Journal of International Trade, Logistics and Law, Vol. 11, Num. 1, 2025, 440-445

TECHNOLOGICAL LEARNING: LESSONS FROM SOUTH KOREA AND CHINA

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Received: May 01, 2025 Accepted: May 23, 2025 Published: June 01, 2025

Abstract:
In the contemporary global economy, firms face competitive settings and must adapt to dynamic changes, particularly those operating in industrial sectors. The disparities in economic development among countries can be attributed to variations in technological advancement levels (Ghazinoory et al., 2021). Firms in developing countries, known as latecomers, aim to learn technology by following firms in developed countries. This path continues until latecomer firms achieve innovation. Developing countries have started to produce innovation by using technological learning and have a strong voice in the global market with their products. Technological advancements in developing countries have played a significant role in fostering economic growth. This study aims to provide a perspective of technological learning within these context. We focus on the cases of South Korea and the People's Republic of China for deepen our understanding of how technological learning is strategically built in in developing countries. Both countries have applied reverse engineering as a means of acquiring and internalizing foreign technologies.

Keywords:
Technological Learning, Developing Countries, South Korea, China

1. Introduction

National development visions can shape the production of scientific knowledge and the design of systems and technological artifacts—core elements of power technologies that reinforce specific political narratives about a nation's past, present, and future (Kim, 2017, p. 343). Over the past few decades, building technological, innovative, and scientific capabilities has become a central component of economic development strategies in emerging economies, though with varying degrees of success (Guridi et al., 2020, p. 2). Economic development in these contexts depends on multiple factors, including productive infrastructure, access to raw materials, skilled labor, and the availability of capital. Moreover, the trajectory of economic growth and technological advancement is closely linked to the accumulation and upgrading of technological capabilities (Xie, 2004; Lee, 2004).

The enhancement of productivity via the development of technological capabilities is widely acknowledged as a fundamental driver of economic growth and development, particularly in the context of the increasingly competitive global economy. This can be accomplished through continual technological learning in an economy with adequate resources (Ying et al., 2009). According to Xie (2004), in developing countries, technological learning is the main driver of growth (Xie, 2004). In parallel to this, Mbassi and Messono (2023), in their article, revealed the importance of investing in technology to ensure long-term economic development and put forward that the adoption of advanced technologies is a catalyst for growth and a significant opportunity for developing economies to catch up with developed economies (Mbassi and Messono, 2023). At the same time, Al-Roubaie and Alvi (2014; 243) stated that technological learning and knowledge of the environment are critical for promoting sustainable development and economic growth.

Newly industrializing economies such as Korea, Taiwan, Thailand, Singapore, and China have achieved remarkable progress in rapid development and narrowing the gap with advanced economies through sustained efforts in building technological capabilities and engaging in intensive technological learning (Xie, 2004; Kim, 2001; Ferretti & Parmentola, 2015; Guridi et al., 2020, p. 2).

Within the scope of this study, firstly, South Korea is described as having emerged from Japanese colonization after World War II and as being in the process of technological learning to adapt to difficult conditions. In the second part, the technological learning process of China, which declared its Republic in 1949, is described. In the third part, the discussion section is presented, followed by the conclusion section.

2. Mechanisms of Technological Learning in the South Korean Context

In Korea, the onset of modern industrialization commenced during the colonial era of 1910-1945, when the government of Japan ruled the peninsula's economy as a vital component of its empire (Pack and Westphal, 1986; Pak and Hwang, 2011; McNeill, 2018). In addition to trying to assimilate Koreans, Japan continued its exploitative and discriminatory practices (Pak and Hwang, 2011). Although the 36 years of Japanese colonialism in Korea were oppressive and harsh, this period witnessed significant industrialization (Kim, 2017; 346). In Korea during this period, manufacturing growth was both rapid and widespread; however, it was heavily dependent on Japanese (Pack and Westphal, 1986). Numerous empirical studies have highlighted this dependency. Bell and Pavitt (1992) noted that historical research on Japan shows a superficial similarity with the experience in Korea (Bell and Pavitt, 1992). Nevertheless, it was during this period that Korean employees, particularly through on the job experience, gained important knowledge about managing and operating modern industries. This is evident in Korea's capacity to manage a significant portion of its existing industry immediately following the conclusion of the Second World War, despite the enormous disruption resulting from the severance of relations with Japan in 1945. Japan was forced to abandon its colonies. Separate the Korean peninsula was divided into two political states (Pack and Westphal, 1986; McNeill, 2018; Richey et al., 2021).

