경제학박사학위논문

The Role of Trademarks and Patents in the Long term Evolution of Firm Performance in Korea

상표권과 특허를 이용한 한국 기업의 장기 성과분석

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서울대학교 대학원
경제학부 경제학 전공
강 래 윤

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이 논문을 경제학박사 학위논문으로 제출함

2016년 4월

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Abstract

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This dissertation examines the effect of trademarks and patents on firms' performance from the point of view of sectoral difference from the knowledge base. Korean IPR system was activated in 1946 and progressed for 70 years, it is possible to perform long-term analysis on IPRs at each development level. We described the development of the Korean IPR system and why we focus on trademarks as the measurement of economic development. We find that all sectors can be classified into two groups, the trademark-dominant group and the patent-dominant group. We began this study with the question of why some firms in some sectors apply for trademarks more than other IPRs, while other firms in other sectors change their main IPR to the patent or utility model. To investigate what makes the difference between the two groups, we examine different features of different sectors' knowledge bases, including explicitness/tacitness. With sector-level data as well as sector-firm combined data, the empirical results reveal that the trademark-dominant sector has a negative relation with explicitness. Another finding of the sector-level analysis with export ratio is that the sectors in the trademark-dominant group are less relevant to technology than patent-dominant group. Also, we focus on different effects of trademarks and patents on firm performance in each group and period. Concentrating on technology accumulation through OEM and firm conversion to OBM, this study compares each period's performance in the trademark-dominant group and patent-dominant group. From the empirical results, we find that trademark registrations of firms in the trademark-dominant group have a positive effect on performance even in the underdevelopment stage. With this result we can infer that through imitative innovation (non-technological development), latecomer firms in the underdeveloped stage make progress and catch up to the incumbent firms in the trademark-dominant group. Meanwhile, firm performance in the patent-dominant group is related to trademark registration only in period 3. We also find a dynamic effect of patents and trademarks in the patent-dominant group, where trademarks and patents show an interaction effect in the developing stage. This mean that it is more effective for firms to manage trademarks and patents together when they decide to enter into OBM. With this analysis of the development of Korean IPRs, it would be possible to provide a desirable IPR strategy for other developing countries.

Keywords: Trademark, Patent, OEM, OBM, Explicitness, Tacitness, Firm performance, Imitative innovation

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Chapter 1. Introduction

Korea is the model of a successful advanced country with remarkable economic growth, and the country's technological capabilities have played a major role in this growth. One core element of the Korean model can be seen in its efforts to build the country's technological capabilities, which has enabled the Korean economy to achieve continuous growth within existing industries and make successive entries into new promising industries (Lee 2013). In a knowledge-based economy, technological innovation and intellectual capital are important determinants of economic growth. In particular, intellectual property rights (IPRs) are the most powerful intangible assets that maintain a firm's capability. Lee (2013) described the capability-based view to explain the Korean and Asian experience in the catching-up development process. This approach can be considered an extension of the technology-based view (OECD 1992; Hobday 1995; L. Kim 1997). Within this view, it is firms' accumulated capability that has enabled economic growth for the past several decades.

Korea has been developing its industrial property systems since 1946. However, the capabilities of Korean firms at the founding stage differed from those of firms in advanced countries. As followers lacking local technological capabilities, Korean firms prior to the 1980s depended heavily on reverse engineering and imported equipment and machinery (Lee et al. 2003). After accumulating technological capabilities, the strategies of Korean firms became similar to those of advanced countries. In Korea, the number of IPR registrations per year increased from 17,659 in 1970 to 396,145 in 2010. This large amount of data allows researchers to analyze the correlation between economic development and intellectual property rights in light of the country's technological development. Until now, a large portion of the literature has focused on the patent or utility model to verify their influence on firm growth (Crépon et al. 1998; Ernst 2001; Hall, Jaffe and Trajtenberg 2005; Kim et al 2012). However, other IPRs like trademarks have gained little attention in comparison to patents.

A trademark is "a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises" (WIPO 2015). Trademarks are used to differentiate each firm's products so that consumers distinguish the firm's products from those of rivals (Economidas 1987; Landes and Posner 1987; Besen and Raskind 1991); as such, a new trademark is an essential element for selling new product in the market. A trademark is usually treated analogously to the product itself and may be one of the main sources of competitive market advantages (OECD, 2016). Moreover, trademarks become increasingly important if basic technology is diffused and standardized. Once they have absorbed a certain level of technology, many companies can produce goods of the same quality. After reaching this point, firms seek other possible methods to distinguish their products from others', and some find that trademarks can be used as a useful differentiator.

The purpose of this thesis is to determine the different impacts of trademarks on sectors and firms. To verify the role of the trademark, we investigate sectoral differences in technology according to characteristics of knowledge. Even though trademarks were originally used to express the name of a product, a trademark can now imply the quality of a product by the reputation it has obtained in the market; in contrast, a patent explains the technology directly. From these distinguishing features of trademarks and patents, it is possible to assume that some characteristics of knowledge explain each of property rights. By classifying a sector as a trademark-dependent group or patent-dependent group, we attempt to verify whether we can tell these two groups apart based on one of the characteristics of knowledge: explicitness (i.e., tacitness).

Another purpose of this thesis is to analyze the relationship between trademark registration and the original brand manufacturing (OBM) system. In Korea, many firms have developed their abilities through original equipment manufacturing (OEM) because they initially lacked sufficient technology to produce goods by themselves and the government drove the export-led growth plan. Through OEM systems, firms have acquired the ability to produce high-quality goods. With these accumulating capabilities, firms have tried to produce their own products to overcome the OEM trap. On the other hand, the non-technological feature of trademark enables firms lacking sufficient patentable technology to register trademarks for selling in the market with their own brand even in the OEM stage in some sectors. From these distinct roles of trademarks by sector, we assume that trademarks play a role in the OBM system, and we analyze the relationship of trademark registration between firm performances.

In addition, this thesis follows a series of studies about diverse Korean IPRs. In Kim et al. (2012), they analyze a time period comparison of the Korean patent and utility model. They examine the effect of Korean patent and utility model data on firm performance and find that not only the patent but also the utility model can explain Korean firms' performance. The effects of the utility model and patents on firm performance differ according to the level of development. Specifically, at a less developed level, the utility model performs a role in acquiring technological capability, whereas at a more developed level, patentable innovations have positive and significant influences on firm growth. From this result, they conclude that the utility model is a stepping-stone for further technological advances. In this thesis, taking their study one step further, we analyze the effect of trademarks on firm performance compared to patents.

The remainder of the dissertation is organized as follows. In chapter 2, we describe the development of Korean IPRs and compare it to economic growth. In Korea, the application of intellectual property rights began in 1946, and all four IPRs (patent, utility model, trademark, and design) have been administered by the Korean Intellectual Property Office (KIPO) for more than 60 years. We also provide an overview of the history of Korean IPRs and explain different application patterns of each development stage in chapter 2.

In chapter 3, we explore the sectoral differences in IPR applications in the manufacturing sector, especially in regard to patents versus trademarks. We examine the IPR application patterns of each sector and classify sectors into two groups, a trademark-dominant group and a patent-dominant group. We begin the analysis with the question of why some firms in some sectors apply trademarks more than other IPRs, while other firms in other sectors convert their main IPR to patent and utility model.

In chapter 4, we analyze different effects of trademarks and patents on a firm's performance in each group and period. Specifically, we divide the whole period into: (1) under-development stage from 1971 to 1986; (2) developing stage from 1987 to 1997, before the crisis; and (3) rebuilding stage from 1998 to 2010. Concentrating on technology accumulation and trademark registration, we compare each period's performance in the trademark-dominant group and patent-dominant group. We also check the interaction effect of patents and trademarks on firm performance according to period.

Overall, this dissertation differs from previous studies in several ways. First, this study analyzes Korean long-term IPR data and shows the dynamic development of manufacturing firms. In particular, it focuses on trademarks to identify their role in economic development. To the best of our knowledge, this long-term analysis of trademarks is the first attempt of its kind in the Korean context. Second, this study verifies sectoral differences between trademark and patent using the feature of technological knowledge. Third, this study looks into the different influences of trademarks on firms in each group and each development stage. Through the empirical analysis of an IPR dataset in the rapidly catching-up economy of Korea, this paper provides implications for a desirable IPR strategy for other developing countries.

Chapter 2. Evolution of Intellectual Property Rights in Korea

I. Introduction

In this chapter, we will provide an overview of Korean economic history and intellectual property rights. The modern state of Korea started at the end of World War II, and full-scale, government-driven development of the Korean manufacturing industry began in the 1960s with light industry, such as apparels and shoe making. In the 1970s, the main industry changed to heavy and chemical industries like steel, oil refining, and shipbuilding. In the 1980s, automobiles and electronics started to boom. Finally, the information technology (IT) industry was added in the 1990s.

The Korean IPR system has grown alongside the country's economic development. Legal management of intellectual property rights stared in 1946, and all four IPRs (patent, utility model, trademark, and design) have been administered by the KIPO (Korean Intellectual Property Office) for 70 years. In 1948, 363 IPRs applied, but only 11 were registered. However, in 2010, the application and registration of IPRs totaled 362,074 and 159,977, respectively. Before explaining the history of Korean IPRs, we will describe how to build the data for this thesis and explain each IPR so as to provide an understanding of the characteristics of the rights.

II. Construction of data

Application and registration of IPRs in Korea started in 1946. Patents, utility models and designs have accumulated since 1948, but registration of trademarks did not begin until 1950. We have compiled all the IPR data from the KIPRIS (Korean Intellectual Property Rights Information Service, www.kipris.or.kr). KIPRIS provides a downloadable database of patents, utility models, trademarks and designs. We downloaded all of the IPR data from 1948 to 2009. The raw data for each IPR include information such as application number, application date, registration date, expiration date, main agent code, nationality, number of claims, legal status, classification code (IPC, Madrid) and corporation number. From 1948 to 2009, the application data totals are as follows: patents, 2,153,902; utility models, 893,091; trademarks, 2,053,097; and designs, 900,812. These constitute an excellent source for investigation of the history of IPR growth; however, to analyze industry or firms in chapter 3 and chapter 4, we modify these raw data by corporation number to merge financial data of firms and restrict the status to registration.

Although the IPR law was established in 1946, use of the IPR law system was not vigorous.[1] Most rights were applied for by individuals or foreign companies. Table 2-1

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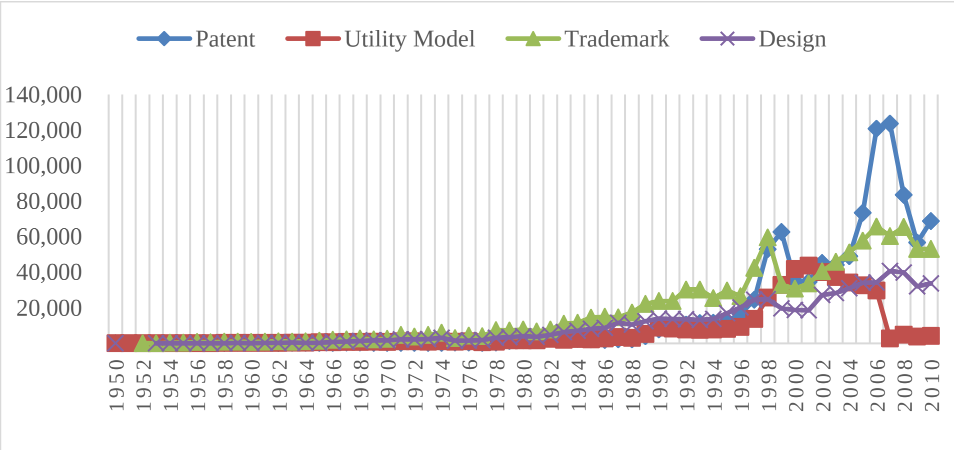
[1] The first patent was 'The processing of *sulphur dye'* by Central Research Institute for Industry (1948); the first utility model was 'Cart for children' by Kyoungchul Shin (1948); the first design was 'The shape and color of half badged coat string' by Changrok Chio (1948); and he first trademark was 天 by Chunil Industry (1950).

displays all types of assignees'[2] applications and registrations of IPRs, and Table 2-2 shows all manufacturing firms' applications and registrations. Most firms' IPR applications were made later than applications by individuals and foreign companies; however, trademarks were registered earlier than other IPRs, and firms' IPR applications were all accepted without rejection until the mid-1970s.

[Figure 2-1] Registration of IPRs in Korea



[Table 2-1] Application and registration of IPRs in Korea (whole assignees)

Year	Patents		Utility Models		Trademarks		Designs	
	Application	Registration	Application	Registration	Application	Registration	Application	Registration
1948	169	4	166	2			38	5
1949	233	7	229	10			46	10
1950	126	5	123	6	599	14	30	7
1951	30		29	1	40		3	
1952	91	21	69	14	151	138	19	
1953	76	8	152	20	229	150	62	14

2 The kinds of assignees are as follows: Schools by the Higher Education Act, public research institutions, public corporations, other public institutions, other nations, other corporations, individuals (domestic), large firms, individuals (foreign), foreign corporations, governments, SMEs, enterprises of middle standing, local autonomous entities.

