
THE IMPACT OF ARTIFICIAL INTELLIGENCE ON ECONOMIC GROWTH

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Abstract: *This paper studies the impact of artificial intelligence (AI) on economic growth through key microeconomic aggregates in both the short and long run. The macroeconomic variables of this study include GDP, Consumption and Investment. The study adopted multi-sector models to chart the economic effects of AI. The study followed an endogenous economic growth framework that starts with the basic Cobb-Douglas function. AI is a general-purpose technology that improves productivity growth. AI adoption raises aggregate output, consumption and investment. The successful adoption and integration of AI technologies need adequate infrastructure, data availability and supportive policies which vary across different economies. Government should make public policy on AI to encourage firms and households to adopt AI and focus on sectors of the economy that produce consumption goods as they promise high returns.*

Keywords: *Artificial Intelligence, Economic Growth, Consumption, Investment and Employment.*

Introduction

The advent of artificial intelligence (AI) systems such as digital personal assistants (e.g. Apple's Siri and Amazon's Alexa), robots, and other AI-enabled devices have become very popular and essential part of everyday life. With the emergence of AI, the technological revolution has transformed human lives and processes, empowering the products and services in today's market place. AI introduces new ways of doing jobs and business, and of exploring new global market opportunities. AI is a new "digital mythology" raising both hopes and fears. The progress of AI gives hope for a revival of consumption, a growth in productivity in most professions and better risk management.

AI is considered to be one of the driving forces behind the revolution in technologies, organizations and society at the start of the 21st century. The concept of AI was born in 1950 with the Turing test, which is a test designed by Mathematician and Cryptologist Alan Turing, aimed at measuring the ability of an AI to imitate a human conversation. Hence, AI was then defined by Marvin Lee Minsky in

1956 as “the construction of computer programs that engage in tasks performed unsatisfactorily by human beings”.

AI covers an artificial rationality that optimizes the resolution of more or less complex problems, in a logical deductive mode and in specific fields. It is part of cognitive science and the internet ecosystem, which also includes Internet of Things (IoT), big data, cloud computing and block chain. The dissemination of AI cannot be as inclusive and systematic as that of computers or the internet because AI covers a set of models and method whose fields and modes of applications are heterogeneous. The 3D image recognition is, for example, is used to make medical diagnoses and to steer self-driving cars. Recently, Yong, Zeshui, XinXin, and Marinko (2023) show that the proliferation of AI in the economy has been unprecedented. AI today is segmented into two main streams. The first current is “Symbolic AI” where the computer is programmed so that it can manipulate knowledge. The second consists of “Machine learning” which covers advanced statistical models and in which we find in particular neural networks (Lecun, 1987). A third wave is emerging which combines symbolic AI, machine learning and natural language capable of merging knowledge of various origins (Pearl & Mackenzie, 2018).

The processing of big data is becoming one of the major techniques of AI because of the computing power of current computers. AI can solve complex problems, it cannot replace all forms of human intelligence, including intuition and emotion (Houde, 2019). However, it is worth noting that the impact of AI on economic growth is not uniform across all sectors and regions. Some industries may experience more significant changes and growth while others may face challenges or disruptions.

Additionally, the successful adoption and integration of AI technology need adequate infrastructure, data availability and supportive policies which can vary across different economies. Many scholars believe that AI has the potential to be “the most important general – purpose technology of our era” (Brynjolfsson et al; 2023). The recent inroads of generative AI (algorithms that can be used to create new content such as text or images) in every day applications in particular promise wide spread efficiency gains. Unlike automation through robots, which can accomplish only explicitly understood (ie routine) tasks, AI can infer tacit relationships that are not fully specified by underlying software (Autor, 2022). By transforming occupational tasks, altering corporate strategies, and affecting production efficiency, AI may have significant consequences for labour markets, firms and whole industries (Agrawal et al; 2019).

AI is considerably easier to use and implement in processes as it is a general-purpose technology that does not require the deployment of new hardware, deep user know-how, or a substantial reconfiguration of business practices. As a consequence, the impact of AI on productivity will likely be felt in the coming years already (Brynjolfsson et al, 2018; Furman and Seaman, 2019).

In summary, according to previous research works on AI, AI has both positive and negative effects on an economy. On a positive side, AI represents a driver of productivity and economic growth, it can increase efficiency and significantly improve the decision-making process by analyzing large amount of data, AI can stimulate growth by replacing labour, by harnessing the power of data analytics and algorithms, AI applications optimize service quality, help businesses identify and fight fake transactions and help better in protecting organizations from hackers as well as strengthening the fight against accounting fraud. AI significantly raises output, consumption and investment in the short and long run.

