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Human Complementation Must Aid Automation to Mitigate Unemployment Effects due to AI Technologies in the Labor Market

AI teknolojilerinin İşgücü Piyasasında Yol Açtığı İşsizlik Etkilerini Azaltmak İçin Otomasyona Yardım Eden İnsanı-Tamamlama Yaklaşımı

Abstract

Artificial intelligence (AI) technologies are spreading into all areas of life much more comprehensively than major technologies of the past. This rapid and extensive spread is leading to the formation of an AI ecosystem in a short period of time. We are now talking about a machine culture beyond human culture. The massive benefits provided by AI technologies have facilitated their rapid spread, but on the other hand, have also led to the neglect of the risks they cause and will cause in the long term. At this point, humanity is at a stage where it can no longer ignore the risks. Since AI technologies deepen inequalities in all areas where they are applied, the benefits they bring are not shared fairly, and are limited to very few groups. Moreover, a strong wave of unemployment is coming, especially in the labor market. Therefore, this study evaluates the potential impacts of AI technologies on employment. We emphasize that humanity is at a crossroads in this context; an automation path that does not prioritize employment will lead to unemployment waves unlike previous technological revolutions. These unemployment waves will have varying adverse effects at individual and societal levels. Individuals with low skills and countries that are industrially underdeveloped and unable to invest in AI technologies will be affected most. Therefore, instead of rapidly progressing towards the path of automation, we emphasize that a human-complementary path, which prioritizes employment and continuously reduces the gap between low- and high-skilled individuals, could mitigate these adverse effects. Thus, we caution that while it is possible to benefit from the automation provided by AI technologies, overall productivity and welfare can increase only by focusing also on reducing skill gaps and creating new job opportunities.

Öz

Yapay zekâ (AI) teknolojileri geçmiş büyük teknolojilerden çok daha hızlı ve kapsamlı bir şekilde yaşamın tüm alanlarına yayılmaktadır. Bu hızlı ve kapsamlı yayılım toplumlarda kısa sürede bir AI ekosisteminin oluşmasına yol açmaktadır. Artık insan kültürünün ötesinde bir makine kültüründen bahsedilmektedir. AI teknolojilerinin sağladığı devasa faydalar bir taraftan hızla yayılmasını sağlamışken diğer taraftan yol açtığı ve uzun vadede yol açacağı risklerin de göz ardı edilmesini sağlamıştır. Ancak, gelinen noktada insanlık riskleri göz ardı edemeyeceği bir aşamadadır. AI teknolojilerinin uygulandığı tüm alanlarda eşitsizlikleri derinleştirdiği, yol açtığı faydaların adil bir şekilde paylaşılmadığı ve çok düşük sayıda gruplarda kümelendiği görülmektedir. Dahası, özellikle işgücü piyasasında çok güçlü bir işsizlik dalgası gelmektedir. Bu nedenle bu çalışmada, AI teknolojilerinin istihdama olası etkileri değerlendirilmektedir. İnsanlığın bu bağlamda bir yol ayrımında bulunduğu, istihdamı öncelemeyen bir otomasyon yolunun daha önceki teknolojik dönüşümlere benzemeyen derin işsizlik dalgalarına yol açacağı vurgulanmaktadır. Elbette, bu derin işsizlik dalgası hem bireysel hem de toplumsal düzeyde farklılaşan etkilere sahip olacaktır. Bu dalgadan özellikle düşük becerilere sahip bireyler ve endüstriyel olarak gelişmemiş ve AI teknolojilerine yatırım yapamayan ülkeler çok daha fazla etkileneceklerdir. Bu nedenle, bu çalışmada otomasyon yoluna hızla ilerlemek yerine, istihdamı öncelikli hale getiren ve düşük ve yüksek becerilere sahip bireyler arasındaki farkı sürekli azaltan bir insanı tamamlayıcı yolun, bu olumsuz etkileri hafifletebileceği vurgulanmaktadır. Ayrıca, AI teknolojileri tarafından sağlanan otomasyondan faydalanmanın mümkün olduğuna, ancak genel üretkenlik ve refahın aynı zamanda beceri farklarını azaltmaya ve yeni iş fırsatları yaratmaya odaklanarak artırılabileceğine işaret edilmektedir.

