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Advantages, Disadvantages, and Development of Technology Licensing

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Abstract

With the increasing importance of technological innovation in economic development, technology licensing has become a key mechanism for promoting technology diffusion and knowledge transfer, and an essential tool for firms to gain competitive advantages and achieve technology commercialization. This paper analyzes the advantages, disadvantages, and future development trends of technology licensing. The study finds that technology licensing can enhance innovation returns, reduce R&D costs, promote technology diffusion and industrial upgrading, and improve resource allocation efficiency and market competition, thereby contributing to overall social welfare. However, it may also generate several negative effects, including the erosion of licensors' competitive advantages, risks of technology spillovers and knowledge leakage, weakened incentives for independent innovation among licensees, and increased market concentration and transaction costs. Furthermore, with the development of the digital economy and global innovation networks, technology licensing is evolving toward greater openness, platformization, digitalization, and internationalization. It is expected to play an increasingly important role in open innovation, green transformation, and global technological cooperation. Overall, balancing technology diffusion and innovation incentives remains a central issue in the design and development of technology licensing systems.

Keywords

Technology Licensing; Royalty Fee; Fixed-Fee

1. Introduction

With the rapid development of the knowledge economy and the intensification of global technological competition, technological innovation has become a crucial source of competitive advantage and industrial upgrading for firms. However, technological research and development is often accompanied by substantial investment costs, long development cycles, and significant market uncertainty. As a result, relying solely on independent innovation imposes considerable risks and

burdens on firms. Against this background, technology licensing, as an important mechanism for technology diffusion and knowledge transfer, has gradually become a key strategic choice for firms to achieve resource optimization, technological sharing, and enhanced market competitiveness.

Technology licensing refers to the practice whereby a technology owner grants other firms the right to use its patents, production processes, or core technologies in exchange for compensation through fixed fees, royalty payments, or hybrid contracts. Through technology licensing, licensors can not only monetize their technological assets and expand the influence of their technologies, but also accelerate technology diffusion by leveraging the production capacity and market channels of licensees. At the same time, licensees can reduce independent R&D costs and shorten the technological catch-up process, thereby entering the market more quickly and improving their competitive positions. Consequently, technology licensing has been widely adopted in manufacturing industries, high-tech sectors, and the digital economy, playing an increasingly important role in industrial innovation and economic growth.

Nevertheless, technology licensing does not always generate mutually beneficial outcomes. While it promotes technology diffusion, it may also create new forms of competition and conflicts of interest. On the one hand, licensors can obtain additional revenue and facilitate the standardization and dissemination of technologies through licensing. On the other hand, technology spillovers may weaken the licensor's original market advantage and even cultivate stronger competitors. In highly competitive markets, licensors may become reluctant to license their technologies due to concerns about market share erosion. Furthermore, once licensees acquire advanced technologies, their production efficiency and market competitiveness may improve significantly, thereby reshaping the existing market structure and competitive landscape. Therefore, technology licensing involves not only the allocation of intellectual property revenues, but also firms' competitive strategies, market structures, and the speed of technology diffusion.

Existing studies mainly focus on licensing contract design, the choice of licensing modes, and the effects of market competition on licensing incentives. Some studies suggest that fixed-fee licensing enables licensors to extract the entire technology surplus, whereas royalty licensing can mitigate the profit erosion caused by market competition. Other studies investigate firms' licensing incentives and technology adoption behaviors under Cournot and Bertrand competition. However, with the emergence of platform economies, network effects, and mixed-ownership enterprises, traditional technology licensing theories face new challenges. For instance, in markets characterized by network effects, technology diffusion may strengthen rather than weaken the licensor's market position. Moreover, in mixed-ownership markets, firms may pursue not only profit maximization but also social welfare or policy objectives, thereby influencing licensing strategies and

technology adoption timing.

Motivated by these considerations, this paper examines the advantages, disadvantages, and development of technology licensing, with a particular focus on its impact on firms' competitive behavior, technology diffusion, and market performance. Furthermore, this study investigates the optimal licensing strategies and technology adoption decisions of firms under different market structures, competitive environments, and ownership types. The findings of this paper are expected to enrich the literature on technology licensing and industrial organization, while also providing theoretical implications for firms' technology cooperation strategies and governments' innovation and intellectual property policies.

