Artificial Intelligence and Productivity Improvement in the Digital Economy

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Abstract:
The digital economy and AI development have significantly revolutionized diverse sectors, profoundly influencing productivity. Focusing on agriculture and the artificial fiber manufacturing industry, this paper scrutinizes the impact of AI on productivity in these domains. By methodically analyzing prevalent literature, research studies, industry reports, and case studies, this investigation aims to elucidate how AI has heightened productivity within these sectors. The results exhibit substantial enhancements in resource optimization, yield enhancement, quality control, and efficiency resulting from the implementation of AI. Furthermore, the subsequent sections of discussion and conclusion elucidate these findings, emphasizing the potential advantages and enduring challenges concerning AI's assimilation to ameliorate productivity within the digital economy.
Keywords: Artificial Intelligence, digital economy, agriculture, productivity

1. Introduction

The rise of a digital economy, predominantly powered by technological advancements, notably Artificial Intelligence (AI), has significantly altered numerous economic activities [1]. Swift developments in information technology, especially the Internet and AI, serve as the firm foundation driving its growth. This shift, characterized by reduced costs and widespread technology adoption across industries, enhances labor efficiency, personalization, and the quality of goods and services, albeit with concerns about job displacement and an increase in unemployment.

The burgeoning digital economy, driven by the rapid evolution of the Internet and AI, materializes in daily life through platform and sharing economies, mobile payments, and e-commerce [2]. The ongoing advancement of AI further magnifies the potential of the digital economy, specifically in augmenting productivity and optimizing resource utilization.

Nevertheless, significant challenges endure, including the need for more substantial research depth in pivotal technologies such as high-end chips, constraining the nation's progress in the digital industry [2]. Overall, AI advancements promise advantages for scientific research through potent data analysis capabilities, while deepening digitization holds the potential to bolster economic growth across various sectors substantially.

2. Methodology

Analyzing the impact of AI on productivity within the digital economy involved an extensive investigation utilizing qualitative research methods [3]. To reveal the influence of AI, a diverse range of sources, including existing literature, research studies, industry reports, and case studies, were meticulously collected. By employing a methodology that encompassed a thorough examination of existing literature and a close assessment of practical AI applications in agricultural and manmade fiber manufacturing sectors, the investigation sought to offer insights into how AI impacts productivity, efficiency, and the broader economic progress within these industries.

A comprehensive comprehension of AI's contribution to enhancing productivity and cultivating economic expansion in these domains was attained through reviewing varied sources and examining practical implementations. The application of qualitative methods facilitated an extensive exploration, revealing the nuanced impacts of AI in these sectors [3].

3. Results

3.1. The impact of artificial Intelligence on agricultural productivity

Agriculture has played an essential role in civilization by providing sustenance and livelihoods to people throughout history [4]. However, agriculture faces challenges like climate change, limited resources, and the expanding global population. These circumstances continue to give difficulties for us. In this context, artificial intelligence (AI) emerges as a symbol of hope, offering solutions for the problem. A thought-provoking report from the World Economic Forum recognizes the potential of AI to empower farmers and enhance their decision-making processes through data-driven insights [5]. Leveraging real-time data on weather patterns, soil quality, and crop health represents a turning point in agriculture.

At the heart of AI's influence on agriculture resides precision agriculture, which enables farmers to optimize land usage across each acre through strategic development and implementation [6]. Embracing precision agriculture enhances productivity and saves valuable resources such as money and time. Efficient utilization of resources is an aspect of Intelligence. In agriculture, the availability of resources like water and fertilizer is limited. Implementing an AI-powered system allows us to analyze data from various sources, including weather forecasts and soil moisture sensors. This method reduces production costs and environmental harm while increasing agricultural yields and conserving water.

With this recently discovered ability to use real-time data, including weather patterns, soil quality, and crop health, agriculture has reached a turning point [7]. For academics, predicting agricultural productivity has proven challenging. For instance, agricultural productivity is impacted by soil quality, plant disease, pests, fertilizer, temperature swings, and rainfall. The projection for agricultural productivity has proven challenging for specialists to evaluate. Estimation is difficult because environmental factors, including weather data, have nonlinear and non-stationary data.

However, the research of S. Archana and P. Senthil Kumar shows that deep learning-based models have led to excellent results in predicting agricultural output [8]. These models can help farmers make well-informed decisions about crop management, such as how much fertilizer and water a particular crop will require. They can also identify areas requiring more attention and resources [8]. The study underlines that factors influencing agricultural productivity include soil quality, plant disease, pests, fertilizer, variations in temperature and rainfall, and soil quality.

