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Digital Economy, New Quality Productivity and Economic Growth: Mediating Role Based on Technological Innovation

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Abstract: Under the background of the current global economic transformation and the rapid development of information technology, technological innovation, as the core driving force of development, has a significant impact on the progress of digital economy and new quality productivity. In this context, this paper explores the relationship between digital economy, new quality productivity, and economic growth, focusing on the role of technological innovation. It analyzes theoretical basis, literature review, current situation, dynamic analysis, and innovative strategies to provide practical guidance and new ideas for policymakers and businesses.

1. Introduction

The digital economy, new quality productivity, and technological innovation are crucial for the development of countries in the era of globalization and information technology. The digital economy drives global economic growth by providing new business models and market opportunities. New quality productivity is the foundation of the digital economy, focusing on technological innovation and optimal allocation of production factors to improve economic growth efficiency. Technological innovation has become the core driving force for the development of the digital economy, promoting efficient flow and upgrading industries, enhancing value levels and market competitiveness.

This paper analyzes the digital economy's development status and influencing factors, focusing on new quality productivity and its role in the digital economy. It uses literature review, case analysis, and a comprehensive analysis framework to understand the interaction and influence mechanisms among these factors. Through this analysis framework, the paper aims to reveal the new impetus of economic growth and policy making direction in the digital economy era.

2. Literature review

2.1 Relevant research on digital economy

The digital economy is a rapidly evolving economic model that utilizes digital technology for production, exchange, and consumption. It leverages the Internet, big data, and artificial intelligence

to create value and break traditional time and space boundaries. This model enhances information circulation efficiency and encourages frequent commercial activities. Academic studies have extensively studied the digital economy and its impact on society, resulting in numerous research results.

The connotation of digital economy has many interpretations and definitions in the academic world, but generally emphasizes the central role of information and data in modern economic activities. From different theoretical perspectives, scholars have conducted in-depth discussions on the concept of digital economy. For example, Pei Changhong analyzed the impact of digital economy on traditional economic theories from the perspective of political economy, while Chen Xiaohong systematically reviewed the research on digital economy, including its connotation, characteristics and development trend. Foreign scholar Don Tapscott predicted the far-reaching impact of the Internet on economic activities earlier, while Kling R and Lamb R distinguished the digital economy from the information economy and highlighted the particularity of digital goods, services and information technology industries. Wu Jiapei regards the digital economy as the product of the information revolution, which is equivalent to such concepts as information economy, network economy and knowledge economy. Li Xiaohua regards the digital economy as a key driver of kinetic energy transformation, characterized by innovation, high-speed growth, network effect, and competitiveness. This theory is crucial in the modern economic system and is defined by government, industry associations, and enterprises. Its core elements include data resource utilization, modern information networks, technical efficiency improvement, and economic structure optimization. Understanding the complexity and importance of the digital economy is central to understanding its role in the modern economic system. The following is the definition of the digital economy by various domestic institutions, as shown in Table 1.

Table 1: Definitions of the digital economy by agencies

Issuing Authority (Year)	**The definition of the digital economy**
G20 Hangzhou Summit (2016)	The digital economy, fueled by modern information technology, significantly enhances production efficiency and economic structure optimization through the extensive use of ICT.
National Bureau of Statistics (2021)	China's National Bureau of Statistics categorizes the digital economy into digital industrialization and industrial digitalization, with the former focusing on digital economy development and the latter on traditional industry transformation.
China Academy of Information and Communications Technology (2020)	Information infrastructure is vital for the development of a digital economy, fostering an intelligent, networked society and accelerating the transformation of economic structure and governance.
OECD (2016)	Digital technologies like the Internet, cloud computing, big data, and artificial intelligence are significantly enhancing economic activities, boosting productivity, introducing new business models, and boosting global economy vitality.

