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Licensing or Not Licensing?: Empirical Analysis on Strategic Use of Patent in Japanese Firms

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Abstract

In this paper, IP strategy at firm level is analyzed in a framework of use of patent as a tool for maximizing firm's revenue, based on a dataset from JPO's Survey of Intellectual Property Activities in 2004. Descriptive regressions of IP strategy indicators suggest a non-linear relationship between firm size and licensing propensity. For a small firm with less complementary assets, such as production facility and marketing channels, tends to license more. At the same time, a licensing propensity of large firm is also high due to the effect of cross licensing.

JEL Classification: O31, O34

Keywords: Licensing, Intellectual Property Strategy, Japan

Introduction

In an era of global competition and rapid technological progress, Japanese firms have started to seek for external technology sources for their innovation process. According to the Survey on R&D Collaboration by RIETI (Research Institute of Economy, Trade and Industry), the share of firms with R&D collaboration with other firms, universities or public research institutions have increased in these five years, and is expected to increase in future as well. (RIETI, 2004) Active use of R&D collaboration in firm's innovation process needs proper intellectual property management in order to appropriate its R&D results in a process of collaboration with other firms. In addition, R&D collaboration may involve active use licensing activities by using technology market.

In this paper, licensing activities of Japanese firms are investigated by using firm level dataset from JPO's Survey on Intellectual Property Activities. After patenting its invention, a firm has an option of licensing or not licensing, and this decision is affected by various factors. For example, patent can be used more as a means of appropriating rents from technological innovation in pharmaceutical industry, as compared to in other industries (NISTEP, 1997; Cohen et al., 2002). Therefore, licensing propensity in such industry may be higher than that in other industries. In addition, the firm size does matter as well because rent dissipation effect of licensing by increasing competition in product market is smaller for SMEs, which does not have significant presence in the product market (Arora and Fosfuri, 2003).

Analyzing licensing activities of Japanese firms is important for various reasons. First, a departure from in-house development model becomes imperative for Japanese firms, and external sourcing of technology becomes an important business strategy for them to survive in an era of global competition and rapid technological progress. Deeper understanding technology market by licensing activities provides important managerial implications.

Second, recent IPR policy reforms toward pro-patent system by the Japanese Government are based on the assumption that stronger patent facilitates innovation incentives and spillover, and ultimately, accelerates innovation and economic performance. However, only weak evidences of the impact on innovation activities can be found (Motohashi, 2004). Understanding technology market is critical to clarifying the relationship between IPR policy and firm's innovation performance, which is needed for appropriate IPR policy formulation.

The structure of this paper is as follows. The next section is devoted for setting analytical framework of firm level IP strategy, focusing on licensing activities. This section is followed by data description and summary statistics of IP strategy indicators from JPO's Survey on Intellectual Property Activities. Then, quantitative analysis section follows. The determinants of firm's licensing activities are analyzed with econometrics models. Finally, some concluding remarks with future research agenda are provided.

Analytical Framework of Firm's IP Strategy

In this paper, firm's IP strategy is defined as a management of its technology pool, which is a firm's capacity, based on in-house R&D or acquired technology from external source, used for innovation outputs such as new products and processes. A technology pool is a bundle of IPs as well as know-hows and other intangible assets, but it is narrowly defined as a pool of patents in this paper. Strategic options include in-house development or external sourcing of technology, and in-house use or licensing out of IPs.

One of determinants of IP strategy is characteristics of product and technology market, in which a firm is operating. The strength of patent as a means of appropriating rents from innovation outputs varies by industry, and it is relatively strong in pharmaceutical industry (Cohen et. al. 2002). In this industry, licensing contract can be enforced effectively, so that a firm uses more actively external technology market, in building up its technology pool, as well as licensing out of its technology (Anand and Khanna, 2002).

In addition, the existence of complementary assets does matter. A high-tech startup is typically investing heavily in R&D, but does not have capacity of manufacturing and marketing. In this sense, licensing out of its technological results is its important business strategy. On the other hand, a large firm with substantial complementary assets tend to commercialize its technology by own (Shane, 2001). Therefore, the size of firm will be also an important determinant of licensing strategy.