Furthermore, a groundbreaking study by Jeffries et al. demonstrates the promise of AI in agriculture [9]. Researchers analyzing field sensor data made a remarkable discovery: machine learning models can estimate crop yields with up to 90% accuracy. This breakthrough has revolutionized farmers' planning and decision-making processes. Using this advanced technology, farmers can make precise decisions that optimize the growth of different types of crops, leading to increased revenues and higher yields. The discovery significantly changed the way farmers planned their planting and harvesting seasons. Thanks to this state-of-the-art technology, they can make exact decisions that maximize the development of various crop types and ultimately increase revenues and yields.

Artificial Intelligence has significantly advanced agriculture, particularly in analyzing satellite images. Kalaivani & Khilar have found that artificial Intelligence can rapidly process vast amounts of satellite data to identify crop stress and nutritional deficiencies during early growth stages [10]. In the past, these issues could often go unnoticed until they led to significant crop failures. However, with AI's analytical capabilities, farmers can intervene promptly to avoid losses. Additionally, AI-driven systems actively monitor and evaluate agricultural practices to support farmers in minimizing their impact on the ecosystem [10].

While there is no doubt about the potential of AI in supporting agriculture, there are still obstacles that need to be addressed for widespread adoption. One key requirement is sufficient investment in infrastructure, data collection, and education for farmers. Data privacy and security concerns must be promptly resolved to safeguard farmers' personal information. AI offers farmers valuable technological knowledge and tools to significantly enhance productivity, reduce waste, and increase crop yields [11]. As long as we continue exploring the possibilities of AI in agriculture, it will undoubtedly provide us with more efficient and reliable solutions in the future.

3.2. Manmade Fiber Manufacturing Industry

AI-driven systems possess the capacity to transform productivity within the synthetic fiber manufacturing sector across various avenues: predictive maintenance, quality control, supply chain optimization, and production efficiency [12]. For instance, autonomous decision-making and collaborative interaction among agents facilitate remarkable flexibility in the manufacturing process. Such an automated system capitalizes on feedback mechanisms and central coordination to attain elevated efficiency levels. AI can scrutinize data from diverse machinery-installed sensors to anticipate maintenance requirements and avert unforeseen malfunctions. Moreover, through early detection of equipment issues, AI can schedule maintenance promptly, diminishing expensive downtimes and maximizing machinery availability.

Quality assurance is an integral facet of the manufacturing sector, encompassing the establishment of stringent quality benchmarks, their verification, and the enhancement of overarching product excellence [13]. The conventional quality control method predominantly hinges on manual methodologies and visual scrutiny, contributing to protracted timelines and considerable expenses. Nevertheless, incorporating artificial intelligence (AI) in quality control is poised to transform the manufacturing sector significantly, augment operational efficiency, curb expenses, and elevate product standards [14]. AI-driven robotic systems and machinery demonstrate superior precision and speed compared to human counterparts, while their capacity to assimilate knowledge from errors empowers iterative enhancements over time.

Fujitsu's study revealed that AI-driven quality control systems could halve product defects [15]. Additionally, Matzka's article illustrates how manufacturers can automate production quality checks by merging computer vision and artificial Intelligence. This integration enhances efficiency, reduces waste, minimizes recalls, and creates a more environmentally sustainable end-to-end process [16]. AI can optimize inventory levels, forecast demand and logistics operations, reduce costs, and improve responsiveness to customer demands by analyzing historical and real-time data [16]. At the same time, Al increases efficiency in production, while Al-powered systems can optimize various processes, like material handling, quality control, and scheduling.

By leveraging machine learning algorithms, Al can analyze data from sensors and machines in real-time, identifying patterns and making adjustments to optimize efficiency, reducing downtime while improving throughput and overall production efficiency [17]. Al can also improve product performance and sustainability, which, in other words, is the optimization of products and processes. By analyzing data from production processes, Al can identify patterns and correlations that humans might overlook. This can lead to new fiber compositions and improved manufacturing techniques. Moreover, enhanced product characteristics. This results in more innovative and competitive fibers in the market.

