APEA in Fukuoka

Impact of transition to OBM on firm performance:

The evidence in Korea

Aug. 2019

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Abstract

This paper analyzes the impact of trademark registration on the transition of original brand manufacturing (OBM) system. Early stage of economic development in Korea, many firms have developed their ability through original equipment manufacturing (OEM) because they did not have enough technology to produce goods by themselves, and the government drove the export-led growth plan. Through OEM system, firms have cumulated their ability of standard-technological goods. After decades, with these accumulated capability, firms tried to produce their own products to overcome the OEM trap. On the other hand, the non-technological feature of trademark enables firms to register trademark and sell in the market with their own brand even in OEM stage with lack of patentable technology in some sectors. From these distinct roles of trademark by sector, we assume that trademarks have some roles in OBM system and analyze trademark registration and firm performance. We analyze different effects of trademarks and patents on a firm's performance in each group and period. To verify furthermore, we divide the whole period into; (1) under development stage from 1971 to 1986; (2) developing stage from 1987 to 1997, before crisis; (3) rebuilding stage from 1998 to 2010. Concentrating on technology accumulation and trademark registration, we compare each period's performance in trademark group and patent group. Also we check the interaction effect of patent and trademark on firm performance according to period. The first finding in this paper is that trademarks affect firms in both the trademark group and the patent group, with some differences according to period. The second finding is the development paths of trademark group are different from those of technological development in the underdevelopment stage. The last finding is that the interaction effect between trademarks and patents appear in the developing stage (period 2) in the patent group. From the result, we conclude that utilizing both patents and trademarks is appropriate for firms when they decide to convert to OBM.

I. Introduction

Korea is the model of a successful developing country beginning its development with poor resources, and its main growth power is technological ability. The remarkable achievements of Korean firms are the result of assimilating and adapting technology of other advanced countries with developing their own abilities. Lee (2013: 25) described the capability-based view of the Korea and Asian experience in the catching-up development process. This approach can be an extension of the technology-based view (OECD 1992; Hobday 1995; Kim 1997). From this point of view, one core element of the Korean model is its emphasis on firms' building capabilities and technological development, which enabled the economy to achieve continuous upgrading within the same industries as well as to advance successive entries into new promising industries (Lee 2013).

In Korea, firms have strengthened their capabilities through diverse channels, including licensing, OEM, foreign direct investment (FDI), strategic alliance, and co-development. Among these, the primary channel of learning is technical guidance from foreign OEM buyers or learning by working in FDI firms (Lee 2013). OEM is a specific form of subcontracting using a vender's exact description of the product. The products are sold using the buyer's own distribution channels and brand name (Hobday 2003).

Before the early 1970s, many firms in Korea were under the technical guidance from foreign OEM buyers. The skill composing in OEM was not complex, and the buyer did not intend to pass on high technology to the subcontractors. However, this simple repeated assemble enabled firms to build know-how and capability. Because many firms could make a certain amount of profit from OEM, they did not intend to have their own brands for a long time. Even now, many firms manage OEM systems, but their profit growth is limited compared to production of an original brand of their own. During the late 1980s, Korean firms began to consider the necessity of moving beyond the OEM trap, which refers to the situation in which subcontracted firms might face trouble owing to unfair demands in the OEM contract despite their development through producing the OEM goods (Lee et al. 2015). In that case, OEM vender firms insist on a low margin of subcontracting firms, or they refuse to sell to or license a subcontractor and move the production order to another lower-wage company. To avoid these

difficulties with OEM, subcontractors started to try to make their own products. In other words, firms change their business strategy to produce their own brands using an OBM system. It is not easy to switch to OBM. OBM firms work comprehensively on their own brands by designing and manufacturing new products, conducting R&D on their products and production processes, and conducting sales and distribution (Lee and Mathews 2012; Lee 2013). However, as long as they succeed in the transition to OBM with their own branded products, they can achieve more profits and higher growth than would be possible in the OEM system.

Meanwhile, trademark registrations are in almost all sectors at the starting point of development in Korea even in the absence of technological ability. This is because the registration of a trademark does not require submitting a blueprint of an invention, so any firms that want to register their product's name can register a trademark if the application is accepted. Sectors like light industry have continued to register trademarks more than any other IPRs even in the developed stage. Those sectors that are less relevant to the level of technological capability, the trademark seems to have its own mechanism to build the capacity of firms producing their own products.

Based on these two different views, we will look into the performance of Korean firms at different stages of development. First, we think that OBM firms may emerge at the developed stage, so we focus on the effects of trademark registration on firm performance in each development stage. After achieving a certain level of innovation through the invention of new technology, firms are likely to differentiate their products from those of other firms. While the firms apply for patents or utility models in order to keep their technological abilities, the role of trademark is protecting their products against competitors in the market. Beating out competitors in the market enables firms to grow to the next level of innovation. We focus on these dynamics; that is, a firm's technological ability (patent or utility model) could promote innovation of product, whereas a new product with an attractive, representative name (trademark) could bring more profits, allowing firms to invest R&D to invent new technology more actively.

Second, some firms have their own brands even in the underdevelopment stage; thus, we examine if trademark may help to build up the firms' capabilities in underdevelopment stage through imitative

innovation. Kim (1997; p. 11-12) explained that rapid industrialization in Korea stemmed largely from duplicative imitation, which does not require specialized investment in R&D and information channels. A catching-up economy like Korea before the 1980s inclines to an imitation-oriented technology strategy because of deficiencies in technological capability. At that time, Korean firms depended greatly on reverse engineering and importing equipment and machinery (Lee et al. 2003). After the era of duplicative imitation, Korean firms engaged in creative imitations, aiming to generate reproduced products with new performance features. Creative innovations involve not only such activities as benchmarking and strategic alliances but also important learning through substantial investment in R&D activities in order to create innovative products, whose performance may be significantly better, or production cost may be considerably lower, than the original. Kim (1997) noted that the strategies of Korea in 1960s and 1970s were largely associated with duplicative imitations, producing on large-scale knockoffs or clones of mature foreign products and imitative goods with their own or original equipment manufacturers' brand names at significantly lower prices. Later, Korea's 1980s and 1990s industrialization increasingly involved creative imitations with cumulated capabilities through duplicative imitations.

In this paper, we classified the sectors into the trademark group and patent group according to Kang (2016), and compare the impact of trademarks and patents on firms' transition to OBM according to group and period.

II. Theoretical Background and Literature Review

1. Building of technological capability through OEM and transition to OBM

OEM systems are the most cost-effective methods for obtaining capabilities in manufacturing production at the lowest stage of technological development (Ernst and O'Connor 1989; Ernst 1998). OEM facilitates technological learning and knowledge transfer because subcontractor firms produce according to specific guidance provided by vendors in OEM system (Romijn 1999; Amsden 1989). This

learning process leads the firms to standard levels of skill and productivity (Hobday 1994; Kim and Lee 2002).