1954	132	29	175	31	375	393	76	70
1955	156	52	281	73	465	419	216	174
1956	287	81	494	135	1,087	739	179	108
1957	469	58	758	123	1,469	701	276	132
1958	555	119	1,105	177	1,439	963	358	143
1959	703	191	1,395	303	1,307	1,032	362	183
1960	611	219	1,207	285	1,209	815	329	174
1961	858	188	1,683	245	1,665	968	470	199
1962	782	99	1,793	233	1,890	1,221	570	185
1963	771	223	1,790	493	1,295	1,045	729	386
1964	908	213	2,244	480	1,845	1,178	804	318
1965	1,018	288	2,849	556	2,053	1,506	825	264
1966	1,060	256	3,252	600	2,752	2,145	1,338	727
1967	1,177	428	3,594	819	3,228	2,165	1,919	979
1968	1,463	359	5,129	828	6,619	2,712	3,277	1,315
1969	1,701	317	5,573	918	9,111	2,180	4,536	1,688
1970	1,846	266	6,167	864	5,124	2,585	4,522	1,657
1971	1,906	229	6,810	1,141	5,816	4,724	5,348	2,324
1972	1,995	218	7,747	1,145	6,878	3,830	5,991	2,235
1973	2,398	199	7,561	999	9,562	4,681	6,333	2,443
1974	4,455	322	6,833	1,174	9,053	5,955	6,220	3,090
1975	2,914	442	7,290	1,046	9,476	2,950	6,707	1,589
1976	3,261	479	8,378	1,115	11,037	4,419	6,018	1,462
1977	3,139	274	7,601	577	9,415	3,989	5,520	1,859
1978	4,015	427	6,645	999	12,040	7,504	6,265	3,158
1979	4,722	1,419	7,957	1,781	13,789	7,206	8,371	3,592
1980	5,070	1,632	8,558	1,753	13,558	7,845	10,075	4,071
1981	5,303	1,808	9,064	1,691	15,755	6,769	10,394	3,731
1982	5,924	2,609	10,669	2,514	19,537	7,793	11,902	4,751
1983	6,394	2,433	11,485	2,079	23,982	11,022	13,947	6,367
1984	8,633	2,365	14,765	2,360	24,764	11,674	15,870	7,109
1985	10,587	2,268	18,548	2,327	26,069	14,453	18,949	8,250
1986	12,759	1,894	22,401	2,758	28,031	15,086	18,731	8,660
1987	17,062	2,330	24,773	3,419	30,762	14,708	20,231	11,552
1988	20,051	2,174	22,677	3,108	34,681	17,272	18,162	10,502
1989	23,315	3,972	21,530	5,311	39,832	22,263	18,196	12,561
1990	25,820	7,762	22,654	8,846	46,826	23,790	18,769	13,927
1991	28,132	8,690	25,895	8,370	46,612	23,876	20,097	13,723
1992	31,073	10,502	28,665	7,870	45,124	30,298	22,948	13,635
1993	36,491	11,446	32,218	7,592	59,593	30,392	27,568	13,133
1994	45,712	11,683	39,806	7,817	72,581	25,409	29,033	13,695
1995	78,499	12,512	59,866	8,149	71,852	29,811	29,978	16,986
1996	90,326	16,516	68,822	9,191	85,062	26,464	29,859	20,192
1997	92,734	24,579	45,809	13,713	87,065	42,484	28,491	24,633
1998	75,188	52,900	28,896	25,717	57,393	59,611	23,732	24,931
1999	80,642	62,635	30,650	32,868	87,332	32,968	32,404	19,636
2000	102,010	34,956	37,163	41,745	110,073	30,849	33,841	18,845
2001	104,612	34,675	40,804	43,842	107,137	33,683	36,867	18,650
2002	106,136	45,298	39,193	39,957	107,876	40,588	37,587	27,235
2003	118,652	44,165	40,825	37,272	108,917	46,023	37,607	28,380
2004	140,115	49,068	37,753	34,182	108,464	51,104	41,184	31,021
2005	160,921	73,512	37,175	32,716	115,889	57,873	45,222	33,993

2006	166,189	120,790	32,908	29,736	122,384	65,825	51,039	34,206
2007	172,469	123,705	21,084	2,795	132,288	60,361	54,362	40,745
2008	170,632	83,523	17,405	4,975	127,910	65,583	56,750	39,858
2009	163,523	56,732	17,144	3,949	126,420	53,155	57,903	32,091

*Source: Kipris (www.kipris.or.kr)

[Table 2-2] Application and registration of IPRs in Korea (by firms)

year	Patent		Utility Model		Trademark		Design	
	Application	Registration	Application	Registration	Application	Registration	Application	Registration
1950					14	14		
1953					3	3		
1954					5	5		
1955					21	21		
1956					48	48	6	6
1957					72	72		
1958					80	80	4	4
1959	1	1			45	45	12	12
1960					62	62	3	3
1961	1	1	1	1	74	74	17	17
1962			2	2	130	130	15	15
1963	3	3	11	11	99	99	38	38
1964	4	4	11	11	119	119	26	26
1965	3	3	15	15	144	144	32	32
1966	4	4	13	13	266	266	72	72
1967	10	10	22	22	222	222	136	136
1968	5	5	26	26	367	367	182	182
1969	9	9	12	12	307	307	244	244
1970	6	6	22	22	367	367	273	273
1971	14	14	34	33	678	678	255	255
1972	10	10	22	22	766	766	344	344
1973	12	12	28	28	1362	1362	344	344
1974	10	10	25	25	1270	1270	390	390
1975	12	12	50	50	1715	1715	543	543
1976	16	14	69	58	1770	1553	435	432
1977	28	24	70	60	1567	1472	477	474
1978	49	41	106	81	2033	1778	632	630
1979	68	41	198	143	2641	2095	698	694
1980	130	82	364	163	2691	2295	1156	947
1981	137	85	440	234	2830	1962	1264	858
1982	192	104	933	441	4808	3427	1692	1163
1983	332	190	1848	779	6068	4284	2418	1795
1984	530	344	3710	1632	6557	4656	3215	2587
1985	929	618	5504	2295	8332	6171	4261	3394
1986	1594	1084	9312	3723	9594	7045	5417	4500
1987	2211	1366	11118	4057	9475	6947	6086	5181
1988	3150	1820	11747	3876	11311	8614	6089	4767
1989	4738	2937	11079	3804	12109	8930	5217	4511
1990	6539	4066	11407	4243	14026	10199	5623	4794
1991	9740	5748	13607	5285	13896	10253	5787	4939

1992	**11792**	**7381**	**13928**	**5866**	**13172**	**9603**	**6767**	**5756**
1993	**15503**	**9445**	**15031**	**6128**	**15913**	**11866**	**7955**	**6903**
1994	**20293**	**11890**	**20599**	**8572**	**19491**	**13819**	**9752**	**8335**
1995	**45051**	**20272**	**39761**	**11087**	**19448**	**14499**	**13656**	**10760**
1996	**55192**	**25547**	**40932**	**10329**	**23035**	**16204**	**11930**	**9794**
1997	**52727**	**26235**	**26825**	**8366**	**24369**	**15639**	**11075**	**9264**
1998	**36514**	**18569**	**13852**	**4558**	**10229**	**7172**	**7087**	**6024**
1999	**36394**	**21174**	**7309**	**4989**	**20747**	**13422**	**10624**	**8536**
2000	**39797**	**21712**	**6517**	**6201**	**31346**	**17083**	**11973**	**8986**
2001	**42717**	**25143**	**6786**	**6487**	**27442**	**14550**	**13319**	**10397**
2002	**44846**	**25465**	**6103**	**5813**	**32438**	**16067**	**14102**	**11526**
2003	**54823**	**28231**	**6697**	**6458**	**31093**	**14972**	**15412**	**12762**
2004	**66682**	**31605**	**4876**	**4692**	**29906**	**15800**	**17753**	**15122**
2005	**76309**	**37105**	**4633**	**4460**	**33602**	**17650**	**19947**	**17161**
2006	**72059**	**33399**	**3788**	**3354**	**35709**	**19652**	**20978**	**17877**
2007	**62784**	**22972**	**3073**	**1294**	**37119**	**19023**	**23851**	**19718**
2008	**55338**	**23825**	**2572**	**381**	**34766**	**16501**	**24589**	**19972**
2009	**47495**	**17291**	**2016**	**104**	**30576**	**15721**	**23362**	**19443**

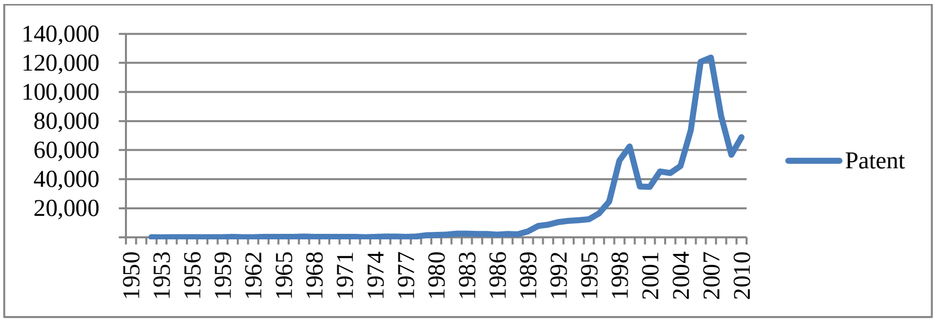
*Source: Kipris (www.kipris.or.kr)

III. Description of Korean IPR data

1. Patent

The patent has been used as an indicator of innovation and economic development (Griliches, 1990; Griliches, Hall and Pakes, 1991). Because a patent indicates a new invention of an individual or a new technological capability of a firm, large numbers of patent applications are usually regarded as an achievement of technological advancement. In Korea, patent applications and registrations were infrequent in its underdeveloped stage. Beginning in the mid-1970s, when the economy shifted toward heavy and chemical industries, large firms began to invest in learning foreign technology to build their capabilities. As a result, registration of patents grew rapidly through each firm's effort to accumulate capacity after the mid-1980s, and the government decided to strengthen the patent's right to protect so as to promote the high technology of inventors after 1986[3] (Kim et al. 2012).

[Figure 2-2] Registration of patents (1950-2010) by firms



In patent and utility model applications, IPC codes indicate to which technology the right belongs. The International Patent Classification (IPC) provides a hierarchical system of language-independent symbols for the classification of patents and utility models according to the different areas of technology to which they pertain (WIPO, 2015). A new version of the IPC enters into force each year on January 1st; in this paper, we use the IPC 2009 version. According to IPC, patentable technologies are divided into eight sections (A to H) with approximately 70,000 subdivisions. We follow the eight-section

[3] The revision of patent law in 1986 adopted "Substance patent", and the validity of patent rights was extended from 12 to 15 years. From 1995, the validity of patent rights was again extended to 20 years, as in other countries.

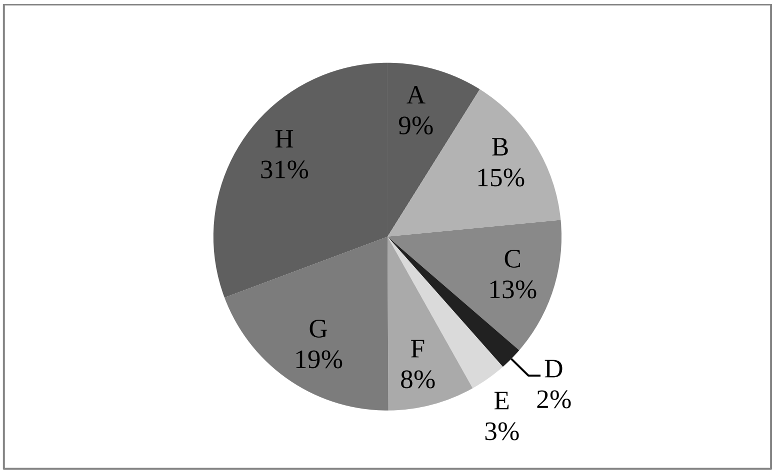
classification in this paper. In Korea, the main section was “C (chemistry, metallurgy)” before the 1980s, but it changed to “H (electricity)” after the 1990s.

