# The Impact of Artificial Intelligence on the Labour Market*

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*Technological progress and economic growth have gone hand in hand in past centuries, necessitating the continuous adaptation of labour markets. Historically, labour markets have demonstrated considerable adaptability to changes in the economic structure, leading to significant productivity gains. Today, however, most analyses agree that by the end of the decade, around 20 per cent of jobs in developed countries are projected to be affected by the spread of artificial intelligence and automation, and in Hungary this could affect nearly 1 million jobs. The use of new technologies may eliminate some jobs, create new ones and contribute to productivity gains mainly by complementing existing work processes.*

## 1. Introduction

In recent times, we have witnessed the rapid development of artificial intelligence (AI). In the future, technology is expected to develop even faster and with an even greater impact, which could radically reshape labour market dynamics (*Acemoglu – Restrepo 2018*). In parallel with the development of AI, demographic trends in the developed world may also exert a significant impact on the labour market. In countries with ageing populations, demographic changes increase global labour shortages and labour market tightness, posing further challenges to companies and governments alike. In this context, the spread of artificial intelligence offers new opportunities in the labour market; on the other hand, it also poses challenges. Automation and robotisation through AI may make work processes more efficient and alleviate labour shortages, but may also lead to job losses, labour market restructuring and increased frictions. In this context of ageing societies and global labour shortages, it is worth examining how companies and individuals adapt to the changes brought about by AI. Grasping the opportunities offered by AI is essential for competitiveness and sustainable development. This article aims to provide an overview of the impact of artificial intelligence on the labour market, in particular, with regard to fears about labour shortages and possible job losses.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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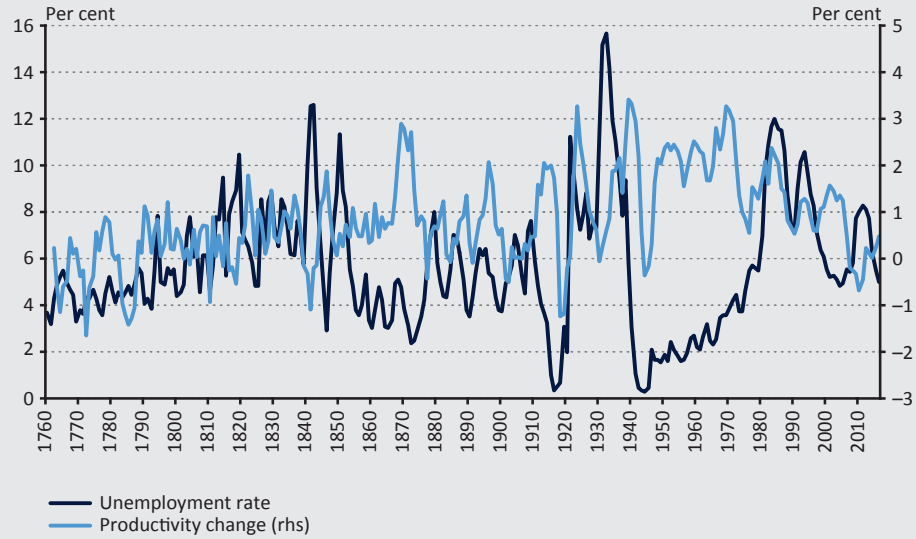
## 2. Historical experiences

Technological and economic development go hand in hand, with the former playing a vital role in driving innovation, productivity and prosperity. However, the question arises as to what impact this has on labour market dynamics and balances. Thanks to continuous progress in science, our environment is also constantly changing, with countless innovative inventions appearing in our lives, creating new markets and jobs, while displacing and transforming existing ones. The first industrial revolution dates back to the second half of the 18th century. Its main achievement was that steam power replaced human power for the first time in history. The late 19th and early 20th centuries saw the second industrial revolution, driven by mass production and electricity. The third industrial revolution has been linked to electronics and information and communication technologies (ICT) since the 1970s. We now live in the age of the fourth industrial revolution, driven by digitalisation. This will be followed by the fifth industrial revolution, with artificial intelligence playing a central role (*MNB 2018*).

