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International Technology Licensing and Intellectual Property Rights : Empirical Evidence

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< 요 약 >

본 연구는 전 세계적으로 1990년에서 1999년 사이에 발생한 기술 라이센스 거래에 관한 자료를 바탕으로, 기업들이 속한 국가의 지적 재산권 보호정도를 포함한 국가별 고유 특성들이 기업들의 라이센스 거래 상대 선택에 어떻게 영향을 미치는 가를 살펴본다. 연구 결과, 기술 보유 기업들은 지적 재산권이 잘 보호되는 나라의 기업들에게 더 많은 라이센스를 주었다. 또한 경제적 자유가 많은 나라로의 기술 라이센스 이전이 보다 활발하다.

Key Words : International Technology Licensing, Intellectual Property Rights, Count Data

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I. Introduction

Technology licensing is one of the most commonly observed types of inter-firm strategic alliances worldwide. For instance, the recent study by Arora, Fosfuri and Gambardella(2001) shows that over 15,000 known technology licensing transactions occurred around the world with a total value of over $320 billion in the period 1985-1997, implying an average of nearly 1,150 transactions worth $25 billion per year. One frequently reads on the popular press that companies like Texas Instruments(TI) and International Business Machines(IBM) follow aggressive strategies of exploitation of their extensive technology patent portfolios through international licensing contracts. However, there are also anecdotal evidences that licensing market for technology is less developed than the optimum and not well functioned. For example, a study by British Technology Group(BTG) found that companies in the United States, Western Europe, and Japan ignore a large fraction of their patented technologies, which could be licensed or profitably sold(British Technology Group1998).

The inefficiency of licensing market is caused by a number of impediments it faces. The best known is the "appropriability problem". Arrow(1962) argues that once an idea is disclosed to a potential buyer, it is possible for that buyer to use the information without paying for it. The higher the degree of knowledge appropriability(i.e. the stronger the patent or intellectual property rights(IPRs) protection), the better the ability of the licensor to capture a larger share of the rents generated from the licensed technology. Thus, strong IPRs protection can be considered as the remedy for "appropriability problem"in the market for technology. For instance, Anand and Khanna(2000) provide empirical evidence that where patent protection is more strong, i.e. chemical industry, firms tend to license more, and to engage in more arm's-length contracting. Cohen, Nelson and Walsh(2000) also present evidence on the relative strength of IPRs in different industries and advocate a positive link between licensing and IPRs.

Technology or intellectual property holders face risks of imitation or piracy not only in domestic markets but also in foreign market. Even though WTO requires countries to enforce the minimum standards of IPRs protection through the agreement on Traded-Related Aspects of Intellectual Property Rights(TRIPS), nations still provide markedly different level of IPRs protection. If so, it is of interest to see how the nations'different IPRs protection levels affect technology owners' cross-border licensing decisions. Existing studies, however, typically examine cross-industry differences in firms' licensing behaviors, but few have focused on cross-country differences in technology licensing.

This paper tries to fill this void and studies how country-specific characteristics affect firms'choices of licensing partners based on the panel data set of

observed licensing transactions worldwide during the period 1990-1999. We specially examine the relationship between a country's IPRs protection level and the number of licenses to be sold to that countryexamines technology holders'incentives to license technology. The total number of licenses granted from the country i to the country j in every possible country icountry j pair, a dyad, is explained by the level of IPRs protection and other characteristics of licensing partner countries. In order to examine this relationship, the econometric model that deals with discrete nature of licensing count and firm-specific unobservables arising from the count panel data is estimated.

Technology holder firms engage in more licensing agreements the stronger IPRs protection level of the partner country is. Companies also tend to sell more licenses to countries with more economic freedom, and GDP levels of countries affect positively firms' incentives to license. Technology holder firms of US, Japan and EU are more actively involved in international technology licensing deals.

The organization of the rest of the paper is as follows. Section 22 describes the data and method. The model is specified in Section 34. Section 45 discusses the main results. Section 56, finally, concludes.

II. Data and Method

The sample of licensing deals we study is drawn from the SDC(Securities Data Company) database of Thomson Financial which records all publicly announced strategic alliances worldwide tracked down in the Security Exchange Commission filings in the United States and abroad, newswires, press, trade magazines, professional journals, and the like. SDC provides information on contract type(i.e. licensing agreement, marketing agreement, joint venture, joint development or production, etc.), description of the deal, the date of agreement, and identities of participant firms(i.e. Standard Industrial Classification(SIC) code of primary business, name, nation, parent companies, etc.).