The G20 Hangzhou Summit in 2016 highlighted the digital economy, based on ICT, where data and information replace traditional resources, driving economic growth. The internet and information networks facilitate efficient knowledge transfer, unlocking potential and promoting intelligent upgrading. China's National Bureau of Statistics categorizes the digital economy into digital industrialization and industrial digitalization. CAICT emphasizes the importance of information networks in the digital economy, while the OECD highlights the role of digital technologies in improving productivity and injecting new vitality into the global economy.

Scholars have conducted a lot of research on the impact of the digital economy on the economy and have drawn a wealth of conclusions. These studies reveal the important role of the digital

economy in macroeconomic growth, mid-level industrial transformation, and micro-enterprise development [1].

The digital economy optimizes resource allocation, promotes economic growth, and innovates business models, enhancing output efficiency and transforming market structures, according to research by Yang Xinming and Pei Changhong.

At the industrial level, the digital economy has significantly impacted the industrial level, promoting the digital transformation of traditional industries and the rapid development of emerging ones. This has improved competitiveness and innovation by upgrading traditional industries using digital technology. Research by Bai Xuejie and Yi Xianrong highlights the reverse integration of service, industry, and agriculture, leading to digital transformation through industrial internet and intelligent manufacturing, resulting in new business forms and models.

At the enterprise level, the digital economy fosters innovation in business operations and management models, breaking down internal and external boundaries. Research by Qi Yudong and Xiao Xu highlights its potential for improving internal operational efficiency and fostering cross-regional and cross-institutional cooperation. This model focuses on instant data sharing and virtual federated platforms for value creation. See Table 2.

Table 2: Effects of new quality productivity on economy

Research perspective	Representative study	viewpoint
macroscopic	Yang Xinming (2017) Pei Changhong (2022)	The digital economy optimizes resource allocation and macro-level factors, impacting traditional theories like the "invisible hand" and the principle of diminishing marginal returns.
Middle view	Xuejie Bai (2022) Yi Xianrong, Chen Yingying and Wei Yushuang (2019)	Digital industrialization, driven by innovation, has led to the creation of diverse formats, industries, and business models, promoting digital transformation in enterprises.
microcosmic	Qi Yudong and Xiao Xu (2023) Wang Ruyu, Liang Qi and Li Guangqian (2018)	The digital economy is transforming enterprise organizations, fostering closer interaction and cooperation, blurring boundaries, and expanding business scope, as enterprises transition from closed entities to interconnected virtual network entities.

2.2. Literature research on new quality productivity

New quality productivity, first proposed by General Secretary in September 2023, aims to increase efficiency, quality, and sustainability in production capacity through scientific, technological, organizational, and management innovations. This stage of productivity development promotes industrial transformation and high-quality development in China's economy, focusing on technological breakthroughs, innovative allocation of production factors, and deep industrial transformation. See Table 3 for details.

Table 3: Definition of new quality productivity

perspective	Representative study	definition
Science and technology	He Defang and Liu Hui (2024)	The introduction of new technologies and equipment enhances automation and production intelligence, promoting industrial transformation and upgrading, making it the core of new quality productivity.

Management innovation	Zhang Zhixin, Zheng Xiaoming and Qian Chen (2024)	The "four-chain" integration of innovation, industrial, capital, and talent chains optimizes production processes, improves efficiency, and reduces costs, contributing to new quality productivity.
Institutional innovation	Wang Tinghui and Li Na (2024)	It is an important guarantee for new quality productivity. Optimize production relations, improve the market system, and provide a good environment and guarantee for the development of productive forces.

Table 4: Characteristics of new quality productivity

Representative study	The characteristics of new quality productivity
Sun Shaoyong and Li Shi (2024)	**Innovation-driven:** Innovation-driven development significantly alters traditional economic growth paths, promoting sustainable development through scientific research, production processes, and management systems, resulting in high technology, efficiency, and quality.
Cai Xiangjie and He zhengchu (2024)	**The improvement of total factor productivity:** New quality productivity boosts total factor productivity through increased capital and labor input, optimal technology allocation, and efficient management, emphasizing data elements' importance in innovation.
Li Xiaohua (2023)	**The establishment of new production relations:** New production relations foster quality productive forces, promote free flow, efficient allocation, market vitality, social creativity, and sustainable development by providing a relaxed environment.