Historical experience suggests that industrial revolutions did not lead to mass job losses, but rather transformed the way in which work is done and tasks are performed (*Acemoglu – Restrepo 2020a*) (*Figure 1*). New technologies can often create entirely new industries and jobs, while making existing processes more efficient and thus improving productivity. However, in transitional periods at the beginning of industrial revolutions, workers were likely to experience increased uncertainty and fear of losing their jobs. In addition, the access to and benefits from the results of technological progress are not evenly distributed across different sections of the society and different sectors of the economy. While productivity typically starts to increase immediately after the adoption of a new technology, real wage growth tends to lag behind, and thus initially it is mainly the owners of the technology who feel the improvement (*Allen 2009*). This leads to a temporary imbalance in the capital-labour income distribution in favour of the capitalists. This section focuses on providing an overview of the impact of major technological shocks on the labour market by observing the historical experience of previous industrial revolutions.

**Figure 1**
**Annual change in productivity and unemployment rates in the UK**




*Note: 5-year moving averages for productivity.*

*Source: FRED (https://fred.stlouisfed.org/series/UNRTUKA and https://fred.stlouisfed.org/series/TFPGUKA, accessed 12 March 2024)*

In the first and second industrial revolutions, innovation initially led to a rise in capital returns, while it was only later that productivity growth resulted in an increase in real wages. The wave of automation that started in the 1970s also reduced the share of wages in GDP, the wage share, and changed the distribution of labour income (*Acemoglu 1998*). Labour market demand for highly skilled workers rose significantly, while the relative position of mid-skilled workers deteriorated.

Since the start of the third industrial revolution, the labour market structure in developed countries has also undergone significant changes (*Acemoglu – Autor 2011*). Losers in the process have been mid-skilled workers, while the share of jobs requiring high- and low-skilled labour has risen. The mid-skilled labour replaced by automation can either be retrained so that they can take higher-skilled jobs or agree to take lower-skilled jobs. This phenomenon is called the U-curve by skill levels by *Autor and Dorn* (*2013*), which plots the increase in income inequality through changes in the skills structure.

Automation has been achieved largely through robotisation, which refers to technological processes that aim to automate human work processes using physical robots and software. When robotisation is coupled with artificial intelligence,

automated systems become much more intelligent and flexible, and thus capable of performing more complex tasks (*Perez et al. 2018*). The practical applications of robots so far show a mixed picture of their impact on the labour market. *Bonfiglioli et al.* (*2020*) summarised the experience of robotisation so far, based on French companies: the use of robots increases labour demand in the short term, but reduces it in the longer term. The reduction in labour demand observed in the longer term is due mainly to indirect effects, as firms that successfully implement robotisation increase their efficiency, which allows them to crowd out their less efficient rivals. Looking at the US labour market, *Acemoglu – Restrepo* (*2020b*) find that robotisation reduces employment and wages to a small extent. The robotisation of the US labour market is relatively low, and thus the impact on jobs is considered to be relatively low for the time being, but this could change rapidly in the future. *Kawaguchi et al.* (*2021*) show that in Japan, a 1-per cent increase in robotisation raises employment by 0.28 per cent, due to a competitive advantage following a price decline. It is important to highlight that the Japanese experience may differ significantly from what has been observed in other countries, because the Japanese labour market is in a unique situation: it was the first country to have a high uptake of industrial robots, a rapid fall in population makes labour shortages a particularly sensitive issue and the highly export-oriented nature of the Japanese economy may also help to accelerate the spread of robots.

## 3. The impact of artificial intelligence on the labour market

The rapid development and innovation in artificial intelligence has generated new research and societal debates around understanding the social, economic and ethical implications of the technology. Researchers differ on how AI will evolve, especially compared to human intelligence.