On the negative side of AI, it creates serious risks of job market polarization, rising inequality, structural unemployment, emergence of new undesirable industrial structures. AI gives rise to fears of massive destruction of jobs in developed countries, a large retraining of skills, a widening of the digital divide within social structures, AI is expected to replace human in 46% of administrative tasks, 44% of legal jobs, and 37% of architectural and engineering professions (Goldman Sachs, 2023). The effects are likely to be felt more in advanced economies than in emerging markets. Cybercrime and some accounting manipulations can be promoted by progress in AI. AI could have a highly disruptive effect on the economy and society. It could even lead to the creation of super firms that could have detrimental effects on the wider economy. It may also widen the gap between developed and developing countries. Many people are highly skeptical about the development and application of AI especially Chat GPT.

With the increasing necessity and demand for improved service delivery, high productivity, quality learning, output growth, efficient capital market operations and enhanced general business practices, it becomes obvious and desirable to look for better ways to migrate from the crude and analogue system of operations to electronic and digital technologies so as to contribute to the global macro economy to keep pace with the industrial revolutions. For this purpose, there is great need for boosting labour productivity and to adapt to work alongside machine in new ways (Aghion et al; 2019).

The traditional factors of production and physical capital and labour may no longer promote substantial economic growth. It is generally believed that AI will be one of the most important factors determining future economic growth. However, unlike traditional machines which replaced the use of human and animal labor for simple manual work and heavy or dangerous activities, AI – related inputs may change the type of human work in a comprehensive way.

The migration and gradual change from the traditional operational mode to AI – enabled technologies started in 1950 with the concept of AI which was developed by a Cryptologist Alan Turing. The AI concept was aimed at measuring the ability of an AI to imitate a human conversation. AI was computer programs constructed to engage in tasks performed unsatisfactorily by human beings. AI aims to use machines to stimulate the cognitive abilities and functions of the human brain to replace

some of the humans' mental work, which not only improves productivity, but can also improve it and generate many jobs with high cognitive intensity and thus influence the structure of work (Holzinger et al; 2019).

Developed and developing countries hastened to include the strategies and applications of artificial intelligence in their economic plans because of their added value to economic growth and technological progress, as well as their benefits in reducing costs, increasing productivity, reducing risks and raising competitive standards for countries of the world (Jiang et al; 2022).

Hence, this study on macroeconomic impact of AI takes a look into differences in production technologies and the AI – induced increase in productivity by determining how AI adoption affects the key macroeconomic aggregates: GDP, Consumption and Investment. The Objective of this study was to in examine the impact of AI on GDP, ascertain the effect of AI on consumption as well as assess the impact of AI on Investment.

This study has an objective of accessing the impact of AI on economic growth through some key aggregates of macroeconomic variables, by specifically examining the impact of AI on Gross Domestic Product (GDP), its effect on consumption as well as on Investment.

Conceptual Review

AI impact on Economic Growth

The relationship between artificial intelligence and economic sectors has grown more complex over time. Economic sectors have started to adopt and utilize AI techniques in a variety of industries primarily to address economic crisis and economic downturns. Most relevant studies emphasise that AI has the potential to significantly impact economic growth in various ways. However, AI impact on economic growth is not uniform across all sectors and regions. Some industries may experience more significant changes and growth, while others may face challenges or disruptions. Successful adoption and integration of AI technologies need adequate infrastructure, data availability and supportive policies which can vary across different economies.

AI drives economic growth by stimulating gains both from the supply side and the demand side. AI can drive business productivity through automation of processes with the use of robots and “autonomous vehicles”, improvements in the existing labour force by equipping them with AI technologies. On the other hand, AI can generate an increase in consumer demand with the availability of “personalized and/or higher quality” products and services. Accordingly, it is expected that AI could contribute up to USD 15.7 trillion to the global economy in 2030 (Rao and Verweij, 2017).

The Concept of AI

AI encompasses a broad category of technology that performs “human-like cognitive processes”, namely “learning, understanding, reasoning and interacting”. As a general-purpose technology, AI can take many forms such as “technical infrastructure (i.e., algorithms), a part of the (production) process, or an end-user product” (Szczepanski, 2019). Hence, in contrast with traditional technologies that automate routine processes, AI technologies even go further to mimic human activities that require cognition, and their application and use are not limited to the production process. AI development is a wide and ongoing practice, and more and newer forms of AI technologies are continuously produced over time. Some examples of AI include “Chat bots”, and “Virtual assistants”, face recognition system, machine translation software, data analysis based on machine learning, autonomous robots, and autonomous drones. Chat GPT, a form of generative AI technology that employs deep learning was released to the public in 2022, and quickly became a ground breaking AI technology due to its ability to interact with individuals and provide “comprehensive and practical responses” (Marr, 2023). Chat GPT is built upon “foundational large language models” (LLMs), which go beyond conventional natural language algorithms.

