

The Development and Transformation of Digital Economy Before and After the Pandemic Era

Jianzhou Liu^{1,a,*}, Yun'er Wu²

¹*Santa Monica College, Santa Monica, United States*

²*Xi'an Qujiang Kangchiao International School, Xi'an, China*

a. liu_jianzhou01@student.smc.edu

**corresponding author*

Abstract: COVID-19 has significantly impacted the global economy. The pandemic pushed the digitalization of the economy as a catalyst accelerating the changes and leaving a profound imprint in the digital economy as many temporary measures had a long-lasting impact or were kept or modified. Nowadays, digital technology has gradually transformed from being merely an information carrier into a production factor. The digital economy enhances the efficiency of production factor allocation by upgrading industrial structures digitally and helping manufacturing break down information barriers. As a result, the application of digital technology has become a key factor in the development and transformation of the manufacturing industry. COVID-19 has driven the transformation of the industrial chain in production, transportation, storage, and sales, improving the efficiency of various economic operations through the expanded application of the digital economy. In the post-pandemic era, the digital economy mainly faces challenges from security, governmental regulation, and the digital divide, whose solution or proper handling is vital for the development of the digital economy. However, the vision for the development of the digital economy is bright as it is beneficial to both individuals and enterprises, is encouraged by many governments, and is consistent with the idea of connectivity and sustainability.

Keywords: Digital economy, digital transformation, COVID-19 pandemic, economic growth, manufacturing.

1. Introduction

Affected by the COVID-19 pandemic, the digital economy is increasingly prominent in various industries, and the scale of the digital economy is large. This phenomenon is especially obvious in China. The reason China has demonstrated a relatively stable economic development trend is the booming digital economy. In 2021, the China Academy of Information and Communications Technology released the "White Paper on the Development of China's Digital Economy (2021)", which showed that the scale of China's digital economy reached 39.2 trillion yuan in 2020, accounting for 38.6% of the gross domestic product [1]. The data illustrates that the digital economy has become a significant force in the perspective of boosting the economy. The digital economy, the essential factor, has driven the development of the manufacturing industry, and it will improve the efficiency of factor allocation in production. The innovative features of the digital economy can be combined with traditional factors to generate new productivity and accelerate value creation [2].

The digital economy plays a crucial role in manufacturing industry transformation, and it is the basis of product personalization and servitization. The application of digital technologies such as big data, cloud computing, artificial intelligence, etc. is a vital constituent part of digitization, and those technologies markedly improve the level of production automation in the manufacturing industry. Relying on the advanced data analysis strength, manufacturers can provide more personalized products based on the result of data analysis on consumer preferences. International trade has experienced a serious influence, so many export-oriented companies have focused on the domestic market to find growth opportunities. This has boosted the development of the digital economy in the manufacturing industry to a high degree. The COVID-19 pandemic has brought serious challenges to the supply chain of the manufacturing industry, including decreasing demand, blocked logistics, and other problems. However, the highly tied industries with the digital economy have shown powerful development momentum during the pandemic period, such as 5G, industrial Internet, and robotics. These industries have not only innovated the production mode of companies but also promoted the optimization of industrial structure and the transformation of economic growth patterns. Additionally, the COVID-19 pandemic has facilitated demand for supply chain innovation and digital transformation, and it has promoted firms to utilize the new technology and management model. Those two aspects can handle uncertainty and improve the flexibility and adaptability of the supply chain.

Existing research mainly concentrates on the role of national policies in promoting the digital economy during the epidemic, but there is inadequate research about how the epidemic specifically promotes and restricts the digital transformation of the economy. This essay will compare the differences in the status and the role of the digital economy in the manufacturing industry before and after the epidemic.

2. Impact of the Pandemic on the Digital Economy

2.1. Shock to the Digital Economy from the Pandemic

The COVID-19 pandemic hurt the digital economy, which is mainly from its impact on the operation of the general economy. Under the impact of the pandemic, many small businesses struggled to adapt to digital marketing methods due to the closure of conventional stores. During the process, many shops or small enterprises were forced to reduce scale or shut down. As a result, the unemployment rate rose and the supply chain was disrupted, which caused declines in payment delays and shortages in goods. These altogether caused the suspension of projects, labor impact, job loss, time overrun, cost overrun, and financial implications, and both the production and consumption sides were negatively affected [3]. These factors force most enterprises to consider the digital economy as one of their production factors. Due to the relatively new nature of this production factor, only a small number of enterprises that can quickly transform benefit from it.