Arora and Fosfuri (2003) present a model for analyzing firm's IP strategy. They set up a two stage game with competition the product market and the market for technology, and shows that licensing propensity is determined as an equilibrium point between "revenue effect" and "rent dissipation effect" of licensing. Figure 1 illustrates this model.

(Figure 1)

Licensing in the market for technology generates licensing revenue (revenue effects), but at the same time, it may induce negative effect on a firm's overall revenue due to increasing competition in the product market. The motivation of licensee is using licensed technology for its product or services development, which possibly dissipates licensor's rents from the product market. In addition, Arora and Fosfuri (2003) takes transaction costs associated with licensing contract into account their model, and shows that lower transaction costs induce more licensing.

There are several implications drown from this model. For example, In a competitive market where rent dissipation effect is relatively small, licensing propensity is relatively high. Arora and Fosfuri (2000) show a nice example that is, BP licenses aggressively in polyethylene, where severe competition takes place, while selectively in acetic acid, where BP dominates it with strong propriety technology. In addition, high-tech start-ups, or technology specialized firms do not worry about rent dissipation effect, so that they are very keen on licensing activities. In chemical industry, entries of SEF (Specialized Engineering Firms) after World War II, changed licensing behavior of existing chemical companies toward more licensing one (Arora, 1997).

Transaction cost story explains why licensing propensity is high in pharmaceutical industry. It is found that appropriability of technology by patent is high in this industry (NISTEP, 1997; Cohen et. al. 2002) which implies perceived transaction cost associated with licensing is smaller. Transaction costs vary by firm size as well. Lanjouw and Schankerman (2001) show that a patent with small firms is more likely to be involved in patent litigations than that in large firms, since large firms have a broader patent pool which can be used for cross licensing, as well as repeated interactions with licensing partners.

In addition, stronger IPR system facilitates activities of technology specialized firms, due to smaller transactions cost associated with the market for technology. Hall and Ziednis (2001) argue that US pro-patent policy in 1980's contributed to increasing number of startups focusing on semiconductor design. This is the case for recent advancement of biotech firms as well, and such 'division of innovative labor' is closely related to growing technology market in high-tech industries. (Arora et al., 2001)

Data and IP strategy indicator

In this paper, a dataset from the Survey on Intellectual Property Related Activities (SIPA), conducted by JPO is used for empirical analysis based on the model of IP strategy by Arora and Fosfuri (2003). JPO started this survey in 2002 for collecting data on various IP related activities including application, licensing and litigation of patent, utility, design and trademark. The survey is conducted for all applicants with over a certain threshold number applications in the previous year[1] and randomly sampled ones for the rest of group. The sample size of 2004 survey is about 12,300 applicants, including firms, individual inventors and research organizations, and JPO collected 5,300 responses (response rate: 43.1%). SIPA covers a broad range of survey items. The survey consists of four parts, (1) applications of IPR, (2) usage of IPR, (3) information on IPR section at firm and (4) IP related infringements.

In this paper, we mainly use the data from section 2, delineating detail information on technology (patent) pool. This section covers data on the number of IPR by various type of status in terms of its usage, such as used by own or by licensing. Here, a firm level data from the most recent survey in 2004 (for 2003 activities) is used. Since we use variables on stock of firm's technology pool, their inter-temporal variations are relatively small. In addition, there are some changes in survey instruments over time, so that available variables in panel data become smaller. Therefore, cross section analysis by using the most recent data, instead of panel data estimate, is conducted in this paper.[2]

In order to capture firm's IP strategy, i.e., the following indicators are constructed by using the dataset from SIPA.

No_USE: The share of un-used either by own or by licensing to total number of patents owned.

DEFENSE: The share of defensive patents to the number of un-used patents.

USE: The share of patents used by own to total number of patents owned.

1 The threshold point varies by the type of IPR, 3 for patent, 2 for utility, 4 for design and 3 for trademark.

2 In a separate paper, a panel data look at firm's IP strategy is shown, and it is confirmed that the results does not change very much from cross section estimate (Motohashi, 2006).