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Keywords
Artificial intelligence, automation path, human-complimentary path, employment, equality

Anahtar Kelimeler
Yapay zekâ, otomasyon yolu, insan-tamamlayıcı yol, istihdam, eşitlik

Introduction

Artificial intelligence (AI) technology is infiltrating all areas of life with each passing day, and the production and accessibility of generative AI technologies, such as Chat-GPT, have taken this infiltration to a much more comprehensive phase. Initially, AI supported decision-making mechanisms by using big data, but as it developed in this context, it began to be rapidly used in a wide range of areas, from education and health to transportation, logistics, and the defense industry (Acemoğlu and Restrepo, 2018; İlikhan et al., 2024; Özer, 2024a; Perc, Ozer, and Hojnik, 2019). By taking automation to a very different phase, AI technology is increasingly shifting the labor-machine balance in favor of machines, especially in the production and service sectors (Frank et al., 2019; Harari, 2017). An AI ecosystem that encompasses all areas of life is now beginning to form.

The rapid and profound spread of AI technologies in daily life has heightened concerns in societies regarding their intended use, data privacy, and ethical issues, and has made the disadvantages caused by biases more apparent and severe (Silberg and Manyika, 2019; Suleyman, 2023). It has been shown that in applications where these technologies are used for decision-making purposes, such as in justice, health, and education, they pose a risk of producing biased decisions that deepen the disadvantages of the disadvantaged and increase the advantages of the advantaged, based on training data and algorithm modeling assumptions (Aquino, 2023; Özer et al., 2024a; 2024b; Ulnicane and Aden, 2023). In other words, the Matthew effect, summarized by Merton (1968) as the continuous accumulation of advantages leading to new advantages and manifesting in most social domains (Özer, 2024b; Özer, 2023a), has gained a new dimension with AI technologies. For example, when healthcare expenditures are used as a criterion in an AI system to identify patients needing advanced care, it has been shown that non-white individuals, who face difficulties in accessing healthcare, benefit much less from this service compared to whites, even if they have the same health condition (Obermeyer et al., 2019). A similar situation arises in AI systems used to determine the daily patrol areas of police forces. These systems, trained on existing police station data, which predominantly features non-whites, direct police patrols mainly to areas where these groups are located. As a result, more criminals from these groups are caught, and the updated system intensifies the Matthew effect. Consequently, non-whites are punished much more frequently than whites in similar situations (Lum and Isaac, 2016). In summary, if the training data or model assumptions of AI algorithms are biased, the results they produce will also be biased, and the Matthew effect will manifest.

The deepest impact of AI systems is expected in the labor market and, consequently, in education systems. As the use of AI systems becomes widespread in daily life and in the production and service sectors, the skill sets required for various occupations in the labor markets are constantly changing. In this context, some occupations will lose their relevance as their skill sets become obsolete, leading to the disappearance of those jobs, while the skill sets of surviving occupations will undergo dynamic changes (Arntz et al., 2016; Pajarinen et al., 2015). In other words, for labor to remain viable in the job market, it must continuously renew and update itself. While labor undergoes these transformations, optimistic projections suggest that AI systems could compensate for this negative situation by creating new occupations and job positions (Aghion and Howitt, 1990; 1994; Bartelsman et al., 2004). The findings presented in this context, however, appear quite contradictory (Frank et al., 2019). Indeed, Acemoğlu et al. (2023) emphasize that if the main characteristic of AI system development and usage aligns with automation, the transformation in the labor market will develop in favor of machines and against labor. They underline that many new occupations and job positions, as suggested by optimistic projections, may not materialize. They argue that policies should be developed to strengthen the human-complementary path to prevent the increase in unemployment and social unrest that could arise from this situation. Therefore, the future of the labor-machine relationship in the labor market remains highly uncertain (Frank et al., 2019).

