This paper aims at analyzing the intellectual property (IP) protection strategies of foreign companies in Korea to suggest policy implications. To this end, the Korean Innovation Survey (KIS) data conducted by Science and Technology Policy Institute (STEPI) is utilized to analyze various IP protection methods — secrecy, lead time and complex design, as well as patent. Specifically, the following three questions were in focus: What are the methods used by foreign companies to protect their IP? How effective are the methods? Can they make more diversified IP protection strategies, compared with domestic companies?

Major empirical findings are as follows. Compared with domestic companies, foreign companies are more likely to use secrecy and lead time (rather than patent) and evaluate their effectiveness higher. Also, they tend to utilize more profiles of IP protection strategies than domestic companies. However, the results are true only in the service sector, where competitiveness is relatively low, but not in the manufacturing sector. This paper emphasizes the importance of spillovers from FDI or foreign R&D to Korean companies, especially in the service sector, and suggests policy implications for maximizing spillovers - the facilitation of academy-industry knowledge transfer channels, the improvement of IP protection environments and so on.

Keywords: Intellectual Property (IP) protection, appropriability strategy, R&D globalization, FDI

JEL Classification: O14, O30, O34, F23
본 논문은 국내진출 외국인기업들의 지식재산(IP) 보호전략을 분석, 시사점을 제시해보고자 하였다. 이를 위해 과학기술정책연구원(STEPI)의 기술혁신조사(KIS) 데이터(제조업 2002-04년, 서비스업 2003-05년)를 활용하여 특허뿐 아니라 사내기밀유지·복잡 설계·시장선점의 비공식적 보호방법들을 다양한 틀로 분석하였다. 구체적으로 특정 IP 보호방법의 활용 여부와 그 유효성, 보호방법의 결합·활용도 면에서 이들 기업의 행태를 살펴보았다. 분석결과, 외국인기업은 국내기업에 비해 특허보다는 사내기밀유지와 복잡설계를 보호방법으로 활용, 그 유효성을 높게 평가하고 있는 것으로 나타났다. 또한 국내기업에 비해 다양한 보호방법을 결합·활용하고 있는 것으로 분석되었다. 그러나 이 현상은 서비스업에서만 나타난바, 국내주재 외국인기업들이 제조업보다는 경쟁력이 상대적으로 약한 서비스업에서 비공식적 보호방법을 적극 활용하고 있는 것으로 해석된다. 이에 본 논문은 우리나라 서비스업의 선진화를 위해 외국투자 또는 외국인R&D의 중요성을 강조하고, 산학협력 등 지식이전 채널의 활성화, 국내 IP 보호환경 개선 등 파급효과 극대화를 위한 정책 시사점을 제시하고 있다.

핵심용어: 지식재산 보호, 전유 전략, R&D 글로벌화, 외국인투자
JEL 분류: O14, O30, O34, F23
I. Introduction

Multinational companies (MNCs) try to enhance their competitiveness, obtaining core technology/capacity through overseas investment or R&D globalization. Especially, since the 1990s, they have been actively utilizing local experts and R&D networks to accelerate business abroad, shifting from simply building production bases or adapting their technology overseas in the 1960s (Gassmann & Zedtwitz 1999). These activities have played a major channel of technology transfer to hosting countries (Mohnen 2001; Veugelers and Cassiman 2004). Namely, technology or know-how generated from foreign companies has been transferred to local companies as a form of spillovers through contract or manpower mobility. Literature also emphasizes benefits or spillovers of the FDI in terms of increases in productivity (Lichtenberg and van Pottelsberghe de la Potterie 1998) and of knowledge transfers (Branstetter 2000).

However, there exist few studies that deal with this issue in terms of the ‘appropriability strategy’ of a company. Foreign companies also use this for protecting their innovation outcome or intellectual property (IP), which may function as a negative factor of “preventing knowledge spillovers” to hosting countries (Faria and Sofka 2008). The appropriability of economic returns from R&D is important for innovating firms, and foreign companies are not exceptions in this respect. According to Nadiri (1993), 50% of companies’ innovations cannot be appropriated by themselves, leaking out as knowledge spillovers, so it is natural for them to have strong incentives to protect their own. Veugelers and Cassiman (2004) also underline that foreign companies are less active in technology transfers than domestic companies.

Korea is one of the countries that host large amounts of FDI. According to the statistics of the Ministry of Knowledge and Economy (MKE 2011), the amount recorded the highest, less than $16,000 million, in 2009, although it decreased to around $12,000 million just recently. A noticeable change is the % of FDI in the service sector, which recorded up to 60–70% of the total in 2008 from 35.2% in 2004. According to the Kim and Kim’s study (2010), during
1990–2008, the backward linkage effect of FDI has increased in both manufacturing and service sectors, and the latter increased more than the former. However, there exists no study that deals with the FDI inflow to Korea in terms of the appropriability strategy of foreign companies. Since 1997, the Korean government has been just in a hurry to make various policies and environments favorable to FDI. Now, it is time to examine the appropriability or IP protection strategies of foreign companies, including the service sector whose economic importance is noticeably increasing recently, and to prepare measures for maximizing the spillovers.

To this context, this paper aims at analyzing the IP protection strategies of foreign companies to suggest policy implications. Specifically, this tries to answer the following three questions: which methods foreign companies tend to use for protecting their IP; how effective is each method; and whether or not they have more profiles of protection strategies, compared with domestic companies. Answers will include differences in their strategies between the manufacturing and service sectors. This study has several academic contributions. First, it is the first empirical study in the IP protection strategies of foreign companies in Korea - a case of latecomer country. Second, it deals with several IP protection methods, secrecy, complex design and lead time beyond patent, and analyzes their strategies from various aspects. Third, it tries to compare their strategies in both manufacturing and service sectors. For estimation, this analysis uses two data sets — 2005 Korean Innovation Survey (KIS): manufacturing sector and 2006 Korean Innovation Survey (KIS): service sector, to apply several estimation methods.