2.2. The Pandemic's Role in Promoting Economic Digital Transformation

However, the influence of the COVID-19 on digital economy is generally positive. Because of the closure of many offline venues, many activities were conducted online including business negotiation, bidding, education, trading, exhibitions, concerts, performances and even working, which directly or indirectly promoted the growth of the digital economy [4]. Meanwhile, many activities that had already been conducted online, including e-commerce and the retail sector, saw growth in volume because consumers who could not leave their homes had an intensified use of digital media [5]. Due to the isolation regulations, the transformation of many economic links from offline to digital took only a few weeks to overcome obstacles from operation systems, hardware, and conservative forces instead of five years or more as anticipated by companies and customers [6]. The transition to

digitalized production systems, e-commerce, digital supply of services, e-invoicing, e-payments, and other services, as well as smart working solutions, including remote working, and innovative new business models, were required by the situation and were encouraged by many governments and international organizations. During this process, the digital infrastructure saw a great improvement and the digital economy environment was optimized. Therefore, many online activities remained online after the pandemic because of their higher efficiency. Most providers and buyers of goods and services benefit from the digital economy as they have access to a bigger market. Many non-trading segments also benefited because of the overcoming of informational and geographic obstacles.

2.3. Reflection on the Pandemic's Impact on the Digital Economy in the Post-Pandemic Era

The COVID-19 pandemic had influenced the digital economy significantly and fundamentally with much of its influence easy to notice in the post-pandemic era. Initially, the crisis acted as a catalyst that accelerated the adoption of digital technologies in various segments. Some measures and policies were temporary, like subsidizing e-commerce platforms, tax relief, extended unemployment benefits, and loosened online business licensing. However, many changes during the pandemic were sustained in the post-pandemic era. Firstly, consumer behavior changed during the pandemic as consumers adapted to online shopping. Service quality, and the breadth and abundance of goods online were improved accordingly. Secondly, the wide appliance of remote work mode led to more online job opportunities and the usage of digital collaboration tools and service to facilitate teamwork and communication. Thirdly, one of the greatest concerns of security in the digital economy has been alleviated with the strengthened digital infrastructure, raised security conscience and insurance, and investment in secured business platforms when having the activities conducted online was a must.

3. The Way the Digital Economy Propelling the Transformation and Upgrading of the Manufacturing Industry

3.1. Digital Economy and Manufacturing Industry

Digit is the carrier of information. Digit gradually transfers to a kind of production factor, and it becomes the foundation for the transformation of manufacturing towards green industries. Green total factor productivity(GTFP) becomes an important indicator for measuring the success of transformation. The well-developed digital economy infrastructure can benefit the manufacturing industry and promote the growth of GTFP for the entire industry. The impact of the digital economy on GTFP may have a nonlinear “threshold effect”. The regional sector scale and institutional environment are threshold variables. The threshold value will relatively boost the digital economy less significantly. When the threshold value is exceeded, the positive influence of the digital economy would be remarkable [2].

The digital economy can improve the efficiency of production factor allocation in two aspects. Firstly, the digital upgrading of industrial structure. For example, companies can widely utilize big data analysis, so the companies can accurately hold the market demand, the supply of raw materials, and materials purchase. This tool efficiently assists firms in adjusting the unsuitable allocation of traditional factors. Secondly, the digital economy helps the manufacturing industry to break the information barrier through the aspects of collecting and analyzing data from different sources. This mode helps to achieve cross-departmental and even cross-industry information flow, which results in the making of final decisions based on comprehensive and correct information [1].

There are two main techniques to demonstrate digital technology that have already become key factors in boosting the manufacturing industry. Firstly, the Industrial Internet of Things is a new type of industrial production method, which is changing the traditional manufacturing industry. Specifically, the parts of most of the equipment in the production process are digitized and intelligent.

For instance, Germany's "Industry 4.0" is a role model for applying the Industrial Internet of Things, and the emphasis on technological development and system matching for "Industry 4.0" is aimed at implementing fully automated manufacturing. Firms can use technologies such as cyber-physical systems, big data, and the Internet of Things. Through these ways, firms can gather logistics resources, which contributes to satisfying the logistics needs of suppliers and buyers [7]. Companies use the above technologies for personalization, such as using big data to analyze customer demand survey questionnaires. This method can provide products that better meet market demand. Thus, to carry out the next step of the "customized production process" and achieve intelligent and customized production, namely mass customization and modular design. In detail, the production line is designed by quick recombining and adjustment, so industries can adapt to the production of different products and illustrate the flexible line of production. Therefore, the firms would be more competitive. Secondly, firms try to integrate and develop technologies from the manufacturing and service industries. As a high-level factor input for manufacturing, the service industry has greatly reduced the production costs of manufacturing. To be specific, transportation, warehousing, postal, and telecommunications promote labor-intensive industries because they highly depend on infrastructure and logistics services [8]. These positively correlated industries are inseparable from the combination of the digital economy, making customers easily access information about the products they purchase on relevant cloud platforms. These platforms include operating guides and online technical support.

