

Patent Thickets and Licensing: Empirical Findings from Japanese Listed Companies

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Outline

- Literature survey
- Data
 - ✓ License data (Important Technology Contracts in Business)
 - ✓ Patent data (JIIP and Patstat)
- Measurement of patent thickets
 - ✓ Method used in Siebert and Graevenitz (2008)
 - ✓ Two alternative methods
- Empirical results
- Main findings and discussion

Literature Survey

- **Patent thickets and hold up problem**

A patent thicket is a dense web of overlapping IPR (Shapiro (2001))

In a patent thicket, rival firms hold patents protecting components of a single technology. Whenever a firm uses such a technology it is vulnerable to hold up by firms holding blocking patents (Grindley and Teece (1997), Shapiro (2001)).

- **Measurement of patent thickets**

Ziedonis (2004) introduced index of fragmentation of prior art cited (the opposite of concentration).

a firm faces a more fragmented set of prior art it must build a larger portfolio of patents against hold up.

Glarkson (2005), Graevenitz et al. (2011, 2012): measurement based on social network analysis, identifying the web of overlapping IPR.

- **Empirical studies on patent thickets and licensing**

Nishimura and Nagaoka (2012): using fragmentation of patent stock ownership in sector from the SIPRA dataset.

findings: patent thickets have no significant impact on patent use (i.e., cross license), Japanese firms can easily access complementary inventions of rivals through cross licensing.

Siebert and Graevenitz (2008): examining the effects of choice between ex ante and ex post licensing on hold up.

findings: licensing helps to resolve blocking; high expected blocking leads to ex ante licensing while ex post licensing arises if expected blocking is low but realized blocking is high; ex ante licensing reduces the level of R&D investment.

Raising problems

- There is a variety of methods to measuring the patent thickets.
- The findings on the relationship between patent thickets and licensing are mixed.

Purpose of the paper

- Utilizing the information released in annual securities reports of Japanese listed companies to gather the data for licensing contracts.
- Employing alternative methods to measure patent thickets.
- Examining the effects of patent thickets on licensing and patent portfolio races in Japanese listed companies.

Data

- **License data**

License dataset is obtained from “Important Technology Contracts in Business” of the Annual Securities Report of Japanese listed companies.

Dataset covers the year the license contracted, the names of licensor and licensee, and the contents of the license.

A total of 621 licensing contracts is identified, with 470 unilateral licenses (selling from licensor to licensee) and 151 cross-licenses between about 440 Japanese listed companies during the period of 1990 and 2007.

Example for the case of Panasonic co. as licensor in 2001

Name of Licensee

Licensee's country

Content of the contract

Start year of the contract

(3) 特許権者との契約

相手先	国名	契約の内容	契約期間
ILメグ・IMI	アメリカ	MPEG-2に関する特許実施の許諾	自 平成9年7月 至 特許満了日
レイ・オ・ボック・コーポレーション	アメリカ	アルカリマンガン乾電池に関する特許・ノウハウ実施の許諾	自 平成10年8月 至 平成30年8月
エニックス	台湾	液晶パネルに関する特許・ノウハウ実施の許諾	自 平成10年10月 至 平成15年10月
IPコス・アグ	ドイツ	受動電子部品に関する特許実施の相互許諾	自 平成11年6月 至 平成21年6月
シャープ(株)他22社	日本他 31国	ビデオ・プロセッサに関する特許実施の許諾	自 昭和55年9月 至 5年毎に更新
TDK(株)他185社	日本他 171国	ビデオ・プロセッサに関するノウハウの供与	自 昭和54年6月 至 5年毎に更新

Sharp co. and
Other 23
companies

Table 1: Distribution of Licensing contracts across Industries

Industry	licensors	licensees
Food	16	11
Textile	14	15
Pulp and Paper Products	7	8
Chemicals	46	35
Pharmaceuticals	111	113
Rubber	6	11
Ceramics	12	14
Iron and Steel	34	37
Non-ferrous Metals	19	23
Machinery	67	76
Electrical and Electronic Machinery	191	188
Shipbuilding	9	7
Motot Vehicles	28	27
Precision Instruments	32	29
Miscellaneous Manufactures	11	23
Construction	8	1
Trade	13	5
Service	29	30
Total	653	653

- **Patent data**

Information for name of applicants of patent application applied for to JPO, date of application, patent citations is obtained from JIIP.

Full IPC for each JPO patent is obtained from Patstat released by EPO.

Nikkei Company Code is used to match name of applicants of JPO patents with name of Japanese listed companies in Annual Securities Report.