This paper is structured as follows. The next section (II) reviews the existing literature in corporate appropriability or IP protection strategies. The following section (III) explains the data and the methodology to be used in empirical analyses. Then the subsequent section (IV) presents empirical results and finally the last section (V) makes summary and conclusion.
II. Theoretical Approach

Intellectual property includes knowledge, skill and other intangible assets that can be converted into usable resources to generate competitive advantages (Harabi 1995). *The Basic Law on Intellectual Property*, which took an effect in Korea on July 20, 2011, defines it as ‘knowledge, information and skill, ideology or emotional expression, mark of business or object, variety or genetic resource and other intangible things through which asset value could be realized’ (Ministry of Justice 2011).’ These imply that it is crucial companies to invest their assets in innovations to strategically appropriate economic returns.

IP protection strategies can be divided by two — formal and informal ones (Harabi 1995). Formal protection strategies, e.g. patent, copyright, trademark and industrial design, are on the legal base, granting a right holder with exclusive rights through application. Formal protection is strong, but its effectiveness is doubted sometimes due to the ‘inventing around’ by competitors or to the high costs of application. On the other hand, informal protection strategies, e.g. secrecy, complex design and lead time, are on the organizational base. Secrecy or complex design may block new knowledge from being utilized by competitors, which continues until additional expertise is combined, and lead time also mitigates the leakage of knowledge spillovers, allowing original companies first-mover advantages. Informal protection is relatively weak to formal ones, but effective in terms of the protection of tacit knowledge, the low cost of protection and no risk of inventing around like patent (Faria and Sofka 2010).

Previous studies have focused on patents, but current studies try to include informal IP protection strategies. Levin *et al.* (1987) conducted the *Yale Survey* on US manufacturing companies to analyze the effectiveness of various appropriability strategies for the first time. According to them, patent is the least ineffective means against imitation; rather, innovative companies prefer lead time, secrecy or complex designs. However, they underline the fact that patent
is prominently used in pharmaceuticals and chemistry where it has traditionally played an important role. Regarding the limitation in patent, Harabi (1995) mentions the disclosure of too much information and the competitor’s capacity of inventing around. Using another survey on this issue — the Carnegie Melon Survey on US manufacturing companies, Cohen et al. (2000) argue that patent is just one of the important protection mechanisms, in spite of its increasing importance among large companies. According to them, patent is significant only in terms of preventing litigation or strengthening a bargaining power over the third party. Through the empirical analysis in Dutch companies, Brouwer and Kleinknecht (1999) figure out small companies are less likely to file or apply patent than large companies, due to high costs of application and maintenance. They also prove that there exist strong sector differences in the company’s propensity of patent, explaining the reason in terms of the speed and cost of imitation by competitors. Arundel (2001), using the Community Innovation Survey (CIS) data of 1993, analyzes the relative importance of secrecy over patent to find that companies evaluate secrecy higher than patent for appropriation but that their R&D has no significant impact on the relative value of the two.

Unlike manufacturing sector, only a few studies exist regarding the IP protection strategies in the service sector. As Kuusisto and Paallysaho (2008) point out, service innovation is different from traditional technological innovation, so it needs a different approach.¹) According to them, manufacturing innovation is based on tangible products, while service innovation, on intangible elements and human capitals or interactions. In other word, companies are dependent on employees’ knowledge or skill rather than on physical capital, the latter of which has no significant role at least in the business service. Accordingly, in the service sector, patent or IPRs account for a small portion in corporate IP protection strategies, and companies often introduce various informal protection methods.²) In their comparative studies in Finland and UK,

¹) They argue that IPRs have emerged basically for “catering the needs of physical products.”

²)
Kuusisto and Paallysaho argue that service or knowledge are so diversified in the service sector that they cannot be protected by IPRs effectively and that they need various informal protection strategies.\textsuperscript{3) Amara et al. (2008), based on the 2003 Statistics Canada Innovation Survey on Service, estimate eight IP protection methods using the multivariate probit model to find the complementary, substitute and independent relationships among them. Most of all, they underline that informal protection methods support or complement formal ones.

As of now, the literature regarding the IP protection strategies of foreign companies — survey or comprehensive analysis — is rare. There is an analysis on European countries conducted by Faria and Sofka (2008), which is based on the CIS data. Using the CIS III data (1998~2000) of 1,800 manufacturing companies in Portugal and Germany, they examine the location choice of MNCs and the way that they protect knowledge. Here, they make indices for the ‘breadth’ and ‘depth,’ of IP protection methods, following Laursen and Salter (2006). According to them, foreign affiliates use more diverse or clearer appropriability strategies beyond patent than domestic affiliates, combining both formal and informal strategies. They also prove that their appropriability strategies are ‘less restrictive’ in the country with ‘more opportunities for knowledge sourcing,’\textsuperscript{4) (here, it is Germany) explaining the reason such that they can exchange knowledge with domestic companies by reciprocity.

For foreign investing companies, as being small-sized or affiliates, in general, patent may be an onerous strategy in terms of the high cost or the disclosure of information from mother companies. In this respect, they are more likely to adopt informal protection methods of evaluation higher than patent. Moreover,

\textsuperscript{2) However, they still emphasize that both formal and informal protection methods are not mutually exclusive, but they support each other in different ways.}

\textsuperscript{3) They explain sector differences in the IP protection strategies for three industries: software sector is most active in using IPRs; advertising sector is not familiar to IP issues, but loyalty building among personnel is important here; and business/management consultancy takes secrecy and fast-moving innovation cycle rather than IPRs.}

\textsuperscript{4) As to the ‘breath’ of IP protection strategies, the coefficient is significant only in Portugal but not in Germany.}
they may apply more diverse protection methods, informal as well as formal, than domestic companies expecting complementary or synergy effects. Moreover, knowledge and innovation outcome in the service sector are rather tacit and tangible, so the above phenomena will be significant compared with the manufacturing sector. In the subsequent sections, this paper examines how foreign companies make the IP protection strategies in Korea, through the statistical and the empirical analyses.

