ISSN: 2688-9323

A Literature Review about the Relationship between Basic Research and Technology Catch-up

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Abstract

Based on recent academic aticles of basic research and technology catching up, starting from theory and practice, a summary of the relationship between basic research and technological catching up is formed. Then related literature is collected mainly from the following three aspects: The connotation of basic research and technology catching-up, the relationship between basic research and technology catching up, and the influence mechanism of basic research on the technology catching-up. Finally the author provides policy recommendations for the government by analyzing the role of basic research in promoting technology catching-up.

Keywords

basic research; technological capabilities; technology catching-up; literature review.

1. Introduction

Late-developing countries such as China mainly use its status as a "world manufacturing factory"to achieve technology catch-up with technological frontier countries by absorbing technological spillovers from frontier countries,imitating the cutting-edge technologies of multinational factories and using late-comer advantages. However, the United States and other developed countries advocated the "China Threat Theory", slowed down the pace of investment in China, and became more aware of technology segmentation and technology blockade. In this situation, researchers of china are looking for ways to improve the technological capabilities of late-developing countries. In recent years, in the process of seeking independent research and development to enhance technological capabilities, researchers have gradually focused on the field of basic research, believing that strengthening basic research is the key to solve the "stuck neck" problem. [1]

The technology catching-up of late-developing countries mainly comes from three aspects: technology spillovers in developed countries, "learning by doing" and local R&D activities. [2] At present, China mainly relies on the expansion of the total amount of research and development, which has led to the lack of "creative destruction" and the "leapfrog change" of technology catching-up has not been realized. How to promote technology catching-up and achieve the convergence of technological gaps has become a current researcher Hot topics of concern.

At the same time, technological capabilities is an important indicator to measure the unbalanced development of the world economy. Therefore, it is of strong practical and theoretical significance to use an empirical approach to incorporate basic research and technological level into an analytical framework to discuss the impact of basic research on technology catching-up.

ISSN: 2688-9323

2. Connotation

Basic research is the source of the entire scientific system, the basis for achieving major technological breakthroughs and seizing the intellectual property highland, and an important indicator of a country's comprehensive scientific and technological strength. [3] In a broad sense, the interpretation of the connotation of basic research refers to a research activity that recognizes phenomena, reveals laws, and acquires new knowledge, principles, and methods. Compared with applied research, basic research has the characteristics of relatively indirect purpose, stronger regularity of results, and longer conversion cycle, but its innovative results constitute the cognitive starting point for scientific development and technology catching-up [4].

Liu Xielin and others believe that for developing countries, as the technological level improves and the gap with the technological frontier continues to shrink, they should decisively reduce their dependence on foreign technology, pay more attention to strengthening basic research, and promote independent research and development of original innovation[5]. According to Liu Xielin's research, China's current basic research is driven by three factors: the curiosity of scientists, policy guidance, and industry demand drivers. Scientists' curiosity, policy guidance, and basic research driven by industrial demand, who can better promote technology catching-up and have a greater impact on improving the technological strength of emerging countries? The researchers conducted a series of explorations. Japan is one of the first countries to implement industrial development policies and it has achieved important research results by guiding the development of science and technology through industrial policies that control investment in basic research. When analyzing the technological innovation of China's high-speed rail industry, Liu Xielin and others found that in terms of technological demand and At the stage of introducing technology demand, the National Natural Science Foundation of China is more heavily funded, and government-guided basic research has a more obvious effect on technological innovation capabilities. Basic research driven by industrial demand mainly focuses on the verification stage of existing technologies. [6] Therefore, basic research with different motivations has different impacts on technical levels and can be further explored.

