

Technological Innovation and Economic Growth: Global Trends and National Differences

Ning Luo

Faculty of Business, Nanjing University of Science and Technology Zijin College, Zhejiang, Tonglu
Daqishanjun, 311500, China

13151586828@163.com

Keywords: Technological Innovation; Economic Growth, Global Trends; National Differences; Case Studies

Abstract: This paper explores the relationship between technological innovation and economic growth, taking a global perspective on trends and national differences. Firstly, it provides a definition and classification of technological innovation, delving into its impacts on productivity, industrial structure, and employment opportunities. Secondly, through case studies of developed countries such as the United States and emerging economies like China, India, and Singapore, it reveals the advantages and challenges each country faces in the realm of technological innovation. Simultaneously, by examining national differences in institutional environments, educational systems, and policy support, it uncovers the diversity within the global competition of technological innovation. In the case studies, the successful technological innovation experience of South Korea underscores the importance of comprehensive and coordinated national strategies, while the failure case of Nigeria suggests the intertwined factors of politics, education, infrastructure, and others. The comprehensive analysis concludes that a country's performance in technological innovation is influenced by multiple factors, including policy support, education and research and development (R&D) investment, and institutional environments. The global landscape of technological innovation exhibits diverse trends, necessitating countries to construct well-guided national systems for technological innovation under government leadership. This will facilitate the application of technological achievements and contribute to sustainable global economic development.

1. Introduction

The close relationship between technological innovation and economic growth has always been the focus of economics, industrial policy and global competitiveness research. In the era of globalization and digitization, technological innovation is not only a key factor in national competitiveness, but also an engine for social progress. This paper aims to provide an in-depth exploration of the global trends in technological innovation, with a focus on differences between countries. First, we will start from the concept of technological innovation and analyze its connotation at different levels and fields. Then, it focuses on the impact of technological innovation on economic growth, including changes in technological progress, industrial structure and employment opportunities. Next, through in-depth analysis of developed and emerging economies, we will reveal the dominance of global technological innovation and the rise of emerging forces^[1]. At the national level, we will examine the impact of institutional environment, education and R&D investment, policy factors, etc. on the shaping of scientific and technological innovation, and reveal the national differences behind it. Finally, through case studies, we will analyze some countries that have succeeded in technological innovation and those that face economic and innovation challenges. Through this comprehensive and in-depth discussion, we aim to provide deep insights into the driving force of technological innovation on economic growth and the performance of different countries around the world in this field.

2. Definition and scope of technological innovation

2.1 Analysis of the concept of technological innovation

Scientific and technological innovation refers to the process of promoting social and economic development by introducing new ideas, methods, products or services, and improving existing technologies and processes in the process of scientific research, technology development and knowledge application. Scientific and technological innovation is not only the invention of new technologies, but also includes the application and promotion of these technologies in actual production and economic activities^[2]. First of all, scientific and technological innovation covers a wide range of fields, including natural sciences, engineering technology, medicine, information technology, etc. It includes both breakthroughs in basic research and the practice of applied research, reflecting the coordinated development of science and technology. Secondly, scientific and technological innovation is not only the update of technology, but also involves many aspects such as society, economy, and culture^[3]. It can not only change the mode of production and improve production efficiency, but also promote changes in social structure and affect people's lifestyles. Globally, technological innovation has become the core of national competitiveness and a key factor in promoting economic growth and improving international competitiveness. The investment and practice of countries, enterprises and individuals in scientific and technological innovation directly affect their status in the global scientific and technological system. Figure 1 shows the analysis of the concept of technological innovation.



Figure 1 Analysis of the concept of technological innovation

2.2 Different levels and fields of scientific and technological innovation

Technological innovation is not just a single concept, but covers multiple levels and a wide range of fields. First of all, the contribution of scientific and technological innovation in basic research cannot be ignored, which includes in-depth exploration of basic scientific principles and the establishment of new theoretical frameworks. At the same time, innovation at the applied research level applies these theories to practical problems and promotes the development and improvement of technology. In addition, innovations in engineering technology drive industry progress by translating scientific principles and technological applications into practical products and services. The interaction between these three levels constitutes the entire process of technological innovation. In the field of scientific and technological innovation, the scope is very wide. Information technology, biotechnology, new materials, energy technology and other fields are important directions for scientific and technological innovation. The rapid development of information technology has not only changed our lifestyle, but also spawned new business models and forms of social organization. Breakthroughs in biotechnology not only promote progress in the medical field, but also play a huge role in agriculture and environmental protection^[4]. Innovations in new materials and energy technologies are directly related to issues of industrial manufacturing and sustainable development. Therefore, technological innovation is not just a narrow field, but a comprehensive driving force involving almost all industries and fields. By in-depth understanding of technological innovation at

these different levels and fields, we can better grasp the context of global technological development and provide sustained impetus for economic growth.

