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An analysis of the effect of software intellectual property rights on the performance of software firms in South Korea

Dukrok Suh, Junseok Hwang *

Technology Management, Economics and Policy Program, College of Engineering, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul 151-742, Republic of Korea

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ABSTRACT

This paper explores the effect of software intellectual property rights (IPRs) on the performance of software firms in South Korea using the statistics of software copyright registrations and patent applications along with the financial statements of firms. According to our empirical results, R&D and software R&D input has a strong positive effect on the production of software copyrights and patents, and large firms exploit software IPRs better than small firms. We also found that there are quite different trends in the selection of the legal means of protection; firms in the software industry prefer to copyrighting, whereas firms in the manufacturing industry prefer to patenting. In addition, software copyrighting has a positive effect on software revenue and total revenue of firms, but software patenting fails to show a positive effect on software revenue. Consequently, in contrast to the prevailing consensus indicating a high preference for patenting, it is obvious in our analysis that software copyrighting is more beneficial for software firms.

1. Introduction

Over the past two decades, the rapid advance of information and communication technology (ICT) has largely relied on technological innovations in computing, networks, and software, which are essential for the efficient performance of hardware. The software industry plays an important role as an industry itself, including the producer of end-user and business software and the provider of computing services. Moreover, software is generally regarded as an indispensable element to other industries since it serves as an overhead capital required to perform core functionalities for efficient production for households, firms, and government organizations. The dependence on software for business, scientific, educational and entertainment purposes has created a highly competitive software industry and has induced a substantial investment of time and money for the creation of software products and services.

Software products are typical knowledge-intensive outputs, which require strong legal protection means in order to provide a proper and balanced incentive to the original developer of the software. For the complex characteristics of software, several legal means such as trade secrecy, license agreement, copyright, and patent are applied to fulfill this objective (Robert, 1984). Since each of the legal protection means has created and modified with its original purpose of protection, a protection means only covers a certain aspect of software intellectual property. For example, literal expressions of software are similar to those of literary works, thereby qualifying software for copyright protection. Therefore, copyrights protect source codes, binary codes, and supplementary documents from unauthorized access; moreover, software simultaneously possesses innovative and even inventive technical characteristics qualifying it for patent protection as well. As a result, patents also serve to protect the underlying technological ideas or functionalities of software.

One of the key driving factors for a firm's long-term competitiveness and economic growth stems from incessant technological innovations (Porter, 1998). Although not all the firm's innovations and innovative activities can be measured by external indexes such as R&D investment, quality of human resources, published papers and patents, patent statistics is one of the frequently used indexes to evaluate the innovative activities and potential competitiveness of firms (Hall et al., 1986; Cohen and Lemley, 2001; Encaoua et al., 2006; Schankerman and Noel, 2006).

The starting point of our research is the insight that software copyrights might serve as an indicator for a software firm's innovative activity in the same way as software patents do. The relationship between software copyrights and the performance of firms has not been evaluated in literature pertaining to software IPRs thus far. This is mainly due to the scarcity of reliable information on software copyrights in most economies. In Korea, the Computer Program Protection Act was legislated as a derivative law of the Copyright Act of 1987 for software

* Corresponding author. Tel.: +82 2 880 8679; fax: +82 2 880 8389.
E-mail addresses: dukrok@gmail.com (D. Suh), junhwang@snu.ac.kr (J. Hwang).

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protection, and it implemented an article that encourages the registration of software with the government agency, the Computer Program Protection Committee. Registering software copyrights provides obvious and effective incentives to the original developer of the software. The developer can establish the creation of software and the relevant rights with this process. In addition, in a legal dispute, it allocates the legal power of opposing third parties who may infringe on the copyright. The registration process is quick and inexpensive, and the legality of the resulting protection is beneficial for the registered software copyright. Moreover, this registration process requires rightly working binary files and then it effectively prevents from registering of false copyright. Because of these incentives, many software developers register their copyright with this system. As a result more than 100,000 software copyright registrations have been accumulated during the past 20 years. This study employed the statistics of software copyright registrations data along with patent application data to evaluate the relationship between software IPRs and the performance of software firms.

In this paper, we extended the patent production function to software copyrights and evaluated the determinants of software IPR production using the zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB) regression methods. We then evaluated the economic impact of software IPRs on the performance of firms and determined the legal method that is more effective in enhancing their performance. In view of our limited knowledge, this is the first study that empirically evaluates the impact of software copyrights.

