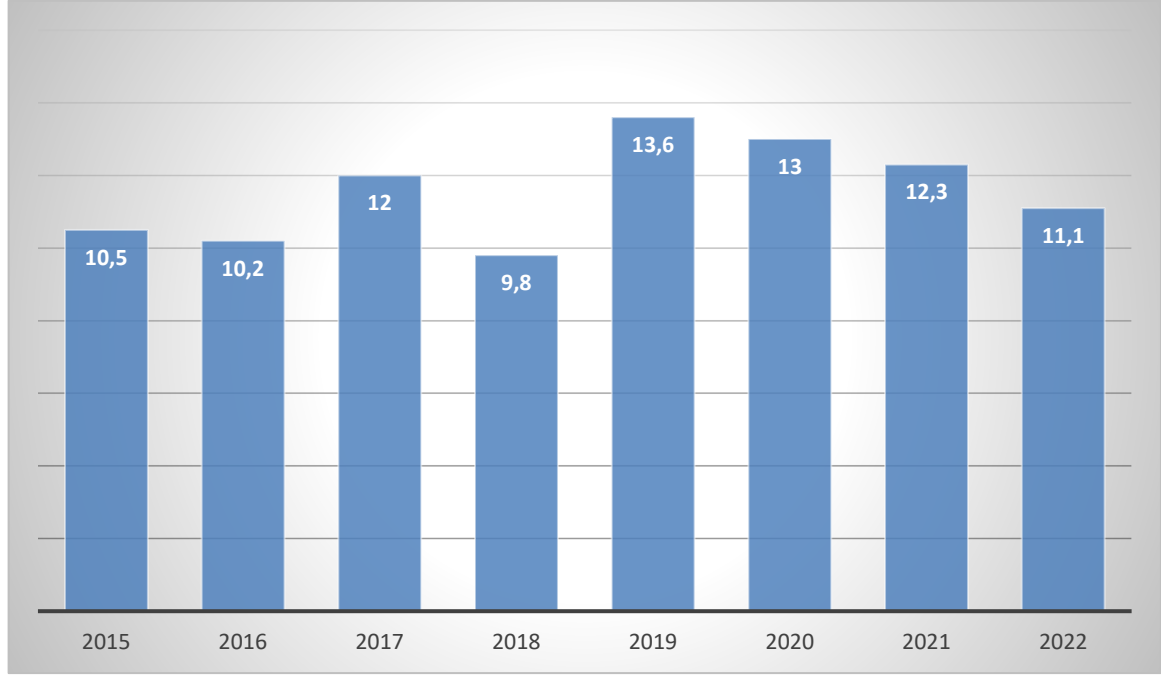
According to our estimates, Turkey has the potential to grow at an average annual rate of around 3 percent over the next 34 years (the fastest growth among the European countries in this study), while the G7 countries have an average growth potential of 1.6 percent. Turkey is firmly committed to the concept of digital industrial development and sustainable policies despite some disruptions, especially in the industrial sector, revealed by Covid19. In this context, the digitalization of the manufacturing industry is particularly prioritized. The manufacturing industry is extremely important for Turkey as it constitutes important export items. With the 2023 industrial and technology strategy, Turkey intensifies its efforts and incentives on infrastructure, human capital, entrepreneurship, high technology and innovation, digital transformation and industrial move (UNIDO, 2022).

The Scientific and Technical Research Council of Turkey (TÜBİTAK) leads the way in Turkey in supporting R&D activities and providing funding for automation and artificial intelligence projects. Over the last 10 years, TUBITAK has provided 1.7 billion TL in funding, directly supporting 1,715 R&D and innovation projects. The institution, which provides support to academic activities at a rate of 25%, subsidizes the development of artificial intelligence and automation investments by providing support to the private sector and industry at a rate of nearly 75%. Machine learning, computer vision, natural language processing, autonomous vehicles and robotics constitute important support items (CBDDO, 2021).