Additionally, upon their departure, the Japanese withdrew the technical and managerial skills that had enabled many of the businesses and organizations they had established in Korea to function effectively. In some cases, it took Koreans more than a decade to reacquire or develop these capabilities. Nevertheless, during the late 1940s and 1950s—including the challenging period of the Korean War (1950–1953)—Koreans not only worked to restore these lost competencies but also adapted the colonial legacy to better suit their own socio-economic conditions (Pack and Westphal, 1986; Eum and Lee, 2022, p. 461).

Korea imitated the intensive industry promotion policies pursued by Japan in the 1950s. In the late 1960s, as Korea commenced its entry into the international electronics markets, its primary focus correlated with that of the Japanese electronics sector in the early 1950s: to swiftly acquire production technologies that would allow it to leverage its low labor costs while simultaneously achieving economies of scale (World Bank, 1993; 21; Ernst, 1998; 249). Korea was classified as a low-income developing country in the 1960s (Eum and Lee, 2022; 461).

Kim (2001) stated that companies in developing countries take on duplicative imitation of established foreign items via reverse engineering during the initial phases of industrialization (Kim, 2001). An example of this situation can be given as follows:

Between 1962 and 1966, the Korean government tried to encourage foreign direct investment to improve the domestic electronic component industry. As a consequence, Komy in 1965, Signetics and Fairchild in 1966, and Control Data, Motorola, and IBM in 1967 founded subsidiaries in Korea that were entirely owned by the company. These subsidiaries were responsible for the assembly of memory planes, integrated circuits, capacitors, and transistors. These foreign corporations utilized Korean facilities solely for basic assembly tasks aimed at minimizing labor expenses and subsequently exporting all manufactured items to their respective countries of origin. In 1968, foreign enterprises accounted for 71% of South Korea's electronics exports. Consequently, they made minimal contributions to the government's drive for import substitution and the advancement of the domestic components sector (Kim and Lee, 2002). Thus, from the mid-1960s to the late 1970s, Korea experienced phenomenal export growth (Kuznets, 1988).

Although the 1980s in Korea were characterized by an increase in exports and production capacity, the electronics sector was still in the early stages of technological learning and research and development operations. Korea, constrained by its limited technological capacity during this period, has relied significantly on imitation, reverse engineering, and technology imports so as to provide its technological requirements. Even substantial enterprises

held by chaebols were significantly dependent on foreign companies in Europe, the United States, and Japan for their core parts and key technologies (Kim and Lee, 2002; 547; Kim et al., 2012; 359).
During the 1980s and 1990s, Korea's industrialization was characterized by creative imitation, whereby replicated products and upgrades to deliver superior performace (REF). Korean companies across sectors like electronics, semiconductors, and biotechnology have augmented their research and expenditure efforts, evolving from imitators to innovators by inventing and launching new products in the global market (Timmer, 2003; 406). By 1995, the best 30 Korean chaebols possessed 41% of the industrial value generated and 16% of the gross national product (Stiglitz and Yusuf, 2001; 21).
The dynamics of a "late industrialization" have been extensively used to explain the rapid economic development of Korea. This theory illustrates Korea's achievement as a follower with the necessary learning abilities to effectively acquire, imitate, and implement innovative technologies developed by more industrialized nations (Lee and Ungson, 2008; 275). The achievement of Korean industrialization is ascribed to the advanced technological learning process by which Korea sought technological independence (Lee, 2004).
Kim (2001) proposed a model for technological learning and explained this model with Korea. This model follows duplicative imitation, creative imitation and innovation. Duplicative imitation started in the 1960s in light industries such as toys, consumer electronics, plywood and textiles and in the 1970s in heavy industries such as steel, machinery, automobiles and shipbuilding.
During the 1980s, the declining competitiveness of mature technology industries reliant on low-wage labor prompted Korean enterprises to shift their learning strategy from duplicative to creative imitation. This strategic transition demanded a significantly more advanced knowledge base than in the preceding phase. Upon mastering intermediary technologies through creative imitation, several Korean chaebols began to engage with emerging technologies as a pathway to innovation. A notable example is Samsung's advancement in the semiconductor industry, where it developed DRAM chips ahead of its Japanese competitors.