New quality productivity, a form of advanced productivity achieved through efficient use of technology, management, and data, is crucial for sustainable economic and social development. It is a cornerstone in the new development concept and guides future development.

In order that further understand the impact of the emergence of new quality productivity, many domestic scholars have conducted a deeper exploration of its characteristics (see Table 4).

Future development should focus on deepening research and exploration of new quality productive forces for economic and social development. Continuous exploration and innovation can promote quality improvement, efficient development, equitable social distribution, and a sustainable model. This requires in-depth theoretical research and continuous optimization in practice.

2.3. Related research on economic growth

Economic growth is the continuous increase in material products and services in a country or region over a specific period, measured by the rate of change in real GDP per unit of population. It emphasizes the relationship between economic growth and living standards.

It is worth noting that economic growth involves both quantity and quality improvements. Research by Fan Jin, Hu Hanhui et al pointed to Kuznets, an American economist, viewed economic growth as a country's ability to offer diversified economic products over time, driven by advanced technologies, institutional changes, and mindset updates.

In summary, economic growth is a multi-dimensional concept, involving economic scale, production capacity, technical level and social structure. It not only focuses on short-term output increases, but also emphasizes long-term sustainability and improved quality of life.

The influencing factors of economic growth (GDP) are mainly divided into four aspects, namely, system factor, industrial structure factor, labor factor and capital factor. First, institutional factors are one of the most important factors affecting economic growth. Specifically, the shift in property rights, marketization, and international trade significantly boosts economic growth by promoting investment, resource allocation, social fairness, and competitiveness. The second factor proposed by Li Ruzi and Liu yaobin is industrial structure, which includes the proportion of the primary industry, the

secondary industry and the tertiary industry, especially the proportion of the number of employees in the secondary and tertiary industries in the total number of employees. The development level of secondary and tertiary industries significantly influences the overall quality and level of economic development in the modern economy. Mi Juan also posits that the labor force, comprising education and skill levels, is a crucial factor influencing economic growth, as an increase in employment can significantly boost productivity. The last factor Wang Hongwei mentioned is capital. The capital factor, comprising material, human, and knowledge capital, improves production efficiency, drives economic growth, and promotes sustained growth. Improving per capita human capital boosts productivity and innovation[2].

2.4. Comprehensive review

In recent years, the digital economy and improved productivity have gained academic attention, but current research is insufficient due to insufficient theoretical systems, single methods, limited empirical analysis, and interdisciplinary research. Future research should deepen the theoretical system, expand methods, and strengthen empirical analysis.

3. Digital economy, new quality productivity development status and endogenous dynamic analysis

3.1. Analysis of current situation and endogenous dynamics of digital economy

From 2017 to 2022, the market size of China's digital economy industry continued to grow, breaking through 50 trillion yuan for the first time in 2022, reaching 50.2 trillion yuan. From 2017 to 2022, the market size of China's digital economy industry has increased by a total of 23 trillion yuan, nearly doubling. Overall, the overall development potential of China's digital economy industry is large, and the industry has a large space for development[3].

The data from 2017 to 2022 show that the industrial digitalization part of China's digital economy accounts for about 80%, while the digital industrialization part is stable at about 20%. In 2022, digital industrialization is projected to reach 41.0 trillion yuan, with the Internet, big data, and artificial intelligence playing crucial roles in promoting innovation and consolidating advantages. The digital economy's rapid development is driven by various factors, including market demand, technological innovation, policy support, enterprise digital transformation, industrial chain synergies, talent training, and knowledge popularization. Market demand, technological innovation, government policy support, and industrial chain synergy drive digital product and service development. Government policies like the National Development and Reform Commission support small and medium-sized enterprises, while Haier Group implements digital reforms. Industrial chain synergy promotes data interoperability, and talent training improves society's understanding of the digital economy[4].

