The Impact of AI and Automation on Job Displacement

Dimitar Kolev, Ivan Petkov

***Abstract*—Expanding on the transformative impact of artificial intelligence (AI) on the global economy, the impending shift towards heightened productivity carries both promises and challenges. As industries adapt to the era of automation, the potential for job displacement in specific sectors looms large, necessitating a nuanced understanding of the intricate dynamics at play. Effective policy formulation and strategic initiatives are essential to mitigate the adverse effects of AI on employment and foster a more inclusive economic ecosystem. This scholarly endeavor embarks on a comprehensive exploration of the complexities surrounding job loss catalyzed by AI and automation through the lens of a robust theoretical framework and meticulous statistical analysis. Delving deeper into the realms of task automation and skill substitution, the research scrutinizes the ripple effects of such transformations, encompassing job polarization dynamics, labor market shifts, and income disparities. Furthermore, this paper explores the emergence of new employment prospects and necessary skills within the AI realm, offering a comprehensive examination of the evolving labor landscape in light of technological advancements.**

***Index Terms*—Artificial intelligence (AI), Automation, Job displacement, job loss, job polarization, work force**

I. Introduction

The integration of Artificial Intelligence (AI) and automation technologies has been transformative across various sectors, offering increased efficiency, productivity, and innovation. However, alongside these benefits, concerns arise regarding their impact on employment. The potential for job loss due to AI and automation has sparked widespread debate and necessitates rigorous investigation. This scientific research aims to explore the phenomenon of job displacement resulting from AI and automation, offering insights into the mechanisms, implications, and potential mitigating strategies.

[1]The industry 4.0 and the emerging 5.0 as an industrial revolutions will decimate some sectors of the global economy and will create a new employment opportunity, that did not exist in the moment. Some of the trends in the job markets are already visible other are not so clear yet.

For instance, Did you know that 30% of workers worldwide fear that AI might replace their jobs within the next three years. Or that in India, a staggering 74% of the workforce shares these concerns [1].

Some projections [1], claim that AI could potentially replace around 800 million jobs worldwide by 2030, which would be a significant effect. The economic forecast is equally staggering, with AI's estimated economic impact reaching a colossal $15.7 trillion by the same year.

However, with each economic revolution there has been a job closure procedure involving the emergence of new jobs. The focus of the current research paper is to make an overview of the job's loss due to AI and automation in recent years. To complete it the following tasks must be fulfilled:

- ✓ Theoretical overview of the evolution of automation and AI;
- ✓ An overview of jobs displacement mechanisms;
- ✓ Comprehensive analysis of statistical data on jobs loss due to AI;
- ✓ Discussion about new job opportunities emerging.

II. Theoretical Overview

A. Evolution of Automation and AI

Automation, dating back to the Industrial Revolution, has continuously shaped labor markets by mechanizing repetitive tasks. In recent decades, advancements in AI have accelerated this process, enabling machines to perform cognitive tasks traditionally reserved for humans. Machine learning algorithms, neural networks, and robotics are among the key technologies driving this evolution. According to some researches [2], the 20th and 21st centuries witnessed another revolution with the emergence of microprocessors and robotics, which brought about a significant reduction in the cost of computer hardware, paving the way for the continued advancement of technology and automation of work in manufacturing industries. Robots can now execute some complex tasks in workplaces, saving humans from hazardous environments and difficult tasks, leading to increased productivity, and reducing the cost of business operations in many manufacturing industries, such as canning and bottling, and automatic process assembly of foods and beverages, and separation of natural gas [2].

According to the US government [3] the AI system is: "an AI system is a machine-based system that is capable of influencing the environment by producing an output (predictions, recommendations, or decisions) for a given set of objectives. It uses machine and/or human-based data and inputs to (i) perceive real and/or virtual environments; (ii)

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abstract these perceptions into models through analysis in an automated manner (e.g., with machine learning), or manually; and (iii) use model inference to formulate options for outcomes".

As far as AI is concerned, it is: "AI stands for artificial intelligence. AI is the result of applying cognitive science techniques to artificially create something that performs tasks that only humans can perform, like reasoning, natural communication, and problem solving. AI is important because it has the potential to help humans become better at completing cognitive tasks, and to automate tasks that are currently difficult or impossible for humans to do" [3].

The use of artificial intelligence in economics is divided into the following categories [4]:

✓ Deep learning – machine learning based on a set of algorithms that attempt to model high level abstractions in data.

✓ Robotisation – Robots have been replacing employees because they work more precisely than humans and cost less.