III. Data and Methodology

1. Data

This study uses the 2005 KIS (manufacturing sector) and the 2006 KIS (service sector) that were conducted by the STEPI, based on the definitions provided by the OECD Oslo Manuel. They are the firm-level data that include various technological innovation activities — innovation inputs (e.g. R&D expenditure and no. of researchers) and outputs (e.g. no. of innovation and patent filed/registered), cooperation strategies, protection methods of innovation outcomes, and so on. The 2005 KIS includes 1,392 companies covering the period of 2002~04, and the 2006 KIS, 877 companies covering the period of 2003~05.

Foreign companies are defined as those whose ratio of direct investment accounts for over 10% of the total assets, as specified in the Surveys: 130 firms (9.3%) are in the manufacturing sector and 40 firms (4.6%), in the service sector. IP protection strategies are based on the companies’ answers to the question,

---

5) The 1st Community Innovation Survey (CIS) was conducted in 1993 based on this Manuel, since which several CIS projects have been undertaken. In Europe, many studies in technological innovation have already been made using this data. Since 2001, the Korean Innovation Survey (KIS) has been conducting, and now it is possible the in-depth study in technological innovation in Korea, comparing the cases of European countries.
“how effective the following methods – patent, secrecy, complex design and lead time – are for protecting your innovations.” They are asked to answer by 6 likert from 0 to 5 (highly important).

According to [Table 1], foreign companies use IP protection methods (answering 1~5 likert in effectiveness) more actively than domestic companies in service sector. Percentage of the former that use patent (23.7), secrecy (55.3), complex design (34.2) and lead time (39.5) is higher than that of the latter, 16.2, 26.6%, 20.1% and 23.5%, respectively. On the other hand, in manufacturing sector, domestic companies tend to use each more than foreign companies, with their higher percentage of patent (57.6%), secrecy (58.4%), complex design (35.5%) and lead time (57.75%) than that of the latter, 45.5, 51.5, 32.3 and 49.2. The difference between the two groups is larger on informal methods in the service sector, while it is in patent in manufacturing sector. However, in both cases, patent is less used than informal methods, except complex design, as an IP protection method.

Table 1. Propensity of using IP protection methods

| IP Protection methods | Manufacturing sector | Service sector |
|-----------------------|----------------------|---------------|
|                       | Domestic companies   | Foreign companies | Domestic companies | Foreign companies |
| Patent                | 757(57.6)            | 59(45.5)       | 142(16.2)          | 9(23.7)           |
| Secrecy               | 768(58.4)            | 67(51.5)       | 233(23.6)          | 21(55.3)          |
| Complex of designs    | 467(35.5)            | 42(32.3)       | 176(20.1)          | 13(34.2)          |
| Lead time             | 759(57.7)            | 64(49.2)       | 206(23.5)          | 15(39.5)          |

Regarding the effectiveness of each method, foreign companies evaluate it higher than domestic companies in manufacturing sector, but the difference is not large between the two groups (Table 2). The scores of foreign companies vs. domestic companies are 4.1 and 4.0 in the case of patent, 3.7 and 3.5 in secrecy, 2.7 and 2.5 in complex design, and 3.8 and 3.7 in lead time. Namely, foreign companies use each IP protection method less but value its effectiveness higher, compared with domestic companies. On the other hand, in the service
sector, foreign companies evaluate secrecy (4.8) and complex design (3.3) higher than domestic companies (3.7 and 3.2), but lower in the case of patent (3.9 vs. 4.2) and lead time (3.5 vs. 3.7). The difference between the two groups is larger only in secrecy, but not in others. Patent is the most effective for both domestic and foreign companies in the manufacturing sector. In the case of the service sector however, secrecy is most effective for foreign companies, while patent is, for domestic companies.

Table 2. Effective of IP protection methods

| IP Protection methods | Manufacturing sector | Service sector |
|-----------------------|----------------------|----------------|
|                       | Domestic companies   | Foreign companies | Domestic companies | Foreign companies |
| Patent                | 4.0                  | 4.1              | 4.2              | 3.9              |
| Secrecy               | 3.5                  | 3.7              | 3.7              | 4.8              |
| Complex of designs    | 2.5                  | 2.7              | 3.2              | 3.3              |
| Lead time             | 3.7                  | 3.8              | 3.7              | 3.5              |

In respect to the breadth of IP protection strategies (Table 3), summing up the number of protection methods - 0 to 4, foreign companies are likely to have more diversified protection strategies than domestic companies in both manufacturing (2.3 vs. 2.1) and service (0.9 vs. 1.1) sectors.

Table 3. Breadth of IP protection strategies

|                  | Manufacturing sector | Service sector |
|------------------|----------------------|----------------|
| Domestic companies | 2.1                  | Foreign companies | 2.3 |
| Domestic companies | 0.9                  | Foreign companies | 1.1 |

2. Models

This paper analyzes the IP protection strategies of foreign companies in three ways. First, for estimating a company’s propensity of choosing IP protection methods, the multivariate probit model is used. The dependent variables are four,
namely, multiple choices — patent, secrecy, complex design, and lead time. Each variable is measured as 1 if a company used a specific protection method (answering 1~5 likert in evaluations on the effectiveness of each method), and 0 otherwise. Separate probit analyses could generate inefficient estimates in this case. Therefore, this study jointly estimates four protection equations using the multivariate probit model to control the correlated disturbances.

Second, for estimating the effectiveness of each IP protection method, the ordered probit mode is used. The dependent variable is measured as 0 (no use), 1 (less effective), 2 (moderate), 3 (effective), 4 (very effective) and 5 (highly effective), representing ordered categories — how effective each IP protection method was. To the notion of these multiple thresholds, this study applies ordered probit mode to estimate the effectiveness.