This study addresses the technical licensing problems. The current literature discusses the choice of technology licensing contracts in terms of the characteristics of technology patent holders, which are divided into two categories. The first category is cost-reducing technology. Kamien and Tauman (1986) established a market framework that falls between perfect competition and monopoly to examine and contrast the financial outcomes for the patent holder, the licensee, and the pricing of products under different licensing arrangements, specifically in the context of cost-reducing technological innovations. Agrawal et al. (2016) explored innovations that reduce costs supplied by external sources and analyzed how the extent of such innovations impacts the profits of patent holders, the pricing of products, and the costs associated with production. Kishimoto (2020) examined the role of negotiation in the licensing of cost-reducing technologies between two firms in a Cournot competition scenario. The other type is quality-improving technology. Zhu et al., (2007) explored the coordination mechanisms among supply chain participants aimed at elevating product quality standards. The buyers, responsible for the design of high-quality products, delegate their manufacturing to suppliers and collaborate in bearing the expenses related to enhancing or preserving product quality. Xuan et al. (2014) proposed a quality development model with variable costs and considered the competition between two firms: one that acquired high-quality technology from a multinational corporation and the other that produced low-quality goods. They studied the optimal licensing issue for multinational enterprises.

2. Advantages

Technology licensing, as an important approach for technology transfer and knowledge diffusion, plays a significant role in promoting innovation, improving market efficiency, and fostering economic development. With the rapid development of globalization and the digital economy, competition among firms has gradually shifted from traditional price competition to competition in technology and innovation capabilities. Against this background, technology licensing has become not only an important means for firms to acquire advanced technologies,

but also a crucial strategic tool for technology owners to maximize the value of their technologies.

First, technology licensing can increase the economic returns to innovation and strengthen firms' incentives for research and development. Technological innovation usually requires substantial financial investment and is often accompanied by considerable uncertainty and risk of failure. If firms can only rely on their own production and sales to recover R&D costs, the returns from innovation are often constrained by market size and production capacity. Through technology licensing, however, licensors can authorize other firms to use their technologies without expanding their own production scale, thereby obtaining revenues in the form of fixed licensing fees, royalty payments, or hybrid contracts. This enables firms to commercialize their technologies in broader markets and improve the return on R&D investment. Therefore, technology licensing helps alleviate the uncertainty between innovation investment and potential returns, thereby encouraging firms to engage in continuous technological innovation.

Second, technology licensing helps reduce innovation costs and lowers the barriers to technology acquisition. For licensees, independent R&D often requires long-term accumulation of expertise and substantial investment, especially in high-tech industries where the risks of innovation failure are particularly high. Through technology licensing, firms can directly obtain mature technologies, thereby avoiding duplicated R&D efforts, reducing trial-and-error costs, and shortening product development and market entry time. For example, in industries such as pharmaceuticals, electronic communications, and artificial intelligence, technological progress occurs rapidly, and firms relying solely on independent innovation may find it difficult to keep pace with industry development. Technology licensing allows firms to acquire advanced technologies more quickly, improve market responsiveness, and strengthen their competitive positions.

In addition, technology licensing facilitates technology diffusion and industrial upgrading. From a macroeconomic perspective, technology diffusion is a major driver of economic growth and industrial progress. Through licensing agreements, advanced technologies can spread across firms and regions, thereby improving overall industrial productivity and technological capability. Particularly in developing countries, technology licensing provides domestic firms with opportunities to learn advanced technologies and managerial expertise, helping narrow the technological gap with developed economies. At the same time, technology licensing can promote coordination among upstream and downstream firms within industrial chains, thereby fostering a more integrated innovation ecosystem. For instance, firms possessing core technologies may attract complementary enterprises into the market through licensing arrangements, which in turn expands industrial scale and enhances industrial competitiveness.

Technology licensing also improves the efficiency of resource allocation. If all firms

independently conduct R&D activities, this may result in duplicated investment and significant waste of social resources. Through technology sharing, licensing enables firms to specialize according to their comparative advantages. For example, technologically advanced firms may focus on innovation and R&D, while other firms utilize their strengths in production, marketing, or distribution to commercialize the technology. Such specialization and cooperation improve overall industrial efficiency and promote more effective allocation of social resources.

