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Valuing academic patents and intellectual properties: Different perspectives of willingness to pay and sell

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ABSTRACT

Academic inventors tend to lack the ability of valuing technologies in their areas. We apply classification tree analysis to discover different perspectives of Willingness to Pay (WTP) and Sell (WTS) of academic inventors when valuing their patents and technologies. Predictor factors considered are development environment, technology characteristics, ownership and patenting policy, and technology transfer characteristics. According to the result of Korean student data, WTS and WTP are differently perceived for the same technology: WTP is higher than WTS for the low valued technologies. The ownership policy, scalability and degree of innovation of technology, among the discovery of significant factors on WTS and WTP, are mainly considered as the important factors on WTS and WTP. From the finding of this research, we provide the policy implication on academic patenting and its ownership for further development of academic patents.

1. Introduction

Academic inventions are an important source of corporate innovations (Geuna and Nesta, 2006). Various studies have been conducted in terms of management, legal aspects, and technology transfers of academic patents (Duderstadt, 2001; Jensen and Thursby, 2001; Mok et al., 2010; Sohn and Lee, 2012). Shane (2002) suggested a conceptual framework to verify the influence of patent effectiveness on the licensing, commercialization, royalty generation based on MIT inventions using various statistical models. Agrawal and Henderson (2002) investigated the degree to which patents are representative of the magnitude, direction, and impact of the knowledge spilling out of the university by focusing on the case of MIT using descriptive statistics and regression analysis. In terms of law, Colyvas et al. (2002) showed, using the case studies, how the intellectual property right can affect the commercialization of university inventions after Bayh–Dole act in 1980. They suggested that the IPR could be important for embryonic inventions and the marketing effort of university institution for technology transfer was important for university inventions. The authors also mentioned that the ability to issue exclusive licenses was most important for embryonic inventions while the dangers of exclusivity were greatest for these types of inventions.

The increasing interest in academic inventions and patent made many researchers to focus on recognizing and exploiting the commercial opportunities; and promoting the community of practice between different stakeholders (D'Este et al., 2012; Theodorakopoulos et al., 2012). Particularly, estimating value of academic inventions and understanding what factors affect it have emerged as the essential tasks to boost technology transfer activities from academia to commercial use. One of the largest studies regarding estimating patent value is the survey-based PatVal-EU project (Final Report of the PatVal-EU Project, 2005). But this project examined the value of retained patents that are not necessarily academic (Giuri et al., 2007; Crespi et al., 2007). Mowery and Ziedonis (2002) found that governmental policy can affect academic patent quality and quantity in the United States. Sapsalis et al. (2006) studied the distribution and determinants of patent value by comparing academic patents to corporate patents in Belgium.

These studies of academic patent and its value estimation, however, do not take into account the perspectives of engineering students who were highly involved in the development of the technologies themselves. Because engineering graduate students have the high possibility of continuously working in research and development (R&D) or related areas, it becomes more necessary for students to be educated about what the estimated value of developed technology can be and how the value can be related with factors, such as ownership policy and environment of development, technology characteristics, and patenting and technology transfer characteristics (Mok et al., 2010). Therefore, this paper investigates the estimated value of technology and related factors in the perspective of engineering students in Korea, one of the most R&D intensified and engineering education oriented countries. Particularly, the ownership policy of developed technology among the related factors can be the important issue to

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students. Generally, if students develop technology on their own, they are entitled to ownership of intellectual property (IP) rights. On the other hand, if students develop technology as part of a research team that is sponsored by or under contract with an industry or government, the ownership of IP rights does not belong to the inventors. While the view of researchers, including students, is not sufficiently considered in Korea, we can find the exceptional case that the teacher's exception policy grants exclusive rights to academic inventors in Sweden, one of the R&D intensified countries (SOU 2005:95, 2005). While the teacher's exception policy is currently effective in Sweden, most countries including Korea do not currently employ the teacher's exception policy. Therefore, we assume that an ownership policy can be related with estimated value of patents or technology by students involved in corresponding R&D.

To estimate the value of patents or technologies, several approaches have been used in terms of future cash flow projections generated by the patents: regression models of patent indicators, net present value, and real option pricing with Monte Carlo simulation (Gambardella et al., 2005; Giuri et al., 2007; Hall et al., 2007; Meng, 2008; Wartburg and Teichert, 2008; Ernst et al., 2010).