Third, for estimating the breadth of IP protection strategies, the negative binominal model is used. The dependent variable is measured by summing up the number of protection methods that were used by companies, ranging 0 (no use) to 4 (using all four methods — patent, secrecy, complex design and lead time). As this variable is a count data including 0 and positive numbers, the OLS estimates may be inefficient, inconsistent and biased. The poisson model may be appropriate as an estimation method in this case, but the negative binominal model is used instead in order to solve the over-dispersion problem of the former (Hilbe 2007).

Models for the empirical analysis are specified by firm size, R&D intensity, R&D cooperation, outwardness, foreign ownership, and industry dummies:

\[
IP_{\text{Protection}}_i = \alpha_0 Lsize_i + \beta_1 RD_i + \beta_2 DFor_i \\
+ \beta_3 DCoo_{i} + \beta_4 Outwardness_{i} \\
+ \beta_6 DIndustry + u_i \\
(i = 1, 2, 3 \ldots n)
\]

Firm size \(Lsize\) is measured as a log value of employees. Large companies, which are competitive or rich in resources for patent-filing, may file or apply
patents more than medium-small enterprises (Brouwer and Kleinknecht 1999). However, empirical result is rather obscure. Arundel (2001) finds a negative sign in the relative importance of secrecy to patent with company size, while Amara et al. (2008), a positive sign in multiple choices of IP protection methods. R&D intensity (RD) is measured as a ratio of R&D expenditures in sales. Much literature underscores that R&D-intensive companies tend to value the codification of knowledge and to use patents for protecting their innovations. Amara et al. (2008) also prove that services which are more related to codified forms of knowledge rely more on patent than secrecy.

Foreign ownership (D_FOR)\textsuperscript{6}) is measured as 1 if a company is foreign, whose ratio of direct investment accounts for over 10% in total assets (as defined in III.1), and 0 otherwise. Affiliates tend to rely on their parents and to use secrecy rather than patent (Amara et al. 2008). This may be noticeable in the case of foreign investing companies, using secrecy, complex design or lead time, to protect their innovations. R&D cooperation (D_COOP) is measured as 1 if a company makes R&D cooperation with external partners and 0 otherwise. Literature points out the fact that patent functions as clarifying the ownership among cooperators and that R&D cooperation may increase the likelihood of a company’s patent-filing (Brouwer and Kleinknecht 1999; Arundel 2001). Outwardness (Outwardness) is measured as a ratio of exports in sales. Exporting or outward companies may file more patents to protect their IP overseas, along with various IP protection strategies. Industry (D_IN) is measured as 1 if a company belongs to a specific industry among nine industries in manufacturing sector and five industries in service sector, and 0 otherwise.\textsuperscript{7}) Brouwer and Kleinknecht (1999) underline that patent is an effective method for IP protection in sectors of higher technological opportunity or those of which the products are easily developed but price for imitation is cheap. Arundel (2001) argues that companies are likely to depend on secrecy rather than on patent when disclosure

\textsuperscript{6) Regarding control variables, explanations are made mainly in terms of patent rather than informal protection methods — secrecy, complex design and lead time, due to the lack of literature regarding the latter.}
is disadvantageous to patenting. On the other hand, there also exist some empirical studies that find the opposite or the insignificant results regarding the sector characteristics (Amara et al. 2008; Park 2006).

IV. Empirical Results

1. Propensity and Effectiveness

[Table 4] and [Table 5] presents empirical results on manufacturing and service sector, respectively. Model 1 in [Table 4] presents the results on the company’s propensity of choosing IP protection methods, using the multivariate probit model. Each dependent variable (total 4) is measured as 1 if a company adopts a specific method and 0 otherwise. The coefficient of D_FOR is negative, except in secrecy, but not statistically significant in all cases, which implies that in the manufacturing sector there is no difference in the company’s choice of protection methods between domestic and foreign. Regarding the results on the effectiveness of each

| Sector                | Industry                      | KSIC        |
|-----------------------|-------------------------------|-------------|
| Manufacturing sector  |                               |             |
| (9)                   | Food                          | 15, 16      |
|                       | Textiles and garments          | 17, 18, 19  |
|                       | Wood and wood products         | 20, 21, 22  |
|                       | Chemicals and chemical products| 23, 24      |
|                       | Rubber and non-metals          | 25, 26      |
|                       | Metal and machinery            | 27, 28, 29, 30, 31 |
|                       | Electronics                    | 32, 33      |
|                       | Transportation                 | 34, 35      |
|                       | Furniture and other manufacturing| 36, 37    |
| Service sector (5)    | Wholesales and retail sales    | 51          |
|                       | Broadcasting and telecommunication| 64, 87    |
|                       | Finance and insurance          | 65, 66, 67  |
|                       | Science and technical service  | 72, 73, 74  |
|                       | Transport business             | 60, 61, 62, 63 |

7) Industry definition.

8) It should be notice that ‘effectiveness’ is not the objective index but the evaluation that was made by companies on how effective each as an IP protection method.
method (model 2), estimated using the *ordered probit model*, the coefficient of \( D_{FOR} \) is not statistically significant. This also implies that no difference exists even in the evaluations on the effectiveness between the two groups.

The results in the service sector are a bit different, however (Table 5). The model 1 presents the results on the company’s propensity of choosing IP protection methods, using the multivariate probit model. The coefficient of \( D_{FOR} \) is significantly positive in secrecy and lead time, implying that foreign companies are more likely to use these methods for protecting their innovations, compared with domestic firms. Regarding the results on the effectiveness of each method (model 2), using the ordinal probit model, the coefficient of \( D_{FOR} \) is significantly positive only in secrecy, implying that foreign companies tend to evaluate the effectiveness of secrecy higher than domestic companies. As of patent and complex design, however, the coefficient of \( D_{FOR} \) is positive but not significant. This implies that, foreign companies are likely neither to protect their innovations through patent or complex design more nor to evaluate their effectiveness higher.