Meanwhile, technology licensing can intensify market competition and improve consumer welfare. Once advanced technologies diffuse through licensing, more firms are able to enter the market and compete, thereby encouraging higher product quality and lower prices. Consumers can therefore enjoy better products and more diversified services at lower costs. For example, in the telecommunications industry, the licensing of standard-essential patents has enabled different firms to develop compatible products, thereby accelerating the growth of smartphones and mobile internet industries and ultimately improving consumer welfare and social efficiency.

At the level of international economic cooperation, technology licensing also serves as an important mechanism for global technological collaboration and knowledge sharing. Through international licensing agreements, multinational corporations can transfer technologies across countries and regions, thereby promoting coordination within global industrial chains. For developing countries, the introduction of advanced foreign technologies not only enhances production efficiency, but also contributes to local talent cultivation and innovation capability improvement. Therefore, technology licensing plays a vital role in promoting economic globalization and international industrial cooperation.

Furthermore, in the context of the rapid development of the digital and platform economies, the importance of technology licensing has become even more pronounced. With the advancement of artificial intelligence, big data, cloud computing, and green technologies, it is increasingly difficult for individual firms to independently complete all innovation activities. Technology sharing through patent cross-licensing, technological cooperation, and platform openness has gradually become a defining characteristic of modern innovation systems. Technology licensing not only accelerates the commercialization of new technologies, but also promotes the cross-industry and cross-regional flow of innovative resources, thereby enhancing the overall efficiency of social innovation.

In summary, technology licensing not only helps firms improve R&D returns, reduce innovation costs, and strengthen market competitiveness, but also promotes technology diffusion, optimizes resource allocation, and facilitates industrial upgrading and economic growth. As a result, technology licensing has become an increasingly important institutional arrangement for promoting technological innovation and knowledge dissemination in the modern economy, playing a crucial role in both corporate strategy and industrial development.

3. Disadvantages

Although technology licensing plays an important role in promoting technology diffusion and improving resource allocation efficiency, it also has several potential disadvantages. With increasingly intense market competition and the growing value of intellectual property, technology licensing may generate negative effects on firms' competitive advantages, market structures, and long-term innovation capabilities. Therefore, technology licensing does not always lead to a "win–win" outcome, and its potential risks and adverse consequences deserve careful attention.

First, technology licensing may weaken the licensor's competitive advantage in the market. For firms possessing core technologies, technological innovation is often the key source of market leadership and excess profits. Once advanced technologies are licensed to competitors, the licensees' production efficiency and product quality may improve significantly, thereby eroding the licensor's original technological monopoly advantage. This effect is particularly evident in markets with a high degree of product homogeneity, where technology diffusion may intensify price competition and reduce the licensor's profits. In other words, although technology licensing can generate short-term licensing revenues for licensors, it may also undermine their long-term market interests by increasing competition. As a result, many technologically leading firms remain cautious about licensing their core technologies.

Second, technology licensing may lead to technology spillovers and the leakage of core knowledge. Technology licensing involves not only the transfer of patent rights or production processes, but also the diffusion of technological experience, managerial know-how, and tacit knowledge. During long-term cooperation, licensees may gradually master the licensor's core technological capabilities and even develop independent innovation capacities after the contract expires, thereby becoming potential competitors. This issue is especially important in high-tech industries, where many critical technologies contain strong tacit components that are difficult to protect fully through legal contracts. Consequently, while technology licensing accelerates technology diffusion, it also increases the difficulty of maintaining technological control and protecting intellectual property.

Third, technology licensing may weaken firms' incentives for independent innovation. For licensees, excessive reliance on external technologies may reduce their motivation to conduct in-house R&D. When firms can obtain mature technologies at relatively low cost through licensing, they may decrease investments in basic research and long-term innovation capability building, thereby creating technological dependence. In the long run, such dependence may limit the accumulation of core technologies and weaken the overall original innovation capability of an industry. This issue is particularly significant for firms in developing countries. If they rely heavily on foreign technology licensing without strengthening their own R&D capabilities, they may remain dependent on external technologies

and find it difficult to achieve genuine technological breakthroughs.