### 3.1. The international impact of artificial intelligence and automation

According to one assessment, the human brain's ability to solve increasingly complex tasks is limitless: just as every technological change since the industrial revolution has shifted human labour from automated tasks to more complex ones, so too will the evolution of AI. The other side views the human brain as a computer-like entity that sees even the most complex human manifestations (such as emotions, creativity, intuition) as some kind of computational result. If this is true, then the complexity of the tasks that the human brain can perform is finite. *Korinek* (*2023*) outlined three scenarios for the future impact of AI. The first is that the development of AI will boost productivity and create new jobs. In the second scenario, Artificial General Intelligence (AGI), which can perform all of the cognitive tasks that humans can, may emerge within 20 years, fundamentally changing the world of work and significantly reducing the role of the traditional labour force.

In the third, most radical scenario, AGI may emerge in up to five years, causing drastic economic and social restructuring. Given the wide divergence of the three pathways, Korinek proposes an adaptive policy framework that can accommodate and respond appropriately to future developments, which are still uncertain. The Fed expects the spread of artificial intelligence to result in a permanent decline in the wage share (*Drozd – Tavares 2024*). Their research suggests that the share of labour in national income production will fall, which could lead to increased inequalities and social tensions.

The impact of the widespread adoption of AI in the workplace may depend on three factors. Firstly, the elasticity of capital and labour supply, which is significantly affected by the heterogeneity of these two factors. According to *Ernst et al.* (*2019*), the more homogeneous an input is, the more elastic its supply will be, and thus the less able it will be to achieve high returns. In terms of the labour market, skilled workers are less flexible than unskilled ones, which is why they also have a wage premium. The second important factor is the substitution elasticity between capital and labour: the higher the elasticity is, the more it can reduce labour market demand when new technologies are introduced. Past technological innovations typically served as a complement to skilled labour, further increasing job polarisation and wage premiums. In the case of AI, however, the complementarity between capital and skilled labour is likely to be smaller, as AI can increase the productivity of low-skilled labour. At the same time, some AI-based applications may replace tasks performed by mid- and high-skilled workers, which, in turn, may lead to reduction in the wage premium for skilled workers. The third factor is whether investment in AI will raise the productivity of capital without a substantial change in output, which would imply a reduction in the labour share, or whether it will raise overall output to a higher level without crowding out labour force. In the latter case, productivity gains could create more jobs with higher wages, but the impact on the wage premium would still be uncertain. The impact of labour-saving technological changes on labour demand also depends on the price elasticity of the goods and services to be automated: if automation takes place in sectors with high unmet demand (mainly services), price elasticity may be high, and prices reduced by automation lead to a strong increase in demand, which compensates for the substitution effect. Taken together, these three factors paint a rather positive picture of the impact of AI on jobs and wages, but the specific effects are very difficult to predict (*Ernst et al. 2019*; *Acemoglu – Restrepo 2018*).

*Autor* (*2024*) anticipates the spread of artificial intelligence to rectify the unequal income distribution resulting from the aforementioned third industrial revolution. He argues that the spread of AI can reduce social inequalities and help to make mid-skill occupations more efficient and rebuild the middle classes. Artificial intelligence can help by making it much easier to access important information

and filter out unnecessary information, something that until now only professionals have been able to do. Autor shares the view of *Varian* (*2020*) that labour will run out earlier than jobs will and that the primary challenge is to alleviate the growing labour shortages expected to emerge in the developed world, which the spread of artificial intelligence can help to address. *Brynjolfsson et al.* (*2018*) expect similar positive effects from AI, stressing that there are very few professions that can be fully replaced by AI, which can perform complementary functions, thus improving productivity. However, productivity can increase differentially, with less experienced and less skilled workers growing more dynamically than more experienced and skilled workers (*Brynjolfsson et al. 2023*). This could lead to both an upward mobility of groups disadvantaged by past technological changes and diminishing the wage premium of those with higher skills.