In sum, no significant difference exists in IP protection strategies between foreign and domestic companies in the manufacturing sector, but it does exist in the service sector: In the latter, foreign companies use secrecy and lead time more and evaluate secrecy more effective. The result that informal methods are preferred to patent as IP protection strategies is consistent with the Arundel’s study (2001) and with other survey results (Levin *et al.* 1987; Cohen *et al.* 2000), but it is applicable only to the service sector in Korea. This results from the innate characteristics of knowledge in service sector, being more tacit and intangible, such that their IP can be protected through informal methods effectively. This explains the low competitiveness of this sector. Foreign investing companies are likely to make stronger and informal IP protection strategies in hosting countries for fear of technology leakages, which is significant when the competitiveness to which they belong is lower. Namely, this result reveals that foreign companies protect their innovations through informal methods in Korean service sector where its competitiveness is low.
Table 4. Company’s propensity and effectiveness of using IP protection strategies: Manufacturing sector

|                           | Model 1: Propensity (Multivariate probit model) | Model 2: Effectiveness (Ordinal probit model) |
|---------------------------|-----------------------------------------------|-----------------------------------------------|
|                           | Patent             | Secrecy             | Complex designs | Lead time | Patent             | Secrecy             | Complex designs | Lead time |
| **Lsize**                 | 0.21(5.90)***     | 0.19(5.54)***      | 0.17(5.43)***   | 0.18(5.49)***     | 0.18(6.03)***     | 0.12(4.35)***     | 0.13(4.40)***   | 0.16(5.62)***     |
| **RD**                    | 3.48(3.97)***     | 0.33(1.61)         | 0.14(1.46)      | 0.59(1.42)      | 0.69(3.22)***     | 0.18(1.61)         | 0.07(0.56)     | 0.34(2.43)***     |
| **D_COOP**                | 0.13(1.56)*       | 0.21(2.63)**       | 0.30(3.85)***   | 0.32(4.04)***   | 0.19(2.70)**       | 0.15(2.22)**       | 0.22(3.04)***   | 0.16(2.43)**     |
| **Outwardness**           | -0.11(-0.80)      | -0.03(-0.19)       | -0.21(-1.52)    | -0.18(-1.34)    | -0.06(-0.48)      | 0.06(0.52)         | -0.09(-0.67)    | -0.06(-0.46)     |
| **D_FOR**                 | -0.04(-0.28)      | -0.13(-1.05)       | 0.11(0.90)      | -0.07(-0.53)    | -0.04(-0.38)      | -0.06(-0.54)       | 0.07(0.65)       | -0.06(-0.57)     |
| **D_IN1**                 | -0.31(-1.13)      | 0.15(0.57)         | -0.19(-0.70)    | -0.06(-0.22)    | -0.22(-0.93)      | 0.13(0.54)         | -0.40(-1.56)    | -0.02(-0.08)     |
| **D_IN2**                 | -0.86(-3.07)***   | 0.08(0.32)         | -0.26(-0.92)    | -0.22(-0.82)    | -0.68(-2.70)**    | -0.03(-0.13)       | -0.52(-1.96)    | 0.01(0.06)       |
| **D_IN3**                 | -0.45(-1.53)      | -0.09(-0.30)       | -0.34(-1.14)    | -0.59(-2.00)*   | -0.40(-1.49)      | -0.16(-0.62)       | -0.40(-1.40)    | -0.41(-1.53)     |
| **D_IN4**                 | 0.30(1.19)        | 0.55(2.20)**       | 0.04(0.15)      | 0.19(0.77)      | 0.26(1.19)        | 0.41(1.86)*        | -0.14(-0.60)    | 0.28(1.26)       |
| **D_IN5**                 | -0.17(-0.66)      | 0.42(1.62)         | 0.00(0.00)      | 0.11(0.42)      | 0.03(0.11)        | 0.23(1.00)         | -0.17(-0.69)    | 0.13(0.59)       |
| **D_IN6**                 | 0.30(1.25)        | 0.30(1.27)         | 0.09(0.37)      | 0.17(0.70)      | 0.29(1.39)        | 0.10(0.47)         | -0.15(-0.65)    | 0.23(1.08)       |
| **D_IN7**                 | 0.30(1.24)        | 0.41(1.72)*        | 0.10(0.40)      | 0.11(0.48)      | 0.33(1.55)        | 0.18(0.85)         | -0.15(-0.68)    | 0.16(0.78)       |
| **D_IN8**                 | -0.17(-0.62)      | 0.08(0.32)         | -0.36(-1.35)    | -0.13(-0.49)    | -0.03(-0.15)      | -0.11(-0.47)       | -0.53(-2.11)**  | -0.06(-0.26)     |
| **Cons**                  | -0.87(-3.18)***   | -0.95(-3.53)***    | -1.22(-4.47)**  | -0.83(-2.78)**  |                     |                     |                 |             |

|                           | No. of obs.       | 1143               | 1151             | 1143             | 1143             | 1142             |
|---------------------------|-------------------|-------------------|-----------------|-----------------|-----------------|-----------------|
| **Wald/LR chi2**          | 206.52 (0.00)*    | 130.5             | 49.93           | 49.93           | 67.0            |
| **LL**                    | -2394.99          | -1626.5           | -1373.32        | -1373.32        | -1709.98        |

Note: 1) D_IN1 (food), D_IN2 (textiles and garments), D_IN3 (wood and wood products), D_IN4 (chemical and chemical products), D_IN5 (rubber and non-metals), D_IN6 (machinery), D_IN7 (electronics), D_IN8 (transportation).