LICENSE: The share of out license patents to total number of patents owned.
CROSS: The share of patents licensed out by cross licensing to total number of out license patents.
POOL: The share of patents licensed out by patent pool to total number of out license patents.
Figure 2 illustrates concept of these indicators. All patents owned by firm can be classified (a) ones not used either by own or by licensing, (b) ones used only by own, (c) ones used both by own or by licensing and (d) ones used only by licensing. NO_USE shows the share of un-used patents reflecting the relative size of patents not used at the timing of survey, regardless of firm's intension of holding such patents. DECENSE picks up the portion of "defensive part" of such un-used patents. "Defensive patent" in this survey is defined as un-used patents with which a firm does not have an intention of licensing out. USE shows the share of patents used by own (b+c). Finally LICENSE shows the licensing propensity. In addition, there are two sub-indicators on licensing, CROSS and POOL, shows the share of cross licensing patens and patent pool ones to the total number of licensing patents, respectively.

(Figure 2)

Table 1 shows summary statistics of these indicators by firm's employment and industry. The sample size is 1,981. There are about 5,300 responses, but first, we take out the data for individual inventors and public organizations. In addition, we use the samples with positive number of patent owned. Since SIPA is conducted for a list of firms with patent applications, there are some firms with patent application, but not with granted patents. Therefore, the number of samples used for analysis is substantially reduced.

(Table 1-1 and Table 1-2)

An average share of un-used patents is 49.0%, and 68.1% of them are held for defensive purpose. In addition, the share of licensing patent is small in general (5.7%). 15.2% of licensing patents are those by cross licensing, while the share of patent pool is very small (1.1%). In terms of size distribution of IP strategy indicators, NO_USE is the smallest in the category of 101-200 employees. In this category, the value of DEFESE and USE is the largest. NO_USE is particularly large in the largest firms, but also it becomes larger for the smallest category of firms. The share of licensing patents is the largest in the smallest category of firms, but a non-linear relationship with firm size can be found also in LICENSE. As for age distribution, we can see some trends in DEFENSE and LICENSE. The younger a firm is, its licensing propensity is larger and share of defensive patent is smaller.

There are also variations in IP strategy variables across industries. First, in "drugs", the ratio of unused patents is relatively large. However, DEFENCE is also small, implying that drug companies own unused patent for future own use or for licensing purpose, but not for defensive one. This is consistent with the fact that pharmaceutical firms are actively involved in licensing activities (Anand and Khanna, 2002; Motohashi, 2005), because the patent protection is relatively strong in this industry (NISTEP, 1997; Cohen et. al, 2002). In contrast, a high defensive patent share can be found in "Textile, pulp, paper and publishing" and "Chemicals". In these industry, the licensing share is relatively small, where a firm uses patent as a tool for protecting own technology, instead of licensing out. It should be also noted that licensing propensity is particularly high in "R&D and related services" and "other services". This is due to the fact that substantial numbers of high-tech start-ups, which are served as technology provider to large firms, are found in these categories. Finally, the share of cross licensing is relatively high in "Electronics and electrical" and "Precision machinery". In these industries, a typical product is based on integrated circuits involving numerous patents owned by different firms. In such case, cross licensing is used as a working solution to navigate patent thicket, found in semiconductor industry (Grindly and Teece, 1997).

In order to check with the observations above, we conduct descriptive regressions of IP strategy variables by firm's employment size, age and industry. Table 2 shows the results. Here, "emp" and "age" are logarithms of firm's employment size and age, respectively. In order to control for non-linear patterns with firm's size, square of "emp" (emp2) is included as an independent variable as well. Industry dummies are created by using "Other services" as a base category.