3.2. The Impact of the Epidemic on the Transformation of the Industrial Chain

In the context of the COVID-19 pandemic, the application of the digital economy in the manufacturing industry has become the elementary factor to accelerate the continued growth and transformation of the sector. To cope with the interruption of the industrial chain during the epidemic, a part of enterprises introduced many intelligent machines that altered traditional labor. Passing the means of data detection systems, intelligent monitoring of production lines, etc., the company has begun to monitor the real-time volume of products in the supply chain. The model of working has been hindered, so many companies try to via digital transformation, such as achieving remote work, online sales, and contactless delivery. In other words, the epidemic has promoted digital technology to some level, such as new sales models that combine 5G with traditional sales models - online live-streaming sales generating innovation in the field of manufacturing.

The identity and after-sales service of the sales side can be affected by the epidemic, leading to consumers not passively accepting fixed products. They would conduct research and development design, automated procurement and storage, digital twin technology virtual simulation, network collaborative manufacturing, and replace human resources affected by the epidemic - intelligent robot customer service and after-sales service - as "consumers" [8]. This skill needs the support and replacement of algorithms. The advantage of this skill would be not jeopardized by epidemic for the results of operation stagnation. Intelligent robot customer service and after-sales service can prevent the occurrence of consumer dissatisfaction, capital chain rupture, and shutdown results to a certain extent. Conversely, the epidemic promoted the necessity and growth of this technology.

In the field of storage, as the division of the industry chain becomes more specific, the complexity of the entire system increases accordingly. It generates the amount of information that needs to be processed, which has significantly increased. Especially, for the number of participating members exceeding the specified value, it would lead to diminishing benefits. Because of the redundant department, the information interaction becomes more complicated, and the coping period is stretched. It contributes to increasing the costs of coordination and communication drastically. Putting intelligent manufacturing into use means the total expense rises and turns into a fixed cost. Intelligent manufacturing can replace the inconsistency of information in different sections, so it effectively solves challenges of efficiency and communication. With the growth in production in the long run,

sharing equal charges of every good to undertake decline, and fixed costs would be downed continuously. Due to restrictions on offline working hours and poor population mobility, the effectiveness of the enterprise has been significantly reduced during the period of pandemic. This further deepens the problem of information barriers. The online conversation misunderstands information easily, because of external factors such as network latency and geographical location limitations. The Internet of Things (IoT) replaces some of the workforce and holds the logistics resources available in various regions. This technique can regulate logistics arrangements during the epidemic period and achieve reasonable factor allocation.

With the advancement of digitization, this tech triggers a series of safety potential hazards, such as hacking into cloud platforms, private information leaks, and so on. The government should also introduce relevant safeguard policies to support the digital transformation of the manufacturing industry and create a favorable external environment. Enterprises in the manufacturing industry need to establish a sound data management system to protect their business information and customer privacy.

4. The Situation of Development and Transformation of the Digital Economy in the Post-pandemic Era

4.1. Challenges and Difficulties

In the post-pandemic era, the digital economy faces various challenges that hinder its sustainable growth. Firstly, security is one of the primary concerns. The digital economy desperately needs a safe cyberspace to thrive, which includes internal and external security. Internal security is from the systems' ability to function stably, as when an increasing amount of business is done online, a paralysis of an important system can cause an economic shutdown, with online business and small enterprises being exceptionally vulnerable, it can be costly and consistently demanding to build and maintain operational systems. External security comes from the systems' ability to defend themselves from malicious attacks from persons or nations. The digital economy is more vulnerable than conventional economic modes as it can easily be interrupted, therefore many enterprises can be lacking the information or technology to keep themselves safe. Secondly, it is difficult for governments to effectively regulate digital platforms, data privacy, and online transactions. Inadequate or inappropriate regulation can lead to monopoly and disorderly competition. The insecurity of personal information can shake the confidence of the public. And unregulated online transactions facilitate economic crimes and fraud. Meanwhile, unlike similar regulations on conventional business, governments of different areas are now imposing relatively different policies on the digital economy, and this can lead to cost increases, especially for multinational companies. Regulations also set limits on enterprises and increase their operating costs, which decreases enterprise efficiency and hinders innovation to different extents. Thirdly, the development of the digital economy enlarges the digital divide, with some communities prominently suffering. Low-income communities lacking access to technology and reliable internet, old people lacking network literacy, and low educated populations lacking digital skills are the victims during the process [9]. The young find it difficult be competent in e-commerce jobs while the old find their habitual daily consumption methods are replaced by unfamiliar new ones.