✓ Dematerialization – because of automatic data recording and data processing, traditional 'back office' activities are no longer in demand.

✓ Gig economy – There are more and more independent contractors for individual tasks that companies advertise on online platforms.

✓ Autonomous driving – Vehicles have the power for self-governance using sensors and navigating without human input. Taxi and truck drivers will become obsolete.

Moreover, in terms of scientific research (see fig. 1), the machine learning and computer visualization are top priorities.

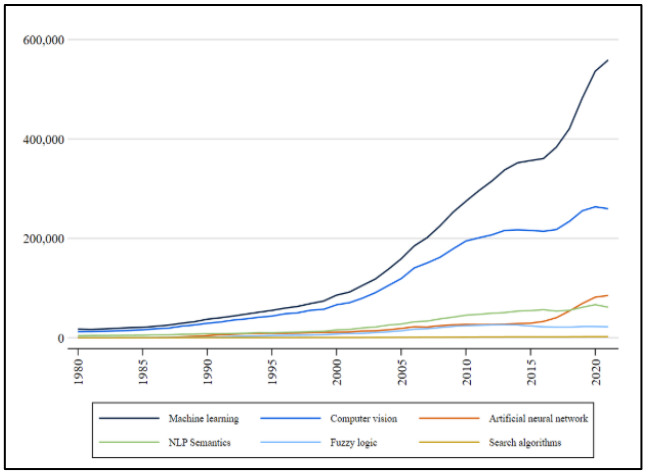

Fig. 1. AI research publications by topic, 1980-2021 (source: US Government [3])

The leaders by country are the USA and People republic of China. In the last five years very popular are also artificial neuro networks and the idea of trans- humanism.

B. Job Displacement Mechanisms

The displacement of human labor by AI and automation occurs through various mechanisms:

➢ **Task Automation**: Routine and predictable tasks susceptible to automation are often the first to be replaced. For example, in health care, AI can be used to automate the tasks of sorting through medical images to diagnose conditions. In manufacturing, AI can be used to automate the tasks of quality control and inspection [3].

➢ Skill Substitution: AI and automation may substitute specific skills or entire job roles, rendering certain occupations obsolete. For example, financial decisions, some researchers experimented using AI-powered algorithms to analyze market data, assess risk, and generate investment recommendations, leading to improved financial outcomes. They inferred that AI could provide decision-makers with timely and accurate information, enabling them to respond quickly to changing market conditions and make informed investment decisions [5], [6].

➢ Efficiency Gains: Increased productivity resulting from automation may reduce the overall demand for labor in certain sectors. Jobs in transportation such as truck, taxi, and delivery drivers; manufacturing and warehouse workers; many clerical and administrative support roles; cashiers and retail salespeople; accountants; paralegals; loan officers; technical writers; and even some medical diagnostic workers are among the roles considered most vulnerable [7], [8].

The two main effects are:

✓ Displacement effect – by displacing workers from tasks they were previously performing.

✓ Productivity effect – by increasing the demand for labor in industries or jobs that arise or develop due to technological progress [4].

Other researchers [9] claim, In the management, field the decision making with AI assistance could play a very important role AI generates and processes information from the database and provides it to managers, but it cannot take into account the moral judgment of the human factor about the situation-occurrence, reasons and consequences of making the decision .The process is still under the control of humans, as emotional and social intelligence are so far outside the scope of machine learning and AI. Therefore, the provision of ready-made decision scenarios through AI needs to be considered and refined, as the technology makes decisions based on data and information, and the manager takes them by assessing the situation. In the second case, it is about cyber security, which must be at a high level against a breach in the companies information systems and the prevention of theft of personal data, strategic and operational corporate information [9].

C. The impact of AI and automation on employment

There are several impacts to be considered. Firstly, **Job Loss - c**ertain occupations may experience outright displacement, leading to unemployment for affected workers. Not all sectors will be impacted with the same intensity. Automation is predicted to displace 20 million manufacturing jobs by 2030, and 25% of American jobs are highly susceptible to automation, with 73 million jobs potentially lost in the US over the next five years. Thus, automation is becoming increasingly prevalent and is likely to have a significant impact on the job market in the near future. AI is estimated to replace 85 million jobs by 2025, but 97 million new jobs will be created due to AI. 93% of HR leaders and employees in the U.S. are open to training delivered via AI [10].