(Table 2)

In terms of size and age distribution, the observations in Table 1 are almost confirmed. As the firm gets larger, NO_USE decreases first, but increases after some point. This U shaped relationship can be found also in LICENSE. In contract, we find an inverted U shaped relationship in DEFENCE and USE. Statistical significant association of age can be found in USE and LICENSE, suggesting younger firms use in-house less and license more. In terms of industry distribution, there are some industry with greater NO_USE and smaller USE as compared to "Other services", but not statistically significant coefficients with DEFENCE and LICENSE. In a CROSS regression, positive and statistically significant coefficients are found with "Electronics and electrical" and "Precision machinery", consistent with findings in Table 1.

Determinants of IP Strategy: Licensing or not licensing?

The greater licensing propensity for smaller firms is predicted under the framework in Figure 1, if we assume firm's size and its complementary assets with patent pool, such as production facilities and marketing channels, are positively correlated. For firms in the smallest category or the youngest category, presumably high tech start-up firms without enough production facilities, we have found a higher licensing propensity, which is consistent to this prediction. However, the licensing propensity does not degrease monotonically by firm size, but it increases for firms in the largest category. The regression result in Table 2 confirms such non-linear relationship between licensing propensity and firm size. The effect of cross licensing may explain such diversion from the prediction under the basic framework. Cross licensing is an effective tool for reducing risks of patent infringements in an area where large number of patents for one product are owned by different firms. However, it can be applicable only for firms with large patent pool as well as production activities. Therefore, cross licensing propensity will be positively correlated with the firm size.

In addition, we have found that substantial amount of patents are not used either by own or by licensing, which is not taken into account by the basic framwork in Figure 1. And, substantial numbers of un-used patents are held for defensive purpose. One example of defensive use of patent is so-called patent fencing, which refers to not only patenting technologies for production but also substituting technologies in order to keep other firms from inventing around. Reizig (2004) shows that patent fence is typically found in process innovation in chemical industry.

In this paper, determinants of licensing propensity are analyzed with some extensions to the framework in Figure 1. As well as firm's size and age, reflecting the degree of rent dissipation effects in Figure 1, propensities of cross licensing (CROSS) and defensive patent (DEFENCE) are included in regression model. We would expect that a size effect of cross licensing opposite to that of rent dissipation effect can be controlled by including CROSS variable. In addition, DEFENCE reflects firm's strategy in use of patent for defensive use, instead of licensing out. It depends on the nature of innovation, as is mentioned above, which cannot be controlled sufficiently by industry classification of firm. Inclusion of DEFENCE may contribute to more accurate estimate of licensing function.

The results of regression models are presented in Table 3. In all models, dependent variable is LICENCE, and Tobit regression is applied because substantial numbers of LICENCE variables have the value of zero (no licensing). In addition, industry dummies are included in all models.

(Table 3)

Model (1) is a base model, confirming non-linear relationship between licensing propensity and firm size. However, the size and age effects are disappeared when DEFENCE is included in model (2). The coefficient to DEFENCE is negative and statistically significant. In model (3), cross licensing variables are included. Here, the value of CROSS of no licensing samples is set to zero, and dummy variable for no licensing samples (DCROSS) is also included. Therefore, the information on CROSS variables is used only for licensing samples, but the data of all samples are used for a whole model Unless we do this treatment (leaving CROSS of no licensing samples as missing values), we will lose substantial numbers of observations with variable information in the other variables. The coefficient to CROSS is positive and statistically significant, as is expected. Both coefficients to EMP and EMP2 are still statistically significant. However, the value of EMP2 coefficient is smaller than that of model (1), suggesting the size effect on licensing propensity becomes more close to negatively sloped linear relationship. Model (4) is a full specification, including both DEFENCE and CROSS. Both coefficients to EMP and EMP2 become not statistically significant at 5% level, but the coefficient to EMP is negative and statistically significant at 10% level. Again, by controlling cross section effect, size distribution of licensing becomes monotonically negative one, predicted by the framework in Figure 1.

Model (5) and (6) shows the results by splitting all samples into manufacturing and services ones, respectively. A negative size effect can be found in manufacturing, but not in services. In addition, positive and statistically significant coefficient to CROSS can be found in manufacturing samples again. This finding suggests that the framework in Figure 1 is fitted more to manufacturing firms. Model (7) and (8) shows the results by firm size. Since the largest category of firms have substantially large patent pool as compared to the others (Table 1-1), this group is separated out as

Model (8). Generally speaking, the results look quite similar. In both models, the effect of CROSS is relevant, while the size effect disappears by splitting up a whole sample into two group by firm size.