3.2. Technological innovation status and endogenous dynamic analysis

Primarily, China's high technology dependence, with over 50% foreign-dependent, necessitates importation of over half of its technical elements. Science and technology contribute 30% to economic growth, with only 0.03 percent of domestic companies having independent intellectual property technology. To become an innovative country, China needs to increase its contribution to economic growth.

On the top of that, there is a disconnect between science and technology and the economy, and it is difficult for high-tech research results to be quickly transformed into real productive forces. China's high-tech research faces challenges in transforming into productive forces due to a disconnect

between science, technology, and the economy, inadequate docking mechanisms between research and industry, and insufficient cooperation between employers and scientific research institutions. For example, Tsinghua University and an electronic manufacturing enterprise collaborate to establish a joint laboratory, enabling timely access to scientific research results for product development. However, the current investment and financing system is inadequate for new technology research, as seen in a drone technology start-up struggling to complete development due to lack of funds. The lack of high-level innovative personnel in the US is a systemic issue that requires comprehensive measures. This includes improving the docking mechanism between scientific research and industry, perfecting the investment and financing system, and optimizing personnel training and use mechanisms. This will help bridge the gap between science, technology, and the economy, promoting innovation and industrial transformation[5].

3.3. Analysis of current situation and internal causes of economic growth

At present, the global economy is in a profound transition period, and economic growth has shown new dynamics and characteristics. According to the International Monetary Fund's latest World Economic Outlook Report, global economic growth is forecast to slow from 3.5 per cent in 2022 to 3 per cent in 2023, before recovering slightly to 2.9 per cent in 2024. In this context, China's economy is also facing certain downward pressure but driven by the government's policy support and internal momentum, the economy has shown signs of stabilization.

China's domestic demand market drives economic growth, with investment and consumption playing key roles. High-tech industries, particularly tourism, are key drivers, with the government accelerating technology development through tax incentives, financial support, and policy support. For example, BYD and other enterprises have made significant breakthroughs in battery technology and vehicle design, occupying a leading position in both domestic and international markets. Macro-policy is also essential for ensuring economic growth, with sales of new energy vehicles reaching 1.8 million in 2022. The Chinese government has implemented a proactive fiscal and monetary policy to support stable economic growth. In 2020, they allocated 1 trillion yuan for local infrastructure construction and livelihood protection projects. The People's Bank of China lowered reserve requirement ratio and interest rates to release liquidity and reduce financing costs. Also, the government has increased investment in education, enhancing labor force quality and saving energy for long-term development. The National Vocational Education Reform Implementation Plan aims to create 50 outstanding higher vocational and technical colleges and 150 leading undergraduate majors by 2022. The gross enrollment rate of higher education is expected to reach 57.8% in 2021, ensuring talent for high-quality economic development. The internal causes of China's economic growth are multidimensional and require integration from domestic market, technological innovation, macro policies, and education.

3.4. The mediating role of technological innovation in digital economy and new quality productivity

Technological innovation is a key driver of the digital economy, fostering new business models, enhancing production efficiency, reducing costs, and enhancing product and service quality. It also influences the job market structure and labor demand. IBM believes that AI will positively impact productivity and open new opportunities across industries. On the one hand, Zeng Shihong and Gao Chen pointed out that technological innovation can improve production efficiency and reduce the need for certain types of work, while creating new jobs in emerging fields such as data analytics, artificial intelligence and cybersecurity. On the other hand, the International Labor Organization's research report points out that generative AI is more likely to increase employment opportunities than

to impact the job market[6-8].

