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Policy Brief

Robotics and Artificial Intelligence: A New Economic Order*

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Key Messages:

- Various technological advancements have revolutionised business operations and transformed how people live and work.
- These advancements serve as catalysts for increased efficiency, precision, and reliability in manufacturing and trade-related activities.
- The heterogeneous effects of automation and artificial intelligence on the labour market focus on the distinction between high-skilled workers, who enhance their productivity as industrial robots take over, and low-skilled workers, whose manual tasks are supplanted by these robots.

Various technological advancements have revolutionised how businesses operate and how people live and work. In recent years, significant advancements have occurred regarding industrial robotics and artificial intelligence (AI). The adoption of robotics and AI positively impacts productivity at both firm and national levels through increased precision and cost efficiency. While these technologies have the potential to substantially enhance productivity and to facilitate trade in goods and services, this paper also looks at the research on their impact on workers, wages, and economic welfare. Indeed, the extensive and uneven effects of robotics and AI on different skill sets have become a focus of economic research, which has explored how these technologies may yield outcomes that differ markedly from previous technological advancements. The research shows that adoption of robotics and AI does facilitate trade in goods and services, but their impact on the labour market, employment, and wages depends on the preparedness of both governments and the workforce to embrace cutting-edge technologies, including AI and super AI.

In the last 3 centuries, numerous technological advancements have occurred that have revolutionised production methods, how business organisations operate, and how individuals live and work. In recent times, significant advancements have been witnessed in industrial robotics and artificial intelligence (AI). Industrial robotics and AI are revolutionising production and transforming industries, much like past innovations such as the steam engine and digital computer.

George Devol, credited as the 'grandfather of robotics', invented the first industrial robot in the 1950s, with the Unimate debuting at a United States (US) General Motors plant in 1961. Unimate automated hazardous tasks, improving efficiency and safety on the automotive assembly line. Devol, alongside Joseph Engelberger, later founded Unimation, the world's first robot manufacturing company, establishing the foundation for today's AI-driven robotics. By 1967, Unimate robots – which were manufactured in Japan by Kawasaki – were exported internationally, used in Swedish die-casting and handling various hazardous tasks across Europe and Asia (Wallen, 2008; Gasparetto and Scalera, 2019). German and Japanese firms installed robots for automated welding and handling in manufacturing, with early models replacing multiple workers and offering safer, cleaner alternatives (McMorris, 2019; Flamm, 1986).[1] Following Japan, other emerging economies began adopting industrial robots; South Korea's Hyundai

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1 Kawasaki Robotics, From the Birth of Industrial Robots in the United States to Their Launch in Japan, https://robotics.kawasaki.com/en1/anniversary/history/history_01.html

Motor Company and Taiwan's electronics sector integrated them into production by the mid-1980s (Sung, 2004; Flamm, 1986).

By 2019, global robot installations had doubled from 2012, with 373,240 new installations and a stock reaching 2.7 million. China and Japan were the leading adopters, driving nearly two-thirds of this growth between 2012 and 2019 (Zhang et al., 2021). Automotive and electronics sectors accounted for the most robot usage, while falling prices and improved functionality contributed to rising global adoption. Indeed, average robot costs dropped over 60% from 2005 to 2017 (Ark Invest, 2021).

AI research began in 1956, defining AI as non-human systems that interact with their environment to achieve specific goals. The US Department of Defense heavily funded AI from the 1960s, leading to the establishment of several global research laboratories. Modern advances, especially in machine learning and neural networks, have significantly enhanced AI's predictive abilities at lower costs (Agrawal, Gans, Goldfarb, 2019; Taddy, 2018). AI-driven robots now perform complex tasks with improved sensory functions and human-like problem-solving skills. From 2015 to 2020, global investment in AI surged, with the US and China emerging as leaders. AI-related hiring also grew rapidly in countries like Brazil, Canada, and India between 2016 and 2020 (Zhang et al., 2021).

As a result, technological advances, particularly regarding industrial robotics using AI, are driving economic growth by enhancing the productivity, safety, and quality of goods and services. However, these advancements can lead to job displacement and wage declines for workers whose tasks are more efficiently performed by robots, resulting in increased income inequality and concerns over privacy.

Thus, the effects of robotics and AI on different skills levels has made them critical subjects for economic research, as they may impact income distribution and worker welfare differently than past technological changes. Research has noted, however, two potential benefits of robotics and AI. First, technological advancements are cost-effective in terms of production and operational costs, as they can help companies perform complex tasks faster and with greater precision and accuracy than humans. Second, robotics and AI help markets operate efficiently by learning consumer preferences and allocating goods and services to where they are needed to improve availability and to enhance efficiency in logistics and delivery.