Conclusion

In this paper, IP strategy at firm level is analyzed in a framework of use of patent as a tool for maximizing firm's revenue. A dataset from JPO's SIPA provides detail information on firm's patent pool, and firm's strategy of its development and use. There exist substantial cross industry and technology variations of various IP strategy indicators, and the results in this paper are generally consistent with past literature showing cross industry difference on licensing contracts such as Anand and Khanna (2002).

In this paper, the size distribution of licensing propensity is investigated in detail. According to the model for licensing in Arora and Fosfuri (2003), the negative relationship between firm size and licensing propensity can be expected. However, descriptive regressions of IP strategy indicators suggest non-linear relation, i.e., the licensing propensity is high in very small firms, but it is relatively high for very large firms as well.

Firm's licensing decision involves various kinds of factors other than revenue effect and rent dissipation effect presented in Arora and Fosfuri (2003). In this paper, the licensing function taking into account the degree of using cross licensing as licensing contract and the degree of defensive patent as firm's IP strategy are estimated. By controlling for cross licensing effect, the size effect on licensing becomes consistent to a basic framework, i.e., monotonically negative relationship. In addition, it is found that defensive IP strategy variable is negatively correlated with licensing propensity. The robustness of these results are confirmed by regressions for sub-groups by firm's industry and size.

This paper sheds new light on firm's licensing activities, but this paper opens up new questions as well. Firm's IP strategy is evolving over time in a real world. For example, licensing decision is made as a result of patent infringement. Or, a firm involved in patent infringement may have more serious view on IP management. It is important to model such dynamic process of IP management to understand licensing decision more deeply. In addition, it is important to understand patenting or not patenting decision before talking about licensing or not licensing question. Arora and Ceccagnoli (2005) show that stronger patent protection induces more patenting, but not increases the propensity of licensing to patent. In order to answer these questions, we need more data and an appropriate economic model picking up important factors in a complicated nature of firm's IP strategy.

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Figure 1. Framework of Analyzing IP Strategy of Firm