4. Conclusion

In summary, the research outcomes undeniably demonstrate AI's pivotal significance in propelling productivity enhancements within the digital economy. Notably, integrating AI technologies in sectors such as agriculture and manmade fiber manufacturing has yielded remarkable progress in efficiency optimization, quality assurance, and resource management. Nevertheless, issues concerning data privacy and the assurance of steady economic advancement must be tackled. Concentrated endeavors should be directed toward formulating resilient measures for safeguarding data and establishing policies that promote the conscientious and ethical application of AI technologies. Moreover, additional research and investment are imperative to completely leverage the potential of AI within the digital economy and surmount current constraints. Progressing ahead, policymakers, researchers, and industry leaders must unify efforts to tackle these challenges and effectively harness the revolutionary potential of AI to enhance productivity within the digital economy.

Reference

[1] Martín, J. G., Lilic, M., & Martínez, M. R. (2022). Digital Economy. *AI Knowledge Transfer from the University to Society*, 33–52. https://doi.org/10.1201/9781003276609-3

[2] Sazonov, A. A. (2022). Development of strategic mechanisms for high-tech enterprises in the Digital Economy Environment. *Revista Amazonia Investiga*, 11(49), 136–148. https://doi.org/10.34069/ai/2022.49.01.15

[3] Gilgun, J. F. (2014). Writing up qualitative research. *The Oxford Handbook of Qualitative Research*, 657–676. https://doi.org/10.1093/oxfordhb/9780199811755.013.032

[4] IDARA. (2023). Potential impact of artificial intelligence applications on agricultural productivity. *IDARA*, 1(1), 49–57. https://doi.org/10.37075/idara.2022.05

[5] Leliaert, I. (2023). *How to harness the power of generative AI for better jobs. experts share their views.* World Economic Forum. https://www.weforum.org/agenda/2023/09/how-to-harness-the-power-of-generative-ai-for-better-jobs/

[6] Zhao, C., Chen, L., Yang, G., & Song, X. (2015). Data Processing and Utilization in *Precision Agriculture. Precision Agriculture Technology for Crop Farming*, 55–102. https://doi.org/10.1201/b19336-3

[7] Belattar, S., Abdoun, O., & Haimoudi, E. K. (2023). Overview of Artificial Intelligence in agriculture. *Artificial Intelligence and Industrial Applications*, 447–461. https://doi.org/10.1007/978-3-031-43520-1_38

[8] Archana, S., & Kumar, P. S. (2023). A survey on Deep learning-based crop yield prediction. *Nature Environment and Pollution Technology, 22(2),* 579–592. https://doi.org/10.46488/nept.2023.v22i02.004

[9] Jeffries, G. R., Griffin, T. S., Fleisher, D. H., Naumova, E. N., Koch, M., & Wardlow, B. D. (2019). Mapping sub-field maize yields in Nebraska, USA by combining remote sensing imagery, crop simulation models, and Machine Learning. *Precision Agriculture, 21*(3), 678–694. https://doi.org/10.1007/s11119-019-09689-z

[10] Kalaivani, A., & Khilar, R. (2019). Crop classification and mapping for agricultural land from satellite images. *Remote Sensing and Digital Image Processing*, 213–233. https://doi.org/10.1007/978-3-030-24178-0_10

[11] Ibrahim, A. O., & Elghamrawy, S. (2023). Plant disease detection using artificial intelligence techniques for agricultural productivity enhancement in Egypt. *2023 International Telecommunications Conference (ITC-Egypt).* https://doi.org/10.1109/itc-egypt58155.2023.10206149

[12] Szladow, A. J. (1995). *Application of Artificial Intelligence Technology to Increase Productivity, Quality and Energy*

Efficiency in Heavy Industry. https://doi.org/10.4095/315015
[13] PROZIMA (Productivity, Optimization and Manufacturing System Engineering), 4(2), 41–50. https://doi.org/10.21070/prozima.v4i2.1306
[14] Vermesan, O. (2021). Artificial Intelligence for digitising industry. *Artificial Intelligence for Digitising Industry*, 1–541. https://doi.org/10.13052/rp-9788770226639
[15] Fujitsu. (2022, March 23). *How ai-automated quality control helps manufacturers become more sustainable.* Global. https://corporate-blog.global.fujitsu.com/fgb/2022-03-23/02/
[16] Matzka, S. (2018). Using process quality prediction to increase resource efficiency in manufacturing processes. *2018 First International Conference on Artificial Intelligence for Industries (AI4I)*. https://doi.org/10.1109/ai4i.2018.8665706
[17] Shai, I., Bakama, E. M., & Sukdeo, N. (2020). The impact of smart manufacturing approach on the South African Manufacturing Industry. *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD).* https://doi.org/10.1109/icabcd49160.2020.9183853