When analysing the impact of robotisation and AI on the labour market, it is worth pointing out that (to varying degrees) nearly all jobs include easily replaceable routine tasks and specialised tasks that are more difficult to replace. *Autor et al.* (*2003*) define cognitive and manual tasks that can be performed in a limited and strongly simplified context as routine tasks. By contrast, they define situations where machines are used to supplement problem solving and complex communication sessions as non-routine tasks. Jobs exposed to higher risks cannot be grouped along the physical-mental axis, as in both cases there are both routine and non-routine tasks. According to *Deloitte* (*2023*), routine physical jobs include, for example, factory work or transport, where a significant part of the activities can be replaced by non-human labour; as a result, there is likely to be lower demand for such workers in the future, but their productivity can be significantly positively affected by AI as an additional tool. Unlike these jobs, manual workers who perform more complex tasks, such as plumbers, chefs or electricians, are much harder to replace. Regarding white collar jobs, administrative, customer service and simple programming jobs, among others, have a higher share of routine tasks and are expected to suffer the largest employment losses. For jobs with humans as their focus (e.g. psychologists, social workers) and those requiring strategic thinking (e.g. consultants), the risk of automation is much lower, while for creative and analytical jobs, AI is both a threat and a new tool that significantly increases possibilities.

### 3.2. Where are we in the transformation of labour markets?

The rapid spread of artificial intelligence has had a significant impact on labour markets in recent years, and been the subject of in-depth analyses by a number of institutions. The *OECD* (*2023*) has found that administrative and highly skilled white-collar jobs are most exposed to the effects of AI, while blue-collar jobs are more susceptible to automation. Analyses reveal that employers prefer training to redundancies, as the use of AI contributes to increased productivity. Workers reported that the use of AI tools had improved performance significantly, especially

when tasks were performed under algorithmic management. Generative artificial intelligence has transformed the structure of automation potential and has an increasingly large impact on knowledge-based jobs with low risk of automation. Historically, it was the simple physical and routine administrative tasks that were most affected; recently, however, automation potential of management, decision-making and creative tasks has grown significantly. According to *McKinsey* (*2023*), the highest increase in automation potential has been observed for high-skilled workers, while increase has been smaller for low-skilled workers, which narrows the educational gap.

According to the *World Economic Forum* (*WEF 2023*), 83 million jobs could be displaced between 2023 and 2027, while 69 million new ones could be created. Declines are mainly expected in personal services and administration, while the IT and technology sectors are expected to expand significantly. Generative AI technologies have a particular impact on office jobs, where there are typically more women than men. The analysis also found that labour markets in higher-income countries were the most affected, where the biggest technological gains were also expected. The IMF estimates that AI may affect nearly 40 per cent of the global workforce (*Cazzaniga et al. 2024*). Developed countries, where the transformation brought about by automation and AI is more pronounced, are hit particularly heavily. Conversely, in low-income countries, the lack of digital infrastructure and skilled labour limits the use of AI, which may further widen inequalities between countries. Developed economies need to establish regulatory frameworks to ensure the safe and responsible use of AI, while less developed countries need to focus on developing digital infrastructure and education.

## 4. The impact of artificial intelligence on the Hungarian labour market

Naturally, artificial intelligence will also affect the Hungarian labour market. For these effects to be analysed, it is necessary to understand the current structure and the future evolution of the labour market.