Furthermore, technological innovation promotes the formation of new quality productivity. Technological innovation enhances productivity and economic growth by introducing new methods, improving products and services, optimizing resource allocation, and transforming traditional industries, thereby improving production efficiency and output quality, Tangsong et al. mentioned. The positive externalities of technological innovation cannot be ignored. It includes the knowledge spillover effect, which enhances innovation capacity and competitiveness by allowing learning from other enterprises and industries. This knowledge dissemination promotes wide technical knowledge dissemination, forming a solid foundation for new quality productivity. In this context of new quality productivity, Qian Xiaojing believe that the role of technological innovation is far more than that. It not only changes the combination of production factors, but also promotes the optimization of economic structure and the upgrading of industry. By introducing new technologies and management methods, enterprises can use resources more effectively, improve production efficiency and reduce costs. At the same time, technological innovation has also promoted the rise of emerging industries and the transformation and upgrading of traditional industries, providing a strong driving force and support for economic development.

And then, technological innovation contributes to economic growth. Technological innovation plays a crucial role in driving economic growth. Technological innovation has improved production efficiency and product quality, making enterprises more competitive. Automation and intelligent technology have led to stable products. Internet technology has created new industries like e-commerce, online education, and logistics, creating job opportunities and supporting sustainable economic development. Big data and artificial intelligence have further improved production efficiency and scientific decision-making, boosting economic growth.

Additionally, the role of technological innovation in the relationship between the three. Technological innovation plays a crucial role in the relationship between the digital economy, new quality productivity and economic growth, acting as a bridge and a link [9-11].

Technological innovation not only drives the rapid development of the digital economy but also enhances productivity. It integrates with traditional industries, transforming them and fostering economic growth. Technologies like cloud computing, big data, and IoT improve production efficiency and product quality, offering new development opportunities and business models for all.

Technological innovation is the key driving force for the formation of new quality productivity. It integrates with traditional industries, transforming them and fostering economic growth. Technologies like cloud computing, big data, and IoT improve production efficiency and product quality, offering new development opportunities and business models for all.

Technological innovation enhances economic growth by enhancing production efficiency, reducing costs, and expanding growth spaces. Emerging fields like internet finance and sharing economy diversify markets, balancing development with environmental sustainability and improving resource efficiency [12-13].

4. Policy suggestions

To begin with, we need to deepen the integration of the digital economy with the real economy. Accelerating digital transformation and upgrading traditional industries is crucial. Advanced information technologies like big data, artificial intelligence, and cloud computing can transform industries and achieve industrial upgrading. For instance, a steel enterprise improved production efficiency and reduced operating costs by 20% and 15% through industrial Internet technology implementation. Ye Ziqing and Zhang Yingxi believe that accelerating digital transformation and upgrading traditional industries is the first step. They suggest that technology foresight systems help

anticipate trends, guide industrial transformation, and promote digital advancements, particularly in intelligent production equipment, process optimization, real-time monitoring, efficiency improvement, and personalized customization in automobile manufacturing. Ren Baoping emphasizes the importance of fostering new economic growth, accelerating digital infrastructure construction, and promoting industrialization through digital quality productivity. He believes that digital infrastructure is the foundation for the development of a digital economy and the upgrading of traditional industries.

Secondly, we need to improve preferential tax policies for the digital economy. The government can provide a certain percentage of income tax relief, such as reducing tax rates or providing tax credits. Such measures can effectively improve the profitability of enterprises, so that enterprises have more funds for technology research and development and market expansion. Chuanshan District in Suining City suggests that the government can offer preferential tax policies to stimulate the digital economy industry. These policies include pre-tax deductions for R&D expenses, which encourages increased investment and substantial tax concessions. Additionally, the government can offer tax incentives to enterprises utilizing advanced technologies like AI, big data, and blockchain, thereby aiding small and micro enterprises in their early stages of entrepreneurship by reducing value-added tax rates [14-15].

Thirdly, we need to strengthen digital infrastructure. The development of new infrastructure, including 5G and data centers, is crucial for the digital economy. Local governments are providing high-speed, stable networks for enterprises, promoting rapid development. This initiative supports the digital transformation of traditional industries and deep integration of the digital and real economy. Promoting data sharing and openness, a unified data standard, and a government data sharing platform are also essential.