According to Trajtenberg (2018), with AI swiftly becoming the new general-purpose technology (GPT), comparisons between AI and previous technologies, particularly ICT, have been vanished. However, AI is considered to “impact a broader range of sectors” leading to different implications at the aggregate level” and an “unpredictable future development”. Furthermore, ICT is known to require high investments in capital over long periods, whereas AI can leverage data and cloud services that can help lower capital investments. These differences could potentially lead to a distinct pathway for AI adoption, different from that of previous technologies (Lu and Zhou, 2021).

Advances in AI Technology

Advances in AI technology have received considerable public attention, particularly after the release of Chat GPT 3.0 in November, 2022. Rapid increases in the share prices of AI – related firms suggest that financial market participants, at least, have started to factor the transformative possibilities of these technologies into their investment decisions. AI is considered to have the potential to instigate a fourth industrial revolution and is dramatically changing people’s patterns of interaction and economic activities. Agricultural robotics also known as agro bots is a rapidly growing field that combines robotics, AI and the Internet of Things (IoT) to improve farming efficiency, productivity and sustainability. There are autonomous planting Robots/Robotic seeders, Robotic weeding, Harvesting Robot, etc. These are mild compared to autonomous Tractors: self-driving tractors that can plant, spray, and harvest crops with precision and accuracy.

The Cat girl robot developed by Musk can clean a house, cook and chat with you and even bear you children. The robot is 5.68 feet tall, weighs 123 pounds and has a life like texture on its face and hands. Its appearance and voice can be customized to your liking. She has a gentle and obedient personality with no negative emotions making her the ideal partner. Moreover, the Cat girl robot can

give birth as it has an artificial uterus inside which fully simulates the growth environment of amniotic fluid in a mother. This system is capable of cultivating embryos and can also monitor the baby’s weight, blood pressure, heartbeat and respiratory rate in real-time using over 300 including intelligence levels. It is said that this robot will be ready for mass production by 2026. One would ask, if the Cat girl robot really enters households, what will our lives be like?

AI impact on Investment: Countries and levels of investments in AI technologies

According to the Stanford University report, “2023 AI Index report” (Table 2.1), the levels of Investments of ten (10) countries in AI technology are shown. The countries that invested the most in AI during the 2013 – 2022 period were the United States of America with an amount of \$248.9bn followed by China with \$95.1bn. In 2022, the largest investment in AI was made in medicine and health care (\$6.1bn), according to the same report.

Table 2.1: Top 10 countries and their levels of investments in AI

Countries	United States	China	Great Britain	Israel	Canada	India	Germany	France	South Korea	Singapore
Amount invested (Billions of \$)	248.9	95.1	18.2	10.8	8.8	7.7	7.0	6.6	5.6	4.7

Source(s): AI Index Report 2023

According to the latest study by the International Federation of Robotics, the number of operational robots in the Chinese manufacturing industry reached a ratio of 322 units per 10,000 employees in 2021 followed by the American Industry with 274 units per 10,000 employees. China now ranks fifth in the world, behind South Korea (1,000 per 10,000 employees), , Japan (399) and Germany (397). The global average is 141 units per 10,000 employees. The results of this study were shown in Table 2.2.

Table 2.2: Number of robots per 10,000 employees in the manufacturing industry in 2021

Countries	South Korea	Japan	Germany	China	Sweden	United States	Switzer land	Italy	Canada	France
Number of robots	1000	399	397	322	321	274	240	217	191	163

Source(s): International Federation of Robotics 2021

According to the Accenture company study on the impact of AI on the productivity of companies in each country as shown in table 2.3, for France, the study estimated that companies will increase productivity by 20% because of AI and increase annual GDP growth from 1.7% to 2.9%.

Table 2.3: Business Productivity rate of countries based on AI adoption

Countries	Sweden	Finland	United State	Japan	Australia	Germany	Netherlands	United Kingdom	France	Belgium	Italy	Spain

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Productivity rate	37%	36%	35%	34%	30%	29%	27%	25%	20%	17%	12%	11%

Source(s): Culled from Mohamed, A.T. (2024).