SDC database provides many advantages for our analysis. First, this is the largest database on strategic alliances including licensing agreements. Second, it identifies all licensing participants and provides the detailed supplementary information on them. Finally, it provides a link to the original source of information and date of licensing agreements.

For the analysis, we have read through the description of every agreement to distinguish between licensors and licensees among all participant firms and coded accordingly. We have also ensured that each chosen deal was related to technology transfer or exchange in the licensing agreement. We have excluded deals referring to termination of licensing agreements and litigation settlements of past licensing deals in our sample. Thus, we have reached a final sample of 8,177 unique participants with 20 major countries of origins in 7,788 licensing agreements between 1990 and 1999.

Table 1 provides geographical distribution of licensing participants of twenty countries in our sample. Firms in United States and Japan are the most active sellers of technology through licensing deals. They are trailed by firms in Canada.

Table 1. National Distribution of Participant Firms in International Technology Licensing, 1990-1999.

Country	*Number of Paricipant Firms*
United States	2,794
Japan	980
Canada	901
United Kimgdom	890
Germany	451
France	397
Australia	289
South Korea	201
China	195
Italy	186
Netherlands	178
Switzerland	154
India	103
Taiwan	92
Sweden	88
Singapore	70
Hong Kong	64
Israel	59
Spain	44
Austria	41
Total	8,177

Next, the sample data were used to construct panel in which the unit of observation is the unique country icountry j pair, a dyad. For each year, the dyad data is constructed as follows : *c1~c1, c1~c2, c1~c3,, c1~cn; c2~c1, c2~c2, c2~c3,, c2~cN; cN-1~c1, cN-1~c2, ,cN-1~cN; cN~c1,cN~c2,, cN~cN,* where *c1*=county *1,, cN*=country *N*. Hence, for every year there are *N*×*N* dyads. Since we have *N*=20 countries, this gives us 400 dyads in each year or 4,000 year-dyad across all 10 years in the period of 1990-1999(i.e. 400 10).

We use count panel data where the dependent variable the total number of licenses granted by the country i to the country j at period t in a given year is discrete, non-negative, with numerous zero entries, which generate non-linearities. Conventional linear regression models are, thus, inappropriate. Thus, we employ random effects negative binomial model for our analysis assuming unobserved firm-specific effects are uncorrelated with right hand side independent variables.

III. Model Specification

A key focus of interest in this paper is the estimation of a licensing equation. This takes the form:

$$L_{ijt}=f[Y_{it}, W_{jt}] \text{ for } i \text{ and } j=1, \ldots, n \text{ and } t=1, \ldots, T \quad (8)$$

where L_{ijt} is the total number of licenses granted by firms of the country *i* to firms of the country *j* at time *t*, Y_{it} is a vector of characteristics of country *i* at *t*, and W_{jt} is a vector of characteristics of country *j* at *t*.

3.1 Dependent Variable

$LICENSE_{ij}$ = total number of licenses[1] Includes non-exclusive licenses, exclusive licenses and cross-licenses granted by firms of the country i to firms of the country j at period *t;*

3.2 Independent Variables

(a) Characteristics of country *i* at *t*

IPR_i = the strength of IPRs of country I.

We use GP index by Park and Ginarte, 1997. They create the index based on patent laws of countries examining five categories : extent of coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms, and duration of protection. The index ranges from 0 to 5, where higher values represent stronger level of IPRs protection.

GDP_i = per capita GDP of country *i.*

World Development Statistics CD-ROM provides this information, in terms of 1995 US dollars.

$TRADE_i$ = trade openness of country *i*

This denotes international trade as a percentage of GDP.

$FREEDOM_i$ = economic freedom of country *i.*

The data on this variable can be obtained from the Economic Freedom of the World 1997, Annual Report (Gwartney and Robert, 1997). The index ranges from 0 to 10, where lower values represent lower level of economic freedom.

US_i = 1 if country *i* is United States(geographical dummy),

= 0 otherwise.

$JAPAN_i$ = 1 if country *i* is Japan(geographical dummy),

= 0 otherwise.

EU_i = 1 if country i is EU(geographical dummy),

= 0 otherwise.