Moreover, the government should optimize the mechanism of talent training and introduction. Optimizing personnel training and introduction mechanisms is crucial for promoting technological innovation and industrial upgrading. Strengthening vocational education and higher education can foster high-quality technical personnel. Colleges can attract high-level innovative talents through partnerships with enterprises, favorable treatment, and a good scientific research environment. High-tech enterprises partnering with internationally renowned universities can lead to significant technological breakthroughs and market competitiveness [16-18].

Finally, improving the digital economy governance system is also a necessary measure that the government needs to take. The digital economy governance system requires enhancement, including the creation of laws and regulations protecting legitimate rights and interests. Local governments have adopted "Data Protection Regulation" to clarify data collection, use, and transmission norms. Strengthening international cooperation is crucial for global digital economy governance, with China actively participating in WTO negotiations and promoting fair, transparent, and inclusive international rules.

Through the above policy recommendations, we can effectively address the existing problems of the digital economy and technological innovation and promote high-quality economic development. These measures not only encourage technological innovation and industrial upgrading but also ensure sustainable development by benefiting a wider group [19-20].

5. Conclusion and prospect

5.1. Research conclusion

This paper explores the link between digital economy, new quality productivity, and economic growth. It argues that technological innovation is crucial for promoting the development of digital economy and new quality productivity. This innovation enhances production efficiency, reduces costs,

and promotes industrial upgrading. However, it also highlights the challenges of insufficient innovation and privacy security in the current digital economy, while technological innovation faces issues disconnected from the economy and heavily reliant on foreign countries.

With the aim of dealing with these challenges and problems, this paper discusses strategies to address challenges in the digital economy and real economy, including strengthening technological innovation, creating an industry-university-research platform, fostering collaborative innovation, breaking traditional boundaries, and promoting open data sharing.

5.2 Innovation of the paper

Firstly, by reviewing and sorting out relevant literature, this paper explores the digital economy and its impact on productivity and the current economic environment, highlighting its advantages in adapting to The Times and highlighting the importance of technological innovation in future research [21-23].

Secondly, this paper examines the digital economy and technological innovation, highlighting its advantages and challenges, and its motivations. It concludes that technological innovation is crucial for new quality productivity and economic promotion.

Finally, based on the above problems and combined with the current situation and motivation analysis, this paper screens the relevant paths and puts forward an innovation strategy of the mechanism of the joint action of various subject units, which is conducive to solving the problem of insufficient impetus for the development of digital economy and technological innovation.

5.3 Outlook

Although this paper has made some achievements, it also has some limitations. Initially, the theoretical review and literature review in this paper are mainly based on the existing research results, while the connotation of digital economy and new quality productivity is extremely extensive, resulting in the failure of comprehensive and in-depth research in dynamic changes and specific fields, with a small coverage[24-25].

Simultaneously, the research object of this paper tends to generalize in the general direction, such as macro, miso and micro aspects, while ignoring the differences between individuals and the uniqueness of hell, which needs further in-depth research.

In addition, in terms of research methods, it relies too much on theoretical analysis of literature review, and the empirical research of digital economy is mainly based on quantitative data, which may not fully reflect the complex job market situation in reality and cannot fully understand the changes and real conditions of digital economy and technological innovation in the economic environment, thus reducing the persuasive power of the article.

Future research on the digital economy should expand its scope, refine its research object, adopt diversified methods, and strengthen interdisciplinary cooperation. This includes dynamic changes, domain-specific studies, regional and national differences, and specific case studies. Diversified research methods like empirical, case studies, and experimental can help understand the digital economy's impact on the job market and economic environment.

With the continuous upgrading and iteration of scientific and technological innovation, the digital economy is constantly evolving due to scientific and technological innovation, presenting both challenges and opportunities. Therefore, to capitalize on these, we must address digital skills development, education, the digital divide, privacy protection, and collaborate with government, enterprises, and society to promote economic growth and social progress.

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