3. Mechanisms of Technological Learning in the People's Republic of China Context

The Chinese Academy of Sciences was established in 1949, the year of the People's Republic of China's establishment, and it functions as a national administrative department under the State Council. For the past seventy years, the Chinese Academy of Sciences, as a public service entity, has significantly contributed to advancing national science and technology development to support the goal of transitioning to an innovation-driven economy. In China, the Chinese Academy of Sciences has acted as the main driving force behind scientific research and developments over the years (Chen et al., 2022; Zhang et al., 2011; 876).
The Chinese Academy of Sciences, as the foremost national research institution in China, has been instrumental in the development of reforms that have been designed to facilitate the transmission of technology and to promote national economic growth. National research institutes are a vital element of national innovation systems. They frequently obtain substantial public research funding and are anticipated to transfer technologies to improve national innovative capability (Chen et al., 2022). The National Innovation System is defined as the network of institutions in both the public and private sectors that engage in operations and interactions to originate, import, modify, and disseminate innovative technologies (Ferretti and Parmentola, 2015).
Government, industry, and university research institutions serve as the core actors in research and development within national innovation systems (Xiong et al., 2020, p. 2). In response, many countries have established diverse technology transfer systems and mechanisms within their national research institutes to facilitate the commercialization and dissemination of research outputs. As global competition in science and technology intensifies, governments around the world are increasingly focused on enhancing the effectiveness of technology transfer by refining these systems and models (Chen et al., 2022).
China, as an emerging economy (Chen et al., 2022; Wang et al., 2025), has shifted the focus of technology transfer at national research institutes from encouraging economic catch-up to promoting sustained, high-quality socioeconomic development driven by science and technology (Chen et al., 2022).
In line with this objective, China has implemented a range of strategies to narrow the technological gap with global innovation leaders. This objective has been articulated as state-defined targets in China's 2006 Medium and Long-term Science & Technology Plan, aiming to establish the nation as an 'innovation-oriented' country by 2020 and a 'leading scientific power' by 2050, while also reducing reliance on foreign technology to 30 percent or less through

the promotion of 'indigenous innovation' (Prud'homme, 2016; 1586). Liao and colleagues (2020; 146) argue that "China's innovation performance still lags behind other countries." Enterprises in China are importing cutting-edge technology to reduce the technical disparity with developed countries.

Chinese companies have actively pursued a learning-by-licensing strategy, acquiring technologies through both international and domestic licensing markets. This approach has played a significant role in building technological capabilities across various sectors. Notable examples include Haier in white goods, Huawei in communication equipment, Sinovel and Goldwind in wind energy, and CSR and CNR in rail transport equipment—all of which have successfully leveraged international licensing to enhance their technological competence (Wang et al., 2015, p. 30).

Arvanitis et al (2006) found that medium-sized companies in China learned about technology mainly from their foreign customers during the industrialization process, instead of getting it from foreign companies investing in China or from other sources like technical centers, universities, or consultants (Arvanitis et al., 2006; 111).

4. Discussion

The prerequisite for the economic success of developing countries is to advance along the trajectory of technology development via technological learning (Ghazinoory et al., 2021; 5092). Developing countries often face challenges and technological constraints that hinder sustainable economic growth. Therefore , the advancement of developing countries often depends on their absorbing, adapting and utilizing technologies in more technologically advanced nations. This exploitation occurs not merely through the straightforward acquisition of solutions that are already made but through a concerted endeavor by technology purchasers to comprehend the many components of technology (Wang and Du, 2024; 3787; Lin, 2003; 337).

The literature on Korean studies has constantly highlighted the significance of science and technology in the swift socio-economic change of post-colonial South Korea (Kim, 2017; 342). As the largest emerging economy, China has consistently prioritized the advancement of science and technology within its economic policy. In the past thirty years, substantial investment has been allocated to research and development, as well as associated infrastructure and education. At present, it ranks as the world's second most research and development (R&D) intensive country. The substantial R&D initiatives have markedly enhanced the external technological circumstances of local companies (Wang et al., 2025; 2; Wang et al., 2015; 30).

5. Conclusion

This study explores the dynamics of technological learning in developing countries by focusing the cases of South Korea and China. Through technological learning, South Korea has successfully completed the duplicative imitation and creative imitation stages and moved to the innovation stage. The People's Republic of China, on the other hand, has established the Chinese Academy of Sciences as part of its national innovation system to strengthen technology within the country. Both countries have applied reverse engineering, an important step followed by developing countries to acquire technology and have achieved innovation.

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