2) * represents the Wald test’s p-value.
Table 5. Company’s propensity and effectiveness of using IP protection strategies: Service sector

|                     | Model 1: Propensity (Multivariate probit model) | Model 2: Effectiveness (Ordinal probit model) |
|---------------------|------------------------------------------------|---------------------------------------------|
|                     | Patent  | Secrecy | Complex design | Lead time | Patent  | Secrecy | Complex design | Lead time |
| $L_{size}$          | 0.15(3.37)** | 0.08(2.16)** | 0.10(2.68)** | 0.10(2.65)** | 0.13(3.03)** | 0.08(2.18)** | 0.11(3.01)** | 0.10(2.63)** |
| $RD$                | 0.15(1.36) | 0.13(1.21) | 0.19(1.79)* | 0.08(0.81) | 0.16(1.59) | 0.18(1.77)* | 0.12(1.18) | 0.07(0.71) |
| $D_{COOP}$          | 0.50(4.09)** | 0.78(6.88)** | 0.69(6.22)** | 0.70(6.32)** | 0.46(3.83)** | 0.75(7.18)** | 0.61(5.66)** | 0.60(5.58)*** |
| $Outwardness$       | 0.04(0.04) | -2.29(-1.04) | -2.93(-1.16) | 0.21(0.28) | 0.23(0.26) | -0.52(-0.38) | -0.59(-0.38) | 0.02(0.02) |
| $D_{FOR}$           | 0.25(1.02) | 0.76(3.26)** | 0.35(1.60) | 0.39(1.82)* | 0.12(0.47) | 0.63(3.10)** | 0.29(1.36) | 0.29(1.35) |
| $D_{IN1}$           | -1.45(-3.53)** | -0.29(-1.56) | -0.45(-2.29)** | -0.60(-3.16)** | -1.51(-3.81)** | -0.33(-1.82)* | -0.54(-2.67)** | -0.63(-3.26)*** |
| $D_{IN2}$           | -0.86(-2.59)** | -1.01(-3.39)** | -0.68(-2.51)** | -1.03(-3.76)** | -0.94(-2.71)** | -0.84(-2.93)** | -0.60(-2.22)** | -1.03(-3.50)*** |
| $D_{IN3}$           | 0.25(0.68) | 1.14(3.68)** | 0.65(2.25)** | 0.88(3.00)** | 0.33(0.86) | 0.96(3.20)** | 0.57(1.98)* | 0.90(2.90)*** |
| $D_{IN4}$           | 0.31(2.10)** | 0.31(2.19)** | 0.13(0.92) | 0.05(0.36) | 0.29(2.04)** | 0.39(3.04)** | 0.17(1.24) | 0.13(1.00) |
| Cons                | -1.66(-7.23)** | -1.16(-5.72)** | -1.34(-6.64)** | -1.12(-5.77)** |

| No. of obs.        | 772     | 772     | 772     | 772     | 772     |
| Wald/LR chi2       | 150.07 (0.00)* | 104.1 | 129.89 | 78.63 | 88.89 |
| LL                 | -1161.96 | -498.27 | -761.14 | -655.04 | -710.81 |

Note: 1) $D_{IN1}$ (wholesales and retail sales), $D_{IN2}$ (broadcasting and communication), $D_{IN3}$ (finance and insurance), $D_{IN4}$ (science and technical service).
2) * represents the Wald test’s p-value.
Regarding the other variables, the coefficient of $L_{size}$ is shown to be positive and statistically significant. This is consistent with the Amara et al.'s result (2008) such that large companies tend to actively make IP protection strategies. The coefficient of $RD$ is statistically significant only for patent in the manufacturing sector. This implies that the level of codification of knowledge is high in this sector, so R&D-intensive companies protect their innovations through patent. However, this is not applicable for the service sector where the codification is not normal or less important. The coefficient of $D_{COOP}$ is statistically significant as seen in Arundel (2001), which underscores that more cooperative companies file or apply patents, clarifying the ownership with their partners. They protect their innovations through informal methods, as well. Unlike expectation, however, $Outwardness$ is shown to be not significant, implying that outwardness does not matter to the IP protection strategies of Korean companies. Sector characteristics are not statistically significant in manufacturing sector, except chemicals and chemical products: The coefficient of $D_{IN4}$ is significant only in secrecy.9) In the service sector, on the other hand, sector characteristics are significant. In finance and insurance ($D_{IN3}$) and science and technical service ($D_{IN4}$), secrecy or informal protection method is used, and, in the latter case, patent also matters. On the other hand, broadcasting and communication ($D_{IN2}$), which are characterized as being open or interactive, and wholesales and retail sales ($D_{IN1}$), which are irrelevant to intellectual property or knowledge-based expertise, are less likely to make IP protection strategies.

2. Breath

Next, [Table 6] presents empirical results on the breadth of IP protection

9) For example, in the case of pharmaceuticals, it takes much time a patent to be created and filed, with a large amount of investments, but this cross-section data cannot cover the whole period. Instead, it reflects the state that pharmaceutical companies keep the relevant information to secret to a certain period, due to high development costs.
strategies, using the *negative binominal model*. The dependent variable is measured by summing up the number of IP protection methods that a company uses. The coefficient of $D_{FOR}$ is negative but not statistically significant in the manufacturing sector, so it cannot be said that foreign companies use more sets of IP protection methods than domestic companies. On the other hand, the coefficient of $D_{FOR}$ is significantly positive in the service sector, implying that foreign companies are likely to use more diverse profiles of IP protection strategies. Based on Faria and Sofka’s study (2008), this result can be interpreted such that foreign companies are ‘more restrictive’ in knowledge spillover in service rather than in manufacturing sector, because the Korean service sector has low competitiveness to provide fewer opportunities for knowledge outsourcing.

|                | Manufacturing sector | Service sector |
|----------------|----------------------|----------------|
| $L_{size}$     | 0.11(6.68)***        | 0.15(3.56)***  |
| $RD$           | 0.13(2.60)**         | 0.24(1.43)     |
| $D_{COOP}$     | 0.17(4.05)***        | 0.72(5.90)***  |
| $Outwardness$  | -0.07(-0.91)         | -0.47(-0.35)   |
| $D_{FOR}$      | -0.04(-0.59)         | 0.44(1.82)*    |
| $D_{IN1}$      | -0.06(-0.39)         | -0.94(-4.03)***|
| $D_{IN2}$      | -0.30(-1.86)*        | -1.32(-4.00)***|
| $D_{IN3}$      | -0.29(-1.66)         | 1.20(3.43)***  |
| $D_{IN4}$      | 0.19(1.34)           | 0.30(2.00)*    |
| $D_{IN5}$      | 0.07(0.48)           | -              |
| $D_{IN6}$      | 0.14(1.06)           | -              |
| $D_{IN7}$      | 0.16(1.19)           | -              |
| $D_{IN8}$      | -0.08(-0.53)         | -              |
| $Cons$         | 0.11(0.74)           | -0.90(-4.02)***|