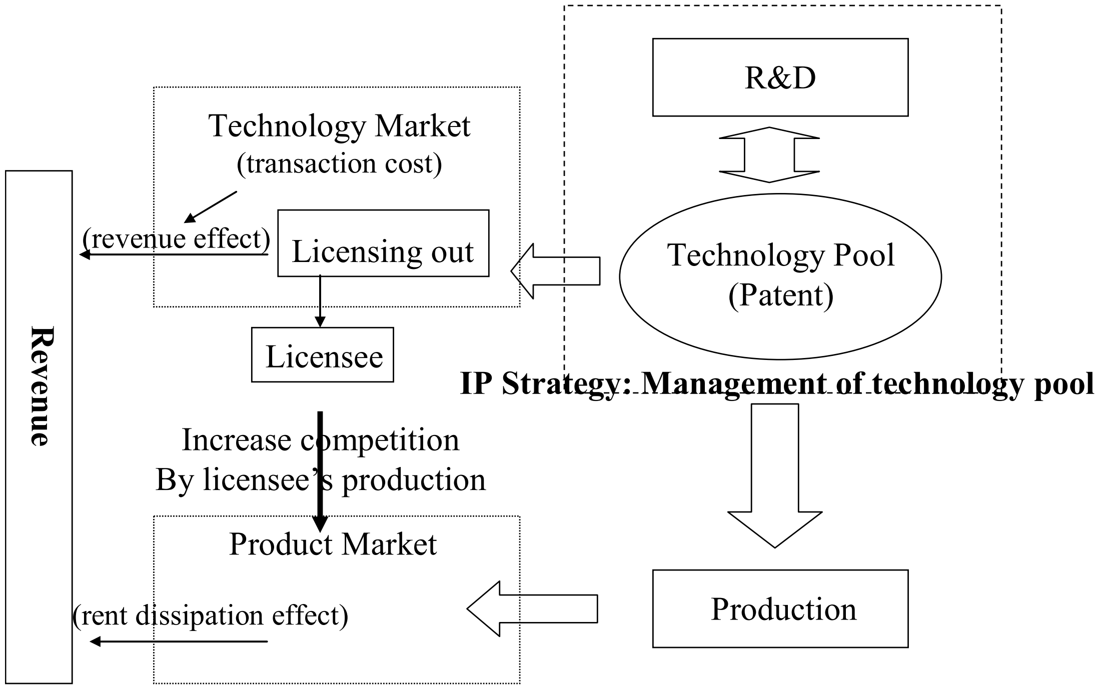

Figure 2: IP Strategy Indicators

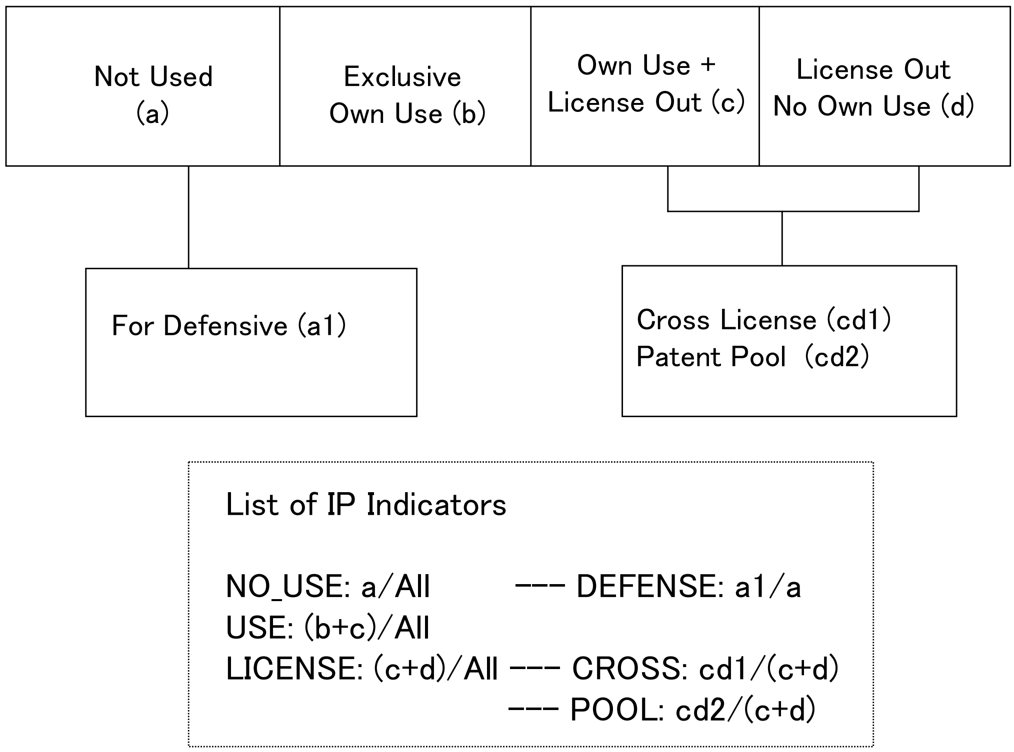

Table 1-1: Summary Statistics of IP Strategy Variables (1)