In OEM systems, subcontractor firms do not take risks, and they usually remain heavy dependency on the client firms. Although this mode may guarantee a certain level of growth, it is hard to expect to further growth, because new latecomer with low cost firms continue to emerge from developing countries (Lee and Mathews 2012). To achieve more development, many subcontractor firms which had accumulated technological capabilities from OEM tried to transition to OBM.

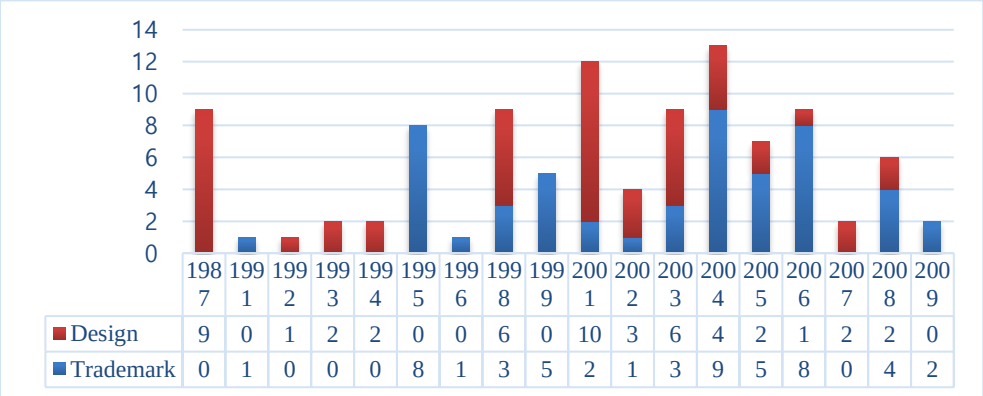
Under OBM, a latecomer firm should carry out all the steps of production and innovation, including manufacturing, new product design and R&D, and independent marketing (Hobday 2003; Lee et al. 2015). OBM firms generally register a trademark to protect their newly introduced products in the market, whereas OEM firms have no need to have their own brand during contracts because the goods are sold under the brand of the vendor.

In fact, a typical upgrading path for latecomer firms is from OEM to original design manufacturing (ODM) and finally to OBM. In an underdeveloped country, firms acquire advanced technology through OEM. ODM is the second step of their catching up to the incumbent firms. In the ODM stage, firms engages in the entire production process, from design to production and packaging. ODM firms can hold the trademarks for their products. Moreover, producers can collect technology royalties and reduce production costs. However, marketing and channel management still depend on multinational vendor firms in ODM stage. OBM is the last step, as these manufacturers can perform all the functions of production, design, marketing, channel management, and R&D. The transition from subcontracting (OEM) to independent marketing (OBM) is a severe challenge for firms, because it is difficult to compete with incumbent firms with noname-value products. However, if the latecomer firm does not develop the ability to produce and sell its own brands for fear of failure, it would be stuck in low value-added segments. Thus, it is recommendable for OEM firms to convert to OBM if they have enough technological ability to handle their own production.

Case 1. Aurora World[1]

Aurora World is a toy company established in 1981. The firm achieved OBM status after going through the OEM and ODM stages, and it is now one of the leading brands in the global toy market. The firm converted to OBM in 1991 to overcome difficulties in the toy industry and enhance its profitability. However, starting to OBM was not easy. The firm confronted risks such as stopped or cancelled OEM/ODM orders by the incumbent vendor, which intended to prevent the firm from becoming a competitor. For this reason, the firm underwent a five-year period of stagnation. For overcoming these difficulties, Aurora World concealed itself and registered a new name in the United States so that the previous vendors could not notice its independent marketing by OBM. In addition, by hiring marketing experts from the host country and establishing design research centers in abroad, they succeeded in converting to OBM at last. Now, Aurora World is the second largest toy brand in the US, and they still try to maintain brand value and create new character to sustain continuous revenue. Because this firm is a typical firm in the trademark group, the firm has registered trademarks and designs to protect its goods in the market.

[Figure 1] IPR registrations by Aurora World



	1987	1991	1992	1993	1994	1995	1996	1998	1999	2001	2002	2003	2004	2005	2006	2007	2008	2009
Design	9	0	1	2	2	0	0	6	0	10	3	6	4	2	1	2	2	0
Trademark	0	1	0	0	0	8	1	3	5	2	1	3	9	5	8	0	4	2

Case 2. Cuckoo Electronics[2]

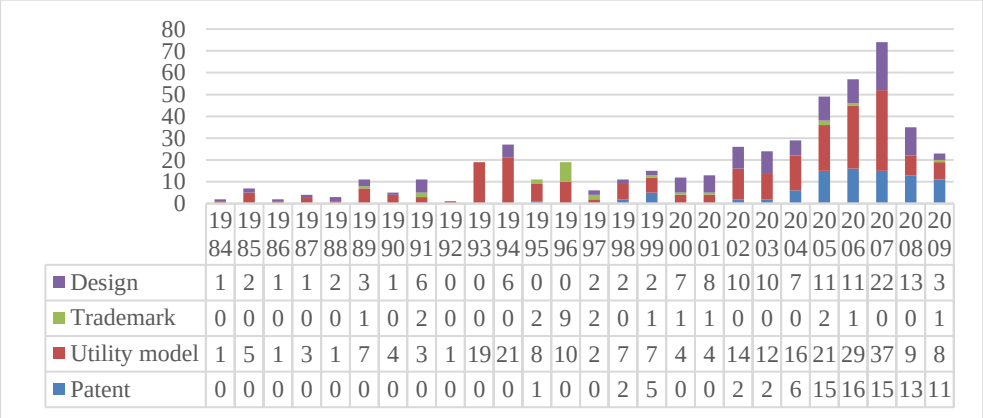
Cuckoo Electronics is a producer of rice cookers which began as an OEM firm in 1978 and later

1 This case is brought from Lee et al. (2015).

2 This case is taken from Lee et al. (2015).

successfully entered the OBM stage. Cuckoo introduced consumers with new products that effectively combined gas pressure technology with old electric rice cooker technology and the combination has both convenience of an electric cooker and the quality of a gas cooker. When they prepared to enter the OBM stage, Cuckoo never disclosed their plan of developing new products publicly. The R&D team of the firm even worked only at night to avoid the scrutiny of their rivals. After developing the electric pressure rice cooker with the 'Cuckoo' name, they managed an aggressive marketing promotion, with a huge amount of expenditure on advertising. As a result, Cuckoo became the leading firm of the rice cooker industry, beating the former No. 1 market share electric rice cooker produced by ZOJIRUSHI from Japan. The firm belongs to the paten sector and has registered patents, utility models, trademarks and designs since 1984. Around 1998 (the year of converting to OBM), they registered 13 cases of trademarks, and since then they have devoted resources to R&D in order to upgrade their product quality.