On the other hand, while a strong wave in the labor market rapidly transforms occupations and skill sets, education systems are also facing a significant challenge to produce resilient human capital capable of adapting to this uncertain situation. Furthermore, AI technologies like Chat-GPT have triggered significant transformations within the education system itself. Education systems are primarily focusing on discussions to rapidly respond to transformation demands within themselves in order to address this challenge. Simultaneously, they are also heavily engaged in figuring out how to impart new skill sets to individuals in the new circumstances (Chiu, 2023; Grassini, 2023; Lo, 2023; Rudolph et al., 2023; Özer, 2024a).

At this point, there is a need for comprehensive evaluations on how AI technologies will impact the labor market and what measures can be taken to prevent unemployment and social unrest from increasing. Therefore, this study addresses the transformations that AI technologies will bring to labor based on professions. Additionally, attention is drawn to the dangers of the automation path that ignores employment and focuses solely on productivity, and how these negative effects can be mitigated is discussed.

Transformation of the Labor Market

AI technologies are leading to significant transformations in the labor market and thus in the scale and capacity of labor utilization. It has long been known that in major technological transformations, three effects, namely the displacement effect, productivity effect, and job creation effect, occur simultaneously (Bian, 2024; Lane and Saint-Martin, 2021). Accordingly,

in each major technological transformation, while productivity increases (productivity effect) and new occupations and job positions are created in the labor market (job creation effect), many occupations are also eliminated from the labor market (displacement effect). In past major technological transformations, especially two effects, particularly the displacement effect and job creation effect, balanced each other, resulting in minimal social unrest. However, the expectation that AI technologies will lead to a similar situation maintains the uncertainty as to whether these expectations reflect those of past major transformations and whether the same situation will recur. This uncertainty persists because AI technology resembles a very comprehensive and different wave compared to past major transformations (Suleyman, 2023).

The most notable feature of major technological transformations is the disappearance of labor market demands for certain occupations that existed before the transformation (displacement effect). As AI, robots, and automation technologies rapidly advance, machines take over routine and repetitive tasks, leaving individuals performing these tasks in unemployment (Yan, 2024). AI-powered automation not only takes over routine and repetitive tasks but also changes skill demands from other occupations in the newly shaped work environment, triggering a continuous downward trend in wages (Maxmudovich, 2024; Yan, 2024). General assessments regarding the effects of AI technologies on labor markets indicate that low-skilled occupations will be more exposed to robots, medium-skilled occupations will primarily be affected by software, and high-skilled occupations will be most susceptible to AI effects. In this context, it is emphasized that the most significant negative impact of AI on employment will be on white-collar jobs (Bian, 2024; Septiandri et al., 2023).

AI technologies enhance automation, increasing its scope and prevalence, which places occupations susceptible to automation at the forefront of unemployment concerns. The share of jobs susceptible to automation in labor markets actually provides significant clues about the impending wave of unemployment. For example, it is observed that 47% of jobs in the US labor market (Frey and Osborne, 2013) and 55% in the Japanese labor market (David, 2015) are susceptible to automation. In this regard, local markets in Italy, Norway, and the United Kingdom, where robots are concentrated, have experienced significant job losses (Chen and Frey, 2024). Similarly, robots have caused significant employment losses in the United States as well (Acemoglu and Restrepo, 2020). A study examining the impact of industrial robots on employment in six European Union countries showed that an additional robot per thousand workers reduced the employment rate by 0.16-0.20 percentage points (Chiacchio et al., 2018).