Effect of AI on Consumption

AI's effects on consumption are reflected in enhanced customization, convenience, improved search and discovery, optimized pricing, predictive analytics, immersive experiences and increased security. It is also seen as a driver for creating new business models in many industries. The "Sizing the Prize" study published by the audit company Price water house Coopers (PwC) in 2017 identifies eight main sectors directly impacted by AI: Health, Automotive, Financial Services, Retailing, communication and entertainment, manufacturing and production, energy and logistics. AI promotes the construction of increasingly complex digital product and service transaction platforms. The platform is the basic structure of the digital revolution (Rifkin, 2013). Intermediation via a platform makes it possible to reduce information asymmetries between the different parties.

AI impact on technology revolution:

AI plays a central role in the ongoing technological revolution by fueling innovation, transforming industries and reshaping the way we live and work. AI is a real revolution because it allows you to go much further than the technologies already operating the complex tasks performed. Studies (Agrawal, Gans, & Goldfarb 2019; Yang, 2022) have shown that automation using AI improves productivity. AI capabilities in innovation, automation, data analytics, customization and integration with emerging technologies are transforming industries and reshaping society. It is in this regard that AI can be frightening because it evades the ability of total control by humans.

AI impact on skills transformation

AI has a significant impact on skills transformation both in terms of the skills needed to work with AI technologies and the broader skills required in a world where AI is increasingly prevailing. The Boston Consulting Group estimates that 32% of companies in China have already adopted AI in their daily process compared to 22% in the United State and 20% in France and Germany (Mohamed A. T., 2024).

AI impact on risk management

AI has a significant impact on risk management across various industries. By leveraging advanced algorithms and data analytics, AI enhances risk assessment, predictive and mitigation process. It makes it possible to improve conventional risk management tools (scoring method, fraud detection, optimization of debt recovery strategies, rapid detection and interpretation of poor signals, construction of economic models, etc.) used by bankers, insurers, brokers, accountants, managers, etc. Some AI applications help to analyse and secure data flows made increasingly massive by new regulations imposed on companies. Some AI software can better protect organizations against

hacking and strengthen the fight against accounting fraud. AI associated with block chain technology helps create value by promoting risk management and the fight against fraud. It presents itself as a new trusted third party between an organization and its stakeholders (Leloup, 2017).

Theoretical Framework

This study adopted the theoretical framework of Julius Tan Gonzales (2023) in a similar study on implications of AI innovation on economic growth: a panel data study. The study followed an endogenous economic growth framework that starts with the basic Cobb-Douglas function and took into account human capital as input to production: $Y = AK^\alpha L^\beta H^\gamma$

Where Y is the total output, K stands for capital, L for labour, and H is human capital. The elasticities of output to capital, labor, and human capital are denoted by α , β , and γ , respectively. Meanwhile, A is the level of knowledge or stock of ideas available in an economy.

Empirical Review

Julius Tan Gonzalos (2023) conducted a study on the implications of AI innovation on economic growth: a panel study. The study conjectures a positive relationship between AI and economic growth. To test this hypothesis, the study makes use of a panel data set of countries from 1970 to 2019 and the number of AI patents as a measure of AI. A text search query is performed to distinguish AI patents from other types of innovations in a public database. Employing fixed effects and generalized method of moments (GMM) estimation, the paper finds a positive relationship between AI and economic growth, which is higher than the effect of the total population of patents on growth. Furthermore, other results indicate that AI's influence on growth is more robust among advanced economies and more evident towards the latter periods of the dataset.

Recently, Lu (2021) built a theoretical framework that traces the impact of AI on endogenous growth. Lu (2021) likens AI to human capital accumulation, "as it can learn and accumulate knowledge by itself". Secondly, AI is a "non rival input", which can be used in production without having it "detract from its ability to accumulate AI." This implies that AI is disembodied from physical capital, and should be considered a separate input. Moreover, Lu (2021) unveils a balanced growth path in the three-sector endogenous growth model, where production and factors including AI grow at the same rate.

Using provincial data from China, He (2019) estimated the effect of AI on regional economic growth. Unlike most innovation studies on ICT and growth, He (2019) makes use of fixed assets investment in ICT to GDP as a measure of AI, rather than AI – specific patents or published articles. Similarly, Fan and Liu (2021) tested AI as a tool for the sustainable economic development of Chinese provinces. The results in both studies are consistent with theories on the growth-enhancing capability of AI. Furthermore, Yang (2022) evaluated the effect of both AI and non-AI patents on firm-level productivity and employment in Taiwan. Both types of patents were found to improve productivity

and employment among Taiwanese electronic firms. Estimation results revealed that both AI and non-AI patents contribute to total factor productivity (TFP), and the difference in elasticities between the two patent types is insignificant. Moreover, when TFP is replaced by labor productivity, the estimated coefficient for AI patents is lower than in the model with TFP as a dependent variable. Yang (2022) suggested that this can be attributed to AI technology having a “greater effect on capital productivity”, which is consistent with the frameworks of Arrow (1962) and Zeira (1998).