[Figure 2] IPR registrations by Cuckoo



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Design	1	2	1	1	2	3	1	6	0	0	6	0	0	2	2	2	7	8	10	10	7	11	11	22	13	3
Trademark	0	0	0	0	0	1	0	2	0	0	0	2	9	2	0	1	1	1	0	0	0	2	1	0	0	1
Utility model	1	5	1	3	1	7	4	3	1	19	21	8	10	2	7	7	4	4	14	12	16	21	29	37	9	8
Patent	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	5	0	0	2	2	6	15	16	15	13	11

2. Trademark and firm performance

In the OBM stage, firms should develop their own brand with their own capabilities, begin research to develop their products, and find their market by themselves. If they have accumulated technological abilities through OEM, it is possible for them to produce their own products as they intend. And from the OBM stage, they have to decide to apply a trademark or not to secure their product in the market competition. Trademarked products signal to customers that the product has a certain level of quality

and produced by a reliable manufacturer. In Korea, the registration of trademarks has increased steadily since the early stage of economic development[3].

Researchers in diverse countries have paid attention to the role of trademarks in firm performance (Allegrezza and Guard Rauchs 1999; Schmoch 2003; Mendonça et al. 2004; Bosworth and Rogers 2001; Malmberg 2005; Greenhalgh and Rogers 2007; Sandner and Block 2011; Mehrazeen et al. 2012). These authors collected firm-level data of listed companies in each nation and analyzed whether trademarks affected firm performance. Research papers about trademarks and firm performance are in Table1.

[Table1] Researches on trademark

Researcher	Data	Findings
Allegrezza and Guard Rauchs, 1999	a survey of 2 500 Benelux SMEs from the Benelux Trademark Office (BTO).	Positive relationship between trademark deposits and the size of the firm
Seethamraju, 2003	237 US firms from selected industries 1993-97	Positive role for trade marking on sales and also market values.
Schmoch, 2003	EU Mark & survey data for German firms	Service marks represent innovation
Mendonça et al., 2004	CTM and investigate the case of Portugal	trademarks are complementary to other innovation indicators in sectors in which patenting is weak.
Kallapur and Kwan, 2004	33 brands asset value recognized by UK firms.	Positive and significant relation between stock prices and trademarks value
Malmberg, 2005	Swedish firm	The numbers of trademarks and of new products correlated in the pharmaceutical industries
Graham and Somaya, 2006	US	The complementarity of trademarks in Software firms
Greenhalgh and Rogers, 2007	UKTM & CTM of large UK firms	Role of trade marks using a new dataset of the trade mark activity
Arbussa, A. & Coenders, G., 2007	Spanish firms	The complementarity of trademarks in all sector
Amara et al., 2008	Canada Innovation Survey	Patents, registration of design patterns and trademarks are complementary legal methods on which knowledge intensive business services rely
Buddelmeyer, Jensen and Webster, 2010	Australian companies	Trademark applications and stocks were associated with higher company survival rates
Schwiebacher and Müller, 2009	German companies	Complementary relationship between patent and trademark protection
Flikkema et al. 2010	A sample of 660 Benelux trademarks	Trademarks refer to innovative activities
Sandner and Block, 2011	CTM data	Trademarks have a positive effect on firm value.

III. Hypothesis development

1. OBM and Trademark Registration

In the early stage of development, the lack of technological capability caused Korean firms to depend heavily on reverse engineering and imported equipment and machinery (Lee et al. 2003). Most

[3] The first trademark was 天, by Chunil Industry (1950).

Korean manufacturing firms contracted OEM with advanced firms in other countries and accumulated their abilities through OEM which started in the 1960s.[4] However, the profits through OEM have decreased from the 1990s because the entrance of other OEM firms in underdeveloped countries. Since then, some firms have tried to convert to OBM and tried to use trademark to protect their own products in the market. However, many firms still manage a mixture of OEM and OBM, because it is not easy for firms to manage the whole process of production when they enter into OBM. Moreover, if the profits from OEM were acceptable to firms, the decision of converting to OBM would be more difficult for them. According to Hobday et al. (2004), some Korean firms indeed found themselves in the 'innovation dilemma', debating whether to continue relying on the global leaders that generate new products and new markets or trying to compete as leaders on the international stage by deploying in-house R&D to develop their own leading-edge products and systems. Indeed, even the most advanced producers such as Samsung and Hyundai Mobis still produce large quantities of products under basic OEM arrangements. Some companies maintain OEM even though they have the ability to make their own brand. As an example, Youngwon Corporation is a famous OEM-specialized supplier and distributer, which concentrate on OEM until now. They produce and supply high quality garments like North Face, NIKE, and POLO, etc.

For the analysis, we classify sectors into two groups. One is a trademark group, which trademark is the most applied and registered IPR in the sector in the entire period, from 1971 to 2010. The other is a patent group, which at first trademark is the most applied IPR, but from the mid-1990s, the patent becomes the dominant IPR in the sector. In the trademark group, the number of trademark registrations is always larger than that of other IPRs, but in the patent group, patent application surpasses trademark registration only after the mid-1990s. In this paper, we investigate the different impacts of trademark on firm performance according to group and period.

[Table2] Average number of trademark registrations of firms in each group

Period	Trademark group	Patent group
Period1(1970-1986)	6.97	2.39

[4] The first export through OEM occurred in 1962, by Dongshin Chemicals, with shoe products of around $120,000 from the US.

Period2(1987-1997)	6.84	1.72
Period3(1998-2010)	7.13	1.03

As shown in Table2, firms in the trademark group register trademarks more than in the patent group in all periods. Being an OBM means that a firm produces its own brand, so we assume that trademark registration should increase after converting to OBM. However, based on the data, it might seem that the transition effect from OEM to OBM only appears in the trademark group, because in the patent group the average number of registered trademarks declines according to period. Even so, we suppose that converting to OBM occurs in both the trademark group and patent group according to technological development. In the patent group, OBM would be particularly related to the level of technological capability, so a firm will have its own brand after a certain cumulate level of technology. On the other hand, in the trademark group, the firms in the sector have their own brands even in the underdevelopment stage. From these different features of having a brand, we build our hypotheses as follows:

Hypothesis 1

In the trademark group, a firm's possession of its own brand will always affect firm performance positively regardless of development stage.

Hypothesis 2

In the patent group, a firm's possession of its own brand will affect firm performance positively in developed stage.

2. Interaction effect of patent and trademark

When a firm decides to convert to OBM, it must consider every possible risk. In order to successful OBM transition, first of all, the cumulative technological ability or absorptive capability to conduct independent marketing is required. The transition from subcontracting delivery to independent selling

is a major challenge for firms to enter the OBM stage, but it is necessary in order to catch up with incumbent firms and enter the global market (Lee et al. 2015).