3. The impact of technological innovation on economic growth

3.1 Technological progress and productivity improvement

Technological progress is one of the core driving forces of scientific and technological innovation on economic growth, and it has a profound impact on productivity improvement. First, the introduction of new technologies and the adoption of innovations often lead to increased efficiency in the production process^[5]. The application of automation, digitalization and intelligent technologies, such as the Internet of Things, artificial intelligence and big data analysis, not only simplifies the production process but also improves resource utilization efficiency. The application of these technologies has promoted fundamental changes in production methods in manufacturing, service industries and other fields. Secondly, technological progress also promotes the emergence of new products and services, thereby promoting market innovation. The launch of new products often drives the development of related industrial chains, creates new market demand, and then promotes the upgrading of the entire economic system. For example, in the field of information technology, the continuous introduction of new electronic products, software applications and communication technologies has greatly expanded the market space and promoted the vigorous development of related industries.

3.2 The impact of innovation on industrial structure

Scientific and technological innovation plays a key role in industrial structure and leads the structural transformation of the economy. First of all, innovation promotes the rise of emerging industries and drives the upgrading of industrial structure. Innovations in emerging technology fields, such as artificial intelligence, biotechnology and new energy, often become new economic growth points. The rise of these industries not only creates new business opportunities, but also changes the pattern of traditional industries^[6]. Secondly, innovation promotes the upgrading and optimization of traditional industries. By introducing new technologies and improving production processes, traditional industries can improve efficiency, reduce costs, and remain competitive. Taking the manufacturing industry as an example, advanced automated production lines and digital management systems make traditional industries more competitive and thus play a more important role in the global value chain. Innovation also promotes industrial integration and breaks the boundaries of original industries. Through technological crossover and knowledge integration, new industrial forms have emerged between different fields. For example, the combination of digital technology and health care has given rise to digital medicine, and the integration of smart manufacturing and green technology has created new industries with sustainable development.

3.3 Technological innovation and employment opportunities

Technological innovation not only has a profound impact on production methods and industrial structure, but also shapes the face of the job market. First, technological innovation has promoted the rise of emerging industries and created a large number of high-skilled jobs. The widespread application of new technologies requires high-quality talents with corresponding professional knowledge and skills, such as artificial intelligence engineers, data scientists, etc., thus increasing the demand for high-skilled positions. Secondly, technological innovation has changed the labor demand of traditional industries. With the widespread application of automation and intelligent technologies, some tedious and repetitive tasks are gradually replaced by machines, but at the same time, new job opportunities have been created that require the maintenance, development and management of these technologies. Not only that, technological innovation also promotes the development of entrepreneurship and independent innovation, and promotes the emergence of small enterprises and start-up companies. This innovation ecosystem provides more opportunities for entrepreneurs and creates more entrepreneurial jobs, thereby promoting diversity and flexibility in the job market.

4. Global scientific and technological innovation trends

4.1 The dominant position of developed countries in scientific and technological innovation

(1)U.S. technological leadership

The United States has always been at the forefront of global technological innovation and has become the world's leader in science and technology. First, the United States invests heavily in basic scientific research and has world-class universities and research institutions. This provides a solid foundation for scientific and technological innovation, cultivates a large number of scientists and engineers, and lays a talent foundation for innovation. Secondly, the United States occupies a dominant position in high-tech industries and enterprises. The Silicon Valley area has become synonymous with global technological innovation, gathering many high-tech companies and nurturing many innovative projects. The corporate culture of the United States focuses on venture capital and entrepreneurship, which has promoted the emergence of many start-up companies and thus maintained competitiveness in the global market.

The U.S. government also plays an active role in technological innovation. The substantial increase in national science and technology policy and R&D investment has provided strong support for scientific and technological innovation. In addition, the flexibility of the regulatory environment and the protection of intellectual property rights have attracted a large number of international scientific and technological talents and investments.

(2)Singapore's technological innovation trends

Singapore has performed well in the field of technological innovation and has become one of the technological hubs in Southeast Asia. First, Singapore focuses on building high-level R&D infrastructure and has first-class research institutions and universities. The government encourages industry-university-research cooperation to better transform scientific research results into practical applications and promote innovation. Secondly, Singapore is known for its innovation-friendly policy environment. The government encourages companies to increase investment in R&D through incentives, tax incentives, and R&D funding. In addition, the flexibility of the regulatory system and the protection of intellectual property rights provide strong support for innovation, attracting international companies to set up R&D centers in Singapore. Singapore is also committed to promoting the development of digital and smart technologies. In the field of digital economy and artificial intelligence, Singapore has adopted active policy measures to promote the innovation and application of digital technology and enhance the country's technological level.