### 4.1. The impact of demography

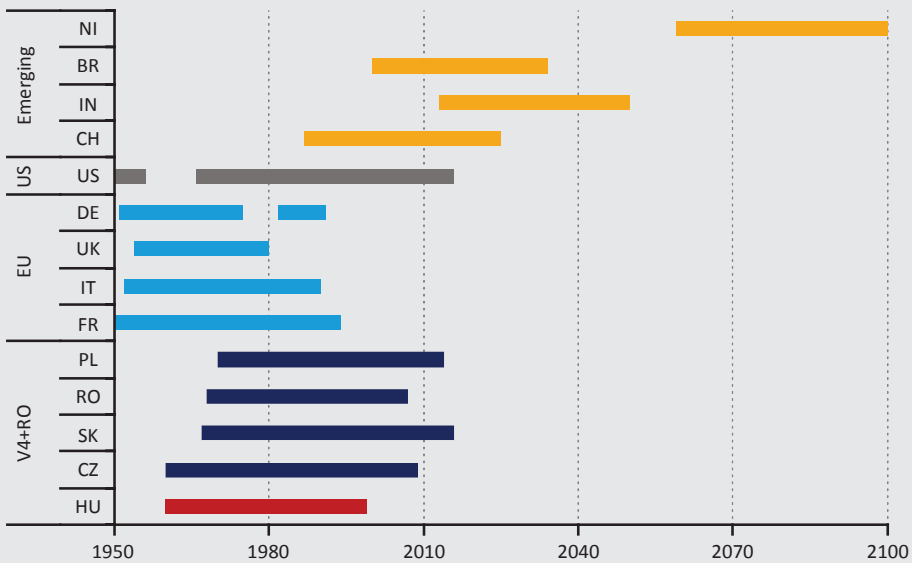
Like most countries in the developed world, Hungary is also affected by an ageing population and a decline in working age population. According to Eurostat's population projections, the natural decrease in the 15–74 age group in Hungary could be close to 300,000 by the end of the decade. The challenge is further exacerbated by the fact that the largest population decline is expected in the prime working age group (25–54 years of age) (*MNB 2024*). The OECD also predicts that[1] demographic constraints will be increasingly present and felt, which may limit future

[1] Old-age dependency ratio. https://data.oecd.org/pop/old-age-dependency-ratio.htm. Downloaded on 24 January 2024

employment growth. As society ages, the number of people leaving working age exceeds the number of those entering it. In developed and emerging societies, old-age dependency ratios are projected to climb at an accelerating pace until 2050.

Economic history has shown that the evolution of population size can have a profound impact on a country's economic prospects. When the proportion of people under 15 in a country's population falls to below 30 per cent and the proportion of people aged 65 and over is below 15 per cent, it is called a 'Demographic window of opportunity' or 'window of opportunity' (*UN 2004*) (*Figure 2*). In such a period, a country's economy can grow very dynamically thanks to the high proportion of the working age population. This window closed for most developed countries and for Hungary around the turn of the millennium; however, it may be an advantage for African countries and some Asian countries with a younger population (e.g. India) (*MNB 2018*). With the 'window' closed, most countries are now facing the problems of an ageing society, most notably, labour shortages.

**Figure 2**
**Demographic window of opportunity in some countries**




*Note: V4: Czechia, Hungary, Poland and Slovakia*

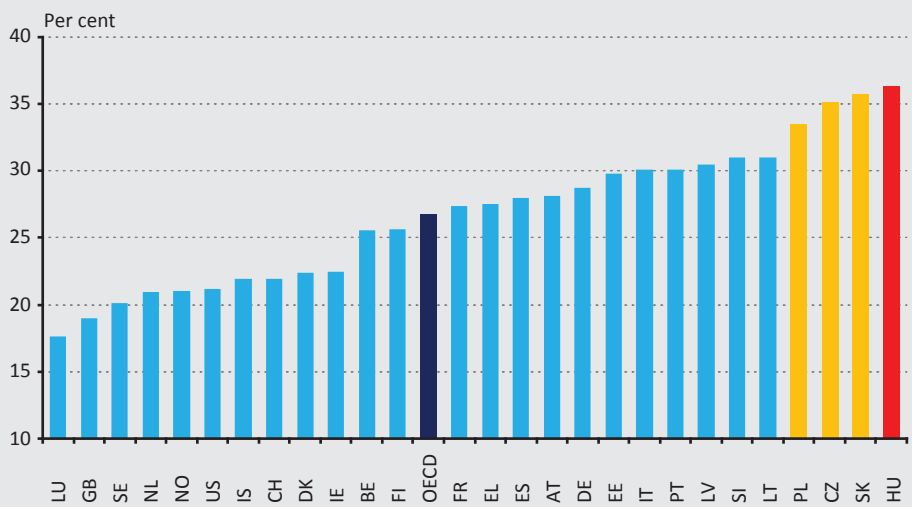
*Source: based on UN World Population Prospects 2024 (https://population.un.org/wpp/, downloaded 5 April 2024)*

Given the shrinking working-age population, AI and robotisation may even alleviate increasing labour market tightness and ease labour shortages. In Hungary, it has become increasingly difficult for companies to fill vacancies since the mid-2010s (*MNB 2023*).