Moreover, technology licensing may intensify market monopoly and unfair competition. In some cases, large technology-leading firms may use patent licensing to establish technological barriers and exclude potential competitors through high licensing fees, restrictive clauses, or cross-licensing agreements. For example, firms owning standard-essential patents may utilize licensing advantages to control market access and strengthen their dominant market positions. Such practices may restrict the entry of small and medium-sized enterprises, reduce market competition, and ultimately harm consumer welfare and market efficiency.

At the same time, technology licensing contracts themselves may involve high transaction costs and contractual risks. Technology licensing often requires complex agreements regarding intellectual property rights, revenue allocation, and liabilities for contract breaches. Since the value of technology is inherently uncertain, licensors and licensees may easily disagree on licensing fees, the scope of technology usage, and ownership of subsequent technological improvements. In addition, information asymmetry may lead to moral hazard and adverse selection problems. For instance, licensors may conceal technological defects, while licensees may engage in unauthorized technology use or infringement. These issues increase transaction costs and reduce licensing efficiency.

From the perspective of industrial development, technology licensing may also result in excessive competition and declining industry profits. When advanced technologies are widely licensed, market entry barriers decrease and more firms enter the market. Although this may improve consumer welfare, it can also compress industry profit margins. Particularly in mature industries, excessively rapid technology diffusion may lead to severe homogeneous competition, making it difficult for firms to sustain profitability through technological innovation.

In international technology licensing, issues of technological control and economic dependence may also arise. Firms in developed countries usually possess core technologies, whereas firms in developing countries are more often technology importers. Under such circumstances, technology licensing may reinforce unequal patterns of international technological division. Technology-exporting countries continue to earn substantial profits through patents and licensing agreements, while technology-importing countries may remain dependent on external technologies and struggle to establish independent innovation systems. Furthermore, some critical technologies may be subject to export controls and geopolitical factors, increasing uncertainty in technology acquisition.

Finally, in the context of the digital economy and platform economy, technology licensing may create additional concerns regarding data security and platform control. Technologies such as artificial intelligence algorithms, cloud computing platforms, and digital infrastructure often exhibit strong network effects and platform dependence. When core digital technologies are controlled by a small

number of large platform firms, technology licensing may further strengthen platform monopolies and data control capabilities, thereby affecting fair market competition and data security.

In summary, although technology licensing can promote technology diffusion and economic growth, it may also lead to intensified market competition, technology spillovers, weakened innovation incentives, and market monopoly problems. Therefore, while promoting the development of technology licensing, it is necessary to improve intellectual property protection systems, optimize licensing contract design, and strengthen market regulation in order to balance technology diffusion and innovation incentives and achieve the long-term sustainable development of technology licensing.

4. Development of Technology Licensing

In the future, with the rapid development of the digital economy and global technological innovation, technology licensing will play an increasingly important role in firm competition and industrial upgrading. On the one hand, the advancement of artificial intelligence, big data, cloud computing, and green low-carbon technologies is continuously increasing the demand for inter-firm technological cooperation. As modern technological innovation becomes more complex, it is difficult for a single firm to complete all R&D activities independently. Therefore, technology licensing will serve as an important mechanism for resource sharing and collaborative innovation.

On the other hand, the development of open innovation will further promote the widespread use of technology licensing. In the future, cooperation among firms, universities, and research institutions will become increasingly close, and mechanisms such as patent cross-licensing, joint R&D, and platform-based collaboration will become more common. This will not only help reduce R&D costs but also accelerate the commercialization and industrialization of new technologies.

Meanwhile, the development of the green economy will create new opportunities for technology licensing. Against the backdrop of global efforts toward energy conservation, emission reduction, and sustainable development, technology licensing in areas such as renewable energy, environmental protection technologies, and low-carbon manufacturing will continue to expand. Through international technology cooperation and licensing, advanced green technologies can be disseminated more rapidly, thereby facilitating the global transition toward greener industrial systems.

In addition, the future technology licensing system will become more 完善 and standardized. Governments are likely to further strengthen intellectual property protection while improving market regulatory frameworks to balance technology diffusion and innovation incentives. In the context of the digital economy, emerging technologies such as blockchain and smart contracts may also be applied to

technology licensing management, thereby improving transaction efficiency and reducing contractual risks.

Overall, technology licensing is expected to evolve toward greater openness, digitalization, and internationalization in the future, playing an increasingly important role in promoting technological innovation, industrial upgrading, and global economic cooperation.

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