Artuc et al. (2022) analysed the impact of industrial robots in developed countries on their trade participation as well as on the trade patterns of developing countries. They found that a decline in the price of robotics increased the installation amount of robotics in developed countries. Other findings indicated that the sectors with the highest robotisation experienced a surge in exports from developing to developed countries. They concluded that developing country firms are more likely to adopt robotics when they are larger and globally connected; when they do, they capture a greater market share, resulting in a decreased market share for the firms that do not automate.

Ing and Zhang (2022) examined the impacts of automation on firms in Indonesia, using detailed product-level data from 2008 to 2012. Over a 5-year period, Indonesian firms that embraced automation saw greater output, increased employment, higher export shares, and higher-quality goods. According to the heterogenous firm model used, firms that were more productive automated a greater number of tasks, produced better-quality goods, earned higher revenue, and hired more employees. In the case of Indonesia's manufacturing study survey, the adoption of automatic machines increased labour productivity by 49% compared to those that did not adopt automatic machines.

Sun and Trefler (2022) examined merged data on international downloads of smartphone apps from 2014 to 2020, along with AI patents held by the app's parent company, to study trade in mobile apps. Findings suggested that increased AI deployment induced a sixfold increase in downloads at the importer-exporter level, categorised by app type and year. Additionally, greater AI deployment led to higher levels of creative destruction and gains from trade. They thus determined that adoption of robotics and AI facilitates trade in goods and services. In developed countries, the adoption of robotics and AI would increase exports from developing countries, with a 10% increase in robot density in developed countries associated with a 12% increase in exports from developing countries.

The research has also shown that the impact of robotics and AI on the labour market, employment, and wages hinges on the preparedness of both the government and its workforce to embrace digitalisation. Central to this readiness is the quality of the workforce and its proficiency in digital skills. Moreover, heterogenous effects of automation and AI on the labour market centre on the distinction between high-skilled workers, who are able to leverage their productivity as industrial robotics take over, and low-skilled workers, whose manual tasks are taken over by industrial robotics.

However, findings on the net effects of continued and increased use of industrial robotics and AI on labour market segments remain inconclusive, and there is minor disagreement on the distributional implications.

Aghion et al. (2022) presented two contrasting views – a pessimistic view that robotics primarily replace labour, and an optimistic view that firms that install robotics become more productive and can expand their market shares, which translates into decreased prices and increased employment. They noted that despite mixed evidence, recent studies have indicated a more optimistic view on automation using firm-level data. Previous work by Aghion et al. using firm-level data from France indicated a positive effect of automation on employment at the industry level as well.

Faia et al. (2022) illustrated that automation creates increased worker specialisation; workers must possess particular skills, which include specialised knowledge in core competencies as 'core-biased technological change'. Using data on European occupations and industries from 1995 to 2010, they found that automation increased skills concentration, which led to longer unemployment periods for displaced workers but reduced the educational mismatch between firms and workers. Selectivity was more pronounced in industries that are highly offshorable.

Furusawa, Kusaka, and Sugita (2022)studied how improvements in industrial robotics affect wages and the labour market. They treated advancements in AI as a substitute for high-skilled labour in conceptual tasks, while industrial robotics substituted for low-skilled workers regarding manual tasks. A quantitative general equilibrium model was used of task-based production in 17 industries and 50 countries that featured input-output relationships and global value chains. They found that robotic technology advancements played a role in decreasing the wages of unskilled labour in some countries; however, impacts on the labour market were modest compared to the effects on declining trade costs.

Policy Recommendations

Policy recommendations to further advance robotics and AI are as follows:

Enhance robotics and AI development. Advancements in robotics and AI should be welcomed, but human-centric developments should be upheld to ensure human welfare is improved in the process. In the era of digital transformation, embracing the development of robotics and AI across key economic sectors, particularly those with a high multiplier effect on the economy, is imperative for enhancing overall productivity. Through these efforts, businesses can achieve significant gains in efficiency while streamlining their operations and fostering innovation. Thus, it is important at both private and public levels to embrace the adoption and development of digital technologies.

Focus on skilling, reskilling, and upskilling. The impacts of industrial robotics and AI do lead to increased productivity and cost reduction. While it appears that these technologies do replace lower-skilled labour in specific tasks, the resulting increase in productivity and subsequent expansion of output counterbalance the direct adverse impacts on these workers with lower wages. Thus, it is imperative to develop human capital through skilling, reskilling, and upskilling the workforce with the digital skills necessary for workers to transition smoothly into complex work that is not easily automated. Proficiency in digital skills can offer substantial advantages, including enhanced access to employment prospects, higher wages, and better social outcomes.

Increase international cooperation on robotics and AI. Countries must put coordinated efforts forwards to advance robotics and AI through international collaboration. Multilateral cooperation between countries is vital, as it can accelerate the development and deployment of robotics and AI through pooling resources and expertise in digitalisation. Through cooperation amongst governments, researchers, and developers, countries can capitalise on economies of scale and utilise comparative advantages for shared benefits and growth in their countries' digital economy.

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