In the patent group, firms usually apply for a patent since success of the sector depend on mostly codified and scientific knowledge. However, with patent only, firms cannot make a profit in the market. They need to know about marketing. In market management, marketers identify and distinguish their products by the use of trademarks. Brands and trademarks are firms' most valuable assets in the market (Schewe and Smith 1979). Especially when a product is standardized, trademarks or labels can be the killing factor in promoting business. Thus, the value of a brand is more and more important even in the technologically advanced period.

Meanwhile, in the trademark group, firms register trademarks to get legal protection for their own products. Because a trademark application need not include a description of the product like a patent, the application and registration of trademarks is much easier and more accessible for firms without technological capabilities. However, although the registration of a trademark is simple, the maintenance of a trademark is quite a different matter. To keep its reputation established with a brand name, a firm must keep up with consumer needs, because brand management is beyond the choice of a name or symbol for a product. Contrary to the firms in the patent group, firms in the trademark group emphasize technological abilities to seize attention of customers. For example, we can easily find food or cosmetic companies that advertise with explaining patents or utility models of their products.

Because firms in both groups may improve their performance with another IPR which is not the main IPR of the group, we set the following hypothesis to identify the relation between patents and trademarks according in the developed level.

Hypothesis 3

In the technologically developed period, the registration of trademarks will positively affect firm performance in the patent group, and the registration of patents will positively affect firm performance in the trademark group.

IV. Data and Methodology

1. Description of Data

For the analysis of firm performance and IPR registration, we use firm-level panel data from Korean manufacturing sectors from 1971 to 2010. Patent, utility model, and trademark data are downloaded from the Korea Intellectual Property Rights Information System (www.kipris.or.kr). To build the financial data for Korean external auditing or listed companies, we use the financial database of the Center for Economic Catch-up[5] until 1979 and the Korea Information Service-Value Ⅱ from 1980 to 2010. After matching IPR data with financial data, we delete firms with less than three-year-period. The dataset has the structure of an unbalanced panel consisting of 7,094 companies. SMEs and LEs are classified based on the number of employees[6] in 2009 but amended according to period. In making the variables, we set some guides as follow; 1) making the IPR variable: in patents, the assignee invents or develops the product before he or she applies with the description. Thus, we count the number of granted patents at the application date. However, trademarks are valid only after approval from the office, so the count of trademark usually started from the granted date. 2) using IPR intensity: Greenhalgh and Rogers (2007) use trademark intensity rather than the simple number of trademarks to control the fact that large firms often have more trademarks than smaller firms. 3) using IPR dummy variable: To examine the effect of IPRs registration, we run a regression with an IPR dummy that indicates whether or not the firm applies for the IPR in a given year. As the decision of having its own brand is crucial for surviving in the market, we will compare the "registration effect" of trademark to other IPRs.

[Table3] Description of variables

Variables	Description	Obs	Mean	SD
Patent_intensity	The number of patent registration of the firm in each year/ sales(billion won) of the firm in each year	92574	0.094	2.991

[5] The financial data of 1970s only appeared in print, so researchers and students at the Center for Economic Catch-up compiled the financial data of the 1970s manually in 2007. These data have been utilized by many researchers analyzing the firm performance of 1970s.

[6] Firms with fewer than 300 employees are classified as SMEs.

Utility model_ intensity	The number of utility model registration of the firm in each year/sales(billion won) of the firm in each year	92574	0.113	5.063
Trademark_intensity	The number of trademark registration of the firm in each year/sales(billion won) of the firm in each year	92574	0.083	2.408
Patent dummy	1 if the firm applies(and registered later) patent in the year, or 0	99273	0.188	0.390
Utility model dummy	1 if the firm applies(and registered later) utility model in the year, or 0	99273	0.167	0.373
Trademark dummy	1 if the firm registers trademark in the year, or 0	99273	0.240	0.427
Sales growth	sale(t)-sales(t-1) / sales(t-1)	90758	0.232	0.85
Investment	fixed assets(t) - fixed assets(t-1)/sales(t-1)	86709	0.111	2.89
Advertisement ratio	Advertisement cost(t) / sales(t)	86709	0.011	0.05
R&D intensity	R&D expenses(t)/sales(t)	60181	0.037	1.449
Employees	Total number of employees of the year	92742	514	18586.9
Firm age	current year - foundation year	92742	15.04	12.26
Year dummy	1971-2010			
Industry dummy	138 industry(4-digit)			

[Table4] Correlation of variables 1

	s_rgrowth	Patent_ intensity	Trademark _intensity	Utility_ intensity	Employees	Firm age	Investment	Advertisement _sales_ratio	R&D intensity
s_rgrowth	1								
Patent_ intensity	0.1795	1							
Trademark_int ensity	0.0469	0.1324	1						
Utility_ intensity	0.1037	0.2413	0.0852	1					
Employees	-0.1192	-0.1223	-0.0204	-0.1283	1				
Firm age	-0.2028	-0.137	0.0009	-0.1493	0.4823	1			
Investment	0.0865	0.0628	-0.0042	0.0495	-0.0029	-0.15	1		
Advertisement _sales_ratio	0.0287	0.0853	0.2756	0.0658	0.1451	0.0424	0.0376	1	
R&D intensity	0.0628	0.1507	0.0515	0.0887	-0.0067	-0.0678	0.1177	0.1039	1

[Table5] Correlation of variables 2

	Sales growth	Patent dummy	Utility model dummy	Trademark dummy	Number of employees	Firm age	Investment	Advertising sales ratio	R&D intensith	Debtratio
Sales growth	1									
Patent dummy	0.0092	1								
Utility model dummy	0.0056	0.2861	1							
Trademark dummy	-0.0501	0.15	0.1077	1						
Number of employees	-0.0065	0.0367	0.0339	0.0423	1					
Firm age	-0.2004	0.0745	-0.0068	0.2367	0.0425	1				
Investment	0.1397	0.0133	-0.002	0.0018	-0.0004	-0.0294	1			
Advertising sales ratio	0.0047	0.0157	-0.0019	0.1919	0.0046	0.0493	0.0362	1		
R&D intensith	-0.0015	0.0076	0.0041	-0.0027	-0.001	-0.0231	0.0358	0.1057	1	
Debtratio	-0.0005	-0.0047	-0.0017	-0.0042	-0.0004	-0.0018	-0.0005	-0.002	-0.0002	1

2. Methodology

To verify the effects of trademarks on each group and period, we run pooled ordinary least squares (OLS) and fixed effect regressions, with one-year lagged variables, to examine the relationship between IPRs and firm performance in consideration of the time lag. To account for the time-dependent overall effects in markets, a full set of year dummies is included. Full sets of industry dummies are also included to capture industry-specific variations. Initially, we check the “registration effect” of IPRs on firm performance in each group, and then we analyze the effect of IPR registration on firm performance in each group.