Unemployment and the future of work are important issues in Turkey. The concept of unemployment, unlike all other economic indicators, is an important factor that directly affects the individual. The individual is not only affected economically. Even though individuals want to work in a job, their survival is directly related to their ability to find a job, and a psychological devastation begins in those individuals. This thing, which may initially be perceived as an individual situation, is actually a social problem.

The unemployment rate is the ratio of the number of unemployed people to the number of people in the workforce (Blanchard, Johnson, 2013). Measuring the unemployment rate requires determining who is in the workforce. Labor force is defined as the total number of unemployed and employed (OECD, n.d.). Understanding who is employed or unemployed involves making practical assessments, such as how much paid work a person must do to be considered to have a job, and finding out how many people do or do not have a job (Reserve Bank of Australia, n.d.). There is an increase in unemployment rates in Turkey between 2015 and 2022 in 2019. This figure decreased to 11.1% in 2022.

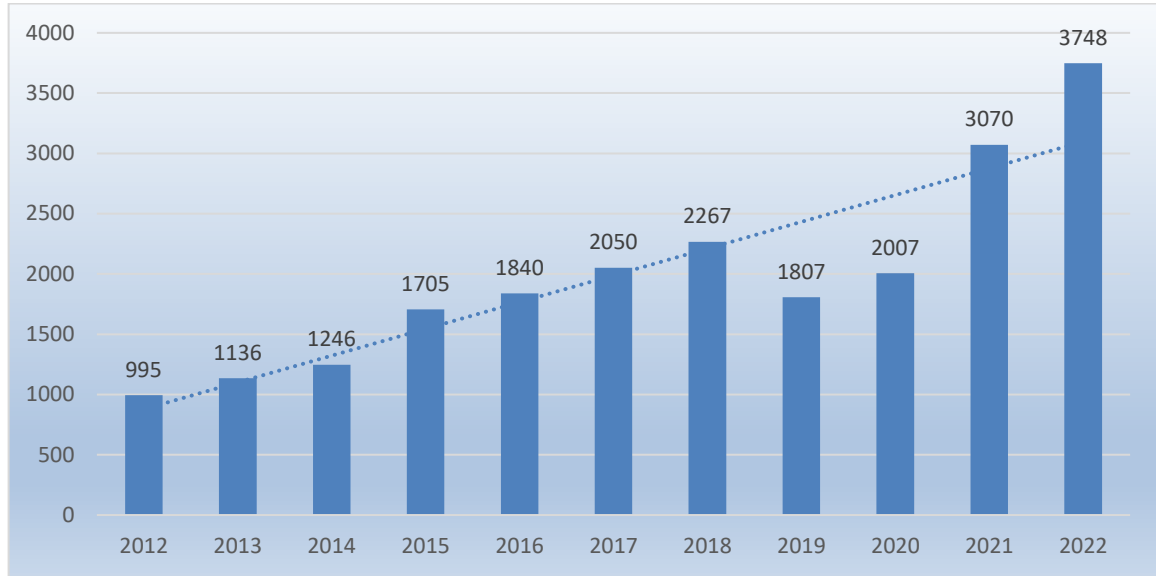
Figure 1. Unemployment Rate Türkiye (%)



Source: TÜİK, <https://data.tuik.gov.tr/>

Turkey has an important position in terms of industrial robots, one of the main indicators of artificial intelligence and automation. When we examine the graph showing the installations of industrial robots between 2012 and 2022, it is seen that the number of installations, which was 995 in 2012, increased to 3,748 in 2022. Considering the negative impact of COVID19 on all world markets, it can be predicted that Turkey has realized a significant increase in industrial robot installations and will progress similarly in the Future (IFR, 2023).