However, it would be inappropriate to expect engineering graduate students to estimate the values of academic patents using these approaches that depend on many assumptions. In this paper, we estimate the value of technology in terms of Willingness to Sell (WTS) and Willingness to Pay (WTP) based on the results of a survey administered to engineering graduate students in Korea involved in technology development. WTP measures the benefit received by individuals (Johannesson, 1996; Coate and Morris, 1999; Jeon et al., 2010), and WTS represents the expected selling price for individuals (Hanemann, 1985). The measures of WTP and WTS, along with factors that influence them, are widely used to estimate the values of intangible goods (Shapiro, 1985; Johannesson, 1996; Noy et al., 2006; LeVert et al., 2009). We consider that these measures can be especially suitable for estimating value of intangible assets by students. As WTS and WTP are different measures of valuing the same goods, we consider both for an overall, balanced understanding of the value of technology in academia. When purchasing a patent, customers consider a specific patent in particular. On the other hand, when inventors sell a patent, they can proceed with licensing the patent to several customers simultaneously. The estimated value of the same patent can vary according to inherent differences in patent buying and selling situations. This is why we consider both WTS and WTP to estimate the value of technology. Then we apply a decision tree (DT) to identify variables that influence WTS and WTP. Among data mining methods, DT is one of the most frequently used methods for knowledge discovery. Decision tree is easy to interpret, and it is robust to input noise (Gayatri et al., 2010; Szepannek et al., 2005; Doctor et al., 2001). By analyzing both WTS and WTP using a decision tree, we expect to understand the relationship between related factors to the estimated value of technology evaluated by students.

The structure of this paper is as follows. Section 2 summarizes the related literature. Section 3 presents our research design, and in Section 4, we analyze WTP and WTS and the associated factors using a decision tree. Lastly, in Section 5, we conclude the study and suggest directions for future research.

2. Literature review

One of the most important studies on the estimation of patent value is the PatVal-EU project (Final Report of the PatVal-EU Project, 2005). The project is a European survey that was carried out in France, Germany, Italy, the Netherlands, Spain and the United Kingdom from May 2003 to January 2004. The PatVal-EU project surveyed approximately 10,000 inventors for their best estimates of the values of their inventions, focusing on determinants for innovative performances of European countries and their potential contributions to economic growth. Using PatVal-EU project data, researchers estimated patent value and found that the distribution of patent value was skewed, with only a small share of highly valued patents: 16.81% of patents were worth more than three million Euros (Final Report of the PatVal-EU Project, 2005).

Using the PatVal-EU project data set, other studies have been conducted for estimating the values of patents, which consider the value distribution of patents together with environmental characteristics of patents. Giuri et al. (2007) studied the characteristics of European inventors, the sources of their knowledge, the importance of formal and informal collaborations, their motivations, and the actual uses and values of patents using frequency analysis. Gambardella et al. (2007) studied the European market for patents and discussed the determinants of patent licensing using a probit regression. They considered the economic value of patents as an important factor in licensing, as well as in patent protection. Deng (2007) investigated the private value of European patents using the modified patent filing model and the patent renewal model. This study found that estimates of the private value of European patent rights vary according to different nationality, technology field, and cohort group. In particular this study pointed out that the value distribution of patents was quite skewed and even more skewed for EPO patent families. Harhoff and Hoisl (2007) discussed some specific differences in national legal provisions dealing with inventor compensation. Using ordered probit analysis, they also demonstrated that the number of inventors, technology field, size of patent family, and cites receiving the developed technology within five years of patenting are significantly associated factors on monetary patent value.

Beyond the PatVal-EU project, other studies about patent value and commercialization of academic patents have been conducted, and are mainly concerned with patent value in light of technological and environmental characteristics, corporate patenting activity, effective management of governmental support, national differences, and other related issues. Goldenberg and Linton (2012) estimated the value of patents by considering patents as the compound options, so that it can be utilized by patent policy makers, inventors and patent attorneys. Gronqvist (2009) estimated private values of Finnish patents using renewal ratio and cost and found that private values of patents were determined by the degree of utility that the patent owner could obtain with the patent, and showed that patent value has a significant relationship to characteristics of technology such as the developer, the environment of the sponsor, assignee type, entity size, and technology category. Bessen (2008) estimated values of U.S. patents using regression and Monte Carlo simulation, and observed that they were substantially higher than those of European patents. Gallini (2002) studied the effect of strong patents due to the U.S. Patent Reform on patenting activity, specifically patent value. Sneed and Johnson (2009) investigated how specific attributes of patents affect patent value by analyzing unique patent auction data using Hexkman's two-step model.

Hausman and Leonard (2007) mentioned that a patent's owner must receive a royalty that at least compensates for lost profit. Chiu and Chen (2007) proposed an analytical hierarchy process (AHP) scoring system for intellectual property with respect to the licensor. Boardman and Ponomariov (2009) pointed out that there is too little systematic assessment of university scientists who worked with private companies, despite the increased importance of university-industry interaction. Pries and Guild (2011) found