(1) $Performance_{i,t}=\beta_0+\beta_1 Trademark\ dummy_{i,t-1}+$

$\beta_2 Patent\ \ dummy_{i,t-1}+\beta_3 Utility\ model\ dummy_{i,t-1}+\alpha_1 Investment_{i,t-1}+$

$\alpha_2 Debtratio_{i,t-1}+\alpha_3 Advertisement\ Ratio_{i,t-1}+\alpha_4 R\&D\ intensity_{i,t-1}+$

$\alpha_5 Employees_{i,t-1}+\alpha_6 Age_{i,t}+\varepsilon_{it}$

(2) $Performance_{i,t}=\beta_0+\beta_1 Trademark\ intensity_{i,t-1}+$

$\beta_2 Patent\ intensity_{i,t-1}+\beta_3 Utility\ model\ intensity_{i,t-1}+\alpha_1 Investment_{i,t-1}+$

$\alpha_2 Advertisement\ Ratio_{i,t-1}+\alpha_3 R\&D\ intensity_{i,t-1}+\alpha_4 Employees_{i,t-1}+\alpha_5 Age_{i,t}+\varepsilon_{it}$

*Performance: sales growth rate$_{i,t}$

*Investment: $\frac{\triangle \text{Fixed Assets}_{i,t}}{\text{Sales}_{i,t-1}}$

*Advertisement ratio: $\frac{Advertisement\ cost_{\ i,t-1}}{\text{Sales}_{i,t-1}}$

*R&D intensity: $\frac{R\&D\ expenses_{\ i,t-1}}{\text{Sales}_{i,t-1}}$

To identify the relation between trademarks and patents in developed stage, we insert an interaction term of trademarks and patents in the model:

(3) $Performance_{i,t}=\beta_0+\beta_1 Trademark\ intensity_{i,t-1}+\ \beta_2 Patent\ intensity_{i,t-1}$

$+\beta_3 Trademark\ \ intensity_{i,t-1}*Patent\ \ intensity_{i,t-1}+\ \ \alpha_1 Advertisement\ Ratio_{i,t-1}+$

$\alpha_2 R\&D\ intensity_{i,t-1}+\alpha_3 Employees_{i,t-1}+\alpha_4 Age_{i,t}+\varepsilon_{it}$

V. Regression Result

1. IPR registration and firm performance

Before analyzing the hypothesis, we check the effect of IPR registration, focusing on firm performance. The trademark registration indicates that the firm decides to have its own product and intends to develop its own brand. Using each IPR dummy, which represents the firm's registration of IPR in the current year, we run the regression as OLS and fixed effect. The results are shown in tables 6, 7, and 8.

[Table6] Registration effect of each IPR on firm performance: All sectors

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		perios3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect
Patent dummy(t-1)	0.047***	0.011	0.091**	0.025	0.044	-0.025	0.044***	0.001
	(3.728)	(0.773)	(2.024)	(0.367)	(1.541)	(-0.791)	(3.051)	(0.062)
Utility model dummy(t-1)	-0.038***	0.013	-0.004	0.015	-0.025	0.008	-0.045***	0.014
	(-2.852)	(0.891)	(-0.123)	(0.275)	(-1.014)	(0.288)	(-2.779)	(0.766)
Trademark dummy(t-1)	-0.010	-0.014	-0.075**	-0.122**	-0.010	-0.004	-0.008	-0.012
	(-0.806)	(-1.044)	(-2.219)	(-2.171)	(-0.433)	(-0.149)	(-0.524)	(-0.755)
Log of Employees(t-1)	-0.047***	-0.175***	-0.024*	-0.163***	-0.019*	-0.235***	-0.056***	-0.242***
	(-9.314)	(-16.908)	(-1.854)	(-3.430)	(-1.954)	(-8.217)	(-9.042)	(-17.287)
Log of investment	0.005***	0.003***	0.002	0.000	0.007***	0.006***	0.004***	0.001
	(8.630)	(4.758)	(1.062)	(0.029)	(7.305)	(5.943)	(6.156)	(1.596)
Log of Ad_ratio(t-1)	0.035***	0.070***	0.016*	0.110***	0.023***	0.051***	0.038***	0.082***
	(14.120)	(17.864)	(1.958)	(4.010)	(4.687)	(5.642)	(12.905)	(16.944)
Log of R&D_intensity(t-1)	0.004***	0.006***	0.005**	0.011***	0.002*	0.003*	0.004***	0.007***
	(6.156)	(6.991)	(2.523)	(3.360)	(1.697)	(1.675)	(5.317)	(6.597)
Log of age(t)	-0.151***	-0.469***	-0.066***	0.116	-0.122***	-0.421***	-0.158***	-0.607***
	(-20.260)	(-20.593)	(-2.894)	(0.426)	(-8.606)	(-6.808)	(-17.726)	(-19.408)
Constant	1.672***	2.431***	0.585***	1.857***	0.519***	2.882***	1.076***	3.859***
	(7.006)	(9.627)	(3.436)	(2.605)	(3.644)	(10.983)	(21.932)	(36.285)
Observations	68,059	68,059	2,293	2,293	13,680	13,680	52,086	52,086
R-squared	0.035	0.034	0.103	0.105	0.019	0.024	0.037	0.040
Hausman test		371.47		28.96		87.91		531.46
Number of firms		6,452		761		2,093		6,331

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Year dummy, industry dummy included

[Table7] Registration effect of each IPR on firm performance: Trademark group

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Random effect	OLS	Fixed effect	OLS	Fixed effect
Patent dummy(t-1)	0.029*	0.027	0.011	0.011	0.006	0.000	0.033*	0.024
	(1.880)	(1.627)	(0.258)	(0.258)	(0.157)	(0.004)	(1.872)	(1.223)
Utility model dummy(t-1)	-0.001	0.022	-0.010	-0.010	-0.025	-0.003	0.003	0.026
	(-0.076)	(1.205)	(-0.292)	(-0.292)	(-0.713)	(-0.066)	(0.166)	(1.148)
Trademark dummy(t-1)	-0.009	0.004	-0.059*	-0.059*	-0.001	-0.002	-0.008	0.010
	(-0.730)	(0.267)	(-1.953)	(-1.953)	(-0.029)	(-0.062)	(-0.495)	(0.570)
Log of Employees(t-1)	0.005***	0.003***	0.006	0.006	-0.048***	-0.335***	-0.051***	-0.211***
	(7.346)	(4.926)	(0.489)	(0.489)	(-3.631)	(-8.699)	(-7.214)	(-13.042)
Log of investment	0.023***	0.049***	-0.000	-0.000	0.007***	0.006***	0.004***	0.002**
	(8.216)	(10.409)	(-0.192)	(-0.192)	(5.377)	(4.528)	(5.149)	(2.058)
Log of Ad_ratio(t-1)	0.003***	0.004***	0.007	0.007	0.022***	0.046***	0.024***	0.058***
	(3.651)	(3.996)	(0.927)	(0.927)	(3.517)	(3.647)	(7.405)	(9.997)
Log of R&D_intensity(t-1)	-0.100***	-0.326***	0.002	0.002	0.004**	0.005*	0.002***	0.004***
	(-11.972)	(-12.382)	(1.298)	(1.298)	(2.210)	(1.910)	(2.629)	(2.994)
Log of age(t)	0.903***	2.011***	-0.043**	-0.043**	-0.050***	-0.215**	-0.115***	-0.493***
	(3.466)	(7.728)	(-2.023)	(-2.023)	(-2.749)	(-2.538)	(-11.668)	(-13.346)
Constant	-0.047***	-0.160***	-0.247	-0.247	0.224	2.668***	0.846***	2.707***
	(-7.922)	(-13.354)	(-0.799)	(-0.799)	(0.712)	(7.115)	(16.114)	(24.379)
Observations		31,608	1,348	1,348	7,179	7,179	23,081	23,081
R-squared	31,608	0.029	0.159	0.172	0.016	0.025	0.032	0.036
Hausman test	0.028	136.91		6.79		74.88		197.23
Number of firms		2,721		433		1,037		2,664