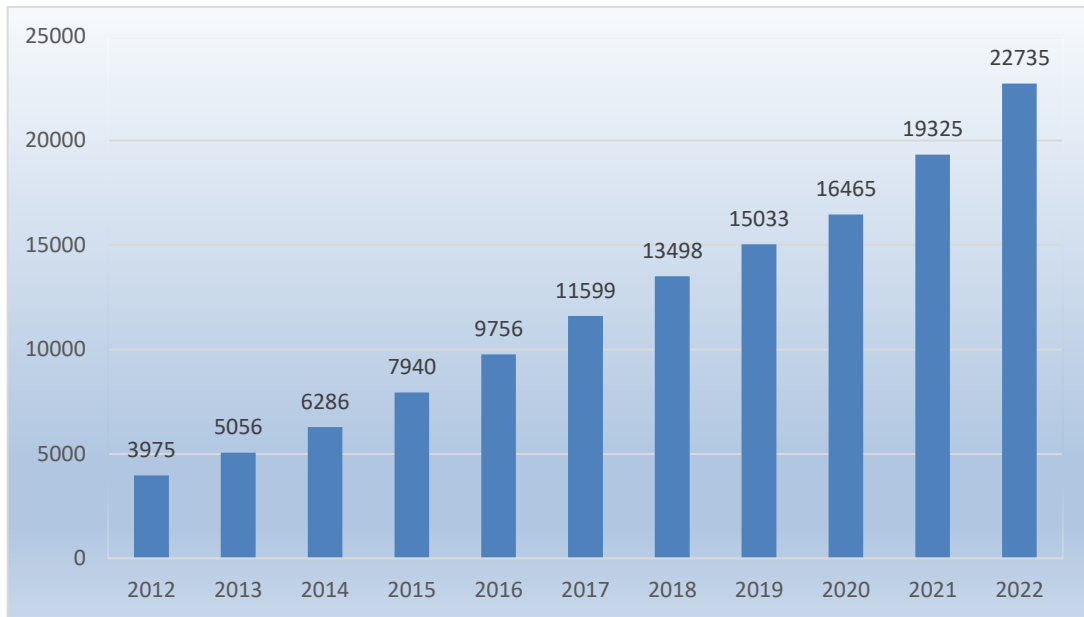
Figure 2. Annual Installations of Industrial Robots - Turkey - Unit



Source: International Federation of Robotics (IFR). (2023). *World Robotics 2023 - Industrial Robots*. <https://ifr.org/>

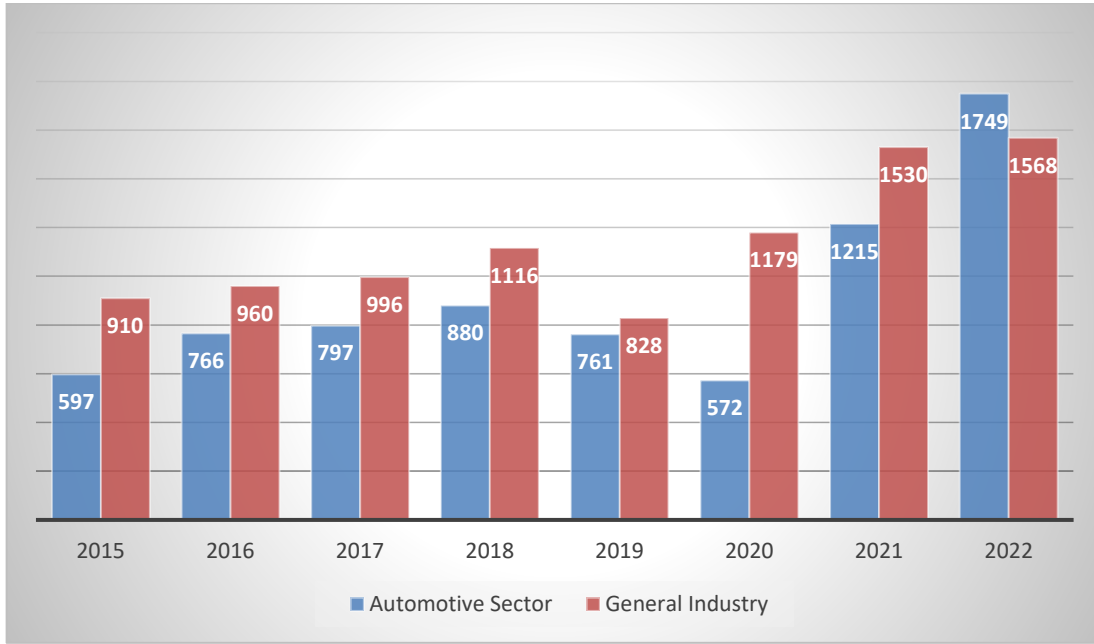
When we look at the operational stocks of industrial robots in Turkey, we can see that there is a similar regular expansion. Between 2012-2022, operational stocks increased from 3,975 to 22,735. Between 2017 and 2022, Turkey's robot stock shows a CAGR of 14% (IFR, 2023).

