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Contemporary Schools of Thought on Technological Innovation

Tong Yu

Danfeng County Human Resources and Social Security Bureau, Shaanxi, Shangluo City 726200, China

Abstract: Technological innovation is the most important source for enterprises to gain competitive advantage, and technological innovation management is a rapidly developing and comprehensive new discipline in recent years. Since Joseph Schumpeter first systematically described the theory of innovation, technological innovation research abroad has experienced more than half a century of development. This paper reviews the course of Western technological innovation theory research and comparatively analyzes the theoretical strands of the Neoclassical School of Innovation Theory, the New Schumpeterian School of Technological Innovation, the Institutional Innovation School, and the National Innovation System School, aiming to contribute to the advancement of domestic technological innovation theory research and development.

Keywords: Technological innovation; Schumpeter's innovation theory; Institutional innovation; National innovation system.

1. Introduction

For a long time, technological innovation was not the main focus of mainstream economics. Although most economists acknowledged its significant role in economic development, due to a lack of understanding and neglect of the laws of natural science, most economists focused their research on trade, employment, and other aspects. In traditional economic models, technology was often treated as a background condition rather than a core variable that could be actively analyzed. As a result, the real driving force behind long-term economic growth was largely overlooked in classical and neoclassical economic studies. It was only when Austrian economist Joseph Schumpeter, in his 1912 book The Theory of Economic Development, first proposed the basic concepts and ideas of innovation that technological innovation began to receive more serious attention. However, it wasn't until the 1950s that the theory of innovation economics gained attention. After World War II, global economic recovery and rapid industrial development made scholars realize that traditional inputs such as capital and labor could no longer fully explain the huge differences in economic growth rates between countries. Starting in the 1960s, with the rise of a new wave of technological revolution centered on microelectronics, the impact of science and technology on human economic life and social progress expanded continuously, making technology a key factor influencing the competitiveness of enterprises and nations. The study and application of technology and innovation theory has become a research hotspot for economists. This paper systematically reviews the origin and evolution of technological innovation theory, focusing on Schumpeter's economic innovation theory and its subsequent development by different academic schools. It also extracts important theoretical implications for China's innovation-driven economic development. The rest of the paper is organized as follows: Section 2 introduces the origin of technological innovation theory represented by Schumpeter; Section 3 analyzes the main development directions and schools of technological innovation theory; Section 4 summarizes the conclusions and enlightenment for China's economic practice.

2. The Origin of Technological Innovation Theory—Schumpeter's Economic Innovation Theory

The classical economists, including Adam Smith (1776), already recognized the importance of technological innovation for economic growth. In the Wealth of Nations, Smith discussed how the improvement of machinery and the division of labor promoted specialized inventions. He pointed out that the wealth of nations depends on division of labor, and one important reason why division of labor promotes economic growth is that it facilitates the invention of certain machines, which reduce labor input in production and increase labor productivity. This idea had elements of technological innovation [1]. Smith's thoughts reflected the early understanding of technology and production efficiency, but he did not form a systematic theory of innovation. Similarly, Karl Marx paid close attention to technological progress, considering technological innovation as central to the role of capital goods. In Capital, Marx argued that "the bourgeoisie cannot survive without constantly reforming production methods." He viewed technological and production method changes as significant driving forces in human history and regarded productive forces as the most active and revolutionary factor in social development [2]. However, neither classical economics nor Marxist economics established a systematic and independent innovation theory. Both of them regarded technological innovation as an exogenous variable in economic growth, rather than an endogenous core driving force. Therefore, their discussions on technology remained scattered and unsystematic. The first economist to clearly propose the theory of innovation economics was Schumpeter [3].

In 1912, Schumpeter first introduced the concept of innovation in The Theory of Economic Development—An Investigation into Profits, Capital, Credit, Interest, and the Business Cycle, where he discussed the impact of technological change on economic disequilibrium and social development instability [4]. Unlike traditional economics that assumed equilibrium as the normal state, Schumpeter believed that economic development comes from internal

changes rather than external shocks. He later published Business Cycles (1939) and Capitalism, Socialism and Democracy (1942), which supplemented and refined his innovation theory. Through these works, Schumpeter established a distinctive innovation economic theory system based on his theory of innovation [5].

His theory completely changed the way economists understand economic growth and laid the foundation for all modern innovation research. Schumpeter defined "innovation" as the "establishment of a new production function" by introducing a "new combination" of production factors and conditions that have never been used before, aiming to gain potential profits [6]. He referred to economic development as the execution of new combinations. These new combinations include:

Producing new products—products unfamiliar to consumers or new features of an existing product, i.e., product innovation;

Adopting a new production method—process innovation or technological innovation, which does not necessarily need to be based on scientific discoveries but can also involve new commercial ways of processing products;

Opening new markets—markets that the relevant country's manufacturing has not previously entered, regardless of whether the market existed before, i.e., market innovation;

Acquiring new sources of materials or semi-finished products, i.e., material innovation;

Implementing a new organizational form, i.e., organizational and management innovation.