[Table 2-3] IPC code of patent in application of Korea

Section \ year	1950s	1960s	1970s	1980s	1990s	2000s	Total
A (HUMAN NECESSITIES)	185	648	1112	5686	21301	71878	**100818**
B (PERFORMINGOPERATIONS; TRANSPORTING)	125	399	1851	10202	47043	105419	**165046**
C (CHEMISTRY; METALLURGY)	308	1224	4341	17140	41735	81001	**145765**
D (TEXTILES; PAPER)	51	266	627	2543	8076	12535	**24100**
E (FIXED CONSTRUCTIONS)	20	54	207	1081	5702	31357	**38421**
F (MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING)	42	91	735	4977	29300	56183	**91330**
G (PHYSICS)	22	94	823	12050	63810	142767	**219566**
H (ELECTRICITY)	20	132	1186	13932	103778	228684	**347734**
Total	**773**	**2908**	**10882**	**67611**	**320745**	**729824**	**1132780**

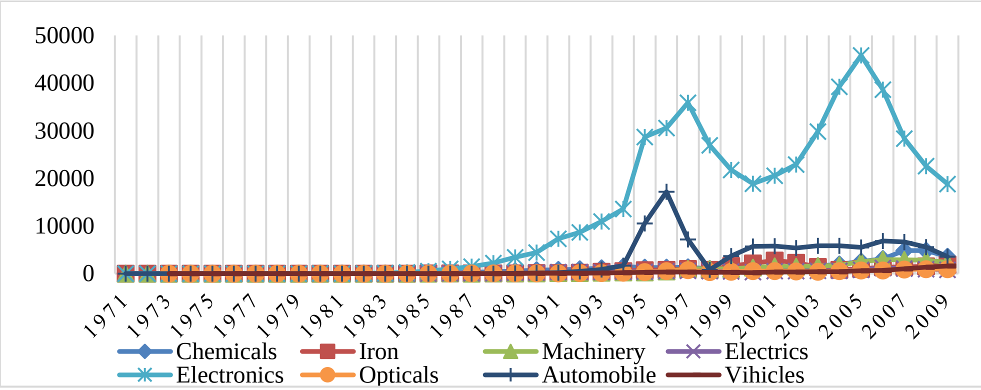
*Source: Kipris (www.kipris.or.kr)

[Figure 2-3] Total rate of IPC codes in patents



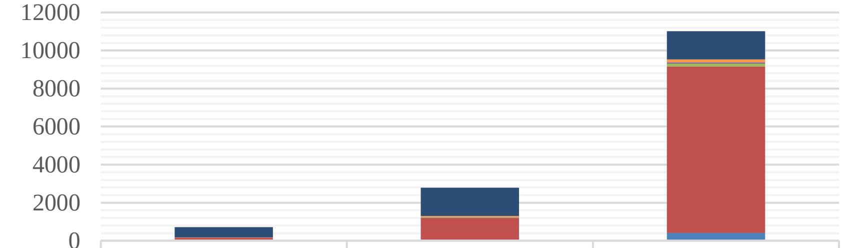
Apart from IPC code, when we examine the yearly registrations of patents by firms sorted into each industrial sector, we find that electronics, automobiles, and chemicals represent the top three industries of patent registration.

[Figure 2-4] Patent registration by firms in each sector (top 8)



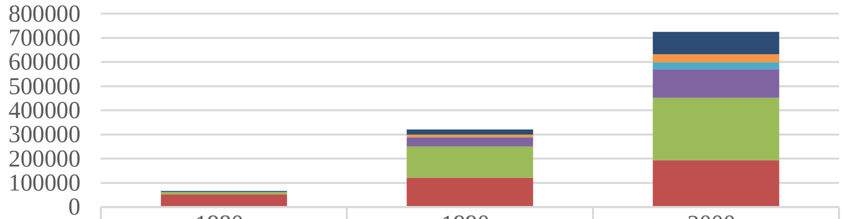
The main assignee of patents until the 1980s was foreign corporations; however, after the 1990s, domestic large firms applied for more patents than did foreign corporations. In the 2000s, domestic firms represented the majority of patent applications.

[Figure 2-5] Assignees of patents, 1950s-1970s



	1950s	1960s	1970s
Individual	541	1489	1488
Public	4	40	147
School	0	0	0
SMEs	2	16	74
Large firms	0	33	156
Foreign_Corp	140	1156	8737
Foreign_ind	21	50	417

[Figure 2-6] Assignees of patents, 1980s-2000s



	1980s	1990s	2000s
Individual	3736	20776	92022
Public	908	11402	33666
School	90	1265	28255
SMEs	1219	36371	118191
Large firms	8181	129882	257936
Foreign_Corp	50405	118274	190235
Foreign_ind	1870	2735	3690

Since 1981, anyone who wants to apply for patents and utility models must indicate the number of claims, which designates the scope of protection. The more claims, the wider the scope of protection. According to table 2-4, most assignees indicate one patent under 10 claims, but some patents are designated for more than 100 claims.[4]

[Table 2-4] Claim count per one patent

Year	Claim count<10	10< Claim count <20	20< Claim count <50	50< Claim count <100	100< Claim count
1981	337	210	82	9	0
1982	1626	920	336	52	0
1983	2155	931	307	39	3
1984	3270	1383	426	46	0
1985	4488	1831	577	57	4
1986	5441	2411	796	93	7
1987	7053	3181	1040	101	6
1988	8212	3509	1047	83	9
1989	9471	3804	1234	106	7
1990	11078	3771	1122	97	8
1991	12397	3929	1192	94	9
1992	13873	5049	1664	193	5
1993	17162	4697	1403	121	8
1994	21213	5702	1815	169	13
1995	32084	7153	2296	252	17
1996	37571	8659	2736	250	17
1997	38255	10610	3544	365	39
1998	31016	10322	3320	327	34
1999	34783	10723	3548	320	28
2000	38892	12800	4336	413	38
2001	42091	14843	5083	554	53
2002	42161	15394	5220	521	41
2003	44126	17134	5724	562	38
2004	46479	20043	6430	593	44
2005	52518	22397	6183	405	22
2006	63659	34607	10733	812	64
2007	60251	23839	10043	870	96
2008	54424	23236	8785	738	120
2009	51154	21680	6741	635	77
Total	**787240**	**294768**	**97763**	**8877**	**807**

4 The largest claim count is 941 claims by LGEI in IPC code-G (PHYSICS), applied in 1991.

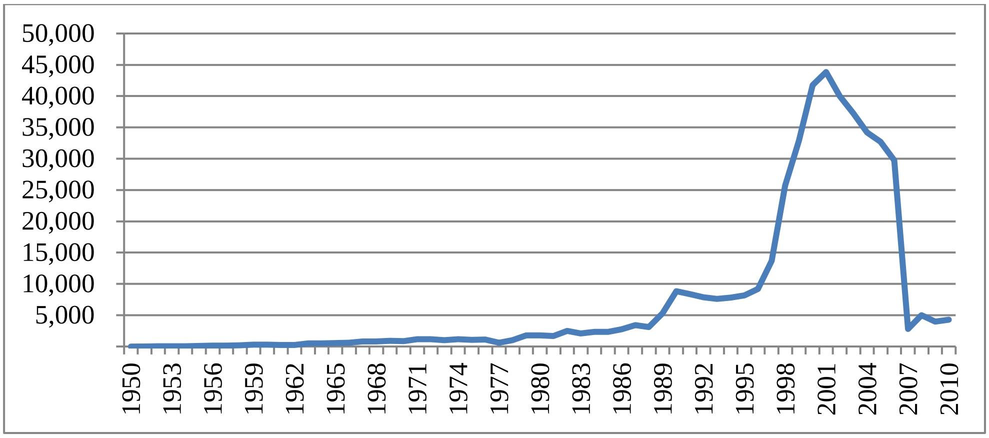
2. Utility model

A utility model is an exclusive right granted for a minor invention, which allows the right holder to prevent others from commercially using the protected invention without his or her authorization for a limited period of time that is relatively shorter than that of a patent.[5] Utility models are sometimes referred to as “petty patents” or “innovation patents” (WIPO 2015). Utility models are usually inexpensive and do not need substantive examination. Kim et al. (2012) analyze patents and utility models of Korea and find that utility models play the role of stepping-stones for technological development. They find that when firms are technologically lagging, utility models (or minor inventions) contribute to firm growth and to their capacity to produce (future) patentable inventions.

In Korea, the grant rate for utility models from 1999 to 2006 was very high, because KIPO adopted a non-substantial examination system (Quick Registration System (QRS)) to promote micro invention and support start-up companies. However, this system was changed to an examination and registration system in October 2006, owing to abuses of the right. Since 2007, application and registration of utility models has been much lower than for other IPRs.

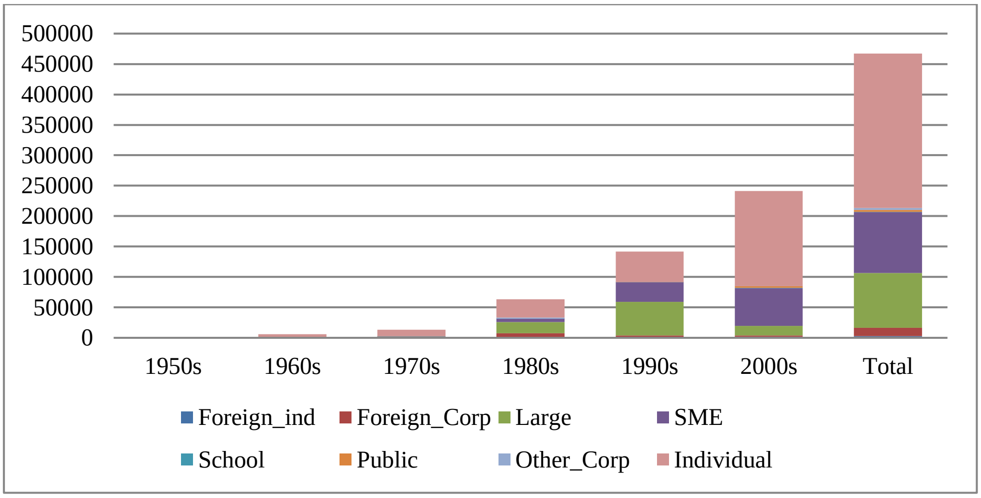
[5] The duration of a utility model is 10 years.

[Figure 2-7] Registration of the utility model by firms (1950-2010)



In almost all periods, domestic individuals apply for utility models most frequently. Unlike patents, foreign companies and foreign individuals seldom apply for utility models.

[Figure 2-8] Assignees of utility model, 1950-2010

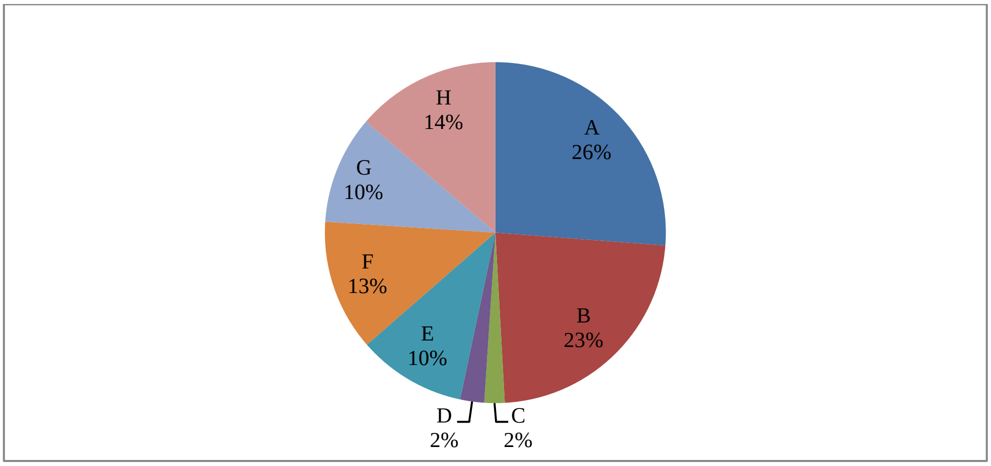


The utility model is also classified by IPC codes, and the main sections are “A (Human necessities)” and “B (Performing operations; Transporting).” Unlike patents, the number of claims per utility model is only one or two.