4.2 The rise of emerging economies

(1)The rise of China's technological innovation

In recent years, China has made remarkable achievements in the field of scientific and technological innovation and has become one of the global leaders in scientific and technological innovation. First of all, the Chinese government strongly supports scientific and technological innovation. Through a series of policy documents such as the "National Medium and Long-term Science and Technology Development Plan", it has clarified the key development directions in the fields of artificial intelligence, biotechnology, new energy and other fields, providing a basis for scientific and technological innovation. Strong policy support. Secondly, China continues to increase its investment in scientific and technological research and development, not only the investment of government funds, but also the active participation of enterprises and social capital. This kind of investment from the whole society has enabled China to achieve remarkable research and development results in a series of cutting-edge scientific and technological fields, such as leading the world in 5G communications, artificial intelligence, gene editing and other fields. China has also emerged in international science and technology competition and actively participated in global science and technology governance and international cooperation. The globalization strategy of Chinese companies, such as the global layout of Huawei, Alibaba and other companies, has further promoted China's influence in international technological innovation. In terms of building an innovation system, China has promoted the in-depth integration of industry, academia and research, and built a series of high-level scientific research institutions and technology parks. The close

cooperation between universities and enterprises and the cultivation of scientific research talents also provide a solid foundation for China's scientific and technological innovation.

(2) Technological progress in emerging economies such as India

Emerging economies, especially India, are rapidly emerging as important forces in global technological innovation. First, India has made significant progress in the field of information technology and has become one of the major global providers of software services and information technology solutions. Indian technology companies are gradually emerging in the global market and creating huge economic value for the country. Secondly, the Indian government actively promotes technological innovation and digital transformation through plans such as "Digital India". This includes investment and R&D in cutting-edge technologies such as artificial intelligence, the Internet of Things, and blockchain to promote India's competitiveness in global technological innovation. India has also made unremitting efforts in cultivating scientific and technological talents. It has a large young population and high-quality engineering and scientific professionals, providing a sufficient talent base for technological innovation. At the same time, India has further improved its domestic science and technology level by introducing foreign technical talents and cooperating with international universities. In terms of building an innovative ecosystem, India is constantly improving scientific research institutions, incubators and technology parks to provide a better entrepreneurial environment for start-ups. Indian start-ups have emerged in areas such as e-commerce, financial technology and healthcare, becoming a hot spot for global innovation and investment.

5. National differences and technological innovation

5.1 The impact of institutional environment on scientific and technological innovation

The institutional environment is one of the important influencing factors of scientific and technological innovation and directly shapes a country's innovation ecology. First, sound legal systems and intellectual property protection are the cornerstones of innovation. A stable and transparent legal system can provide protection for innovation, while an effective intellectual property system encourages innovators to invest in research and development and ensure that they obtain reasonable returns in the market. Second, public R&D funding and policy support play a key role in the institutional environment. By providing scientific research funds, tax incentives and industrial policies, the government can guide companies to increase investment in R&D and promote the development of scientific and technological innovation. The construction and operation of public R&D institutions also play an active role in promoting basic and applied research. In addition, the balance between market competition and supervision also affects technological innovation. On the one hand, competition encourages companies to improve their innovation levels; on the other hand, reasonable supervision ensures the safety and social responsibility of technological innovation. An open market environment and competition mechanism can encourage companies to pay more attention to innovation to stay competitive in the competition. Education and talent training in the institutional environment are also crucial. A country with strong scientific and technological innovation capabilities needs to cultivate talents with high-level scientific literacy. The institutional environment should provide support for the education system and encourage cooperation between academia and industry.

5.2 National differences in investment in education and R&D

National differences in investment in education and R&D directly affect the level of scientific and technological innovation. First of all, the high-level education system has cultivated outstanding scientific research talents and provided strong support for scientific and technological innovation. The state's investment in basic education, higher education, and vocational training determines the reserve and quality of future scientific and technological talents. For example, some developed countries focus on cultivating innovation awareness and practical capabilities, and strive to cultivate scientific and technological elites with global competitiveness.

Secondly, the state's financial investment in R&D directly affects the speed and breadth of

scientific and technological innovation. Countries that invest heavily in R&D are usually able to support more scientific research projects and promote breakthroughs in cutting-edge scientific and technological fields. This includes not only direct government funding for scientific research institutions and universities, but also incentives for companies to increase investment in R&D. Developed countries often regard R&D funding as an important part of national strategies, thus promoting the comprehensive development of scientific and technological innovation.