Figure 3. Operational Stock of Industrial Robots - Turkey



Source: International Federation of Robotics (IFR). (2023). *World Robotics 2023 - Industrial Robots*. <https://ifr.org/>

The size of the domestic market in Turkey and the fact that the automotive sector is at a more advanced level compared to other developed countries stand out at this point. For automotive suppliers, Turkey stands out as one of the most important production sites for automobiles and commercial vehicles. In 2022 alone, 1.4 million cars and commercial vehicles were produced in Turkey (OICA, 2022). This situation is also very effective in robot installations. In 2022, 1,749 installations were realized in the automotive sector, while 1,568 were realized in all other industries (IFR, 2023).

Figure 4. Annual Installations of Industrial Robots: Automotive and General Industry - (Units) - Turkey

Source: International Federation of Robotics (IFR). (2023). *World Robotics 2023 - Industrial Robots*. <https://ifr.org/>

The automotive sector has been the engine of growth with its share of industrial robot installations. This figure accounts for 47% of total installations in the country. The automotive sector was followed by the metal sector, plastics and chemical products, rubber and plastics, food and beverages, and electrical/electronics. When we look at the robot density in Turkey, it is the automotive sector: 344 robots per 10,000 employees, manufacturing sector: 45 robots per 10,000 employees, while in other sectors: 28 robots per 10,000 employees. Unorthodox monetary policy and the depreciation of the Turkish lira have led to an expansion in demand from export markets. As a natural consequence of this, there is a need to increase production capacity. Considering all these factors, robot installations have become a promising and growing market in Turkey, and have become an indispensable agenda for the Turkish industry (IFR, 2023).

Turkey's increasing position and potential in industrial robot installations shows that it can evolve to robotic technology in production stages. This situation reveals the assumption that labor and machines can be replaced in the future.

2. CONCLUSION

Although the displacement of labor does not make itself felt today, it seems likely that in the long run labor will be replaced by machines in order to reduce costs. All developed countries in the world, especially China, the USA and the UK, are working with the vision of becoming the world leader in artificial intelligence and automation technologies. Mexico, Brazil, India and Indonesia are also taking important steps in this field. For this reason, R&D investments, adaptation of the education system to future-oriented technologies, increasing democracy, law and welfare, and inviting qualified labor force to their countries are among the important issues. Turkey is among the countries that have made significant progress in automation and artificial intelligence technologies. However, one of the major problems in Turkey is that the automotive industry plays a dominant and pioneering role, especially in industrial robot installations. This situation, which may be perceived as good on the one hand, actually reveals the fact that the technology has not spread sufficiently to the general industry. At this point, it is important for Turkey to develop policies that will target all sectors in robot installations. Although Turkey suffers from the disadvantage of its geopolitical location due to wars in neighboring countries, it can be transformed into a center of attraction in terms of the employability of artificial intelligence and automation developers in the world. At this point, especially the

problem of access to financing resources needed by developers can be solved with government incentives. In addition, by reforming education, training on artificial intelligence and automation technologies can be examined with a broader literature in secondary and higher education and trained human resources can be obtained. Ensuring equality of opportunity in education can improve equal access to technology for all students. Artificial intelligence and automation technologies can be taken out of the limitation of an academic study and coordinated industry-university cooperation is presented as policy recommendations. This will prevent possible labor-reducing shocks. Labor that is not integrated with mechanization can be pushed out of employment.

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