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Year dummy, industry dummy included

[Table8] Registration effect of each IPR on firm performance: Patent group

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect
Patent dummy(t-1)	0.044	-0.025	0.196**	0.163	0.076*	-0.051	0.049**	-0.009
	(1.541)	(-0.791)	(2.001)	(1.028)	(1.747)	(-1.123)	(2.257)	(-0.366)
Utility model dummy(t-1)	-0.025	0.008	0.007	-0.014	-0.036	0.022	-0.073***	0.009
	(-1.014)	(0.288)	(0.099)	(-0.115)	(-0.972)	(0.551)	(-3.153)	(0.335)
Trademark dummy(t-1)	-0.010	-0.004	-0.113	-0.165	-0.024	-0.005	-0.009	-0.038
	(-0.433)	(-0.149)	(-1.509)	(-1.407)	(-0.606)	(-0.119)	(-0.355)	(-1.409)
Log of Employees(t-1)	-0.019*	-0.235***	-0.067***	-0.405***	0.008	-0.109**	-0.055***	-0.257***
	(-1.954)	(-8.217)	(-2.688)	(-3.901)	(0.544)	(-2.557)	(-5.721)	(-12.007)
Log of investment	0.007***	0.006***	0.004	0.002	0.008***	0.006***	0.004***	0.001
	(7.305)	(5.943)	(1.146)	(0.362)	(4.905)	(3.875)	(3.990)	(0.639)
Log of Ad_ratio(t-1)	0.023***	0.051***	0.034*	0.186***	0.031***	0.056***	0.051***	0.096***
	(4.687)	(5.642)	(1.820)	(3.852)	(3.812)	(4.322)	(10.581)	(13.335)
Log of R&D_intensity(t-1)	0.002*	0.003*	0.008*	0.014**	-0.000	0.001	0.006***	0.010***
	(1.697)	(1.675)	(1.938)	(2.180)	(-0.044)	(0.450)	(4.602)	(5.993)
Log of age(t)	-0.122***	-0.421***	-0.093*	0.413	-0.209***	-0.673***	-0.194***	-0.682***
	(-8.606)	(-6.808)	(-1.962)	(0.854)	(-9.269)	(-7.338)	(-13.707)	(-14.272)
Constant	0.519***	2.882***	2.235***	3.930***	0.753***	3.010***	1.265***	3.604***
	(3.644)	(10.983)	(6.726)	(3.172)	(3.567)	(8.095)	(16.211)	(28.125)
Observations	36,451	36,451	945	945	6,501	6,501	29,005	29,005
R-squared	0.019	0.024	0.112	0.120	0.029	0.031	0.039	0.045
Hausman test		240.27		29.23		39.48		239.69
Number of firms		3731		328		1,056		3,667

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Year dummy, industry dummy included

From the result of the regression with the dummy variable, the registration effect analyzed with the IPR dummy variable is not apparent in the case of trademarks. Moreover, the registration effect of patents is only positively significant in the OLS result. Before this analysis, we supposed that registering an IPR (especially a trademark) in the current year is a signal of building the firm's brand, but the regression result shows that the firm registered a trademark alone is not related to firm performance. Thus, another analysis is needed to ascertain the relation between firm growth and IPR.

2. OBM effect on different groups and periods

We analyze the effect of IPR registration on firm performance with IPR intensity in each year. Though we categorize into two groups for the comparison, we analyze the whole sector to confirm the periodical different influence of IPR registration on firm growth. The results are shown in Table9; all IPRs have an impact on firm performance in all periods. As a more specific investigation, we examine firm performance in relation to IPR registration in each group.

[Table9] Impact of IPRs registration on firm performance in all sector

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect
Patent_intensity(t-1)	0.026***	0.018***	0.002	-0.000	0.495**	1.022***	1.431***	1.664***
	(5.031)	(3.491)	(0.869)	(-0.013)	(2.522)	(4.572)	(34.449)	(32.247)
Utility_intensity(t-1)	0.600***	0.867***	0.256	1.608**	1.365***	1.638***	0.232***	0.490***
	(14.353)	(15.917)	(0.808)	(2.331)	(11.395)	(10.959)	(4.947)	(8.004)
Trademark_intensity(t-1)	0.362***	0.542***	0.945***	1.638***	1.493***	1.979***	0.024	0.156***
	(10.873)	(13.553)	(6.773)	(7.616)	(21.750)	(24.061)	(0.620)	(3.310)
Log of Employees(t-1)	-0.039***	-0.166***	-0.029**	-0.169***	-0.026***	-0.220***	-0.041***	-0.230***
	(-8.169)	(-16.217)	(-2.490)	(-3.642)	(-3.110)	(-7.948)	(-7.152)	(-16.713)
Log of investment	0.005***	0.003***	0.002	0.001	0.007***	0.006***	0.003***	0.001
	(8.543)	(4.606)	(1.174)	(0.245)	(7.086)	(6.170)	(5.040)	(0.914)
Log of Ad_ratio(t-1)	0.026***	0.064***	0.001	0.103***	0.001	0.047***	0.025***	0.067***
	(10.677)	(16.457)	(0.123)	(3.838)	(0.237)	(5.348)	(8.742)	(14.022)
Log of R&D_intensity(t-1)	0.004***	0.005***	0.005**	0.009***	0.001	0.002	0.002**	0.005***
	(5.452)	(6.404)	(2.386)	(2.957)	(0.964)	(1.250)	(2.199)	(5.113)
Log of age(t)	-0.145***	-0.455***	-0.068***	0.119	-0.108***	-0.417***	-0.132***	-0.561***
	(-19.511)	(-20.037)	(-3.022)	(0.444)	(-7.741)	(-6.956)	(-14.882)	(-18.165)
Constant	1.560***	2.300***	0.455***	1.758**	0.181	2.617***	0.830***	3.461***
	(6.549)	(9.146)	(2.709)	(2.514)	(1.303)	(10.289)	(16.830)	(32.743)
Observations	68,059	68,059	2,293	2,293	13,680	13,680	52,086	52,086
R-squared	0.040	0.042	0.118	0.139	0.065	0.084	0.061	0.065
Hausman teest		447.09		52.48		93.41		600.65
Number of firms		6,452		761		2,093		6,331