No. of obs. | 1143 | 772  |
Wald/LR chi2 | 123.78 (0.00)* | 116.26 |
LL           | -2016.71 | -1005.41 |

Note: 1) Manufacturing: $D_{IN1}$ (food), $D_{IN2}$ (textiles and garments), $D_{IN3}$ (wood and wood products), $D_{IN4}$ (chemical and chemical products), $D_{IN5}$ (rubber and non-metals), $D_{IN6}$ (machinery), $D_{IN7}$ (electronics), $D_{IN8}$ (transportation).
2) Service: $D_{IN1}$ (wholesales and retail sales), $D_{IN2}$ (broadcasting and communication), $D_{IN3}$ (finance and insurance), $D_{IN4}$ (science and technical service).
3) * represents the Wald test’s p-value.
Regarding other variables, results are almost similar to those of the propensity and the effectiveness in the previous part. The coefficient of $Lsize$ is statistically significant, implying that large companies make diverse IP protection strategies. The coefficient of $RD$ is statistically significant only for the manufacturing sector. This implies that R&D-intensive companies protect their innovations through combined strategies in manufacturing sector, but not in the service sector. The coefficient of $D_{COOP}$ is statistically significant, revealing that cooperative companies make more various protection strategies rather than non-cooperators. However, unlike expectation, $Outwardness$ is shown to be not significant, implying that outwardness does not affect the IP protection strategies of Korean companies. As in the previous part, sector characteristics are not significant in the manufacturing sector, while they are significant in the service sector. Finance and insurance ($D_{IN3}$) and science and technical service ($D_{IN4}$) tend to make more diversified strategies for protecting tacit knowledge or expertise, while broadcasting and communication ($D_{IN2}$), which are characterized as being open or interactive, and wholesales and retail sales ($D_{IN1}$), which are irrelevant to intellectual property or knowledge-based expertise, are less likely to make combined IP protection strategies.

V. Summary and Conclusion

As a late-comer, Korea has achieved a rapid economic growth benefited from FDI, in the form of reverse engineering or employment, which became more important than in the past along with the foreign companies trend to increase their R&D. On the other hand, no interest has been made in their appropriability or IP protection strategies, which may shields knowledge spillovers from their R&D here. In this situation, this paper has investigated the IP protection strategies of foreign companies in Korea.

This study used the $2005\ KIS\ (manufacturing\ sector)$ and $2006\ KIS\ (service$
sector) to find out the characteristics of their IP protection strategies. The main findings are as follows. First, compared with domestic companies, foreign companies are more likely to use and evaluate informal IP protection methods higher than patents, and this is true only in the service sector. Second, foreign companies have more profiles of IP protection strategies than domestic companies in service sector. Based on the findings above, foreign companies make their IP protection strategies more actively in service sector rather than in manufacturing sector.

This paper suggests some policy implications. First, considering the fact that foreign companies prefer informal IP protection methods to patent, contact or R&D cooperation needs to be utilized as a channel to their knowledge. For this, incentives or opportunities should be encouraged to lead them participate in this cooperation, particularly, with academic institutions - universities or public research institutes (PRIs). PRIs can be safer partners for foreign companies, rather than competitors, in terms of technology leakages. Moreover, R&D cooperation with PRIs is rather basic, so research outcomes from it can take the form of paper or patent. Through cooperation between PRIs and foreign companies, tacit knowledge of the latter could be patented or partly shared. Moreover, manpower mobility during this cooperation can be an efficient way of learning tacit knowledge, particularly, in the service sector where foreign companies keep their IP to secret. In these respects, industry-university (IU) cooperation should be encouraged, and a policy concern needs to be made on solving the ownership problem that is inherent between them: for example, the stylized guidelines to IU cooperation could be helpful. Second, IP-friendly environments should be established, such that foreign companies can actively register to commercialize their patents or other forms of IPRs. The rapid increase in patent-filings in the U.S., since the 1980, has benefited from the government’s pro-IP policy. As of 2010, the ranking of Korea in IPR protection is 32nd, positioning at the middle-low level, according to the IMD (2011). Foreign investing companies in Korea will get to depend on IPR systems more, increasing filing patents or other forms of IPRs, if its protection environments
become improved. Here, the Basic Law on Intellectual Property, which took an effect on July 20, 2011, will be helpful: this Law declares the establishment of IP respecting culture as one of the five major policy objectives. Third, in order to enhance the competitiveness in service sector, more opportunities should be made for knowledge exchanges or network-building between residents and foreigners, e.g. international conferences, seminars or consulting. For the Korean service sector, where competitiveness needs to be upgraded, the transfer or spillover of advanced knowledge from foreign companies is crucial. This is particularly the case for knowledge-based industries where knowledge is generated in combination of new or tacit knowledge. Therefore, it is important to improve the competitiveness, by enlarging opportunities or network-building for knowledge exchanges between residents and foreign companies in the short-run.

The contribution of this paper is that it deals with various IP protection methods to analyze the strategies of foreign companies in Korea. As a latecomer economy, Korean service industry is not yet developed, where knowledge spillovers from foreign companies are limited due to their strict IP protection strategies. This is the first try to examine the IP protection strategies of foreign companies in a latecomer economy, expanding the empirical analysis in manufacturing to service sector. One limitation of this study, however, is that it covers a particular period of 2002~04 for manufacturing sector and 2003~05 for service sector. Thus, it would be interesting to try a pooled or panel data set to verify if there would be any maturation.