The adoption of AI can influence macroeconomic patterns in multiple ways. Empirical evidence indicates that AI can improve productivity and foster innovation, thus contributing to economic growth (Hatzius et al., 2023). The implementation of AI-powered technologies has the potential to generate efficiency improvements across various industries, thereby promoting higher rates of growth in gross domestic product (GDP). According to research conducted by Price water house Coopers (PwC), the implementation of AI is projected to lead to a potential increase of up to 14% in global GDP by 2030. This increase in economic output is estimated to amount to approximately \$15.7 trillion, thereby positioning AI as the most significant commercial prospect within the contemporary rapidly evolving economy. It is anticipated that the most significant benefits from AI will likely be observed in China, with a projected increase of up to 26% in its GDP by the year 2030, and in North America, which has the potential to experience a 14% boost (PwC, 2017).

The sectors poised to experience the largest advancements include retail, financial services and healthcare, as AI is expected to improve productivity and stimulate consumption (PwC, 2017). Goldman Sachs Research suggests that the integration of tools that leverage advancements in natural language processing into various sectors of the economy and society may result in a substantial 7% surge in global GDP, equivalent to nearly \$7 trillion, and a corresponding 1.5 percentage point boost in productivity growth over a decade (Goldman Sachs, 2023). According to the recent investigation of McKinsey & Company, the implementation of generative AI across the 63 use cases it analyzed could result in an annual increase of approximately \$2.6 trillion to \$4.4 trillion (McKinsey & Company, 2023). The potential influence of Generative AI as a special kind of technology on productivity can contribute trillions of dollars in value to the global economy. Consequently, the overall impact of AI could be enhanced by 15 to 40 percent (McKinsey & Company, 2023). However, there are apprehensions regarding the possibility of job displacement because of automation, which could subsequently lead to alterations in employment trends and modifications in consumer expenditure patterns.

The Model

This study adopted a multi-sector model used by Aldasoro et al (2024) in their study on the impact of artificial intelligence on output and inflation. The study used the multi-sector model to chart the economic effects of AI. The model features a detailed industry structure in both its demand and supply sides which capture the key industry – level and aggregate transmission mechanisms of AI.

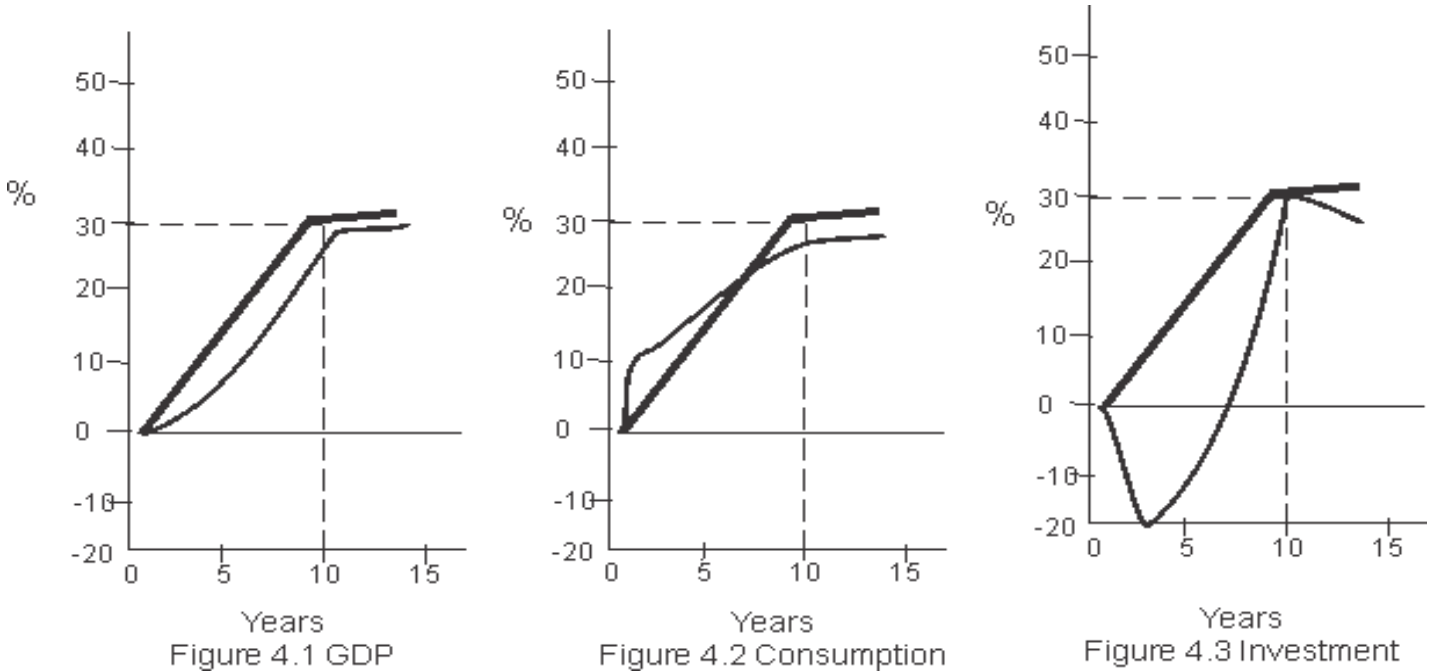
The model was used to account for the direct effects of AI on industry – level productivity and then to trace through the effects of these changes across the economy to assess the implications for aggregate outcomes. The model consists of a closed economy featuring households’ firm, the government and the central bank. Households make consumption, work, investment and saving decisions to maximize their lifetime utility, subject to an inter temporal budget constraint. Their utility function is given by:

$$\sum_{t=0}^{\infty} \beta^t \left[\log(C_t - hC_{t-1}) - \frac{AN}{1+V} N_t^{1+v} \right]$$

Where C_t and N_t are household consumption and labour supply. The parameters β , h and v are the household’s intertemporal discount rate, its habits parameter and its Frisch labour supply elasticity. Based on the multi-sector model constructed to take care of various industry-based dynamics, the effect of AI is modeled by simulating its effects.

Results and Discussion

Our discussion is based on how AI adoption affects key macroeconomic aggregates, in other words, we are looking at the macroeconomic impact of AI on GDP, consumption and investment. Figures 4.1, 4.2 and 4.3 represent GDP, Consumption and Investment respectively.



In figure 4.1, productivity improvements from AI adoption lead to a significant increase in GDP. Growth is fastest in the first 10 years, ie the period in which AI directly raises industry level of total

factor productivity (TFP) at which point GDP is almost 30% higher than it would have been without AI adoption. GDP continues to increase even after the direct productivity gains from AI adoption are exhausted, however, at a slower pace, as it takes time for firms to adjust their capital stock and use of intermediate inputs to take full advantage of AI. The level of GDP ultimately stabilizes around 35% above the no- AI baseline. The paths of aggregate consumption and investment broadly resemble that of GDP (figure 4.2 and 4.3). The level of investment overshoots, thereby delivering the required increase in the economy's capital stock, before converging to its long-run level. Taken together, these results illustrate that while different expectation formation mechanisms change the transitory dynamics of macro variables, they do not affect the long-term input of AI on the economy. These results support the productivity effect in the task-based framework of Acemoglu and Restrepo (2018). The impact of AI across sectors of the economy records three observations: First, value-added output rises in all industries, reflecting the nature of AI as a general-purpose technology (GPT). Second, the impact varies significantly across industries, ranging from a nearly 50% increase in value-added output in manufacturing and real estate services to about 20% in education and management services. Third, there is no direct mapping between an industry's initial exposure to AI and the long run increase in value added output. In general, primary and secondary industry display the largest increases in value added output, while professional services are in the bottom half of the distribution, with a couple of notable exceptions such as information & communications and Real Estate Services. AI adoption leads to a reallocation of labour across industries. In general, employment increases in services industries that experience higher relative prices and the smallest increases in value added output. Higher selling price allow firms in these industries to raise wages more than firms in industries whose relative prices decline. This induces workers to adjust their labour supply towards these industries. In contrast, in the capital-intensive industries that record the largest increases in value-added, and where relative prices decline, hours worked falls. AI as a general purpose/factor – specific technology, some qualitative differences in terms of the effect on output: the long run impact is smaller when AI is a factor – specific technology (especially so for capital – augmenting TFP). But regardless of how AI enters the production function as a general purpose or factor specific, the long run impact on output is positive and significant.

Based on knowledge from previous studies on the impact of AI on economic growth and this present study on the impact of AI on economic growth through key macroeconomic aggregates, the findings, conclusion and recommendation of this study are as follows:

Findings

The successful adoption and integration of AI technologies need adequate infrastructure, data availability and supportive policies which can vary across different economies. By transforming occupational tasks, altering corporate strategies, and affecting production efficiency, AI may have significant consequences for labour markets, firms, and whole industries. While AI, and in particular

generative AI is a general-purpose technology, its impact differs across occupational and industries. AI adoption leads to a reallocation of labour across industries. AI is neither capital nor labour specific, but is rather a general-purpose technology affecting overall total factor productivity (TFP).