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period dummy, industry dummy included. Samsung, LGEI, DAEWOO, POSCO, HYUNDAI, KIA dummy included[7]

We analyzed the influence of IPRs on firm performance in the trademark group. According to the regression result, from 1971 to 1997 trademark registrations affected the trademark group's firm performance, but in later, more technologically mature periods, patents and utility models (and not trademarks) affect firm performance in the trademark group. The result that the registration of trademark affected the growth of firms in trademark group in period 1 and period 2 is remarkable. As we know, a trademark is the name of a good and not particularly related to technological ability. However, firms can register the names of applied goods as trademark through a process of imitation. Latecomer firms are good at imitating developed goods. Also firms cannot register patents or utility models with replicas or imitations, but they can sell the product in the market if the product does not violate the patent of the original good. This is an another catch-up route of latecomer firms, and Korean firms accumulate their capability by imitating or reverse engineering of advanced products from foreign countries (Hobday 1995; Kim, 1997; Lee 2013). Although the power of a brand is not huge and has regional limitations, Korean firms in the trademark group had developed their capability by managing the domestic market

[7] For controlling the effect of big firms (Chaebols), we contain top 6 firms as dummy variable.

until the 1990s. This may be considered different effect of owning a brand like imitative innovation (Levitt 1966, Kim 1997). After the late 1990s, the positive effect of patents and utility models on firm performance might come from the necessity for firms that have to maintain brand power to improve the quality of their goods. Thus, the firms even in the trademark group have to develop their technological capabilities in order to survive in the market competition. That is, technological ability matters in almost all sectors in the developed stage.

[Table10]Impact of trademark registration on firm performance in trademark group

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect
Patent_intensity(t-1)	0.008*	0.005	0.003	0.001	-1.066*	-0.203	1.352***	1.446***
	(1.823)	(1.110)	(1.620)	(0.550)	(-1.809)	(-0.306)	(24.222)	(20.063)
Utility_intensity(t-1)	0.443***	0.420***	-0.443	0.753	-0.232	-0.149	0.386***	0.365***
	(7.004)	(4.871)	(-1.242)	(0.776)	(-1.036)	(-0.528)	(5.704)	(3.902)
Trademark_intensity(t-1)	0.440***	0.629***	1.114***	1.774***	1.948***	2.249***	-0.029	0.022
	(13.559)	(15.789)	(11.215)	(12.373)	(27.432)	(25.994)	(-0.785)	(0.467)
Log of Employees(t-1)	-0.039***	-0.146***	-0.010	-0.016	-0.050***	-0.300***	-0.031***	-0.198***
	(-6.920)	(-12.383)	(-0.851)	(-0.427)	(-4.377)	(-8.226)	(-4.615)	(-12.378)
Log of age(t)	0.005***	0.003***	-0.000	-0.001	0.007***	0.006***	0.003***	0.001
	(7.463)	(4.985)	(-0.211)	(-0.467)	(5.566)	(4.786)	(4.181)	(1.606)
Log of investment	0.012***	0.045***	-0.012*	-0.012	-0.009	0.044***	0.016***	0.050***
	(4.404)	(9.607)	(-1.787)	(-0.461)	(-1.559)	(3.731)	(5.126)	(8.648)
Log of ad_sales_ratio(t-1)	0.002***	0.004***	0.002	0.005*	0.002	0.003	0.000	0.003**
	(3.007)	(3.705)	(1.252)	(1.789)	(1.237)	(1.232)	(0.362)	(2.334)
Log of R&D_intensity(t-1)	-0.097***	-0.320***	-0.041**	0.067	-0.047***	-0.243***	-0.097***	-0.463***
	(-11.710)	(-12.213)	(-2.018)	(0.235)	(-2.726)	(-3.017)	(-9.942)	(-12.664)
Constant	0.764***	1.860***	-0.365	0.003	-0.184	2.411***	0.627***	2.495***
	(2.943)	(7.184)	(-1.237)	(0.004)	(-0.616)	(6.773)	(11.822)	(22.556)
Observations	31,608	31,608	1,348	1,348	7,179	7,179	23,081	23,081
R-squared	0.036	0.039	0.230	0.296	0.110	0.122	0.059	0.056
Hausman test		178.07		47.23		156.92		264.2
Number of firms		2,721		433		1,037		2,664

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Industry dummy, year dummy included.

[Table11] Impact of trademark registration on firm performance in patent group

	Entire period(1971-2010)		Period1(1971-1986)		Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect	OLS	Fixed effect
Patent_intensity(t-1)	1.094***	1.142***	-0.864	-4.796	0.538**	1.081***	1.457***	1.744***
	(22.826)	(20.925)	(-0.333)	(-1.164)	(2.416)	(4.459)	(24.958)	(24.533)
Utility_intensity(t-1)	0.373***	0.767***	1.046*	2.986***	2.086***	2.382***	0.156**	0.505***
	(6.439)	(10.419)	(1.735)	(2.671)	(13.815)	(13.417)	(2.431)	(6.176)
Trademark_intensity(t-1)	0.143**	0.349***	-0.813	-1.150	-0.294*	-0.030	0.123*	0.341***
	(2.222)	(4.647)	(-1.123)	(-0.802)	(-1.703)	(-0.132)	(1.738)	(4.172)
Log of Employees(t-1)	-0.035***	-0.174***	-0.064***	-0.423***	-0.010	-0.111***	-0.047***	-0.248***
	(-4.488)	(-10.345)	(-2.668)	(-4.089)	(-0.765)	(-2.659)	(-5.091)	(-11.796)
Log of age(t)	0.004***	0.002*	0.004	0.002	0.007***	0.005***	0.004***	0.000
	(4.626)	(1.767)	(1.274)	(0.378)	(4.365)	(3.811)	(3.312)	(0.173)
Log of investment	0.033***	0.072***	0.035*	0.191***	0.023***	0.056***	0.032***	0.076***
	(7.947)	(11.863)	(1.864)	(3.985)	(2.890)	(4.405)	(6.820)	(10.758)
Log of ad_sales_ratio(t-1)	0.003***	0.006***	0.008*	0.013**	-0.001	0.001	0.003**	0.007***
	(2.748)	(4.698)	(1.931)	(1.991)	(-0.308)	(0.535)	(2.409)	(4.739)
Log of R&D_intensity(t-1)	-0.172***	-0.571***	-0.100**	0.443	-0.185***	-0.619***	-0.160***	-0.623***
	(-14.122)	(-15.351)	(-2.048)	(0.920)	(-8.304)	(-6.901)	(-11.410)	(-13.230)
Constant	0.711	3.224	2.247***	4.032***	0.584***	2.713***	0.967***	3.204***
	(0.000)	(0.000)	(6.710)	(3.263)	(2.809)	(7.446)	(12.277)	(25.161)
Observations	35,617	35,617	945	945	6,501	6,501	29,005	29,005
R-squared	0.056	0.059	0.111	0.127	0.063	0.073	0.062	0.072
Hausman test		-		33.92		26.52		316.91
Number of firms		3,731		328		1,056		3,667