[Table 2-5] IPC codes of utility model

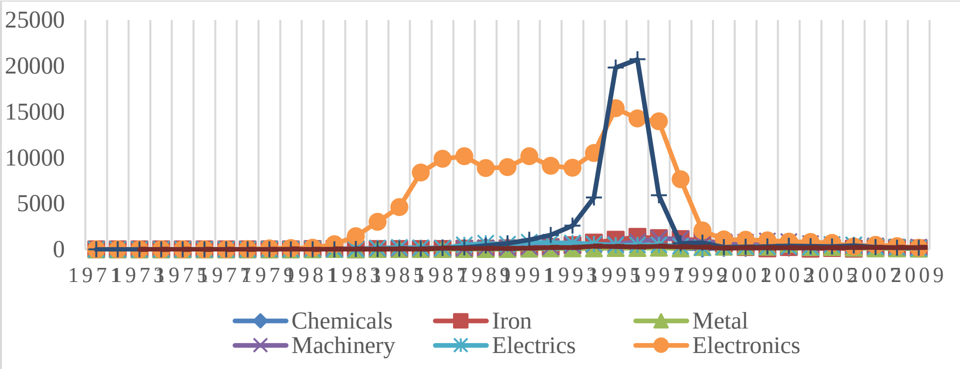
	1950s	1960s	1970s	1980s	1990s	2000s	Total
A (HUMAN NECESSITIES)	382	1925	3736	14517	26108	75740	**122419**
B (PERFORMING OPERATIONS; TRANSPORTING)	273	1633	3088	12992	37988	51034	**107021**
C (CHEMISTRY; METALLURGY)	50	122	269	612	2606	5296	**8958**
D (TEXTILES; PAPER)	36	289	466	1873	4228	3772	**10670**
E (FIXED CONSTRUCTIONS)	56	398	1090	3574	9895	32921	**47936**
F (MECHANICAL ENGINEERING; LIGHTING; HEATING;WEAPONS;BLASTING)	234	963	2289	8264	21323	25011	**58097**
G (PHYSICS)	116	417	959	9806	14595	22062	**47961**
H (ELECTRICITY)	46	442	1290	11617	25246	25405	**64048**
Total	**1193**	**6189**	**13342**	**63258**	**141989**	**241241**	**467268**

[Figure 2-9] Total rate of IPC codes in the utility model



Like patents, yearly registration of utility models by firms shows that electronics, automobiles, and chemicals represent the top three industrial sectors of utility model registration.

[Figure 2-10] Utility model registration by firms in each sector (top 8)



3. Trademark

A trademark is a distinctive word, phrase, logo, graphic symbol, or other device that is used to identify the source of a product or service and to distinguish it from competitors. The intrinsic functions of a trademark are identification, indicating source and guaranteeing quality of goods. The derivative functions of a trademark are advertisement, property, defense and competition. In order to receive legal protection for their trademarks, firms or individuals must file an application with a national intellectual property office (in Korea, KIPO). Upon payment of a fee, the trademark office examines whether the proposed signs, symbols or names 1) are unique to the sectoral classes for which protection is sought and 2) are not confusingly similar to already existing marks. If an application meets all the relevant criteria, the trademark is officially registered for a limited time period – typically 10 years (Smith 1997). However, prior to expiration, trademark holders have the option of renewing their registration. Through continuing renewals, and absent any act or failure which might call the rights concerned into question, trademark registrations can continue essentially indefinitely, and the effort involved in filing for a new brand or logo becomes an economic decision that is worth investigating (Economides 1988). However, in the case of becoming a "common name in the trade," the monopoly right by trademark on the product expires.

Trademarks are important to companies because they protects brands and enables consumers to identify a company's products and distinguish them from those of competing businesses (Besen and Raskind 1991; Landes and Posner 1987). Also, a trademarked product is expected to guarantee a certain level of quality, and trademarks give firms an incentive to maintain or improve the quality of their products. This quality function does not ensure maximum quality but does promise dependable quality of the trademarked goods in the market.

The origin of the trademark dates back to the Roman Empire,[6] but protection of trademarks began in 1585 related to Goodwill in England. The first registration system for trademarks was established in France in 1857, with the Legislation Relating to Commercial Marks and Product Marks (Millot 2009). Because of the relation between

[6] In the Roman era, some winemakers drew a trident shape on their wine bottles to distinguish their wine.

new products and trademark registration, many researchers have found that trademark activity is complementary to a firm's innovation (Miles et al. 2000; Schmoch 2003; Mendoça et al. 2004; Arbussa and Coenders 2007; Graham and Somaya 2006; Greenhalgh and Rogers 2007; Amara, Landry and Traoré 2008; Sandner and Block 2011).

[Table 2-6] The important international agreements regarding trademark[7]

Agreement	Year	Content
The Paris Convention	1883	Protection of Industrial Property
Madrid Agreement	1891	International Registration of Marks
Nice Agreement	1957	International Classification of Goods and Services for the Purpose of the Registration of Marks
Vienna Agreement	1973	Establishes an International Classification of the Figurative Elements of Marks
Madrid Protocol	1989	Protects a mark in a large number of countries by obtaining an international registration
WTO/TRIPS	1995	Introduces intellectual property law into the international trading system

*Source: WIPO(http://www.wipo.int/trademarks/en/index.html#laws)

There are some other concepts that are similar to that of trademarks. A "brand" is "a distinguishing name and symbol (such as a logo, term, or package design) intended to identify the goods or service of either one seller or a group of sellers, and to differentiate those goods or services from those of competitors" (Aaker 2009). Like a trademark, a brand is treated as an intangible asset, but the latter is a market-oriented concept; it covers not only the trademark, but also design, image, and reputation. A "brand name" is used to

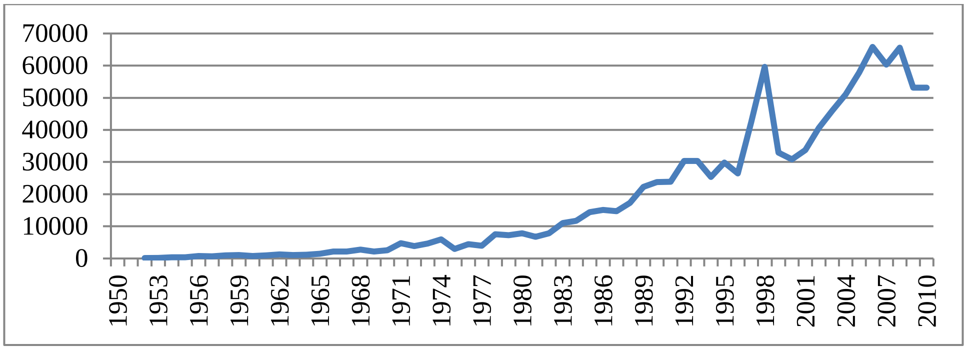
[7] Korea joined The Paris Convention in 1980, WTO/TRIPS in 1995 and Madrid Protocol in 2003. Nice Agreement is adopted from 1998.

denote written or spoken linguistic elements of any product; unlike a trademark, however, the brand name is not always registered. Companies use a “trade name” to perform their business under a name that differs from the legally registered name of the business. The global company Interbrand publishes Annual Best Global Brands and Annual Best Domestic Brands reports. From these reports, we can ascertain which company is the most famous in a given the year. Table 2-7 lists the top 10 brands in Korea and their global rank in 2015 according to Interbrand.

[Table 2-7] Top 10 brand by the ranking of Interbrand (2015)

Rank	Brand (Korea)	Brand (Global)	Country
1	Samsung Electronics	Apple	United States
2	Hyundai Motor Company	Google	United States
3	Kia Motors Corporation	Coca-Cola	United States
4	SK Telecom	Microsoft	United States
5	Samsung Life Insurance	IBM	United States
6	Naver	Toyota	Japan
7	LG Electronics	Samsung	South Korea
8	POSCO	General Electronics	United States
9	Shinhan Card	McDonald	United States
10	KB Kookmin Bank	Amazon	United States

[Figure 2-11] Registration of trademarks by firms



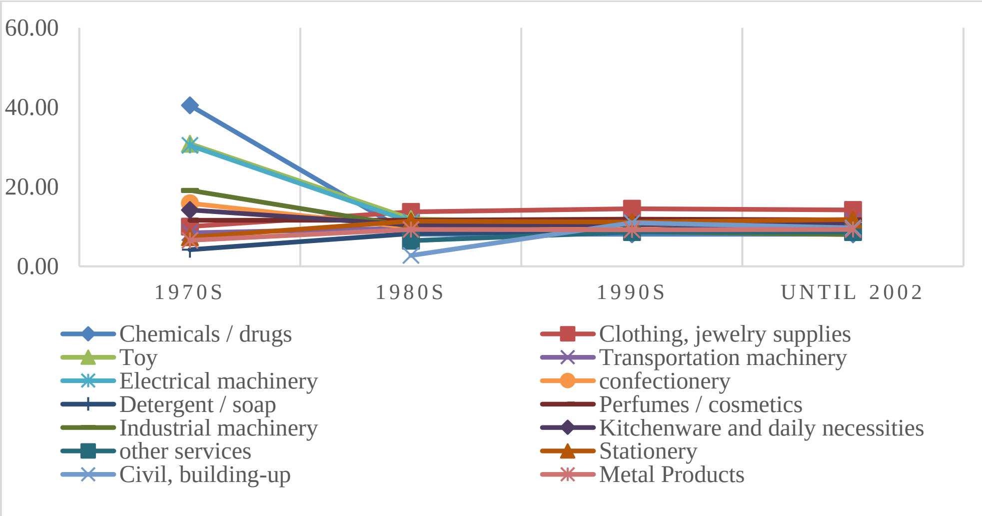
In Korea, revision of trademark law occurs almost every year. Significant revisions occurred in 1973, 1990, 2001, 2007, 2011 and 2016. In 1973 and 1990, there were complete revisions of the trademark law. In 2001, the Madrid Protocol was adopted, and in 2007 the scope of trademark registration was expanded to holograms, colors and actions. In 2011, trademark law was revised for adapting FTA between Korea and the US. Finally, beginning in September 2016, another complete revision of trademark law will be enacted in order to comply with the international standard.

Whenever firms apply a trademark, they should specify the class of goods for which the trademark will be used. Designating multiple classes for a single application is allowed. Before April 2003, KIPO imposed additional fees for the designated goods and services if the designation exceeded 10 classes in one application. This means that the official fee for filing a trademark or service mark application covered only 10 goods, and it was necessary to pay an additional fee to designate more than 10 kinds of goods.[8] In April

[8] If the designation surpasses 10 goods, the applicant must pay 6,500KRW per good.

2003, KIPO repealed the system of imposing additional fees for over-designation of goods. Thereafter, assignees could designate as many goods as they chose in applying for one trademark. However, an additional fee was reintroduced beginning in 2012 to prevent overuse of designation.[9]

[Figure 2-12] Designated goods per trademark



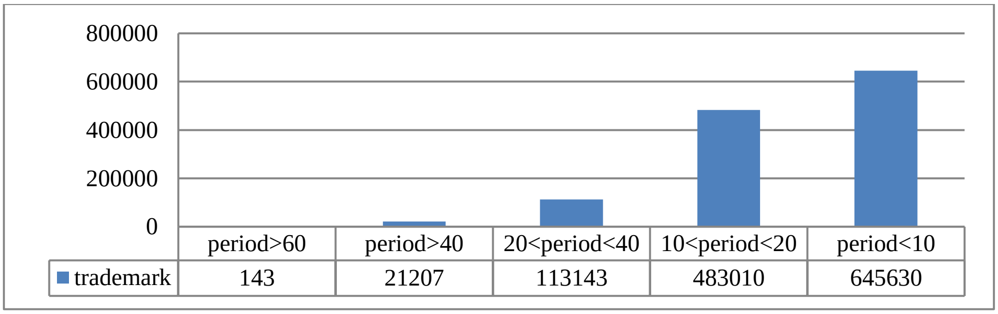
Registration lags are around 10 months in length; however, if the applicant wants to register more quickly, he or she can use preferential examination, which takes 2-3 months.

Trademarks can be valid in perpetuity if the renewal fees are paid every 10 years. In fact, the renewal of trademark occurs when the product is survived in the market, so 90%

9 From 2012, the additional fee for over-designation is 2,000KRW per good if the designation is over 20 goods.

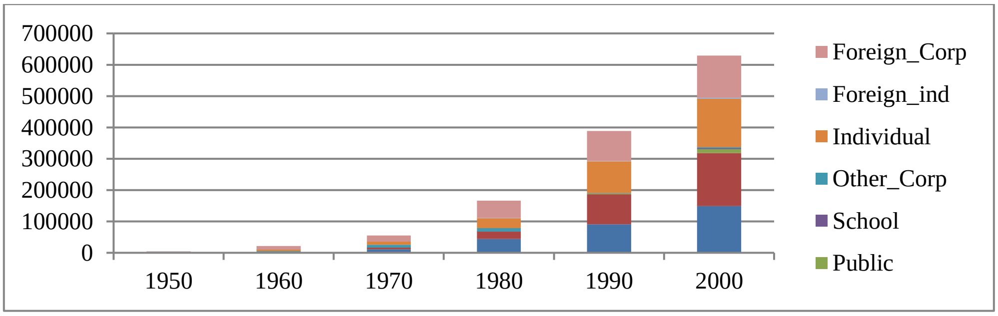
of trademarks are lasted for less than 20 years. But 143 trademarks have been in force for more than 60 years in Korea.[10]

[Figure 2-13] Maintenance period of trademarks



No one kind of agent makes up a majority of trademark assignees. Large firms, SMEs, foreign companies, and individuals apply trademarks similarly at every stage.

[Figure 2-14] Assignees of trademarks, 1950-2010



10 The oldest trademark in Korea is "Sempio", a food company producing soy sauce, red pepper paste and so on. They registered "샘표" on 10th May, 1954. If we include the period of the Korean empire, "활명수", a liquid digestive medicine, was registered in September 1897.