Conclusion

AI represents a driver of productivity and economic growth. It can increase efficiency and significantly improve the decision-making process by analyzing large amount of data, yet at the same time, it creates equally serious risks of job market polarization, rising inequality, structural unemployment and the emergence of a new undesirable industrial structures.

Recommendations

Government should collaborate with academia, industry experts and other stakeholders to leverage their expertise and experiences in AI implementation. Public-Private partnership can accelerate the development and deployment of AI solutions while ensuring alignment with public needs. Once AI systems are implemented, government should continuously monitor their performance and evaluate their impact. Regular assessment will help identify any issues or biases and allow for necessary adjustments and improvement.

Government should make public policy on AI to encourage firms and households to adopt AI and focus on sectors of the economy that produce consumption goods as they promise high returns. There is need to set up strong Data science resource unit for proper functioning of AI adoption since Data Science is the center point of AI and machine learning. Government should encourage and support school management both in the secondary and tertiary institutions to provide opportunities for them to carve a niche for themselves by building innovative AI models tailored toward their unique needs and competitive advantages. Education planners and managers should integrate AI technique into economic and financial sciences as aspects of the knowledge economy which is characterized by providing statistical and measurement methods that achieve more efficient and accurate results compared to traditional statistical models.

Toward a Policy agenda

This study has shown the good, the bad and the challenges surrounding the adoption of AI in different sectors of the economy. As we noted that AI represents a driver of productivity and economic growth, it can increase efficiency and significantly improve the decision – making process. At the same time, AI creates serious risks of job market polarization, rising inequality, structural unemployment, emergence of new undesirable industrial structures, etc.

The question that arises is, how would different sectors and organizations welcome the adoption of AI seeing that AI is capable of raising an organization up or bringing it down through its innovative destructive potentials. This calls for a new policy decision in organizations adopting AI technologies. It is expected that labour unions must figure out what kind of relationship they want with AI and what

their demand will be. Although, we have sketched a number of possible futures for AI, we want to emphasize not only how deeply unpredictable the future of this technology is but also the agency society which AI future emerges. Business organization need innovations in economic and policy understanding that match the scale and scope of the breakthrough in AI itself. Reorienting research priorities and developing a smart policy agenda can help move toward a future of both sustained and inclusive growth.

REFERENCES

- Aghion, P., B., & Jones, C. (2017). Artificial intelligence and economic growth. NBER Working Paper No. 23928. <https://doi.org/10.3386/w23928>
- Agrawal, A., Gans, J., & Goldfarb, A. (2016). The simple economics of machine intelligence. *Harvard Business Review*, 17, 2-5.
- Agrawal, A., Gans, J., & Goldfarb, A. (2019). Artificial intelligence: The ambiguous labour market impact of automating prediction. *Journal of Economic Perspectives*, 33(2), 31-50. <https://doi.org/10.3386/w25619>
- Acemoglu, D., & Pascual, R. (2018). Artificial intelligence automation and work. NBER Working Paper No. 24196.
- Araujo, D., Sebastian, D., Leonardo, G., & Bruno, T. (2024). Artificial intelligence in central banking. *BIS Bulletin*.
- Autor, D. (2022). The labour market impacts of technological change: From unbridled enthusiasm to qualified optimism to vast uncertainty. NBER Working Paper No. 30074.
- Banerjee, S., Singh, P. K., & Bajpai, J. (2018). A comparative study on decision-making capability between human and artificial intelligence in nature inspired computing. In Springer: Singapore, 203–210.
- Babina, T., Anastassia, F., Alex, H., & Hames, H. (2024). Artificial intelligence, firm growth, and product innovation. *Journal of Financial Economics*, 151, 103745.
- Baily, M. N., Erik, B., & Anton, K. (2023). *Machines of mind: The case for an AI-powered productivity boom*. Brookings.
- Brynjolfsson, E., & Andrew, M. (2017). The business of artificial intelligence. *Harvard Business Review*.

Czarnitzki, D., Gonzalo, P. F., & Christian, R. (2023). Artificial intelligence and firm-level productivity. *Journal of Economic Behaviour & Organization*, 211, 188-205.

David, A., Jon, H., & Pascual, R. (2022). Artificial intelligence and jobs: Evidence from online vacancies. *Journal of Labour Economics*, 40(SI), 293-340.

Felten, E., Meera, R., & Robert, S. (2019). The effect of artificial intelligence on human labor: An ability-based approach. (1).

Furman, J., & Robert, S. (2019). AI and the economy. *Innovation Policy and the Economy*, 19(1), 161-191.