5.3 Policy factors shape the innovation ecology

(1) Promote community discussion in the digital age

Policy factors play a key role in shaping the innovation ecology, directly determining the country's competitiveness in the field of scientific and technological innovation and the health of the innovation environment. First of all, clear innovation policies and regulatory systems are the cornerstone of the innovation ecosystem. The government provides companies with a legal framework for innovative activities by formulating policies to encourage innovation, and encourages the development of venture capital and technology companies. Secondly, the formulation of science and technology industry policies is crucial to the formation of an innovation ecology. The government guides technology companies and innovation projects through industrial policies and supports the development of strategic emerging industries. For example, policy support for clean energy, biotechnology, artificial intelligence and other fields can create a good industrial environment and promote scientific and technological innovation in related fields. The government also promotes cooperation between scientific research institutions and universities through investment in scientific and technological innovation and support for scientific research projects, and promotes the in-depth integration of industry, academia and research. In addition, policy support also includes support for start-ups and small enterprises to encourage more innovators to enter the market.

Policies also play a key role in intellectual property protection, introduction and training of scientific and technological talents, etc. Building a flexible and stable intellectual property system and promoting effective protection of patents, trademarks and copyrights can provide sufficient incentives and protection for innovators.

6. Case studies

6.1 National cases of successful technological innovation

A typical successful case of technological innovation is South Korea. South Korea has emerged globally over the past few decades through systematic science and technology policies and investments. First of all, the Korean government has vigorously promoted the cultivation of scientific and technological talents. Through investment in higher education and research, a large number of high-level scientists and engineers have been trained, providing strong talent support for scientific and technological innovation. Secondly, South Korea focuses on the combination of basic research and technological innovation. The government encourages in-depth cooperation between industry, academia and research institutes, and promotes the transformation of basic research results into the market through the construction of science and technology parks and support for innovative enterprises. South Korea's business clusters and technology parks, such as Samsung and LG, have become leaders in the global technology industry. Korean technological innovation is shown in Figure 2.

The Korean government has also attracted investment from domestic and foreign companies by formulating clear science and technology policies and providing financial and tax incentives. This policy environment has created a good innovation ecology and promoted the rapid development of scientific and technological innovation.



Figure 2 Korean technological innovation

6.2 National cases of economic and innovation failure

As a typical case of economic and innovation failure, Nigeria faces a challenging technological innovation dilemma. Although the country is rich in natural resources, it has not been fully translated into sustainable economic growth and technological innovation. First of all, Nigeria has long been plagued by political instability and corruption. Political instability and poor governance have led to the country's long-term neglect of scientific and technological innovation and poor policy implementation. Secondly, Nigeria has large gaps in education system and R&D investment. The education system is weak and the training of scientific and technological talents is insufficient, resulting in a weak talent base for scientific and technological innovation. In addition, the government's investment in R&D is relatively low, resulting in a lack of financial support for scientific research institutions and innovative enterprises, making it difficult to conduct high-level scientific and technological research.

Nigeria also faces problems such as insufficient infrastructure and insufficient market competition. The lack of efficient infrastructure hinders the development of the technology industry, and the unhealthy market environment also makes it difficult for innovative companies to stand out from the competition.

7. Conclusion

The relationship between technological innovation and economic growth is one of the focuses of global development today. By discussing the definition and scope of technological innovation, the impact of technological innovation on economic growth, global technological innovation trends, national differences and technological innovation, case studies, etc., we can draw a series of conclusions.

First of all, technological innovation not only includes technological progress and productivity improvement, but also profoundly affects industrial structure and employment opportunities. Secondly, globally, developed countries such as the United States and emerging economies such as China, India, and Singapore are striving to achieve a leading position in technological innovation by formulating policies and increasing investment in research and development. At the same time, country differences in institutional environments, education systems, and policy support have led to the diversity of global scientific and technological innovation. In the case study, South Korea's successful experience in technological innovation emphasizes the importance of a comprehensive and coordinated national strategy, while Nigeria's failure case reminds us to pay attention to political stability, investment in education and other factors.

References

- [1] Zuo Z , Guo H , Li Y ,et al.A two-stage DEA evaluation of Chinese mining industry technological innovation efficiency and eco-efficiency[J].Environmental Impact Assessment Review, 2022, 9(4):106-107.
- [2] Davydiuk O .Economic and legal regulation of the technology subsystem of the National innovation system[J].Law and Innovative Society, 2020,2 (15):97-104.
- [3] Zhang Z , Chen Y .Building Scientific and Technological Innovation System of Adaptive to Economic and Social Development Trend[J].Bulletin of Chinese Academy of Sciences, 2020, 35(5):534-544.
- [4] Min Z .The New Trends and Developments of China-EU Scientific and Technological Innovation Cooperation[J].Global Economic Observer, 2019, 7(12):19-20.
- [5] Ma M , Xiong H .Upgrading of Technological Capability and Innovation Policy Transformation in China under a New Situation[J].Innovation and Development Policy, 2020, 000(002):83-98.
- [6] Kogan L , Papanikolaou D , Seru A ,et al. Technological Innovation, Resource Allocation, and Growth*[J]. The Quarterly Journal of Economics, 2017, 10(93):40-41.