References

Amara, Nabil, Rejean Landry and Namatie Traore. 2008. “Managing the Protection of Innovations in Knowledge-intensive Business Services.” Research Policy, 37, pp. 1530-1547.

Arundel, Anthony. 2001. “The Relative Effectiveness of Patents and Secrecy.”
Research Policy, 30(4), pp. 611-625.
Baum, C. F. 2006. An Introduction to Modern Econometrics using STATA. Texas: STATA Press Publication.
Branstetter, L. 2006. “Is Foreign Direct Investment a Channel of Knowledge Spillovers? Evidence from Japan’s FDI in the United States.” Journal of International Economics, 68, pp. 325-344.
Brouwer, Erik and Alfred Kleinknecht. 1999. “Innovative Output and a Firm’s Propensity to Patent: An Exploration of CIS Micro Data.” Research Policy, 28(6), pp. 615-624.
Cohen, Wesley M., Richard R. Nelson and John P. Walsh. 2000. “Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not). NBER Working Paper No.7552.
Faria, Pedro and Wolfgang Sofka. 2008. “Formal and Strategic Appropriability Strategies of Multinational Firms – A Cross Country Comparison.” ZEW Discussion Paper No.08-030.
Gassmann, O. & M. Von Zedtwitz. 1999. “New Concepts and Trends in International R&D Organization.” Research Policy, 28, pp. 231-250.
Harabi, Najib. 1995. “Appropriability of Technical Innovations: An Empirical Analysis. Research Policy, 24, pp. 981-992.
Hilbe, J. M. 2007. Negative Binominal Regression. New York: Cambridge University Press.
IMD. 2011. World Competitiveness Report.
Kim, Hyuk Hwang and June Dong Kim. 2010. “Productivity Spillover Effect of Foreign Direct Investment into Korea.” Journal of East Asian Economic Integration, 14(2), pp. 21-48.
Kuusisto, Jari and Selin Pálysah. 2008. “Intellectual Property Protection in Service Sector.” available at http://www.iccwbo.org.
Laursen, K. and A. Salter. 2006. “Open for Innovation: The Role of Openness in Explaining Innovation Performance among UK Manufacturing Firms.” Strategic Management Journal, 27(2), pp. 131-150.
Levin, Richard C., Alvin K. Klevorick, Richard R. Nelson and Sidney G. Winter. 1987. “Appropriating the Returns from Industrial R&D. Cowles Foundation
Discussion Paper no. 862, pp.1-46.
Lichtenberg F. and B. van Pottelsberghe de la Potterie. 1998. “International R&D spillovers: A Comment.” European Economic Review, 8, pp. 1483-1491.
Long, J. S. and J. Freese. 2006. Regression Models for Categorical Dependent Variables using STATA. Texas: STATA Press Publication.
Ministry of Justice. 2011. Basic Law on Intellectual Property.
Ministry of Knowledge and Economy. 2011. http://www.mke.go.kr.
Mohnen, P. 2001. “International R&D Spillovers and Economic Growth.” in M. Pohjola ed. Information Technology, Productivity and Economic Growth. Oxford University Press.
Nadiri, I. 1993. “Innovations and Technological Spillovers.” NBER Working Paper No. 4423.
Park, Kyu-Ho. 2006. “A Study on the Determinants of IP Protection of Innovation Results in Korean Manufacturing Sector.” Technology Innovation Study, pp. 1-21. (in Korean)
Romer, P.M. 1990. “Endogenous Technical Change.” Journal of Political Economy, 98(5), pp. 71-102.
Song, Jaeyoung and Chaerin Yun. 2005. A Study on the Determinants of Localization of Japanese Multinational. Business Management Study, 34(4), pp. 1125-1141. (in Korean)
Teece, J. D. 1986. “Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy.” Research Policy, 15, pp. 285-305.
Veugelers, Reinhilde and Bruno Cassiman. 2004. “Foreign Subsidiaries as a Channel of International Technology Diffusion: Some Direct Firm Level Evidence from Belgium.” European Economic Review, 48, pp. 455-476.
 Boo-Young Eom

Boo-Young Eom is an advisor to the Presidential Council on Intellectual Property. She has been a senior researcher at the KIEP(2001~07) and a deputy director, in charge of FTA negotiations, at the Ministry of Foreign Affairs and Trade(2007~09). He holds a Master’s in international economics at the University of Geneva, IUHEI, and a Ph.D. in economics at Seoul National University. Here research fields include knowledge transfer, R&D and technology, and IP-ODA. Her main papers are “Determinants of Industry-Academy Linkages and Their Impacts on Firm Performance: The Case of Korea as a Latecomer in Knowledge Industrialization”(Research Policy, 2010) and “Modes of Knowledge Transfer from PROs and Firm Performance”(SJE, 2009). Moreover, she has participated as a consultant in two WIPO projects, The Economics of IP in Korea and The Strategic Use of Intellectual Property to Enhance Competitiveness in Select Industries in ASEAN.

염부영(嚴富暎)

현재 국가지식재산위원회 전략기획단 전문관으로 재직 중이다. 2001~07년 대외경제정책연구원에서 전문연구원으로 근무하였고, 2007~09년에는 외교통상부 2동서기관으로서 FTA 협상 담당하였다. University of Geneva, IUHEI에서 국제경제학 석사학위, 서울대학교에서 경제학 박사학위를 취득하였다. 주요 연구분야는 지식이전, R&D 성과분석, IP-ODA 등이며, “Determinants of Industry-Academy Linkages and Their Impacts on Firm Performance: The Case of Korea as a Latecomer in Knowledge Industrialization”(Research Policy, 2010), “Modes of Knowledge Transfer from PROs and Firm Performance”(Seoul Journal of Economics, 2009) 등 다수의 논문이 있다. 아울러 WIPO 프로젝트인 ‘The Economics of IP in Korea’와 ‘The Strategic Use of Intellectual Property to Enhance Competitiveness in Select Industries in ASEAN’에 컨설팅트로 참여한 바 있다.