Our empirical results indicate that software R&D investment and total R&D investment have a strong positive effect on software copyrights and patents. The software sale ratio, however, shows a negative effect on them, which implies that software IPRs are used in a supporting role to other products and services. There is a difference in the effect on software IPRs production between firms in the software industry and manufacturing industry; firms in the software industry show a positive effect on software copyright production and a negative effect on software patent production, whereas firms in the manufacturing industry show the opposite effect. Large firms, such as subsidiaries of conglomerates and stock exchange listed firms, creates more software copyrights and patents. In addition, software copyrighting has a positive effect on the performance of firms both on software revenue and total revenue, whereas software patenting fails to show a positive effect on software revenue. Consequently, in contrast to the prevailing consensus indicating a high preference for patenting, it is obvious, in our analysis, that software copyrighting is more beneficial to software firms.

The paper is organized as follows: in Section 2, we review previous literatures related to software copyrights and patents. Section 3 presents the hypotheses that we wish to test and the methodology that is applied in the paper. We then describe the data employed set out the results of the economic analysis and its interpretations in Section 4. In Section 5, we conclude this paper with remarks on legal protection means and innovative activities of the software.

2. Literature review

In reality, software copyrights and patents do not have a long history. Prior to 1960, there was no conflict in terms of intellectual property with regard to manipulating software, because software was not sold as an independent product without a hardware system. After the US Copyright Office permitted the registration of computer programs as copyrighted works in 1964, software was protected as copyrighted works (Calvin, 1975). Since copyrights provide a shelter only to literal expressions and do not have any protection mechanism for technical aspects such as data structures and algorithms, which are the core features of software, some countries actively investigated *sui generis* legal protection means for computer software. In 1980, the US Congress accepted the recommendation of the National Commission on New Technological Use of Copyrighted Works, and this led to the Computer Software Copyright Act (Bordoloi et al., 1996). Subsequently, software protection under copyright system was generally accepted worldwide. The World Trade Organization's (WTO) Trade Related Intellectual Property Rights (TRIPs) agreement also defined computer software as literary works in Article 10.1, forming a global consensus on computer software as copyrighted objects.

Software patents have a much shorter history, and the patentability of software is still being debated. The US Supreme Court approved software as statutory subject matter first in the *Diamond v. Diehr* case (1981) and continuously broadened its scope thereafter. In 1994, the *In re Alappat* case helped in expanding the scope of software patents to the new algorithms in general purpose computers. In 1998, in the *State St. Bank* & *Trust Co. v. Signature Financial Group* case, it was admitted that internet business method patent is a type of software patent, which does not require hardware dependent implementation (Cohen and Lemley, 2001). As a result of this expansion in the scope of software patents, the share of software patents increased rapidly from 2% in the early 1980s to 15% in 2002 in the United States Patent and Trademark Office (USPTO) (Robert and James, 2004).

However, this trend of pro-software patents is not witnessed in every countries. Except for the US, a conservative approach is still taken on software patents with different levels in the EU and Japan (Park, 2005). The European Patent Office (EPO) officially does not grant patents to software without technical characteristics and inventive steps. It implies that software patent should be granted only to software that is coupled with a hardware system. In July 2005, the European Parliament rejected the Directive on Computer Implemented Inventions for the consolidated software patent reviewing standard among EU countries, and then the patent offices of EU countries still apply strongly restrictive conditions on software patents as before.

Many social studies on software discuss the pros and cons of legal protection means for software and find how to plug the loopholes in these means (Diallo, 2003; Matt and David, 2007). According to Oz's (1998) survey, there is a gap in the understanding of the legal protection means for software IPRs between software engineers and lawyers practicing in this field. Generally, the copyright system is preferred to the patent system as a method for software IPRs protection, but lawyers exhibit a higher preference for the patent system than do software engineers. They also contend that the current patent reviewing system has not been able to keep up with the frontier technology. As a result, many 'trivial' software patents has been granted, which is not technical invention but describes pervasive concepts of the software industry. The worst side effect is a slowdown in technological innovations (Bergstra and Klint, 2007).

Meanwhile, there is little economic research on software IPRs since the software industry is a highly innovative and rapidly growing industry, which does not have sufficient stable statistics for conducting economic analysis. A common problem of economic researches on software patent is the definition of software patents, resulting in incompatible data due to the employment of differing definitions (Bessen and Hunt, 2007). Patent statistics cannot be matched with the corresponding industry since patent information does not have industry classification codes. Moreover, as software is used by all industries and firms, a classification of software patents is more difficult