	# of firms	# of patent median	# of patent mean	No-USE	DEFENSE
	1981	55	697	49.0%	68.1%
By Start Year					
-1950	850	89	1230	52.0%	71.1%
1951-70	599	36	199	45.5%	70.3%
1971-90	304	19	77	45.0%	64.4%
1991-	186	45	489	48.4%	62.0%
By Employment Size					
-30	101	9	22	48.0%	50.6%
31-100	171	10	21	40.1%	66.5%
101-200	273	20	37	35.1%	77.0%
201-1000	826	50	125	46.6%	74.3%
1001-	269	511	2622	63.9%	65.4%
By Industry					
Food Industry	76	39	162	51.7%	64.5%
Textile, Pulp, paper, publishing	53	17	182	46.4%	80.5%
Chemicals (excl. Drugs)	305	62	570	52.9%	76.2%
Drugs	62	58	365	63.7%	47.0%
Metal and metal products	179	39	390	42.9%	71.0%
General machinery	246	57	336	40.5%	76.0%
Electronics and electrical	354	72	1912	46.8%	67.2%
Transportation machinery	144	100	747	58.0%	64.4%
Precision machinery	75	45	603	48.4%	74.6%
Other Manufacturing	159	42	282	45.6%	75.7%
Construction	107	37	131	54.1%	62.8%
ICT services	35	23	106	56.6%	44.8%
Wholesale and retail	59	11	34	41.4%	76.1%
Financial services	8	2	10	26.4%	33.3%
R&D and related service	67	19	86	52.0%	43.3%
Other services	52	27	184	63.1%	26.1%

Table 1-2: Summary Statistics of IP Strategy Variables (2)

	USE	LICENSE	CROSS	POOL
	45.7%	5.7%	2.7%	1.1%
By Start Year				
-1950	44.3%	4.1%	4.4%	1.7%
1951-70	50.3%	5.3%	2.6%	1.2%
1971-90	46.8%	6.9%	1.4%	0.0%
1991-	43.5%	9.0%	1.8%	0.1%
By Employment Size				
-30	41.6%	11.2%	0.0%	0.0%
31-100	53.4%	3.2%	0.6%	0.0%
101-200	60.8%	4.1%	1.3%	0.2%
201-1000	49.3%	4.8%	3.7%	1.7%
1001-	32.8%	5.8%	8.1%	1.5%
By Industry				
Food Industry	43.6%	4.9%	0.4%	0.6%
Textile, Pulp, paper, publishing	48.8%	2.6%	1.5%	0.0%
Chemicals (excl. Drugs)	42.6%	3.5%	2.3%	1.6%
Drugs	27.8%	6.7%	1.0%	0.0%
Metal and metal products	55.5%	3.9%	2.9%	2.7%
General machinery	56.0%	3.5%	4.0%	0.0%
Electronics and electrical	47.2%	7.5%	9.0%	0.7%
Transportation machinery	38.9%	3.3%	5.1%	0.0%
Precision machinery	46.1%	4.3%	6.9%	0.0%
Other Manufacturing	49.8%	4.3%	3.0%	2.8%
Construction	40.2%	11.4%	1.1%	3.4%
ICT services	32.4%	9.7%	0.0%	0.0%
Wholesale and retail	54.6%	2.7%	0.0%	0.0%
Financial services	70.5%	3.9%	0.0%	0.0%
R&D and related service	32.6%	13.3%	0.5%	0.0%
Other services	20.3%	17.4%	0.6%	0.1%