There are various ways to measure technological capabilities. From the macro level, domestic literature mostly uses total factor productivity and the quality of R&D personnel to measure the technical level of countries; From the micro enterprise level, there are indicators such as enterprise sales revenue, enterprise productivity, and invention patent quality to measure technology catching-up. [7]

3. Mutual Relations

Technology catching-up is also affected by many factors. The country's learning ability, technological foundation, education system, R&D investment, technological absorptive capacity, infrastructure, effective financial system, and the number of high-quality labor are all important factors affecting technology catching-up. In recent years, different scholars have conducted research on the above issues. However, when basic research has become a key topic, research on the role of basic research on technology catching-up has become a hot topic among scholars. Sheng Yanchao believes that the technology catching-up of late-developing countries is not only depended on their own technological capabilities, but also the technological gap with frontier countries. When the technological gap narrows, its ability to absorb technological spillovers from frontier countries will increase, which will further promote technology catching-up in late-developing countries and achieve technological catch-up. [8] Researchers such as Li Ping and Li Leilei believe that the adjustment of the R&D structure has an impact on the technological strength of emerging countries. When the intensity of basic research increases, it can bring a qualitative leap to technology catching-up. [9] Improving domestic R&D capabilities to promote

ISSN: 2688-9323

technology catching-up has become the consensus of most scholars. At present, some documents have proved this point.

Sun Zao and Xu Xuelu[10] incorporated basic research, applied research, and technological frontier gaps into an analysis framework, using technology gaps as context variables to study the effects of basic research and applied research on technological innovation performance at different levels of technology gaps Impact. Research shows that applied research has an overall "inverted U" curve for innovation growth. Basic research continues to have a positive impact on innovation growth. At a high technology gap level, the technology absorption effect is used to enhance the technology absorption capacity of applied research to promote innovation growth and achieve technology After the key point of the level, the negative effect of the marginal diminishing effect of excessive applied research investment is reversed through the innovation incentive effect. Although the importance of basic research is self-evident, most domestic researches currently believe that basic research can promote the technology catching-up of the industry, but there is a lack of dynamic analysis of the technology catching-up process. Therefore, this article has made a creative contribution to this aspect. Through theoretical review and literature review, the specific mechanism of basic research on technology catching-up is determined, as shown in 4.

4. Mechanism of Action

Salter and Martin [11] believe that the six contributions of government's basic research to economic growth are: increasing useful knowledge reserves, training skilled graduates, providing new instruments and methods, conducting network and social interaction, solving certain problems, and setting up a new company. This view is also recognized by most scholars.Furthermore, by sorting out the literature, the author concludes that the specific influence mechanism of basic research on technology catching-up is as follows:

4.1. Knowledge Transfer Effect

Bush proposed that innovation is carried out along a linear model of “basic research, applied research and product development”[12]. On this basis, Hu Wanli, Tang Shukun, etc.established a knowledge value chain model based on the R&D process[13] . The complete value chain of "basic research-applied research-product development-process development-technical services" completes the transfer of knowledge from basic research to technology realization.

4.2. Knowledge Absorption Effect

Liu Xielin believes that basic research is a necessary condition for technological learning in late-developing countries. To learn advanced foreign knowledge, especially tacit knowledge, one must have a certain ability to understand information. Therefore, basic research enables less-developed countries to effectively embed in the global knowledge network, so that they can better absorb and use advanced knowledge and skills[5].

4.3. Human Capital Effect

The enhancement of basic research also attracts the influx of talents to a certain extent, and has a certain magnetic effect on foreign specialized talents. Li Yan found through research that basic research, especially the enhancement of technological infrastructure construction, can promote technology catching-up by cultivating and gathering outstanding talents[14].

5. Conclusion

Basic research is the key to achieving technology catching-up in late-developing countries such as China. Although our country has entered the forefront of the world in terms of total R&D and investment, the per capita R&D and key technology research still lags far behind that of

ISSN: 2688-9323

developed countries. In recent years, the total R&D investment has increased year by year, but the proportion of basic research has always been small. To reverse the situation, we must focus on basic research. If we continue to ignore basic research, our country will miss a new round of technological catch-up opportunities. Therefore, we should give full play to the advantages of late-developing countries, enhance industry-university-research cooperation, increase government investment in basic research, improve the structure and mechanism of R&D investment, and focus on promoting the role of basic research in promoting key core technologies.

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