### 4.2. The structure of the Hungarian labour market and the skills of workers

The *OECD* (*2023*) estimates that 36.4 per cent of those employed in Hungary's manufacturing sector have a job with a high risk of automation, the highest among the OECD countries (*Figure 3*). Such large-scale transformation requires changes at the highest level, without which AI will not increase productivity. It is also important to underline that updating definitions and revising jobs should not be a one-off occurrence, but rather a continuous one. This process is also time-consuming for employees, and it is unlikely that all employees will be able to adapt; as a result, the likelihood of displacement will be high for many. According to the *OECD* (*2023*), elderly and low-skilled workers may face the greatest difficulties in adapting, while opportunities for workers with disabilities could improve significantly. According to *Szalavetz* (*2019*), the impact of AI on productivity has not been significant so far, because we are still in the early stages of the megatrend when it is often only inputs that increase; outputs are expected to catch up later. *Szalavetz – Somosi* (*2019*) point out that robotisation and artificial intelligence can significantly reduce production costs, thus impairing the competitiveness of low-cost labour.

**Figure 3**
**Share of employment in occupations at high risk of automation by country**




*Source: OECD (2023)*

According to a study by *PwC* (*2019*), up to 900,000 jobs in Hungary may be affected by changes related to artificial intelligence by the mid-2030s. The analysis highlights the high number of jobs affected due to the structure of the Hungarian economy. The wave of automation affects mainly routine tasks, which account for a large part of the work performed in factories in Hungary. Most of the potential job losses (more than 380,000 jobs) are in manufacturing, while another 100,000 jobs could be affected in both transport and construction. These three sectors are responsible for almost one-third of domestic employment, but they account for nearly two-thirds of the jobs that could potentially be replaced. The study assumes that automation may come in three different waves, with a gradual increase in impact:

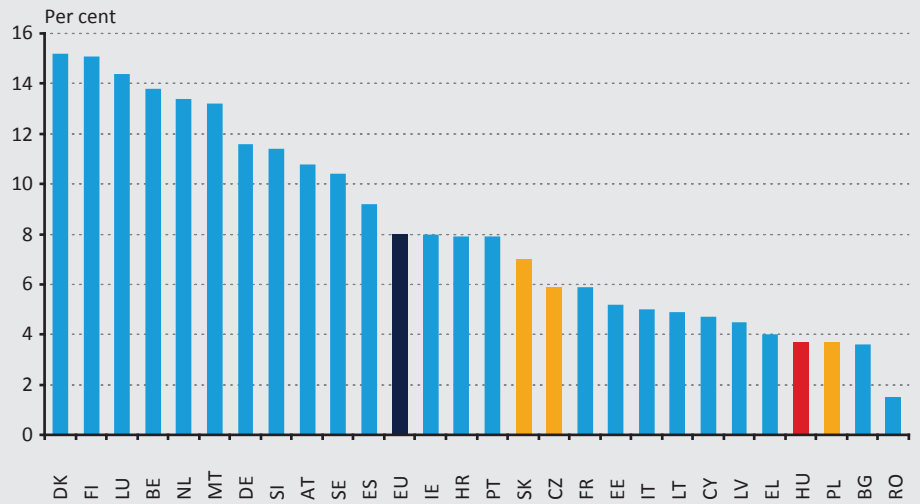
- The first (algorithmic) wave was expected to arrive in the early 2020s, threatening 45,000 jobs, mostly in education and healthcare.
- The second (additional) wave is expected in the mid-2020s, affecting more than 230,000 jobs, mainly in retail and community services.
- The third and most significant (autonomous) wave is expected in the 2030s, potentially threatening more than 640,000 jobs, mostly in manufacturing, transport and construction.