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period dummy, industry dummy included. Samsung, LGEI, DAEWOO, POSCO, HYUNDAI, KIA dummy included

In contrast, in the patent group, trademark registration affects firm performance only in period 3, while patents and utility model registration influences firm performance in periods 2 and 3. In the patent group, utility models affect firm performance in period 1, and patents affect firm performance after period 2; these results are in accordance with Kim et al. (2012). As we supposed, with the technological ability accumulated through OEM, firms in the patent group become brand owners with their own products in the developed stage.

From this result, we see that the OBM effect, or a firm's having its own brand (whether it is original or not), is positively significant in the trademark group in periods 1 and 2 and in the patent group in period 3. From the results, hypothesis 1 (in the trademark group, a firm's possession of its own brand will always positively affect firm performance regardless of development stage) does not hold true in period 3; thus, hypothesis 1 is rejected. On the other hand, hypothesis 2 (in the patent group, a firm's possession of its own brand will positively affect firm performance in the developed stage) is correct and therefore is accepted.

3. Interaction effect between trademarks and patents

To identify the mutual impact of patents and trademarks, we investigate the firms in each group. We expect that trademark and patent registration by firms in each group will interact positively in the developed period. The results in Table12, however, show that neither registration of patents nor registration of trademarks has an impact in the trademark group. In the patent group, as shown in Table13, the interaction effect appears in period 2 but not in period 3. This result is not exactly the same as what we expected in hypothesis 3, because the interaction effect on firms of the relation between patents and trademarks appears during the mid-1980s to mid-1990s only in the patent group. However, that period is the starting point of OBM, so we conclude that registering both patents and trademarks is effective for firms when they decide to convert to OBM.

[Table12] Interaction effect of trademark and patent in trademark dominant group

	Period 2(1987-1997)		Period 3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect
Patent_intensity(t-1)	0.733	0.872	1.572***	1.923***
	(0.945)	(0.998)	(19.096)	(18.030)
Trademark_intensity(t-1)	1.969***	2.420***	-0.023	0.004
	(18.588)	(18.555)	(-0.367)	(0.047)
Patent_intensity(t-1) *Trademark_intensity(t-1)	-14.641***	-13.420***	-0.331***	-0.448***
	(-4.700)	(-3.804)	(-4.476)	(-5.751)
Log of Employees(t-1)	-0.073***	-0.514***	-0.010	-0.228***
	(-4.153)	(-9.238)	(-0.868)	(-8.851)
Log of ad_sales_ratio(t-1)	0.022**	0.112***	0.047***	0.109***
	(2.525)	(6.347)	(9.003)	(11.734)
Log of R&D_intensity(t-1)	0.006**	0.009**	0.001	0.009***
	(2.334)	(2.561)	(0.907)	(4.609)
Log of age(t)	-0.201***	-1.143***	-0.341***	-1.397***
	(-8.151)	(-11.805)	(-22.681)	(-29.290)
Constant	0.576	7.743***	1.380	5.043***
	(1.203)	(17.708)	(0.858)	(3.191)
Observations	7,820	7,820	24,224	24,224
R-squared	0.073	0.108	0.064	0.084
Hausman test		268.47		672.53
Number of firms		1,117		2,674

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period dummy, industry dummy included

[Table13] Interaction effect of trademark and patent in patent dominant group

	Period2(1987-1997)		period3(1998-2010)	
VARIABLES	OLS	Fixed effect	OLS	Fixed effect
Patent_intensity(t-1)	1.901***	1.262***	2.277***	2.494***
	(9.008)	(4.660)	(32.941)	(30.118)
Trademark_intensity(t-1)	0.116	0.618**	0.080	0.253**
	(0.552)	(2.202)	(0.704)	(1.966)
Patent_intensity(t-1) *Trademark_intensity(t-1)	2.485***	0.912*	-0.323**	-0.280**
	(6.007)	(1.948)	(-2.491)	(-2.054)
Log of Employees(t-1)	0.025	-0.054	-0.029**	-0.237***
	(1.519)	(-1.076)	(-2.133)	(-7.719)
Log of ad_sales_ratio(t-1)	0.066***	0.128***	0.086***	0.167***
	(6.585)	(7.583)	(12.063)	(15.832)
Log of R&D_intensity(t-1)	0.001	0.004	0.002	0.009***
	(0.537)	(1.077)	(0.922)	(3.868)
Log of age(t)	-0.453***	-1.831***	-0.445***	-1.695***
	(-17.356)	(-19.322)	(-23.250)	(-29.940)
Constant	0.842**	5.161***	1.394	4.569**
	(2.012)	(13.570)	(0.616)	(2.001)
Observations	7,267	7,267	30,711	30,711
R-squared	0.091	0.099	0.095	0.110
Hausman test		222.88		787.76
Number of firms		1,161		3,691

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period dummy, industry dummy included

VI. Conclusion

In this paper, we focus on different effects of trademarks and patent on a firm's performance in each group and period. Concentrating on technology accumulation through OEM and converting into OBM, we compare each period's performance in trademark group and patent group. From the results, trademark registrations of firms in trademark group have a positive effect on performance even in the underdevelopment stage, but in a developed period, not trademarks, but patents and utility models, affect firm's performance in trademark group. From the positive effect of trademark on firm performance in period 1 and period 2, we can infer that late comer firms in underdeveloped stage make progress and catch-up the incumbent firms in trademark group through imitative innovation (non-technological development). Meanwhile, trademark registrations affect firm's performance on patent group only in the period 3. We also find the dynamic effect of patent and trademark in patent group and

the interaction effect appears in developing stage. This mean that it is more effective for the firms to manage trademark and patent together on firm performances when they decide to enter into OBM.

The first finding is that trademarks affect both the firms in the trademark group and patent group with some differences according to period. The second finding is that in trademark group, non-technological development is possible in underdevelopment stage. This could be new suggestion of another catch up route of imitative innovation by trademark registration in underdevelopment stage. The last finding is that trademark and patent registration play an effective role for successful transition to OBM.

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