Secondly, **Job Polarization** - automation tends to affect middle-skill occupations disproportionately, leading to polarization between low-skill and high-skill jobs. Job

polarization refers to a phenomenon where the demand for highly skilled and low-skilled jobs increases, while mid-skilled jobs may decline. This trend is often associated with the adoption of AI and automation technologies, as they can replace routine and repetitive tasks typically performed by mid-skilled workers. In effect, it is important to address this issue to ensure a balanced and inclusive job market and draw out proactive policies that promote upskilling and reskilling of workers to mitigate the negative effects of job polarization and ensure that individuals have the necessary skills for the evolving job market [2].

Thirdly, **Wage Effects** - automation-induced job loss may exert downward pressure on wages in affected sectors, exacerbating income inequality. As mentioned, AI applications and automation replaces human effort and lowers labor demand, leading to lower wages and reduced hiring. In the most extreme cases, some of these jobs may disappear.

III. AUTOMATION AND AI EFFECT ON JOBS KEY STATISTICS

On the one hand, the most suspected effect of automation and AI is job loss due to the replacement of human effort with machines or computers. According to some researchers, since 1990, the cost of employee labor has risen by over 200%. Meanwhile, the cost of robots has dropped by over 50% [11]. This is clear evidence why industries shift between manual labor and robotics. Other key stats show [11]:

- Automation is predicted to **displace 20 million manufacturing jobs by 2030**.
- The US is home to 310,700 industrial robots, and that number increases by at least 40,000 each year.
- Automation has the potential to eliminate 73 million US jobs by 2030, which would equate to a staggering 46% of the current jobs.
- 37% of Americans are worried about automation displacing them from their jobs.
- 85% of Americans approve of automation only in jobs that are dangerous or unhealthy for humans.
- The installation of industrial robots has increased at a 10.28% compound annual growth rate over the past decade.
- China installed 268,200 industrial robots in 2021; that's almost 52% of all new industrial robot installations across the globe for the year.
- The Automotive Industry employs 38% of manufacturing robots.
- Creativity, emotional intelligence, and STEM proficiency are the most important skills to have to avoid job automation.
- 13% of those aged 18-24 have either lost a job or had pay and hours reduced due to automation.
- Baby Boomers are 67% more likely to be drawn to jobs with a high risk of automation than Millennials.
- Globally, there are 3.5 million operating industrial robots as of 2021 — a 17% increase from 2020.

In addition, very important accelerator in the automation is the one child policy in China in the next few decades the shortage of skilled labor will force the automation and robotization to much higher level. The ageing population will increase the need for industrial robots. Structural unemployment is expected to increase, because of the new jobs with very special skills needed and the unemployed lack of matching qualification.

Moreover, among STEM (science, technology, engineering and mathematics) teachers surveyed, 64% had limited access to computer science resources – rising to 79% when focused on AI, according to the Sky News report. Secondary school children were also surveyed – and 33% had only heard of AI from sci-fi films and books [12].

On job loss, AI is considered to have the following effect [10]:

- 30% of jobs in Britain are at risk of being replaced by AI, with 35% of male jobs and 26% of female jobs at high risk.
- 49% of Japan's workforce is estimated to be replaced by AI or robotic machines within 10-20 years.
- By 2025, AI could take over 52% of jobs globally.
- By 2025, AI is expected to replace 16% of American jobs.
- The healthcare industry will see a 20% increase in tasks performed by AI by 2023.
- By 2030, AI could replace 800 million jobs worldwide.
- The healthcare industry will see a 20% increase in tasks performed by AI by 2023.
- 42% of global job displacement due to AI adoption and automation is predicted to occur in China.
- 77% of CEOs surveyed said AI and robotics technologies will lead to a net reduction in jobs.
- 57% of all jobs paying under $20 per hour are at risk of being replaced by AI in the next two decades.
- By 2030, tasks performed by AI and humans will be split almost equally, resulting in 50% of tasks being performed by AI.

It is evident that there would be a significant impact of AI in many industries. Arguably, the most affected personnel would be low and mid ranged jobs which don't require specific knowledge – as aforementioned for less than $20 per hour. Surprisingly, the healthcare industry is considered to be highly affected due to the increased production of smart devices capable of measuring blood pressure, heart rate, sleep monitoring and so on; the rise of telemedicine and the possibilities to have health analysis on variety of parameters without human contact.

In EU the effect is predicted to be significant and for some countries to reach around and more than 50% of human – robot (machine) replacement. See Fig. 2.