On the other hand, AI technologies, especially generative AI technologies, are known to lead to significant improvements in employee performance and can particularly enhance the productivity of low-performing employees, resulting in significant overall productivity improvements. For example, in another experiment conducted using GitHub Copilot, a productive AI-based programming assistant, it was demonstrated that the experimental group with access to Copilot completed programming tasks approximately 56% faster than the control group without access (Peng et al., 2023). In a new study providing the first empirical evidence

of the effects of a productive AI tool, data from 5,179 customer support representatives were used to examine how a productive AI-based chat assistant affected employee performance. It was shown that the AI-based chat assistant increased productivity, measured by the number of issues resolved per hour, by an average of 14% (Brynjolfsson et al., 2023). The study indicates that this rate varies according to skill levels, providing a 34% improvement for novice and low-skilled employees while having minimal impact on experienced and highly skilled employees. Similarly, in another study examining the impact of ChatGPT on writing tasks, while ChatGPT led to significant improvements in the speed and quality of writing output, it was shown that the least skilled writers benefited the most from these improvements (Noy and Zhang, 2023). Other studies have also shown that the use of productive AI allows low-skilled workers to benefit the most, thereby compressing productivity distribution (Choi and Schwarcz, 2023; Dell'Acqua et al., 2023). In short, AI technologies can complement humans by making employees more efficient, supporting them in performing their tasks more effectively, and providing opportunities for them to take on new value-adding tasks (Alam et al., 2024; Korinek, 2023).

Countries that already possess AI technologies and are making large-scale investments to increase their share in the market will benefit maximally from the productivity and job creation effects while being less affected by the negative impacts of the displacement effect. In this context, leading universities worldwide have made significant investments in AI education in recent times, increasing the number of courses at the undergraduate level by 102.9% and at the graduate level by 41.7% (Pitukhina et al., 2024). Furthermore, looking at the race for patents in the AI field provides clues in this regard: In 2021, the companies with the largest number of patents in the AI field were IBM (USA) (1,813), Google (USA) (1,167), Intel (USA) (1,131), Microsoft (USA) (948), Bosch (Germany) (590), Siemens (Germany) (333), Baidu (China) (317), Tencent (China) (306), Huawei (China) (272) (Pitukhina et al., 2024). Studies conducted in this context also show that AI technologies are more concentrated among relatively high-productivity, large, and young firms (Calvino and Fontanelli, 2023; Zolas et al., 2020). Countries and companies of this kind maximize the benefits of the productivity effect offered by this technology and try to advance their economic development further by facilitating the commercialization of patents and focusing on the practical applications of AI technology. For example, China aims to generate an additional $600 billion in economic value by 2030 by investing in AI technologies in four key sectors (medicine, automotive, manufacturing, and software) (Kai et al., 2022; Pitukhina et al., 2024).

Of course, each country is affected differently by this wave depending on the current state and new trends in the labor market (Bian, 2024). For example, in some countries like Spain and Germany, it is observed that the employment losses in the manufacturing sector due to robots are offset by job creation in other sectors (Chen and Frey, 2024). On the other hand, while automation, on one hand, takes over tasks previously performed by low-skilled labor, leading to unemployment for low-skilled workers, on the other hand, the newly created tasks

also directly increase the advantage of high-skilled labor (Acemoglu and Restrepo, 2017). Acemoglu and Restrepo (2020) examined the effects of the spread of robots on skill levels and showed that the negative employment effects are most pronounced, especially in blue-collar jobs and among workers without university education. Skill expectations for newly created jobs due to AI are also constantly rising. For example, AI companies in China typically require a doctoral degree and at least 3 years of experience in the relevant field for most job openings (Pitukhina et al., 2024). On the other hand, many companies not directly related to AI also prefer to employ individuals with AI skills (Bian, 2024).

On the other hand, many countries with low production capacity will be significantly more affected by the displacement effect passively, and in these countries where unemployment rates are already high, this rate will increase even more. These countries do not have the potential to create more jobs than those destroyed by AI technologies (Acemoglu and Johnson, 2023). Additionally, most of the gains from automation will flow to entrepreneurs and capital owners, deepening inequalities (Acemoglu and Restrepo, 2017). In other words, the profits and losses of AI-powered automation are not evenly distributed in this context. While workers with the high skills demanded by the new situation will benefit from wage increases, many workers assessed as having low skills will either lose their jobs or have to accept lower wages (Maxmudovich, 2024; Yan, 2024). Furthermore, displaced workers by AI technology may compete with already existing low-wage workers for lower-paying positions, leading to further wage declines (Acemoglu and Restrepo, 2022).