In Korea, the NICE classification was adopted on March 1st, 1998. Before its adoption, there were 65 trademark categories, while the NICE classification had 45 categories (except double classification). Among these, we select the top 10 categories for every 10 years and identified which sector succeeded in creating new products or services in each period. Until the 1980s, chemicals and drugs were the most frequently trademarked sector. However, after the 1990s, a number of service trademarks appeared and were registered for legal protection in the market.

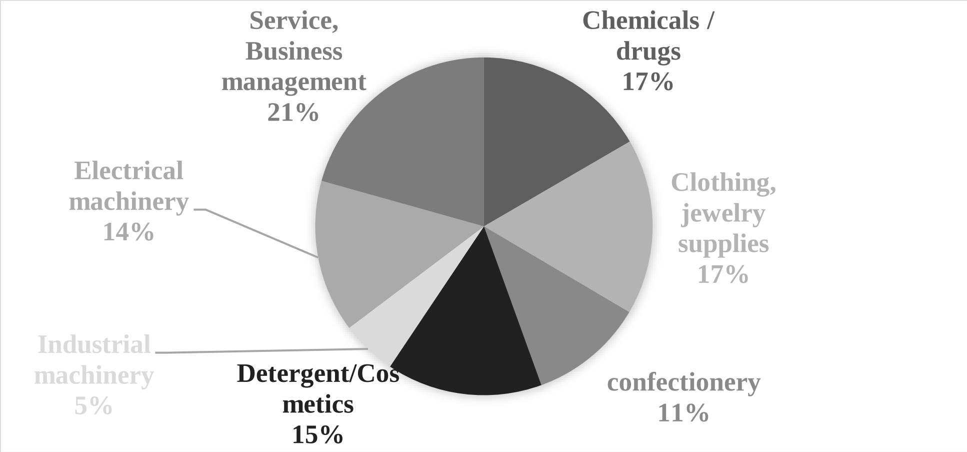
[Table 2-8] Top 10 categories of trademark, 1950s-1970s

Trademark Classification	1950s	Trademark Classification	1960s	Trademark Classification	1970s
10(Chemicals / drugs)	1058	10(Chemicals / drugs)	4689	10(Chemicals / drugs)	8385
6(Alcohol)	530	45(Clothing, jewelry supplies)	1505	45(Clothing, jewelry supplies)	4404
45(Clothing, jewelry supplies)	300	38(Industrial machinery)	961	3(Confectionery)	3621
3(confectionery)	248	39(Electrical machinery)	838	39(Electrical machinery)	2332
13(Detergent / soap)	227	49(Textiles)	719	38(Industrial machinery)	2112
38(Industrial machinery)	169	6(Alcohol)	709	12(Perfumes / cosmetics)	1867
27(Shoes/ umbrella)	165	12(Perfumes / cosmetics)	708	49(Textiles)	1789
49(Textiles)	146	13(Detergent / soap)	652	13(Detergent / soap)	1628
2(Agricultural products)	142	3(confectionery)	642	2(Agricultural products)	1264
12(Perfumes / cosmetics)	140	15(Dyes)	555	37(Transportation machinery)	1210

[Table 2-9] Top 10 categories of trademark, 1980s-2000s

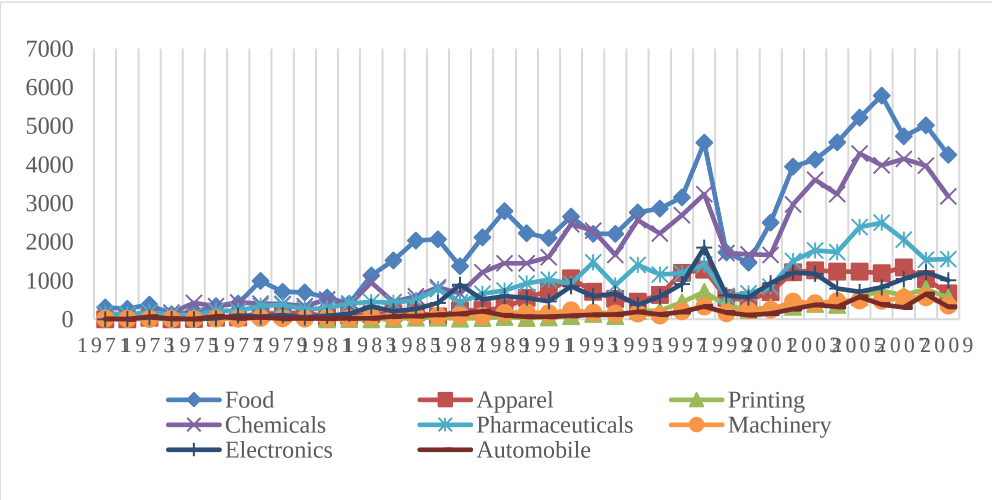
Trademark Classification	1980s	Trademark Classification	1990s	Trademark Classification	2000s
10(Chemicals / drugs)	17679	112(other services)	37645	112(other services)	55553
45(Clothing, jewelry supplies)	15104	45(Clothing, jewelry supplies)	32570	9(Optical, photographic,weighing machines/calculators)	32778
39(Electrical machinery)	9431	39(Electrical machinery)	26274	3(Detergent/Cosmetics)	29556
3(Confectionery)	9313	10(Chemicals / drugs)	24976	25(Clothig,footwear)	28835
112(Other Services)	7214	12(Perfumes / cosmetics)	18348	30(Coffee, tea;confectionery)	25720
38(Industrial machinery)	5804	52(Prints, sculpture, photography)	15694	5(Pharmaceutical and veterinary preparations)	24837
2(Agricultural products)	5790	3(confectionery)	14414	35(Advertising;business management)	21450
12(Perfumes / cosmetics)	5643	25(Woven bags and other containers)	11167	43(Service for providing food and drink;temporary accomodation)	16301
27(Shoes/ umbrella)	5199	2(agricultural products)	11072	29(Meat,fish,poultry and games;milk and milk product)	15913
43(Toy)	5124	43(Toys)	10234	41(Education;entertainment;sporting and cultural activities)	15855

[Figure 2-15] Top 7 in NICE classification in trademark



If we check trademark registration by firms in each sector, we find that the frequency of registration in the sector is somewhat different from that of the patent or utility model. The top three industries in terms of trademarks are food, chemicals, and pharmaceuticals.

[Figure 2-16] Trademark registration by firms in each sector (top 8)



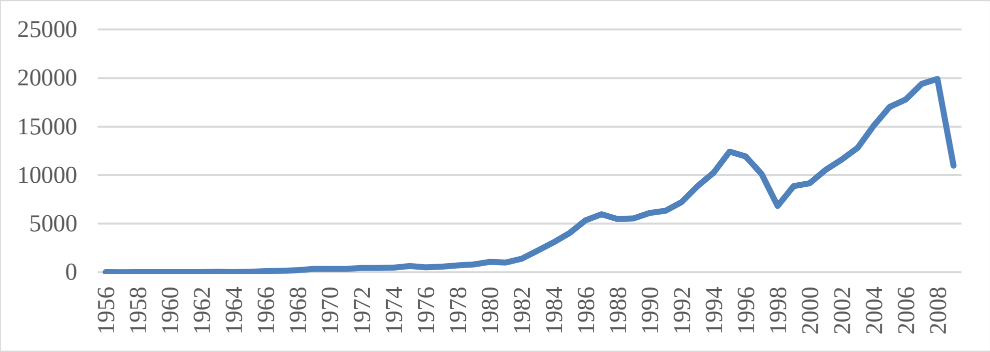
4. Design

A design or industrial design, as defined by World Intellectual Property Organization (WIPO), constitutes the ornamental or aesthetic aspects of an article. A design is defined as “the shape, pattern, color or any combination thereof in an article which produces an aesthetic impression on the sense of sight.” Design has been identified as an important way to add value to products and services and improve competitiveness (Rothwell and Gardiner 1983). The first design protection emerged in 1711 in France, dealing with the protection of designs for silk fabrics; however, it was limited to the city of Lyon. The system of design monopoly began in 1787, “Desret de Conseil d’Etat,” also in France.

A design consists of both stereoscopic features, like the shape or surface of a good, and flat features, such as patterns, lines, and color. Designs make a product more attractive and appealing so as to add commercial value and increase its marketability. Good design is an increasingly essential factor in new product innovation. Thus, design is an important activity for manufacturing firms, as well as an important subject in economics, while the management of design is a vital aspect of corporate strategy (Walsh 1996). Some researchers consider design to be an important driver of innovation, acting as a bridge between technical and customer-oriented functions (Kline and Rosenberg 1986; Rothwell 1992; Walsh 1996). Designs result in other forms of knowledge that have potential impacts on the future economic performance of firms. An original design can be registered and may become a key differentiator of goods. Appropriate design of a user-friendly feature might better satisfy customers. Like innovation, the results of design activity have important potential to influence future economic growth (Moultrie et al. 2008).

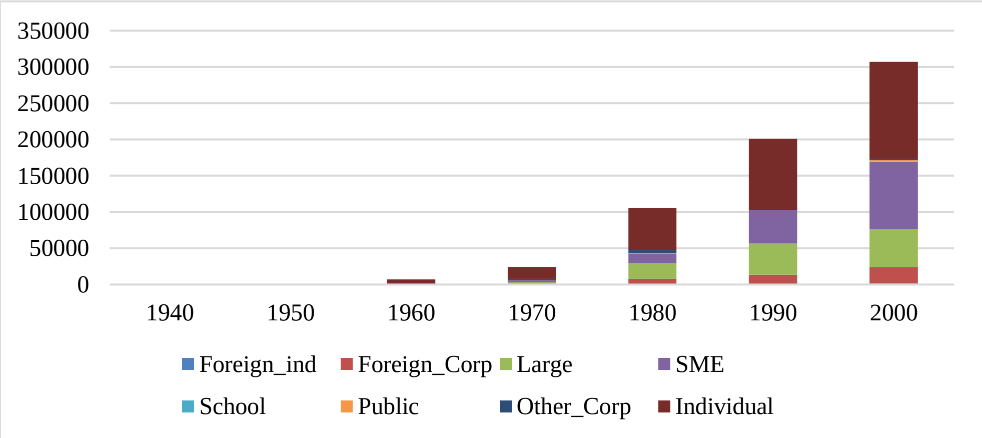
Design has also been a means of communicating with customers through products (Verganti 2009). As technology matures and the cost of development drops, firms increasingly depend on distinctive design and thus pay more attention to creative design. In this respect, design is closely related to technological capability. It may not be an exaggeration to say that the level of technology influences the level of design. It has also been said that attention to design is highly correlated with increased GDP per capita (Chung 2003). Thus, design becomes increasingly important in advanced stages of the firm. In Korea, design has been the focus of leaders of industries since the mid-1990s, when the GDP reached $10,000 for the first time (Chung 2003). In particular, a very famous story concerns the importance of design; in 1993, Kun-Hee Lee, the chairman of Samsung, announced a complete renovation of Samsung via “The Frankfurt Declaration (New Management Initiative).” He emphasized the importance of good design in order to become a competitive global brand and demanded innovation in quality, even encouraging production factories to change the whole production line to improve design. From that time onward, Samsung was able to go forward to become a global brand.

[Figure 2-17] Registration of design by firms



The main assignees of designs are individuals and SMEs. Like the utility model, foreign agents have rarely applied for design registration, but registration of designs by foreign companies has recently increased.

[Figure 2-18] Assignees of design, 1950-2010

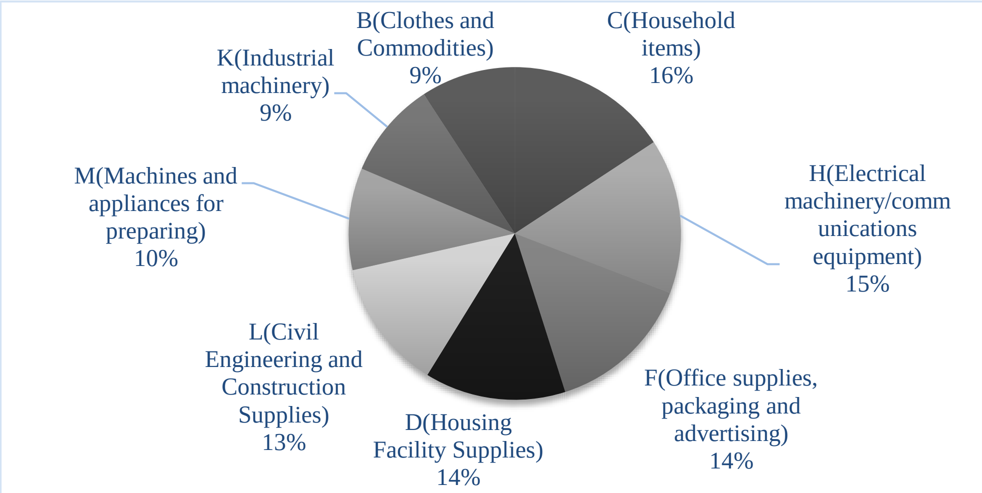


The design classifications are shown in table 2-10. Though the classification of design follows the international classification of the Locarno Agreement Establishing an International Classification for Industrial Design from July 2014, this study follows the Korean classification of design, because we deal with IPR data up to 2009. The main category is that of household items, but electrical machinery, office supplies, and household facility supplies are also frequently applied for. The validity of a design right was previously 15 years, but the protection period has lasted for 20 years since July 2015.