Table 2: Descriptive Regression of IP Strategy Variables

	no_use	defense	use	license	cross	pool
age	-0.007	0.020	0.023	-0.020	-0.016	0.008
	(0.65)	(1.08)	(2.09)*	(4.26)**	(1.05)	(1.60)
emp	-0.082	0.213	0.108	-0.041	0.066	0.007
	(3.54)**	(4.24)**	(4.50)**	(4.00)**	(1.84)	(0.53)
emp2	0.011	-0.018	-0.013	0.004	-0.003	0.000
	(5.68)**	(4.32)**	(6.24)**	(4.18)**	(1.04)	(0.38)
Food Industry	0.207	-0.051	-0.158	-0.034	0.069	0.011
	(2.27)*	(0.33)	(1.69)	(0.85)	(0.59)	(0.28)
Textile, Pulp, paper, publishing	0.228	0.158	-0.190	-0.049	0.217	0.002
	(2.38)*	(0.94)	(1.91)	(1.16)	(1.51)	(0.05)
Chemicals (excl. Drugs)	0.277	0.151	-0.217	-0.051	0.121	0.022
	(3.26)**	(1.04)	(2.47)*	(1.38)	(1.10)	(0.58)
Drugs	0.354	-0.193	-0.346	-0.018	0.065	0.003
	(3.85)**	-1.210	(3.65)**	(0.44)	(0.55)	(0.08)
Metal and metal products	0.162	0.097	-0.075	-0.046	0.133	0.039
	(1.88)	(0.66)	(0.84)	(1.23)	(1.18)	(1.00)
General machinery	0.161	0.129	-0.098	-0.046	0.198	0.005
	(1.88)	(0.88)	(1.11)	(1.24)	(1.76)	(0.13)
Electronics and electrical	0.175	0.073	-0.125	-0.024	0.364	0.017
	(2.07)*	-0.500	(1.44)	(0.67)	(3.33)**	(0.47)
Transportation machinery	0.275	0.104	-0.221	-0.058	0.142	0.002
	(3.14)**	(0.70)	(2.45)*	(1.52)	(1.23)	(0.06)
Precision machinery	0.233	0.133	-0.179	-0.059	0.542	0.004
	(2.57)*	(0.86)	(1.92)	(1.49)	(4.18)**	(0.09)
Other Manufacturing	0.205	0.112	-0.139	-0.047	0.222	0.042
	(2.36)*	-0.750	(1.55)	(1.24)	(1.93)	(1.07)
Construction	0.244	0.049	-0.182	0.017	0.072	0.030
	(2.73)**	(0.32)	(1.97)*	(0.45)	(0.63)	(0.77)
ICT services	0.213	0.049	-0.215	0.018	0.064	0.015
	(2.08)*	(0.27)	(2.01)*	(0.41)	(0.43)	(0.30)
Wholesale and retail	0.191	0.168	-0.102	-0.077	0.067	0.005
	(2.06)*	-1.020	(1.06)	(1.90)	(0.49)	(0.11)
Financial services	-0.221	0.664	0.354	-0.190	0.000	0.000
	(0.70)	(1.66)	(1.09)	(1.38)	(.)	(.)
R&D and related service	0.319	-0.165	-0.332	0.020	0.193	0.018
	(3.43)**	-1.030	(3.44)**	(0.50)	(1.52)	(0.41)
Constant	0.354	-0.038	0.388	0.268	-0.264	-0.060
	(3.38)**	(0.19)	(3.58)**	(5.86)**	(1.74)	(1.16)
Observations	1635	833	1618	1608	629	627
R-squared	0.09	0.08	0.10	0.06	0.15	0.02

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%

Table 3: Determinants of Licensing

Dependent Variable=LICENSE (Tobit Regression Model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All	All	All	All	Manuf.	Services	EMP <=1000	EMP >1000
age	-0.038	-0.006	-0.018	0.006	0.003	0.023	0.006	0.012
	(4.07)**	(0.67)	(2.34)*	(0.76)	(0.31)	(0.83)	(0.55)	(1.00)
emp	-0.054	-0.026	-0.068	-0.038	-0.066	0.010	-0.048	0.145
	(2.58)*	(0.99)	(3.83)**	(1.65)	(2.28)*	(0.17)	(1.10)	(0.61)
emp2	0.006	0.004	0.004	0.002	0.004	-0.002	0.003	-0.009
	(3.69)**	(1.80)	(2.88)**	(1.09)	(1.70)	(0.37)	(0.69)	(0.61)
defense		-0.043		-0.031	-0.024	-0.048	-0.041	-0.003
		(2.35)*		(1.82)	(1.33)	(0.97)	(2.04)*	(0.10)
cross			0.192	0.110	0.104	0.125	0.109	0.116
			(8.37)**	(5.13)**	(4.98)**	(1.09)	(4.31)**	(2.83)**
dcross			0.448	0.351	0.358	0.328	0.376	0.210
			(22.51)**	(16.03)**	(13.70)**	(6.18)**	(14.65)**	(4.88)**
Constant	0.195	0.079	0.037	-0.033	0.037	-0.190	-0.022	-0.704
	(2.11)*	(0.80)	(0.47)	(0.39)	(0.38)	(1.02)	(0.19)	(0.71)
Industry dummy	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,608	826	1,608	826	694	100	691	135

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%