Measurement of patent thickets

- ***Fragmentation***: (Ziedonis (2004))

$$Fragmentation_{it} = 1 - \sum_{j=1}^m \left(\frac{Cit_{ijt}}{Cit_{it}} \right)^2$$

measured for Licensor and Licensee respectively, where Cit_{ijt} is backward patent citation made by firm i to the patents of firm j , during year t .

- **Blocking of SG:** (Siebert and Graevenitz (2008))

$$\text{Blocking of } SG_{ijt} = RCit_{ijt}PROX_{ijt}$$

where $RCit_{ij}$ is measured by

$$RCit_{ij} = \frac{Cit_{ij}}{\sum_{j=1}^m Cit_{ij}}$$

and

$$PROX = \frac{P'_{it}P_{jt}}{\sqrt{P'_{it}P_{it}}\sqrt{P'_{jt}P_{jt}}}$$

where P_{ikt} is vector of patent class shares of firm i 's JPO patent applications in year t . $PROX$ is measured by four-digit IPC between pair of licensor and licensee.

- ***Blocking of adj Clarkson:*** (Clarkson (2005))

$$\text{Blocking of adj Clarkson}_{ijt} = \frac{\sum_{n=1}^M \sum_{k=1}^K C_{ink} / K}{M} \text{PROX}_{ijt}$$

where C_{ink} equal to one if patent n cites external patent k , and zero otherwise with both patents belonging to the same market, and K represents the total number of possible citations to external patents. M represents the number of markets where the firm i engages in business.

The index reflects the cumulative nature of innovation within the same market, and reveals the extent to which hold up occurs in the same technology field.

- **Blocking of Zhang:** (Zhang et al. (2013))

Blocking of Zhang $_{ijt}$

$$= \frac{\sum_k CSame_{ijkt} / Cit_{ijt}}{\sum_j \sum_k CSame_{ijkt} / Cit_{ijt}} PROX_{ijt}$$

where $CSame_{ijkt}$ is index of IPC's overlap in k^{th} citation between citing firm i and cited firm j during year t .

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-336043

(43)Date of publication of application : 22.12.1995

(51)Int.Cl.

H05K 3/34

H05K 3/34

B23K 35/26

G22C 11/06

G22C 13/00

IPC Classifications (C_{ikt})

(21)Application number : 07-074064

(71)Applicant : HITACHI LTD

(22)Date of filing : 30.03.1995

(72)Inventor : YAMAMOTO KENICHI
 SOGA TASAO
 ISHIDA TOSHIHARU
 SHIMOKAWA HIDEYOSHI
 HACHIYA TOSHIHIRO
 TSUNEYOSHI YOSHIRO

(30)Priority

Priority number : 06 76862 Priority date : 15.04.1994 Priority country : JP

(54) SOLDER, SOLDER CONNECTING METHOD AND MOUNTING STRUCTURE FOR ELECTRONIC COMPONENT

$$CSame_{ijkt} = \frac{C_{ijkt}}{C_{ikt}} \frac{C_{ijkt}}{C_{jkt}}$$

where C_{ijkt} is the number of IPC classifications appearing simultaneously both in citing patent and cited patent for k^{th} citation. C_{ikt} and C_{jkt} are number of IPC classifications assigned to citing patent and cited patent respectively.

$CSame_{ijkt}$ has a value between 0 and 1, representing the extent to which the citing and cited patents are overlap in the technical characteristics.

- We utilize citation from firm i to firm j to build the values of blocking for licensor and from j to i for that of blocking for licensee, and average values of them to measure *Blocking of SG*, *Blocking of adj Clarkson* and *Blocking of Zhang*.

Other Explanatory Variables

- ***Average Market Shares*** and ***Difference Market Shares***

Larger firms are more likely to have production facilities and are therefore more susceptible to hold up (Hall and Ziedonis (2001)).

On the other hand, firms with larger market shares are less willing to sell their technologies due to rent dissipation effect ((Arora and Fosfuri (2003)).

- ***Licensing Experience***

Previous experience with licensing will reduce costs of each subsequent contract (Siebert and Graevenitz (2008))

Sample Selection

- We construct a sample of all firm pairs of approximately 440 listed companies during 1990 and 2007, which leads to a cross section with more than 180,000 observations. Of the firm pairs with no license contracts, we then select 10% observations randomly.
- We treat a cross license as two unilateral licenses. This leads the two firms in the firm pair as licensor and licensee simultaneously.