[Table 2-10] Classification of design

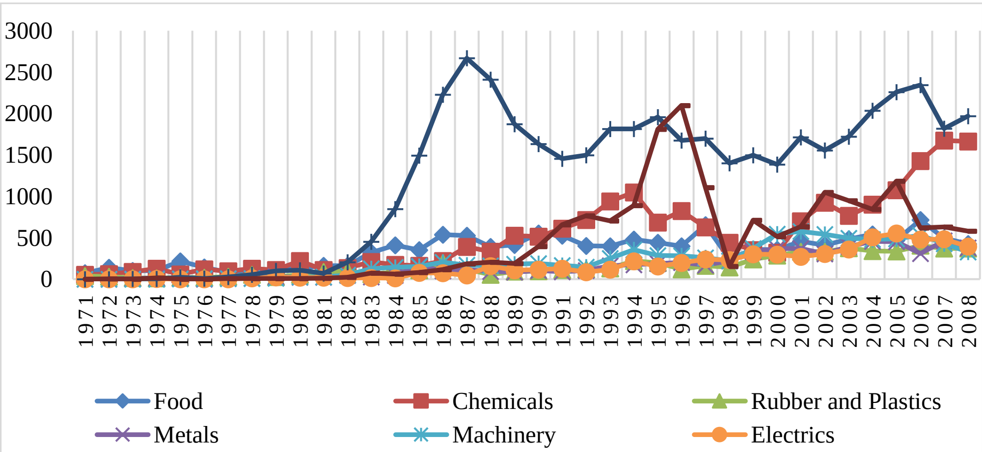
Design Classification	1950s	1960s	1970s	1980s	1990s	2000s	Total
A(Manufacturing and favorite food)	4	57	142	306	497	789	1795
B(Clothes and Commodities)	35	956	2537	9448	13214	19773	45963
C(Household items)	176	1399	4444	18875	24894	28818	78606
D(Housing Facility Supplies)	191	472	2268	9465	21159	34918	68473
E(Exercise and recreation equipment)	47	328	1212	5187	6686	6212	19672
F(Office supplies, packaging and advertising)	1	1727	5693	14244	22559	26990	71214
G(Transportation and conveying machinery)	0	138	740	4466	17203	11788	34335
H(Electrical machinery/communications equipment)	28	250	880	12972	27622	33388	75140
J(General machinery)	398	725	629	4194	10168	9762	25876
K(Industrial machinery)	15	363	1944	10933	20159	13556	46970
L(Civil Engineering and Construction Supplies)	0	209	1400	7773	21061	32614	63057
M(Machines and appliances for preparing)	8	424	2580	6981	15705	23788	49486

[Figure 2-19] Top 8 Korean design classifications



The sectoral registrations of designs by firms show similar patterns in patents. The top three sectors of design registration are electronics, chemicals, and automobiles.

[Figure 2-20] Design registration by firms in each sector (top 8)

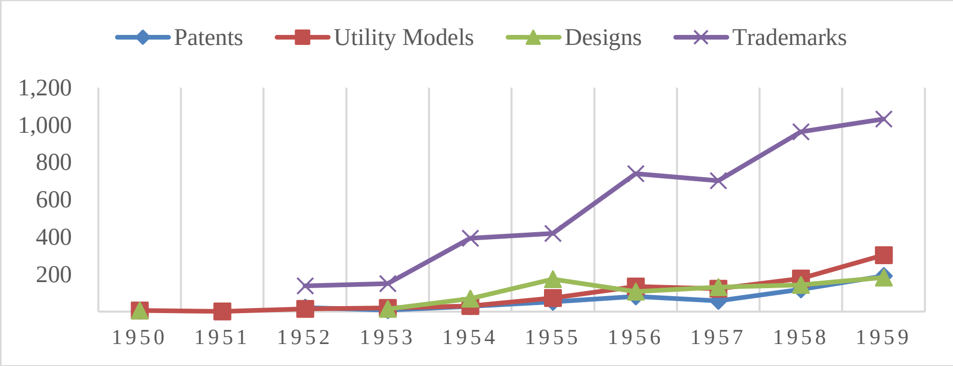


IV. Trends of Intellectual Property Rights in Korea (1947-2010)

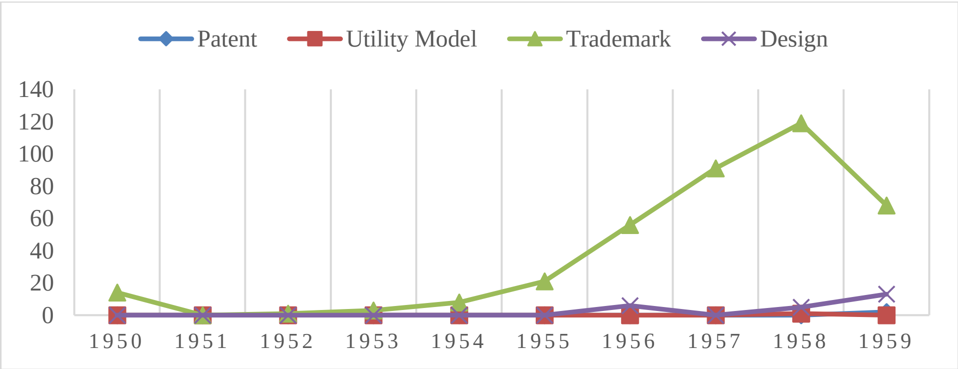
In Korea, the first adoption of an IPR system was in 1908, the last era of the Joseon dynasty. However, at that time Korea was under the intervention of Japan, and Japan adopted the same IPR system during its occupation of Korea. The first patent in Korea was for a "hat made of horsehair" by Inho Jung. In 1946, after Korea's independence from Japan, registration of patent began under the law (US military government command No. 91). The patent law covered patents, utility models, and designs. Trademark law was established in 1949; in the same year, the Patent Bureau was established as an external bureau of the Ministry of Commerce and Industry.

In the 1950s, after the Korean War, there were neither resources for development nor perceptions of technology in Korea, and collusion between politics and business was pervasive in domestic firms. At this time, most IPRs were registered by a foreign company or individual. The most-registered foreign country was the United States, because the IPR law of Korea followed that of the US. From application to grant, the lag time for patents and utility models was usually about 1.5 years, whereas for trademarks and designs it was 0.4 years. According to figure 2-21, registration of trademarks shows a relatively rapid increase compared to other IPRs in the 1950s, though the total number of IPRs was small. When we check the registration by firms, the total number of IPRs was very small.

[Figure 2-21] Registration of IPRs in the 1950s (by total assignees)



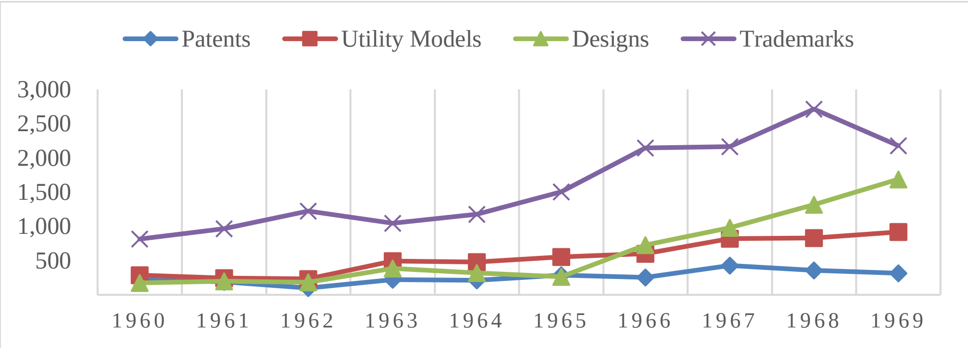
[Figure 2-22] Registration of IPRs in the 1950s (by firms)



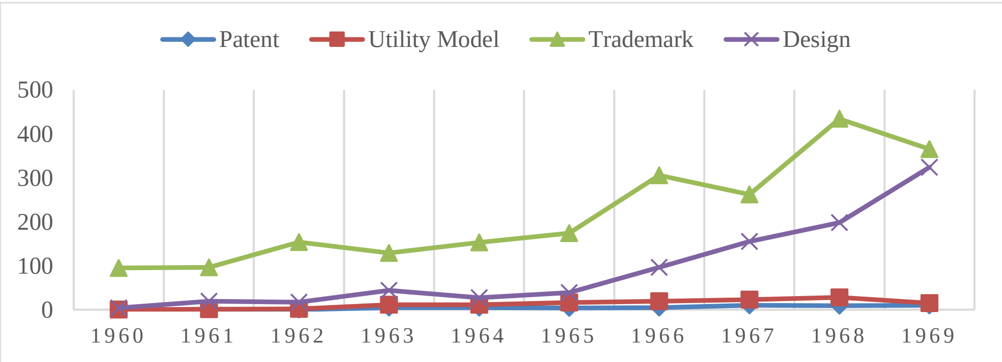
The genuine IPR system was established in 1961 after the success of the military coup on May 16. The military government encouraged society-wide reform and modified whole systems of law. Consequently, the Patent Law (No. 950), the Utility Model Law (No. 952), and the Design Law (No. 951) were promulgated on December 31, 1961, while the Trademark Law (No. 1295) was revised on March 5, 1963. These laws form the substructure of the present intellectual property (IP) laws in Korea. Since 1961, Korean IP legislation has been amended more than 20 times to keep up with rapid changes in the economic environment and technological development.

In the 1960s, trademark was still the most-registered IPR, with design being the second-largest IPR after 1966 by total assignees. However, based on firm data, we find that design became the second-largest IPR from 1960 forward. Though the Korean government implemented the first and second five-year economic development plans from 1962, patents and utility models were still seldom registered by domestic firms in 1960s.

[Figure 2-23] Registration of IPRs in the 1960s (by total assignees)

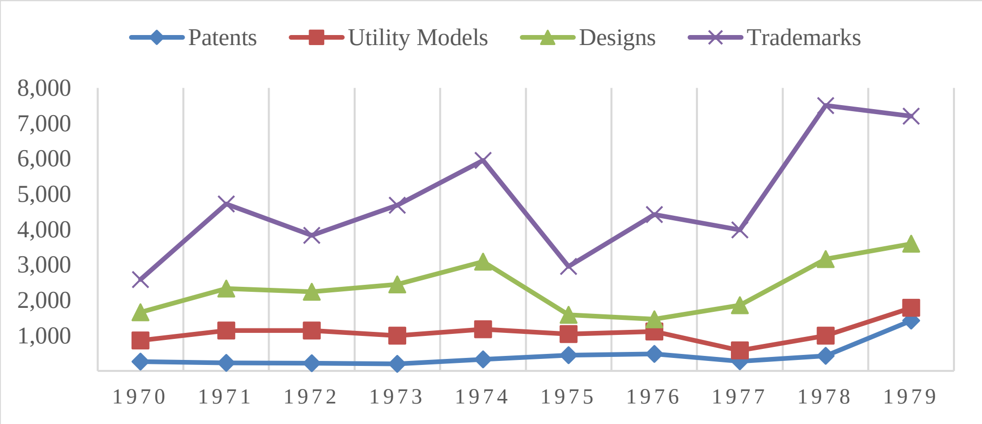


[Figure 2-24] Registration of IPRs in the 1960s (by firms)

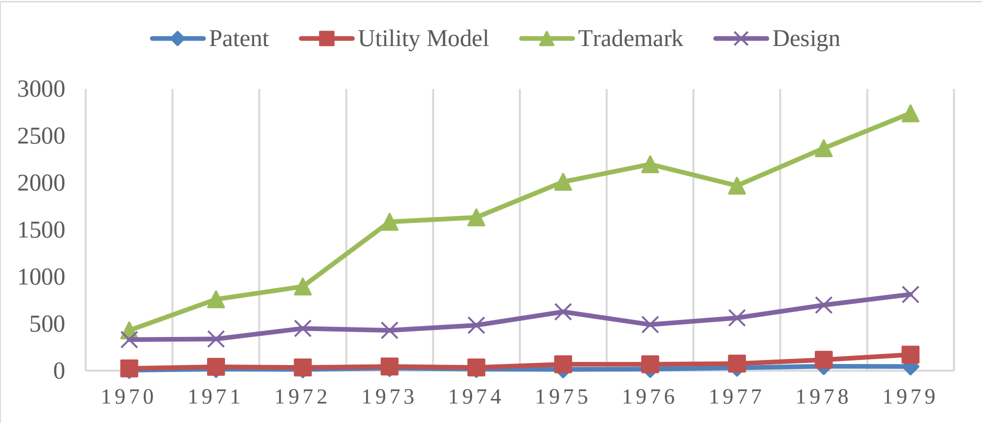


In the 1970s, trademark was still the main IPR, and the volume of trademark registration was almost three times larger than it had been in the 1960s. Although the government emphasized technological development by publicly funding and conducting research and development (R&D) (Lee 2013) in the 1970s, the number of granted patents and utility models remained almost the same as in the previous period.