Globally, considering the recent demographic changes and potential alterations in labor force participation rates between 2010 and 2030, it is estimated that 734 million new jobs will be needed to achieve targeted unemployment rates (Bloom et al., 2018). In this context, the impact of AI on this new number of jobs remains uncertain. On the other hand, some studies highlight that the effects of AI on job positions have been inaccurately calculated. For instance, Atkinson and Wu (2017) argue that many assessments in this regard are flawed. They challenge the finding by Frey and Osborne (2013) that 47% of jobs in the US labor market are susceptible to automation, suggesting instead that only about 10% of jobs in the US market are at risk of automation. Furthermore, Atkinson and Wu (2017) also dispute the methodology of the PricewaterhouseCoopers (2017) report, which predicts that 38% of jobs in the US will disappear by 2030, proposing a focus on productivity increases instead of such concerns. In short, uncertainties persist in determining the impacts of AI technologies on labor markets. Frank et al. (2019) note that both optimistic and pessimistic views regarding the effects of rapid developments in AI technologies on labor markets are incomplete. They associate this inadequacy with a lack of high-quality information about the nature of work, deficiencies in experimental models related to micro-level processes, and modeling shortcomings concerning the relationships between cognitive technologies and economic dynamics and institutional mechanisms.

Human Complementation over Automation

Despite uncertainties persisting regarding the impact of AI technologies on the labor market's labor-machine ratio, it is observed that the uncertainty is more associated with the job creation effect rather than the displacement effect. In other words, the balance of both effects, which Acemoglu and Johnson (2023a) call the virtuous combination of automation of traditional jobs and the creation of new tasks, has been disrupted in favor of automation since the 1970s. In other words, while increasing the scope of automation with AI enhances productivity, the effect of creating new jobs has not occurred at the same level. Furthermore, low-skilled workers have been forced to work in much lower-paying jobs after losing their jobs. Therefore, despite increasing automation with AI, widespread automation has increased productivity and corporate profits in industrialized countries but has not led to socially shared prosperity (Acemoglu and Johnson, 2023a). Therefore, while automation does not lead to socially equitable distribution, its employment effects exacerbate inequality in industrialized countries and are more visible as a destructive effect leading to unemployment in middle- and low-income countries.

At this point, it is evident that AI technology predominantly leads to the displacement of skilled labor through automation (Acemoglu et al., 2023). This is the automation path of AI technology. The reason for preferring automation is not only to increase efficiency and productivity but also to reduce labor (union) opposition (Acemoglu and Johnson, 2023b). This situation, which develops in favor of automation but against equality, has led to the recent proposal of the human complementary path over automation approach to rebalance it based on societal welfare and complementing human deficiencies in this regard (Acemoglu and Johnson, 2023; Acemoglu, Autor, and Johnson, 2023; Capraro et al., 2023).

It is emphasized that the alternative human-complementary path could help reduce economic inequality while preserving productivity growth (Acemoglu et al., 2023). However, given that firms will promote automation over human-complementary technologies if left to their natural course (Acemoglu and Johnson, 2023b), significant responsibilities fall on governments for the implementation of this alternative approach. In this context, it is recommended that governments encourage competition and investment in technologies that match AI with human expertise and provide additional support to determine the appropriateness of using human-complementary technology in publicly funded sectors such as education and healthcare once sufficient progress is made. Tax regulation is suggested to provide incentives for firms prioritizing employment over automation by offering incentives exclusively to firms investing in automation (Acemoglu et al., 2023).