(b) Characteristics of country *j* at t

IPR_j = the strength of IPRs of country *j.*

GDP_j = per capita GDP of country *j.*

$TRADE_j$ = trade openness of country *j*

$FREEDOM_j$ = economic freedom of country *j.*

Table 2 shows descriptive statistics of variables.

1) Includes non-exclusive licenses, exclusive licenses and cross-licenses

Table 2. Descriptive Statistics

Variable	*Mean*	*Std. Dev*
<Dependent Variable>		
$License_{ij}$	.04092	.0154
<Independent Variables>		
IPR_i	2.41	.64
GDP_i	3145.64	2577.50
$TRADE_i$	75.64	10.1
$FREEDOM_i$	5.87	2.13
US_i	.0068	.0079
$JAPAN_i$	.0033	.0064
EU_i	.0027	.0082
IPR_j	2.41	.64
GDP_j	3145.64	2577.50
$TRADE_i$	75.64	10.1
$FREEDOM_j$	5.87	2.13

Table 3. Random effects negative binomial estimates

Variable	
IPR_i	.543** (.176)
GDP_i	.455* (.250)
$TRADE_i$	.007 (.086)
$FREEDOM_i$	.501 (.478)
US_i	1.0005** (.1684)
$JAPAN_i$	.0076* (.0055)
EU_i	.0031* (.0022)
IPR_j	1.333** (.614)
GDP_j	.598 (.65)
$TRADE_j$	.105 (.184)
$FREEDOM_j$	.479** (.127)
$Intercep_t$	8.433* (4.135)
Log-Likelihood	-653.397

** significant at the 5% level; * significant at 10% level;
Standard errors are in parentheses.

IV. Results

Table 3 presents the estimation results. According to table 3, IPRi and IPRj have positive signs and statistically significant. This confirms that technology holder companies engage more in licensing agreements with the stronger the intellectual property rights(IPRs) protection level of the partner country is. The implication is that, under weak IPRs protection, licensee firms can easily imitate or copy the licensor's technology without adequately paying for it. Thus strong IPRs protection(e.g., strong patents) enables licensors to capture a higher share of the returns of their licensed technology and technology owners would tend to license out more of technologies to countries where licensors can appropriate better. GDP level of the country of licensor firms(GDPi) has a positive and significant effect on licensing implying that firms in rich countries are more actively involved in sales of their technology through licensing. FREEDOMjis significantly and positively associated with the probability of licensing showing that firms tend to sell more licenses to firms of countries with more economic freedom. All geographical dummies(USi JAPANi EUi USj JAPANj EUj) are also a significantly positive

indicating that technology owners of these countries are more fiercely engaged in technology licensing transaction. All other variables are statistically insignificant.

V. Conclusion

This paper studies how country-specific characteristics affect firms'choices of licensing partners based on the panel data set of observed licensing transactions worldwide during the period 1990-1999. We specially examine the relationship between a country's IPRs protection level and the number of licenses to be received by that countryexamines technology holders'incentives to license technology. The total number of licenses granted from the country i to the country j in every possible country icountry j pair, a dyad, isexplained by the level of IPRs protection and other characteristics of licensing partner countries. In order to examine this relationship, the econometric model that deals with discrete nature of licensing count and firm-specific unobservables arising from the count panel data is estimated.

Technology holder firms engage in more licensing agreements the stronger IPRs protection level of the partner country is. Companies also tend to sell more licenses to countries with more economic freedom, and GDP levels of countries affect positively firms' incentives to license. Technology holder firms of US, Japan and EU are more actively involved in international technology licensing deals.

We can draw policy implications from this study. Stiglitz(1989) has suggested that the lack of a well-functioning market system could be the biggest obstacle to the development of an economy. Similarly, inefficient market for technology could be main impediment to technology transfer and diffusion. If a technology licensing market is well established and efficient, existing technologies face a better chance of being used extensively and this would accelerate technology transfer and diffusion. As Arrow(1962) argues, knowledge inappropriability is one of the main obstacles to the efficient market for technology. Considering strengthening IPRs protection can be the remedy for "appropriability problem", strong IPRs can be crucial to the establishment of a well-functioning technology licensing market and can thus be crucial to technology transfer anddiffusion. Policy makers should put emphasis on strengthening IPRs protection level if their main interests are to promote technology transfer and the development of the economy accordingly.

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