[Figure 2-25] Registration of IPRs in the 1970s (by total assignees)

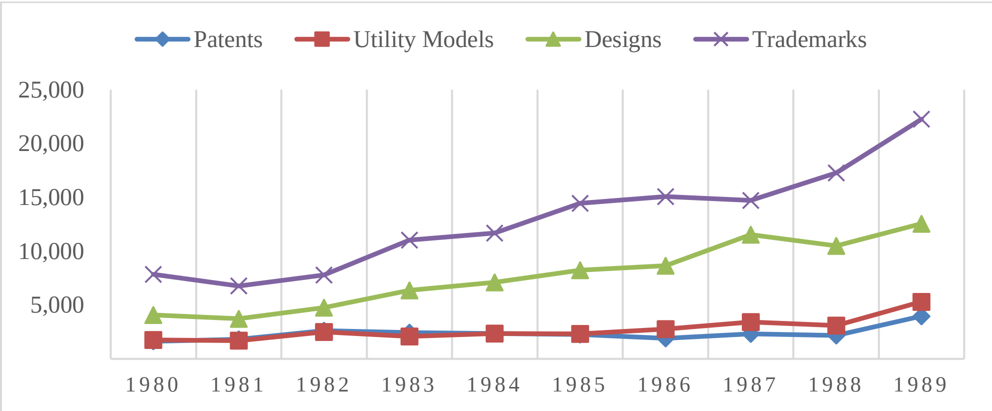


[Figure 2-26] Registration of IPRs in the 1970s (by firms)

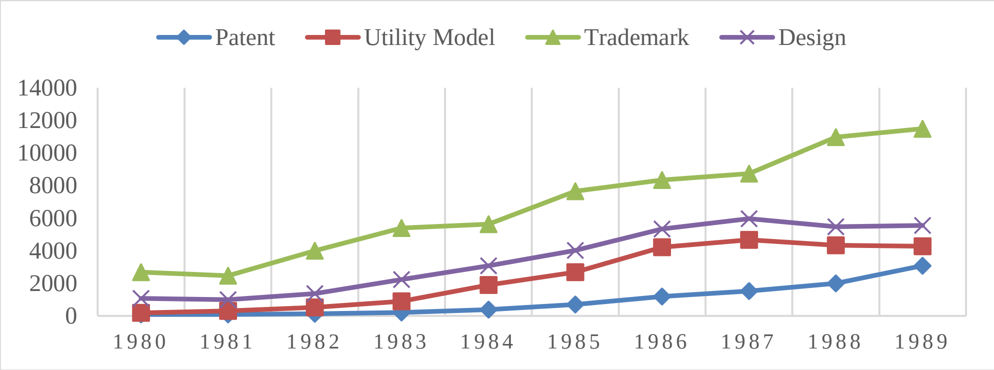


In the 1980s, intensified R&D expenditures and higher education than in the previous period laid the foundation for knowledge-driven growth. The Special National R&D Program was launched in 1982 with a total investment of 334 billion won, of which the government invested 194 billion and the private sector 140 billion (Choi and Branscomb 1996). From the mid-1980s, Korean firms started to establish their own private research centers because they recognized the limitation of the licensing and embodied technology transfer (OECD 1996), and after 1987 the protection of patents became stronger and expanded (Kim et al. 2012). While trademarks stayed in first place in terms of IPR registration, registration of utility models and patents started to increase.

[Figure 2-27] Registration of IPRs in the 1980s (by total assignees)



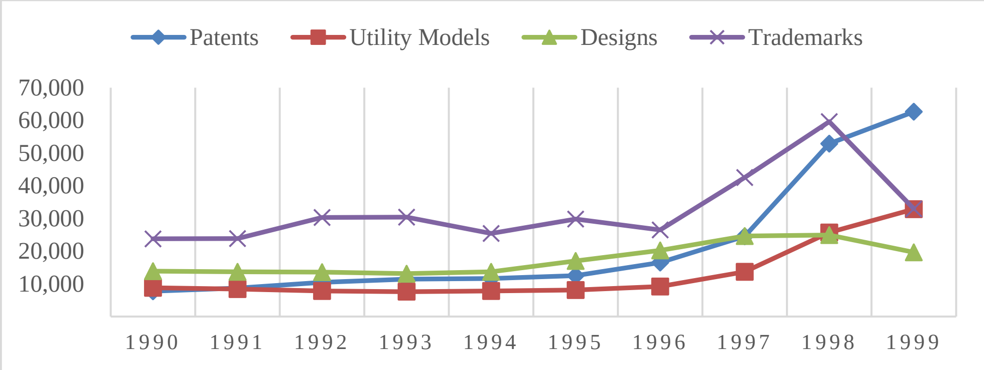
[Figure 2-28] Registration of IPRs in the 1980s (by firms)



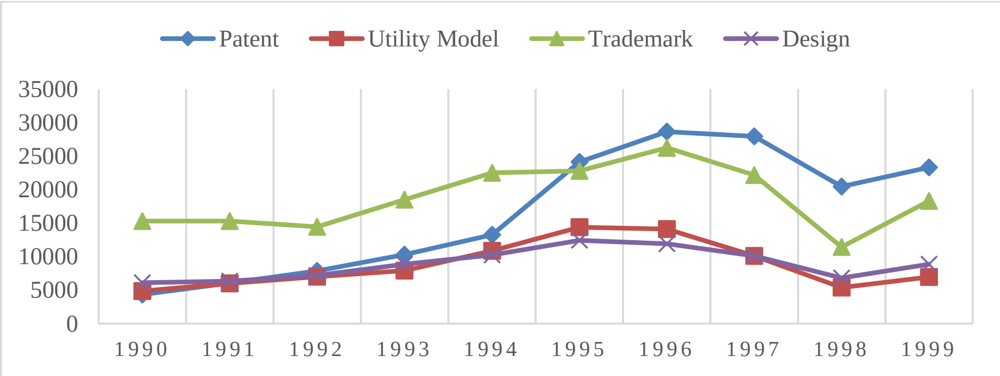
During the 1990s, the Korean economy rose and fell. As a result of economic and political preparation over many years, Korea finally joined the Organization for Economic Cooperation and Development (OECD) in December 1996. However, the next year, Korea suffered a financial crisis and had to ask for a bailout from the International Monetary Fund (IMF). To overcome the crisis, Korea carried out many institutional and policy reforms. According to Choo et al. (2009), technological capabilities are important in explaining the post-crisis performance of surviving Korean firms, especially chaebols.

Firms’ registration of patents exceeded trademark registration beginning in 1994, and this shift appeared in total registration data in 1998. This suggests that R&D and technological development were driven by domestic firms. The overtaking of patents is noteworthy because not all sectors show such a pattern. In this regard, it is necessary to check the pattern of registration by each sector.

[Figure 2-29] Registration of IPRs in the 1990s (by total assignees)



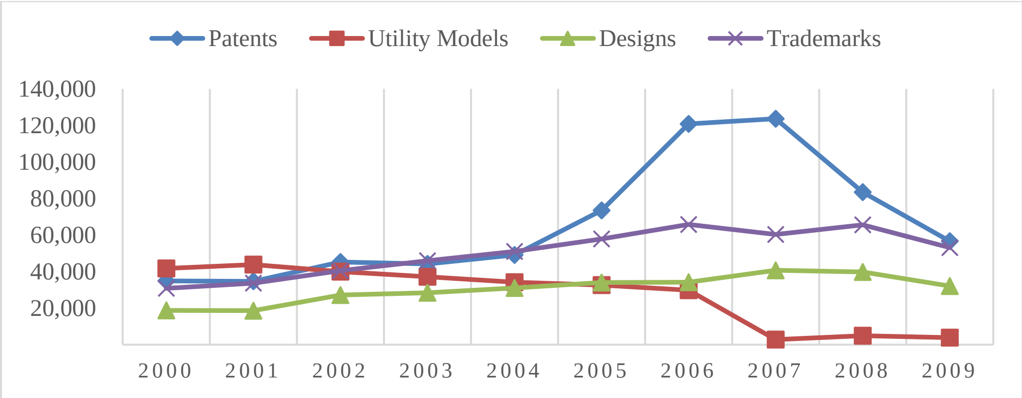
[Figure 2-30] Registration of IPRs in the 1990s (by firms)



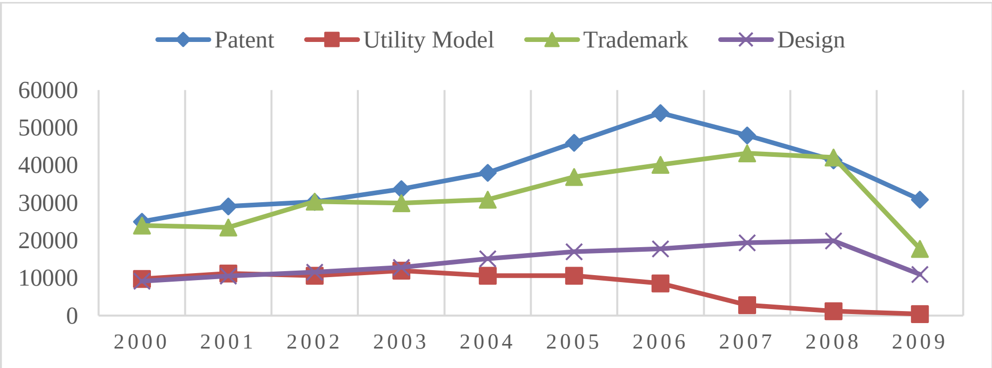
After the crisis, many firms (even chaebols) went bankrupt, and many people were laid off. However, the firms that succeeded in accumulating technological capabilities survived the crisis. Unfortunately, another financial crisis hit the Korean economy in 2008. After undergoing these harsh periods, the Korean government and firms have come to fully realize the importance of intangible assets like IPRs.

In the 2000s, patents maintained the largest number of IPRs, but trademarks and designs also exceeded 20,000 registrations per year by total assignees and 10,000 registrations per year by firms. The total number of IPRs was about 2200 times larger in the 2000s than in the 1950s. Registration of the utility model rapidly diminished, because the process of registering utility models changed to an evaluation system in 2006, and patent registrations also decreased, owing to large firms like Samsung and LG have reduced registration of patents in KIPO.[11]

[Figure 2-31] Registration of IPRs in the 2000s (by total assignees)



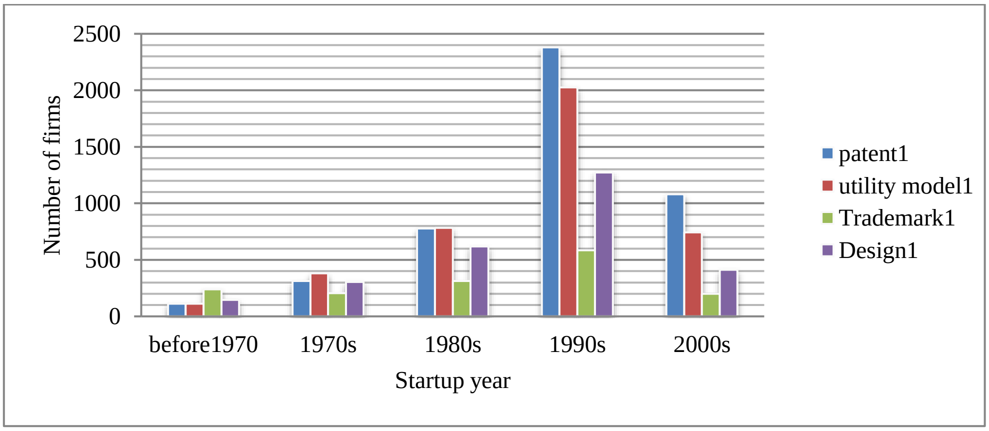
[Figure 2-32] Registration of IPRs in the 2000s (by firms)



[11] From mid-2000s, large firms apply and register patent in USPTO for competing at global market instead of registering patent in KIPO.

When we review firms' registration of IPRs in the whole period, there is some transition of firms' first IPR according to period. Before 1970, firms applied for trademarks first after establishing the company. However, firms' first IPR changed to utility models and patents as time passed. This is one of the available clues about the technological development of Korean firms.