As mentioned in the previous section, ChatGPT can contribute to closing the productivity and quality gap between highly skilled and less skilled workers in many fields. Another important finding from these studies is that novice workers using productive AI tools can reach a level of competence that previously required a long time for workers to achieve (for example, ten months) in a much shorter time (for example, within three months) (Brynjolfsson

et al., 2023). In other words, ChatGPT can significantly reduce the time needed for novices and apprentices to complete their skills. Similar situations apply in the fields of education and healthcare (İlikhan et al., 2024; Özer, 2024a). ChatGPT and other platforms provide personalized learning opportunities for students, allowing them to bridge the gap with their peers. Similarly, most of the teacher's tasks are also accelerated and automated. In all these examples, will the AI technology be allowed to reduce employment in occupations such as workers, writers, teachers, or doctors by subjecting all processes to automation, or will it create new tasks that complement them while benefiting from reducing differences in achievements or access disparities?

To mitigate the effects of unemployment caused by AI technologies in labor markets, measures should be taken to continuously improve labor skills. Otherwise, socioeconomic inequalities in societies will deepen even further. Already, most inequalities in education stem from socioeconomic disparities (Özer, 2023b; Özer, 2023c; Özer et al., 2024b; Suna et al., 2020), and these inequalities deeply affect many aspects of life, from employment to health, in the long term after education. Without intervention, the new situation risks driving societies towards greater sociological inequality and perpetuating these disparities even further through the Matthew Effect.

In this regard, reskilling and upskilling programs will make individuals much more resilient in the dynamic labor market in the long term (Maxmudovich, 2024; Özer and Suna, 2022). Especially, for the relationship between humans and machines to evolve into a comprehensive collaboration, the continuous updating of individuals' skills will not only enhance labor productivity but also support social and economic progress (Yan, 2024). The continuous updating of skills will prevent individuals from gradually transitioning to lower-paid jobs in the long term and increase their resilience.

Discussion

The advantages provided by AI technologies continue to spread across all areas of life. These advantages and conveniences have led to the rapid adoption of these technologies. Thus, from education to healthcare, from finance and consultancy to autonomous vehicles, and from biotechnology to defense industry, a diverse range of fields have facilitated the formation of an AI ecosystem as an integral part of technology. However, a much greater focus on its advantages has made the risks posed by AI technologies much less visible. It is observed that AI technologies will lead to much deeper societal impacts beyond past major technological disruptions. There are numerous threats ahead, from deepening inequalities in wealth distribution and increasing social inequalities, to manipulation of individual preferences, and particularly unpredictable outcomes in the pharmaceutical and biotechnology sectors.

Another significant area where these negative effects are deeply felt is employment. Like previous major technological transformations, many professions are disappearing, unemploy-

ment is increasing, and new skill expectations are emerging from the surviving professions. On the other hand, it is expected that the new professions that will emerge will require much higher skill sets. Therefore, the impact of AI technologies on the labor market varies both at the individual level depending on the skill level and at the country level depending on the capacity to produce AI technologies. What is clear is that both individuals with low skills are likely to face unemployment and there is a high probability of rising unemployment rates in countries with low levels of capacity to produce and own these technologies.

Although previous major technological transformations have compensated for unemployment by creating new jobs, the same expectation from AI technologies may prove to be an empty hope if precautions are not taken. As clearly demonstrated in this study, the current AI ecosystem prioritizes automation over employment. This approach appears more attractive as it not only enhances efficiency but also reduces the influence of labor unions. However, proceeding along this path will inevitably lead to the destructive social impact of increased unemployment. Therefore, humanity is at a crossroads: the path of automation or the human-complimentary path. The consequences of continuing along the automation path can now be predicted with relative certainty. The problematic path of achieving a more equitable distribution of emerging prosperity and alleviating inequalities requires the human-complimentary path. Thus, while it may be possible to benefit from the advantages of automation in a balanced manner, supporting and developing human skills continuously with AI technologies can also be achieved. This approach, particularly by reducing the gap between low-skilled and high-skilled individuals, can contribute to overall productivity and thus the creation of new job opportunities.

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