Descriptive Statistics

	Licensing Pair	No Licensing Pair	Full Sample			
	Mean	Mean	Mean	Std.dev	Min	Max
Patent Application for Licensee	851	635	643	1331	0.000	7809
Patent Application for Licensor	395	208	215	694	0.000	7809
Blocking of SB	0.020	0.001	0.002	0.017	0.000	0.550
Blocking of adj Clarkson	0.005	0.002	0.002	0.009	0.000	0.386
Blocking of Zhang	0.263	0.032	0.040	0.208	0.000	1.000
Fragmentation for Licensor	0.527	0.514	0.514	0.399	0.000	0.958
Fragmentation for Licensee	0.444	0.426	0.426	0.405	0.000	0.977
Average Market Shares	0.002	0.002	0.002	0.003	0.000	0.035
Difference in Market Shares	-0.001	-0.001	-0.001	0.005	-0.066	0.003
Licensing Experience for Licensor	0.727	0.683	0.685	0.465	0.000	1.000
Licensing Experience for Licensee	0.652	0.659	0.659	0.474	0.000	1.000
Observations	653	18455	19108			

Results (OLS Estimates)

	I	II	III	IV	V	VI	VII	VIII
Dependent Variable: Licensing								
Blocking of SG	1.261*** (4.29)	2.176*** (8.67)			1.262*** (4.29)	2.178*** (8.68)		
Blocking of adj Clarkson	0.269 (1.22)		1.531*** (4.69)		0.268 (1.22)		1.532*** (4.70)	
Blocking of Zhang	0.115*** (5.78)			0.187*** (11.67)	0.115*** (5.79)			0.187*** (11.68)
Fragmentation for Licensor	-0.012*** (-2.78)	-0.008* (-1.70)	-0.005 (-1.18)	-0.012*** (-2.75)	-0.012*** (-2.65)	-0.007 (-1.49)	-0.004 (-0.98)	-0.011*** (-2.63)
Fragmentation for Licensee	-0.013*** (-3.35)	-0.006 (-1.40)	-0.001 (-0.26)	-0.014*** (-3.46)	-0.013*** (-3.39)	-0.006 (-1.41)	-0.001 (-0.20)	-0.014*** (-3.50)
Licensing Experience for Licensor	-0.002 (-0.46)	0.001 (0.31)	0.002 (0.59)	-0.002 (-0.51)	-0.001 (-0.37)	0.001 (0.43)	0.002 (0.69)	-0.001 (-0.43)
Licensing Experience for Licensee	-0.013*** (-3.31)	-0.012*** (-2.96)	-0.011*** (-2.67)	-0.013*** (-3.26)	-0.013*** (-3.32)	-0.012*** (-2.95)	-0.011*** (-2.65)	-0.013*** (-3.26)
Average Market Shares	0.937 (1.16)	1.348* (1.66)	1.299 (1.57)	0.822 (1.02)				
Difference in Market Shares					-0.522 (-1.28)	-0.679* (-1.65)	-0.567 (-1.36)	-0.461 (-1.13)
Year Effects	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effects for Licensor	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effects for Licensee	yes	yes	yes	yes	yes	yes	yes	yes
AIC information criterion	-10222.61	-10038.57	-9391.29	-10070.56	-10222.98	-10038.6	-9390.61	-10070.86
BIC information criterion	-9719.20	-9550.64	-8903.37	-9582.63	-9719.57	-9550.68	-8902.69	-9582.93
Log Likelihood	5176.30	5082.28	4758.65	5098.28	5176.49	5082.30	4758.31	5098.43

Results (Logit Estimates)

