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The role of software intellectual property rights in strengthening industry performance: Evidence from South Korea

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ABSTRACT

This paper investigates the effects of software intellectual property rights (IPRs) on the performance of software firms. For this, technical efficiency scores for Korean software firms are examined, and for an empirical analysis, data envelopment analysis (DEA) and stochastic frontier analysis (SFA) methods are employed for robust results. Firm-level data from the Korean software industry on software copyrights and patents for the 1995–2005 period are employed. According to the empirical results, software IPRs increase the technical efficiency of software firms. Policy implications are given based on the results of our empirical analysis.

1. Introduction

The software industry has experienced substantial technological progress in the last three decades. Software is used not only in the ICT industry but also in other industries such as automobiles, medical equipment, shipyards, the military, construction, and education. Manufacturing and service firms make extensive use of computer and hardware systems that function using software. In addition, technological innovation is widespread in the software industry, resulting in the surge of software intellectual properties rights (IPRs).[1] The development of software products and services requires substantial long-term investment, particularly in human capital, which reflects a typical characteristic of knowledge-intensive industries (Graham and Mowery, 2003). Therefore, there is a need for methods that can ensure legal protection for copyrights and patents to provide R&D investors sufficient benefits from technological innovation.[2] Such methods have been modified to satisfy requirements in specific ways to cover certain aspects of software IPRs.

Software features are enabled to be protected by copyrights as well as patents. Some distinct features are as follows: First, writing source codes for software is similar to producing literary works, which makes software a subject of copyright protection. Therefore, copyrights protect source codes, binary

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[1] Robert and James (2004) show a sharp increase in the ratio of software patents to the total number of patents in the U.S. from 2% to 15% from 1980 to 2002. The results of the present paper reveal that the ratio of software patent applications in Korea increases from 6.0% to 15.0% from 1996 to 2000.

[2] Other legal systems such as trade secrecy and license agreements have been developed to achieve this objective (Robert, 1984).

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codes, and supplementary documents of given software from unauthorized access. However, copyrights lack a mechanism for protecting algorithms or data structures, which are core technological features of any software. Second, software also has features reflecting technological innovation that requires patent protection. The patent system serves to protect a software program's underlying ideas and functionalities. Therefore, software developers and publishers generally employ copyrights to protect their final products from illegal copies by end users. They can also exploit patents to shield key technological features of software from market competitors.

In comparison to the original protected target, software is relatively a new subject within the framework of copyrights and patents. The first copyrighted software was tentatively registered in 1964 by the US Copyright Office. However, software was not officially brought under the Copyright Act until the legislation of the Computer Software Copyright Act of 1980 (Bordoloi et al., 1996). Since the Act, software protection has been globally acknowledged through the copyright system. The Trade-Related Intellectual Property Rights (TRIPs) agreement of the World Trade Organization (WTO) defines computer software as a literary work, forming a global consensus on computer software as a copyrightable subject. With this global trend, Korea legislated the Computer Program Protection Act of 1987, a derivative law of the Copyright Act.

Software patents has a much shorter history than software copyrights.[3] Software has been recognized as patentable to a limited extent since the U.S. Supreme Court's *Diamond vs. Diehr* decision in 1981. The scope of its patentability has continued to be broadened since then (Graham and Mowery, 2003). In the case of *State St. Bank & Trust Co. vs. Signature Financial Group* (1998), an internet business method patent is granted as a software patent (Lerner and Zhu, 2007). In contrast to this favorable patent flow in the U.S., the European Patent Office (EPO) has not granted software patents without technological characteristics (inventive steps). That is, software must be integrated into hardware systems, and pure software programs cannot be patented independently (Park, 2005a).

In line with the increasing importance of software intellectual property rights (IPRs), the number of software IPRs applications and publications of software has increased sharply in the last two decades. Software IPRs, just like ordinary ones in the manufacturing sector, stimulate economic growth, requiring the effect of software IPRs to be examined from an economic perspective. The next section discusses several studies addressing software IPRs from this research perspective. It should be noted that previous studies have focused only on the relationship between economic growth and patents.

Although studies have considered the relationship between economic growth and patents, no study has examined the relationship between copyright activities and economic growth. Here some of the reasons for this include the fact that i) copyrights require no official examination process for acquiring rights and ii) most economies do not manage statistically reliable software copyright databases. In terms of general features of software copyrights, the Korean government manages a unique software copyright registration system to strengthen the software copyright owner's rights. This system differs from systems in other countries in that it gives additional legal and institutional incentives to software developers when software copyrights are registered. In detail, the software registration provides the opposing power in the legal dispute. In addition, the Korean system also provides mechanisms for transferring and sharing copyright ownership. Further, the Korean government strictly requires a software copyright registration certificate for any software procured by the government. These incentives have not only facilitated original goals but also made it possible to collect reliable data on software copyrights.

This paper investigates the effect of software IPRs on firm performance in the context of Korea for the 1995-2005 period by using a firm-level data set. Methodologically, data envelopment analysis (DEA) and stochastic frontier analysis (SFA) methods are employed for more robust results. In addition, a secondary Tobit regression analysis is conducted to identify determinants of firm performance. Based on these empirical analyses, the effects of software copyrights and patents on the performance of software firms (along with other factors) are examined.

According to the empirical results, 1) software firms in Korea show fluctuating patterns in terms of their technical efficiency during the analysis period, 2) the technical efficiency of software firms acquiring software IPRs tends to be higher than that of firms without software IPRs, and 3) both software copyrights and patents have positive effects on firm performance. Here it should be emphasized that the Korean software industry faced an economic shock from the East Asian economic crisis of 1997 and the collapse of the dot-com bubble in the early 2000s. The empirical results demonstrate that changes in average technical efficiency reflect the effects of these shocks.

The rest of this paper is organized as follows: Section 2 provides a brief review of previous research on software copyright and patent activities, including studies considering the productivity of the software industry. Section 3 introduces the empirical methodology. Section 4 presents the empirical results and provides a discussion on software IPRs, and Section 5 concludes.

2. Literature Review

2.1. IPRs and firm performance

In the manufacturing sector, including pharmaceutical and other industries, many empirical studies have examined the effect of patent (in a broad sense, IPRs) on firm performance (Ernst, 2001). Previous studies have analyzed the effect of IPRs on firm performance through two performance measures: productivity and technical efficiency. Productivity and technical efficiency have a similar feature: the measurement of the ratio of outputs to inputs. However, they are different in that productivity is an absolute measure, whereas technical efficiency, a relative one. No productivity measure has an upper limit, whereas the technical efficiency measure has an upper limit of unity. Through technical efficiency, the performance of given producers relative to the best performers can be conjectured.

[3] To the authors' knowledge, there is no clear definition of the software patent. Some researchers refer it as a software—related patent or computer—implemented invention. In this paper, the term "software patent" has a broad meaning, including any patents using computer software programs or algorithms.