Goldman, S. (2023). The potentially large effects of artificial intelligence on economic growth. *Economics Research*, 26 March.

Hemous, D., & Olsen, M. (2014). The rise of the machines: Automation, horizontal innovation, and income inequality. *CEPR Discussion Paper No. 10244*.

Howard, A., & Borenstein, J. (2018). The ugly truth about ourselves and our robot creations: The problem of bias and social inequity. *Science and Engineering Ethics*, 24, 1521-1536.

Lin, W., Lin, S., & Yang, T. (2017). Integrated business prestige and artificial intelligence for corporate decision-making in dynamic environments. *Cybernetics and Systems*, 48, 303-324.

Lu, C. (2021). The impact of artificial intelligence on economic growth and welfare. *Journal of Macroeconomics*, 69, 103342.

Malhotra, N. K., Kim, S. S., & Agarwal, J. (2004). Internet users' information privacy concerns (IUIPC): The construct, the scale, and a causal model. *Information Systems Research*, 15, 336-355.

Mitchell, T., & Brynjolfsson, E. (2017). Track how technology is transforming work. *Nature*, 544, 290-292.

Mohamed, A. T. (2024). The impact of artificial intelligence on economic development. *Journal of Electronic Business & Digital Economics*. <https://www.emerald.com/insight/2754-4214-htm>

Misuraca, G., Barcevicus, E., & Codagnone, C. (2020). Exploring digital government transformation in the EU. Luxembourg: Publications Office of the European Union.

Mohammed, F., & Negrish, A. (2024). The impact of the use of artificial intelligence on economic growth: The case of Jordan. *Kurdish Studies*, 12(2), 1929-1941. <https://www.kurdishstudies.net>

Nguyen, C. P., & Doytch, N. (2022). The impact of ICT patents on economic growth: An international evidence. *Telecommunications Policy*, 46(5), 102291. <https://doi.org/10.1016/j.telpol.2021.102291>

Pathak, B. K., & Bend, S. (2020). Internet of things enabled electronic markets: Transparency issues. *Information Systems*, 21, 306-316.

Pearl, J., & Mackenzie, D. (2018). *The book of why: The new science of cause and effect*. Basic Books.

Peiye, Z., Yu, G., & Xue, S. (2022). How does artificial intelligence affect green economic growth? Evidence from China. *Science of the Total Environment*, 834, 155306. <https://doi.org/10.1016/j.scitotenv.2022.155306>

Pesapane, F., Volonte, C., Codari, M., & Sardanelli, F. (2018). Artificial intelligence as a medical device in radiology: Ethical and regulatory issues in Europe and the United States. *Insights Imaging*, 9, 745-753.

Rogerson, A., Hankins, E., Nettle, P. F., & Rahim, S. (2022). *Government AI readiness index 2022*. Oxford: Oxford Insights.

Sahmim, S., & Gharsellaoui, H. (2017). Privacy and security in internet-based computing: Cloud computing, internet of things, cloud of things: A review. *Procedia Computer Science*, 112, 1516-1522.

Scherer, M. U. (2015). Regulatory artificial intelligence systems: Risks, challenges, competencies, and strategies. *SSRN Electronic Journal*, 29, 353.

Thamik, H., & Wu, J. (2022). The impact of artificial intelligence on sustainable development in electronic markets. *Sustainability*, 14, 3568. <https://doi.org/10.3390/su14063568>

Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial intelligence and the public sector – Applications and challenges. *International Journal of Public Administration*, 42, 596-615.

- Wirtz, B. W., Weyerer, J. C., & Sturm, B. J. (2020). The dark sides of artificial intelligence: An integrated AI governance framework for public administration. *International Journal of Public Administration*, 43, 818-929.
- Yang, C. H. (2022). How artificial intelligence technology affects productivity and employment: Firm-level evidence from Taiwan. *Research Policy*, 51(6), 104536. <https://doi.org/10.1016/j.respol.2022.104535>
- Yong, Q., Zeshui, X., XinXin, W., & Marinko, S. (2023). Artificial intelligence and economic development: An evolutionary investigation and systematic review. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-023-01183-2>
- Yuxin, F., Hongjun, C., & Jihui, S. (2022). Impact of artificial intelligence on regional green development under China's environmental decentralization system: Based on spatial Durbin model and threshold effect. *International Journal of Environmental Research and Public Health*, 19(22), 14776. <https://doi.org/10.3390/ijerph192214776>
- Zeira, J. (1998). Workers, machines, and economic growth. *Quarterly Journal of Economics*, 113(4), 1091-1117. <https://doi.org/10.1162/003355>