Schumpeter's innovation concept primarily focuses on technological innovation, but also touches upon management and organizational innovations. He emphasized the integration of technological elements into the economy, positing that innovation is an economic concept rather than a purely technical one. He distinguished between invention—discovering new tools or methods—and innovation, which involves applying these new tools or methods. According to Schumpeter, inventions are often a part of innovation, but innovation is not necessarily dependent on invention; it is only when a new technology is applied in economic activity to generate profit that it becomes an innovation [7].

Schumpeters theory of economic innovation can be summarized into three main aspects:

Innovation and Economic Development: Schumpeter argued that innovation is the driving force behind economic growth and is central to the explanation of economic cycles. According to Schumpeter, economic development is an ongoing process of creative destruction, where innovation continually disrupts existing economic structures to create new ones [8].

Innovation and Entrepreneurs: Schumpeter introduced the role of the entrepreneur in the innovation process, stating that innovation occurs through the actions of entrepreneurs, who seek monopoly profits or excess profits. In Schumpeter's framework, entrepreneurs are the driving force of economic development and growth [9].

Innovation and Destruction: Schumpeter described economic innovation as a process of creative destruction, where existing enterprises are replaced by new, more efficient ones as a result of innovation. This process is necessary for economic growth, but Schumpeter also acknowledged the need for managing the collapse of outdated industries to avoid chaotic disruption [10].

Overall, Schumpeter's innovation theory broke through the traditional framework of neoclassical economics and placed innovation at the core of economic development. It laid the foundational theoretical position for the study of technological innovation in the field of economics.

3. Development of Technological Innovation Theory

After Schumpeter's innovation theory, technological innovation did not receive widespread attention until the 1950s, due in part to the influence of Keynesian economics. However, after the 1950s, many countries experienced a period of rapid economic growth, which could not be simply explained by traditional economic factors like capital and labor. This led Western scholars to study the relationship between technological progress and economic growth, thus advancing the development of technological innovation theory. Technological innovation theory has been developed through four main schools: the Neoclassical School, the New Schumpeterian School, the Institutional Innovation School, and the National Innovation System School [11].

The Neoclassical School, represented by scholars such as Romer and Lucas, regards technological progress as an endogenous variable. It emphasizes the roles of knowledge accumulation, human capital, and R&D investment in promoting long-term economic growth, and constructs a mathematical model to explain the internal mechanism of technological innovation and economic growth.

The New Schumpeterian School inherits and develops Schumpeter's core thoughts. It focuses on entrepreneurial behavior, R&D competition, market structure, and industrial dynamics, and further reveals how creative destruction drives enterprise competition and industrial upgrading.

The Institutional Innovation School, represented by North and others, believes that technological innovation alone is not enough. Effective institutional arrangements, property rights protection, and incentive mechanisms are the fundamental prerequisites for the emergence and diffusion of innovation.

The National Innovation System School, represented by Lundvall and Nelson, regards the country as a complete innovation system. It emphasizes the interactive cooperation among enterprises, universities, research institutions, and government departments, and stresses the importance of systemic integration for innovation efficiency.

In general, the development of technological innovation theory has gradually expanded from focusing on individual technological behavior to a comprehensive perspective involving enterprises, markets, institutions, and nations. The theoretical system has become increasingly complete and systematic.

4. Conclusion: Implications for China's Economic Development

Currently, China is in a critical period of transforming from factor-driven growth to innovation-driven development. Technological innovation has become the core support for achieving high-quality economic development and enhancing national competitiveness. Schumpeter's innovation theory and its subsequent development provide important theoretical reference and practical enlightenment for China.

Focus on Entrepreneurial Spirit: Schumpeter emphasized the role of entrepreneurs in driving innovation. Entrepreneurs are not simply profit-seekers; they are motivated by personal fulfillment and the drive to create new combinations in the

economy. In China, the institutional mechanisms for selecting and incentivizing entrepreneurs are still not fully developed. There is a need to foster an environment that encourages risk-taking and tolerates failure in order to cultivate more innovative entrepreneurs. Only by protecting entrepreneurial spirit can China continuously generate endogenous innovation power.

Orderly Industrial Reform: Schumpeter's theory of creative destruction suggests that innovation requires the destruction of old industries to make way for new ones. However, this process must be managed carefully to avoid sudden disruptions that could lead to economic instability. An orderly transition is necessary to ensure that traditional industries are gradually phased out rather than abruptly dismantled. China's industrial upgrading needs to follow the logic of creative destruction while maintaining economic stability.

Improvement of the Innovation System: Technological innovation is a complex process that requires a complete innovation ecosystem, including technological policies, innovation chains, talent, and culture. The government should play a central role in creating a comprehensive innovation ecosystem to maximize the potential of domestic and international research resources.

To sum up, attaching importance to technological innovation, respecting the role of entrepreneurs, promoting orderly creative destruction, and improving the national innovation system are important paths for China to draw on innovation theory and achieve sustainable economic development.

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