*McKinsey's* (*2018*) analysis predicts an even greater impact, with up to 1 million Hungarian jobs exposed to AI by 2030. However, it is labour shortages that cause problems in the Hungarian economy, which automation can help solve. This process can accelerate productivity by up to 0.8–1.4 per cent a year, depending on the extent and effectiveness of adaptation. The role of education and reskilling is stressed as essential to adapt to new technologies and to dispel fears.

Advanced IT skills are essential for both workers and companies to harness the potential of modern technologies to unlock AI-driven productivity gains. According to the *European Commission's* (*2023*) analysis on digitalisation, less than half of the Hungarian population has at least basic digital skills. Domestic companies also lag far behind in the use of AI, Big Data and cloud services. Only 4 per cent of Hungarian firms use AI, which is less than half the EU average (8 per cent) (*Figure 4*). The upskilling of workers is essential to catch up with the rest of the EU, but Hungary has a low participation rate in such activities (*OECD 2023*). The National Digitalisation Strategy 2022–2030[2] aims to improve this situation, with the key objective of placing Hungary among the top 10 best performing countries in the EU in the field of digitalisation by the end of the decade. To achieve this, progress is to be made in four priority categories: digital infrastructure, digital skills, the digital economy and the digital state. The targets set include raising the share of people with tertiary-level IT qualifications to over 10 per cent by 2030, thus improving the country's competitiveness.

[2] https://kormany.hu/dokumentumtar/nemzeti-digitalizacios-strategia-2022-2030

**Figure 4**
**Share of companies using AI in the European Union (2023)**




*Source: European Commission (DESI) (https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi/charts, accessed 28 March 2024)*

The strategy notes that, according to Artificial Intelligence Coalition estimates, up to 900,000 Hungarian jobs could be affected by the spread of AI-based technologies by 2030, meaning nearly one in four Hungarian workers. At the same time, the strategy emphasises that ideally AI can complement rather than replace human labour; however, to that end the continuous retraining and upskilling of the labour force is essential. AI education is therefore a priority of the strategy. Preparation should start at the level of public education, through awareness-raising materials and competitions, and with the widest possible involvement of teachers, who have a key role to play. In higher education, it is particularly important to integrate AI into courses and to adopt models that already work abroad. The strategy aims to reach out to 1 million people by the end of the decade. With properly skilled labour, labour productivity gains from AI adaptation could reach up to 40 per cent by 2030. As regards high-skilled labour, it is of particular importance to increase the share of data and AI specialists, while preventing low-skilled workers from sliding down the social ladder. For the latter, it is also particularly important to acquire basic competences, which can be facilitated significantly if manuals accompanying the tools are translated into Hungarian.

## 5. Conclusions

Artificial intelligence is expected to reshape the way we think about work and influence the development of labour markets. Experience so far shows that the labour market has always been able to adapt to technological changes, but training and retraining to meet the challenges of the new era is always key. In my paper, I have pointed out that as Hungary is a small, export-oriented economy with a high proportion of workers in the manufacturing sector, it is likely to be affected by the changes, and these challenges are particularly significant in terms of both the risk of job losses and the preservation of competitiveness. In order for labour markets to adapt successfully to the changes already caused by artificial intelligence and automation and to those expected to materialise in the future, training programmes are essential to equip workers and future generations with the skills and competences that a new economic environment requires. Equally important is the creation of a regulatory framework that helps to ensure that the risks from the changes brought about by technological progress do not lead to the increased vulnerability of workers and excessive social inequalities. Taking the right measures and preparing for the changes may enable the labour market and society to remain a winner of the technological progress, and artificial intelligence to increase productivity and overall contribute to job creation, while transforming the labour market.

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