	I	II	III	IV	V	VI	VII	VIII
Dependent Variable: Licensing								
Blocking of SG	5.994*** (2.85)	18.410*** (7.74)			6.028*** (2.86)	18.454*** (7.77)		
Blocking of adj Clarkson	4.892* (1.74)		16.849*** (4.90)		4.874* (1.74)		16.873*** (4.91)	
Blocking of Zhang	1.525*** (8.45)			1.980*** (15.69)	1.527*** (8.49)			1.983*** (15.76)
Fragmentation for Licensor	-0.334** (-2.31)	-0.201 (-1.45)	-0.108 (-0.81)	-0.326** (-2.26)	-0.304** (-2.13)	-0.169 (-1.23)	-0.080 (-0.60)	-0.298** (-2.08)
Fragmentation for Licensee	-0.340** (-2.50)	-0.109 (-0.83)	0.043 (0.34)	-0.347** (-2.54)	-0.344** (-2.53)	-0.109 (-0.83)	0.051 (0.40)	-0.349** (-2.56)
Licensing Experience for Licensor	-0.015 (-0.14)	0.061 (0.58)	0.082 (0.78)	-0.021 (-0.20)	-0.004 (-0.04)	0.074 (0.70)	0.093 (0.88)	-0.010 (-0.09)
Licensing Experience for Licensee	-0.389*** (-3.36)	-0.341*** (-2.97)	-0.307*** (-2.73)	-0.385*** (-3.32)	-0.390*** (-3.36)	-0.341*** (-2.97)	-0.305*** (-2.71)	-0.386*** (-3.33)
Average Market Shares	38.196* (1.69)	43.398** (2.02)	40.309* (1.85)	37.905* (1.69)				
Difference in Market Shares					-20.208* (-1.77)	-21.754** (-1.99)	-17.826 (-1.58)	-19.677* (-1.73)
Year Effects	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effects for Licensor	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effects for Licensee	yes	yes	yes	yes	yes	yes	yes	yes
AIC information criterion	4894.98	5002.08	5178.65	4910.71	4894.66	5002.09	5179.42	4910.51
BIC information criterion	5390.43	5482.05	5658.62	5390.67	5390.11	5482.06	5659.38	5390.47
Log Likelihood	-2383.49	-2439.04	-2527.33	-2393.35	-2383.33	-2439.05	-2527.71	-2393.25

Results (Endogenous Treatment Estimates)

	Licensor's Applications			Licensee's Applications		
	I	II	III	IV	V	VI
Dep: Log Patent Applications						
Licensing	-7.642*** (-35.46)	-7.625*** (-37.11)	-7.612*** (-34.78)	-9.737*** (-37.26)	-9.668*** (-37.85)	-9.817*** (-38.29)
Blocking of SG	26.578*** (10.43)			41.157*** (10.40)		
Blocking of adj Clarkson		41.511*** (8.09)			72.068*** (8.03)	
Blocking of Zhang			2.874*** (18.91)			4.688*** (20.64)
Log R&D Sales for Licensor	1.164*** (147.73)	1.161*** (147.01)	1.160*** (147.61)			
Log R&D Sales for Licensee				0.972*** (94.46)	0.966*** (92.67)	0.963*** (94.05)
Dep: Licensing						
Blocking of SG	8.640*** (9.04)			9.777*** (9.08)		
Blocking of adj Clarkson		11.686*** (7.74)			13.592*** (7.47)	
Blocking of Zhang			0.987*** (16.31)			1.173*** (19.71)
Fragmentation for Licensor	-0.805*** (-11.81)	-0.790*** (-11.90)	-0.847*** (-12.19)	-0.029 (-0.57)	-0.003 (-0.06)	-0.077 (-1.43)
Fragmentation for Licensee	-0.007 (-0.16)	0.030 (0.68)	-0.083* (-1.70)	-0.773*** (-14.33)	-0.729*** (-13.77)	-0.870*** (-15.56)
Licensing Experience for Licensor	0.091 (1.63)	0.101* (1.86)	0.069 (1.23)	-0.024 (-0.56)	-0.019 (-0.46)	-0.051 (-1.18)
Licensing Experience for Licensee	-0.110** (-2.50)	-0.106** (-2.47)	-0.122*** (-2.74)	-0.103** (-2.35)	-0.095** (-2.19)	-0.122*** (-2.74)

Main Findings

- Patent blocking faced both by licensor and licensee has a significant effect on the firms' licensing activities.
- As an index for patent blocking, *Blocking of Zhang* shows more appropriate in the sense of statistics than *Blocking of SG* and *Blocking of adj Clarkson* (see AIC or BIC). The former identified a degree of IPR overlap between citing and cited patents.

- Licensing helps to alleviate the patent portfolio race measured by patent application made both by licensor and licensee, while patent blocking raises propensity for patent applications both in licensor and licensee firms.

Discussion

- Our findings on relation between patent thicket and license activity give partially support to those in Siebert and Graevenitz (2008), but different with those of Nishimura and Nagaoka (2012), suggesting that it is needed to carefully examine the methods in which economists have sought to quantify the extent of patent thickets.

- “Important Technology Contracts in Business” of the Annual Securities Report an available data source and open to access for empirical analysis of licensing in Japan. However, some contracts may not be listed due to the case that the companies do not think the contracts are important and need to disclose to stockholders.

- The methods used in the paper for measuring patent thickets are all based on the citations that do not necessarily indicate that the owner of the cited patent is in a position to limit the use of the citing patent (Hall et al. (2012)). How to quantify the extent of patent thickets is still a big challenge.

Thank You !