4.2. Opportunities and Prospects

The digital economy brings many opportunities that can promote social development in the post-pandemic era. The digital economy creates new consumption points and jobs, increases efficiency for enterprises and fosters greater financial inclusion that creates chances for individuals and companies, which is the fundamental reason for its consistent growth. People with disabilities and living in remote

places will work more efficiently in this system, Companies are also positively affected by the rich diversity of human resources [10]. These groups, along with those who benefit more from the development of the digital economy, strongly endorse the digital economy. Meanwhile, many governments use means of policy support, fiscal investment, and transferring public service to the internet to promote its growth, and research has shown that there is a direct link between governmental support and the growth of the digital economy. The future vision of the digital economy revolves around increasing connectivity and sustainability. On the one hand, the ubiquitous integration of digital technologies including AI, IoT, and blockchain enhances the efficiency of decision-making, production, and transaction, which is consistent with consumers' pursuit of quality life. On the other hand, digital technologies can optimize resource use, reduce waste, monitor resource utilization, and facilitate the formulation of environmental protection regulations by big data, which aligns with the concept of sustainable development and consumers' demand for responsible corporate behavior.

5. Conclusion

The COVID-19 pandemic hurt the digital economy and exposed many problems of the digital economy. In the meantime, it cleared many obstacles thus promoting the digital economy both in the short term and long term.

Nowadays, digital technology has become a key factor in promoting the sustainable development and transformation of industry, with the improvement of digital economy infrastructure benefiting the manufacturing industry, and the digital upgrade of the industrial structure together with higher information interoperability improving the efficiency of production factor allocation.

The COVID-19 pandemic has catalyzed digital transformation in manufacturing from all the production side, logistics side, and consumption side, which improves efficiency by breaking down information barriers and promoting rational allocation of resources.

In the post-pandemic era, the digital economy is facing varying challenges. Safety is one of the primary concerns, which is the foundation of the steady operation of the digital economy. Setting governmental regulations is also difficult as the regulations of the digital economy are not yet perfect, and existing inadequacies reduce efficiency and leave loopholes. However, the digital economy has a bright future because it promotes productivity, improves consumer welfare, promotes sustainable development, and thus is in the interests of the majority of people.

In the post pandemic era, governments and companies should learn from the lessons of the pandemic and attach importance to the digital economy and promote its application, and during this process, face the problems, resolve the obstacles, and leverage the advantages to promote productivity development. With digital transformation having been catalyzed by the pandemic, governments and companies should continue to promote the digitalization of different aspects of production by IoT and cross-industry technology integration. Governments and companies should also pay attention to the safety of the internet platforms with investment and policy support. Meanwhile, the governments should formulate regulations that balance efficiency and fairness, cost and safety. In the foreseeable future, the trend of economic transformation towards digitalization will not change, and the digital economy is likely to reach unprecedented prosperity with the continuous advancement of technology, improvement of supervision, and expansion of applications.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

- [1] Cheng, W.X., Qian, X.F. (2021) *Digital Economy and China's Industrial Green Total Factor Productivity Growth. Exploration of Economic Issues*, (08), 124-140.
- [2] Shao, S., Zhang, K., Dou, J.M. (2019) *Energy-saving and Emission-reduction Effect of Economic Agglomeration: Theory and Chinese Experience. Manage the World*, (01), 36-60+226.
- [3] Gamil, Y., Alhagar, A. (2020) *The Impact of Pandemic Crisis on the Survival of Construction Industry: a Case of Covid-19*.
- [4] Mandal, H. (2020) *R&D and Innovation Approaches in the Postpandemic Period. Reflections on the Pandemic in the Future of the World*, 195–216.
- [5] Gül, S., Arzum, B. (2023) *The Effects of COVID-19 Outbreak on Supply Chains and Logistics Activities*.
- [6] Halit K. (2023) *The Future of the Sectors and the Change of the Firms in the Post-pandemic Period*.
- [7] Huang, S.K. (2015) *Transformation and Upgrading of Manufacturing Industry: Germany's "Industry 4.0" Enlightenment. Study and Practice*, (01), 44-51.
- [8] Li, C.F., Li, D.D., Zhou, C. (2020) *Mechanism of Digital Economy Driving the Transformation and Upgrading of Manufacturing Industry — Analysis From the Perspective of Industrial Chain. Business Research*, (02), 73-82.
- [9] Bayram E. (2024) *Transformation in Consumption and Spending Practices in the Post-pandemic Period*.
- [10] Halit K. (2022) *The Future of the Sectors and the Change of the Firms in the Post-pandemic Period*.