The represented countries have lower than average GDP per capita in EU. Moreover, it is clear that the low productivity jobs are more venerable to AI job repayment. Low value-added services are easier to be replaced today by robotics. Highest rank is for Romania with nearly 62% of jobs at risk. Bulgaria is also among the depicted countries with 56.5% of the employment at risk. Most probably it corresponds for the call and support centers who are well represented in the country. It is notable the presence of Spain which is one of the largest countries and has above the average GDP per capita in EU. Their presence here could be due to country's dependence on tourism and corelated services. Some researchers [10] claim that 82% of restaurant positions could be automated, with 51% being server positions, 57% of fast

food and counter workers, and 38% of waiters and waitresses, and 21% of cooking and food prep positions.

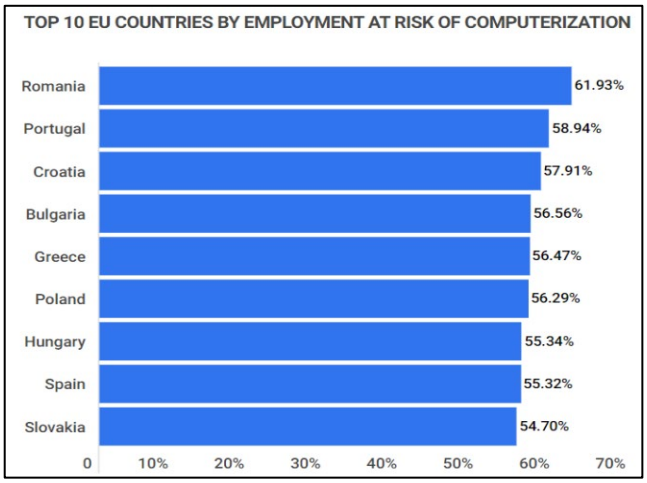

Fig. 2. Jobs at risk from automation in EU

Automation would increase the income gap in the society and between countries. The mass implementation of industry 5.0 will increase the social problem in the society and it will make wealth distribution more unequal. According to a report from the International Monetary Fund (IMF) [13]: "If AI significantly complements higher-income workers, it may lead to a disproportionate increase in their labor income. Moreover, gains in productivity from firms that adopt AI will likely boost capital returns, which may also favor high earners. Both of these phenomena could exacerbate inequality".

On the other hand, the rapid development of automation and AI would lead to the establishment of new jobs and necessary skills for them. Some forecasts [10] claim that 133 million jobs could be created due to AI, compared to 75 million that may be displaced.

Top 10 Jobs of the Future are [10]:

1. Paramedic drone programmer – an AI expert with medical knowledge to 'teach' drones to help emergency rescue teams
2. Smart-assisted sports coach – data and AI skills will help coaches measure player performance and welfare, predict outcomes, and adjust tactics
3. AI speech coach – help voice assistants and visual avatars become more realistic
4. Metaverse architect – create environments and activities to entertain people in the virtual world
5. Zero carbon transport planner – design and programme driverless public transport networks
6. Augmented learning technician – use AI and augmented reality to create state-of-the-art tools for teachers and their lessons
7. Agricultural AI engineer – help farm sustainable foods like synthetic meats and insects at faster and grander scales
8. AI creative skills producer – help creators enhance their music and art by learning popular trends
9. Community care technician – use AI to detect loneliness in the community, alerting care workers to who needs their help the most.
10. Tech fashion designer – create the next-generation of sustainable smart clothing and wearables, like garments that can react and respond to the weather.

It is evident from this list that the upcoming job needs would be mainly in direct link with AI. This would require new skills from the work force and they would need new training and teaching courses. To fill the gap some universities and educational centers should deploy such courses and study programs. However, is can't be sure how many new work places will emerge from this AI revolution. For the moment, the job displacement seems to be stronger and problematic for the governments of countries worldwide.

IV. Conclusion

The proliferation of AI and automation presents both opportunities and challenges for the future of work. The change in some economic branches will more significant than in others, so the job displacement will be stronger. The AI and the robotics are creating completely new sectors so the total effect is too early to be measured. While these technologies hold immense potential to enhance productivity and drive economic growth, the specter of job displacement looms large.

Geographically the impact on labor market will be very different, based on economic development of the selected country. A large number of EU countries would replace human effort with machines by around 50%. Among them are Romania and Bulgaria as the prediction for them is more than 55% job displacement.

The usage of AI fore management decision making will put the management staff in many moral dilemmas.

By prioritizing investments in education, training, and supportive labor market policies, societies can navigate the transition towards an AI-enabled future while mitigating the adverse impacts on displaced workers.

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Acknowledgments (if any) should appear as a separate non-numbered section before the list of references. Use the singular heading even if you have many acknowledgments.

In most cases, sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.

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