[Figure 2-33] The first registered IPR by firms



In table 2-11, the top 10 firms of each IPR are displayed. The ranking is set according to the total number of firms' registered IPRs during the whole duration of the business. Samsung Electronics ranks in first place in patent and design and LGEI in utility model. Top rank companies of these three IPRs are in electronics industry. However, the firm in first place for trademarks is Amore Pacific, a cosmetics and health care product company.

[Table 2-11] Top 10 firms registering all IPRs in Korea

	Patent	**Utility Model**	**Trademark**	**Design**
1	Samsung Electronics	LGEI	Amore pacific	Samsung Electronics
2	LGEI	Samsung Electronics	Lotte Confectionery	LGEI
3	Hyundai Motor Company	Daewoo Electronics	Samsung Electronics	Hyundai Motor Company
4	Hynix Semiconductor	Hyundai Motor Company	CJ	Amore pacific
5	Daewoo Electronics	Kia Motors	LG Chemistry	Daewoo Electronics
6	Kia Motors	Hynix Semiconductor Inc.	Haitai Confectionery	Kia Motors
7	Samsung SDI	Posco	LGEI	CJ
8	Posco	Samsung Electro-Mechanics	Nong-Shim	LG Chemistry
9	LG Philips LCD	LS Industrial System.	Orion Corporation	Hynix Semiconductor Inc.
10	Samsung Electro-Mechanics	Hyundai Semiconductor	Dong-A Pharmarcy	Lotte Confectionery

V. Limitations of Patents and Advantages of Trademarks

Patents and trademarks are rights that protect the applicant’s intellectual assets. They provide an incentive for a firm to promote its innovation and marketing activities (Greenhalgh and Rogers 2010). Information about a firm’s patent or trademark application explains the company's engagement in new product development (Mendonca et al. 2004), because innovative firms use patents or trademarks to discourage imitation by other firms. Also, both have limited geographic validity, so they were originally valid only in the country in which they had been registered. However, patents relate to scientific and technological aspects, whereas trademarks relate to more commercial aspects, so they do differ in some respects.

The first of these differences is that trademark applications do not contain a description, practical examples, claim or drawing, all of which inevitably appear in patent applications. This suggests that trademark information does not have the technological value that patent information does. Thus, if a firm do not have sufficient capability to apply for a patent, it can register a trademark by making a product despite its low level of technology. Because patents imply the technological ability of the firm, many researchers have analyzed the effect of patents on economic growth and firm performance (Pakes and Griliches 1980; Gould and Gruben 1996; Park and Ginarte 1997; Crepon et al. 1998; Ernst 2001; Griliches 1998; Hall, Jaffe and Trajtenberg 2005). In fact, a patent is the most useful method to protect the firm's technological ability and profits. However, if the monopoly of the patent expires, firms must seek some other means to maintain their profits. If they can establish their brand during the period of patent protection, the trademark provides the further possibility to maintain market power after the patent's expiration. Second, most new technology protected by a patent is undertaken before the patent is granted, while trademark protection is only undertaken after the trademark is granted. Another important difference is the validity of the right. Patents are generally valid for 20 years, whereas trademarks are valid for an unlimited period of time as long as the trademark holder maintains the trademark by paying its renewal fees every 10 years. Moreover, the official costs for trademarks are usually lower than for patents.[12]

In addition, not all inventions are patentable, and some inventions are intentionally not patented,[13] but a registration of trademark indicates the introduction of a new product innovation.

Above all things, customers want a different, attractive product if they are exposed to some level of technology in advance, and the trademark can signal a difference of the product through naming. With this name, the products of firms are legally protected in the market.

From the analysis of Korean IPR data, we find that trademark registration occupies a considerable proportion of in total IPR registrations from the underdevelopment stage to the developed stage. Therefore, it may be possible to analyze the effects of trademarks on technological development and firm performance. It is for this reason that we focus on trademarks in this thesis.

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12 The total fee for registering patents is around 200,000KRW for one claim and another 44,000KRW per each additional claim, but the fee for trademarks is 72,000KRW per good.

13 An example comes from the IPR management of the Coca-Cola Company.

VI. Chapter conclusion

In this chapter, we follow the development of Korean IPRs over 60 years. Since Korea is a model of successful development with technological abilities, the investigation of growth in IPRs is important to understand the evolutionary changes in the Korean economy. In the underdeveloped stage, the trademark was the most frequently registered IPR, but the number of patents exceeded that of trademarks beginning in the mid-1990s. However, the role of trademarks may be still or more important in the developed stage, so we will analyze the effect of trademarks compared to patents in this thesis. Because we show IPRs in all sectors in this chapter, it is necessary to examine the pattern of IPR applications by sector to clarify whether or not the change of dominant IPR is common in all sectors. In the next chapter, we will examine the sectoral differences in IPR applications and registrations and investigate what causes the differences between sectors.

Chapter 3. Explaining Sectoral Differences in the Registration of Intellectual Property Rights

I. Introduction

In chapter 2, we presented the economic development of Korea using long-term IPR registration data. In the underdeveloped stage, firms had no ability to produce complicated and technological products. In addition, most firms did not recognize the importance of intangible assets like intellectual property rights, and registrations of IPRs were not active. However, even in that period, some sectors like foods and chemicals registered trademarks relatively frequently.

When we follow the growth patterns of each IPR in Korea, we can see that these patterns are different according to industry. In some sectors like food, apparel, and chemicals, the trademark was registered from the initial stage of development and is still the leading IPR in the developed stage. However, in other sectors like electronics and automobiles, the main IPR changed from trademarks to patents after the mid-1990s (entering the development stage). On the one hand, these different IPR registration patterns by sector might result from the Korean government's economic policy. Beginning in 1962, the Korean government drove policies to promote economic growth such as the "Five-Year Plan for Economic Development." This policy continued until 1986, and the dominant industry changed, according to the development plan, from light industry to heavy industry.[14] Thus, we can suppose that each industry has a somewhat different developing appearance, such as the differing registrations of IPRs. On the other hand, these different evolutions might be explained by the different structures of the sectoral system. Sectoral systems have a knowledge base, technologies, inputs and demand (Malerba 2002). According to Marlerba (2002, 2004, 2005), innovations and technological changes are greatly affected by the sector in which they occur. This is referred to as the theory of the sectoral system of innovation (SSI). SSI focuses on the dynamics of innovation and production in sectors and provides quantitative and qualitative analyses comparatively across industries (Malerba and Mani 2009). With this

[14] Evolution of top 10 industry from 1975 to 2005.

Rank	1975	1985	1995	2005
1	Apparel and Textile	Apparel and Textile	Electronics	Electronics
2	Oil refining	Electronics	Automobiles	Automobiles
3	Chemicals	Chemicals	Apparel and Textile	Steel
4	Foods	Oil refining	Chemicals	Machinery
5	Electronics	Foods	Machinery	Chemicals
6	Steel	Steel	Steel	Metals
7	Tobacco	Ship building	Foods	Foods
8	Beverages	Automobiles	Metals	Apparel and Textile
9	Plywood	Metals	Oil refining	Rubber and Plastics
10	Rubber	Machinery	Ship building	Electrics

framework, we will try to explain the causes of the different growth of IPR according to sectors.

The aim of this chapter is to identify the reasons for the differences in the registration of trademarks and patents across manufacturing sectors. As confirmed in chapter 2, the trademark was the most frequently registered IPR in the initial stage, but from the mid-1990s, the patent became the most frequent registered IPR. However, when we examine Korean IPR data by sector and by stage, it is apparent that the patterns of registration differ according to sector and stage. After investigating sectoral differences in the patterns of registering IPRs, we find that some sectors depend entirely on trademarks, while others make patents their main IPR; these differences emerged around 1994. To illustrate this difference theoretically, we will describe the different characteristics of knowledge by sector and examine technological development patterns according to each sector. Then we will analyze the registration of patents and trademarks with sector-level data from 1971 through 2010.

II. Theoretical Background and Motivation

1. Different knowledge bases of sectors

Technological knowledge involves varying degrees of specificity, tacitness, complementarities and independence and may greatly differ across sectors and technologies (Nelson and Winter 1977). The main advantages of a sectoral system view can be identified in a better understanding of the structure and boundaries of a sector – that is, the agents and their interactions; the learning, innovation and production processes; the transformation of sectors; and the factors at the basis of the differential performance of firms and countries in a sector (Malerba 2002). When we focus on sectoral differences, we can find several classifications of sectors with diverse criteria. First, the Schumpeter Mark I and Schumpeter Mark II models are classified by innovative activities at the sectoral level. Schumpeter Mark I is characterized by “creative destruction”, with technological ease of entry and a major role played by entrepreneurs and new firms in innovative activities. New firms’ entry is challengeable for incumbents and continuously disrupts the present methods of production, organization and distribution. Schumpeter Mark II is characterized by “creative accumulation” with the prevalence of large established firms and the presence of relevant barriers to entry for new innovators according to the ability of industrial R&D labs (Malerba 2002). Another classification of sectors is by Pavitt (1984), who put forward a taxonomy based on differences in the process of innovation, rather than a product-based industrial classification. Pavitt explains the sectoral patterns of technical changes using the data of 2000 innovations in Britain from 1945 to 1979; these classifications are: (1) supplier-dominated industries, (2) scale-intensive industries, (3) specialized equipment suppliers and (4) science-based industries.

[Table 3-1] Innovation patterns of Pavitt's taxonomy

Sector type/ variables	Supplier dominated	Scale Intensive	Specialized suppliers	Science Based
Firm size	Small firms	Large firms	Small firms	Large firms
Type of innovation	Processes	Processes	Products	Mixed products and processes
Locus of innovation	External	Production	Decentralized	R&D departments
Sources of innovation	Specialized suppliers	Production and specialized suppliers	Science based firms/customers	Universities and research centers
Means of appropriability	Tacit knowledge	Tacit knowledge and entry barriers	Tacit knowledge/reputation	Patents and entry barriers
Competitive parameter	Quality/performance	Price/ quality Price	Quality/performance	Performance/quality/ price
Sectors	Stone/glass	Automobiles	Mechanical engineering	Pharmaceuticals/ microelectronics
Trajectories	Improvements in process yields	Improvements in process yields and increases in the scale of production processes and automation	Improvements in performance and reliability of products	Performance and physical properties and improvements in process yields
Learning regime	Learning by using	Learning by doing/ learning by using	Learning by interacting/learning by doing	Learning by searching/learning by doing

*Source: Kristensen (1999: p4)

Recently, Asheim (2007) categorized sectors by knowledge base. He emphasized that the innovation process of firms differs substantially among various industries and sectors whose activities require specific knowledge bases (Asheim & Gertler, 2005; Asheim & Coenen, 2006). He distinguished sectors according to three types of knowledge base: 'analytical' (science-based), 'synthetic' (engineering-based) [15] and 'symbolic' (creativity-based). These types indicate different mixes of tacit and codified knowledge, codification possibilities and limits, qualifications and skills, required organizations and institutions involved, and specific innovation challenges and pressures from the globalizing economy (Asheim 2007). Pavitt's taxonomy can be connected with Asheim's as follows: supplier-dominated and scale-incentive industries are related to synthetic knowledge, whereas science-based and specialized suppliers are related to analytical knowledge.

[Table 3-2] The three knowledge bases by Asheim

Analytical	Synthetic	Symbolic
Innovation by creation of new knowledge	Innovation by application or novel combination of existing knowledge	Innovation by recombination of existing knowledge in new ways
Importance of scientific knowledge often based on deductive processes and formal models	Importance of applied, problem-related knowledge (engineering), often through inductive processes	Importance of re-using or challenging existing conventions
Research collaboration between firms (R&D department) and research organizations	Interactive learning with clients and suppliers	Learning through interaction in the professional community, learning from youth/street culture or 'fine' culture

15 Laestadius (1998).

		and interaction with 'border' professional communities
Dominance of codified knowledge due to documentation in patents and publications	Dominance of tacit knowledge due to more concrete know-how, craft and practical skill	Reliance on tacit knowledge, craft and practical skills and search skills
Biotechnology/Pharmaceuticals /Electronics[16]	Automotive/Food	Advertisement

*Source: Asheim (2007: p227), Asheim and Coenen (2005: p1183)

From these classifications, we can infer that the main difference of the separation stems from whether or not the technology of the knowledge is scientific. In terms of technological regime, appropriability appears differently in each category. In scientific or analytical types, codified knowledge or patents are used, whereas in non-scientific or synthetic types, tacit knowledge is used. The codifiability of knowledge is a similar concept to explicitness, and it represents the extent to which a given knowledge item can be reduced to information by means of drawings, formulae, numbers or words. On the other hand, tacit knowledge can only be observed through its application and can only be acquired through practice (Grant 1996; Spender, 1996; González and Mariano, 2007). When technological knowledge is invented or acquired, firms usually use various instruments to protect the results of their innovative activities from imitation (Dosi et al. 2006). Such instruments can be distinguished into legal property rights like patents and unofficial forms like know-how (Castellacci and Zheng 2010). The percentage of patented innovations varies by sector according to the appropriability of the technology innovation,

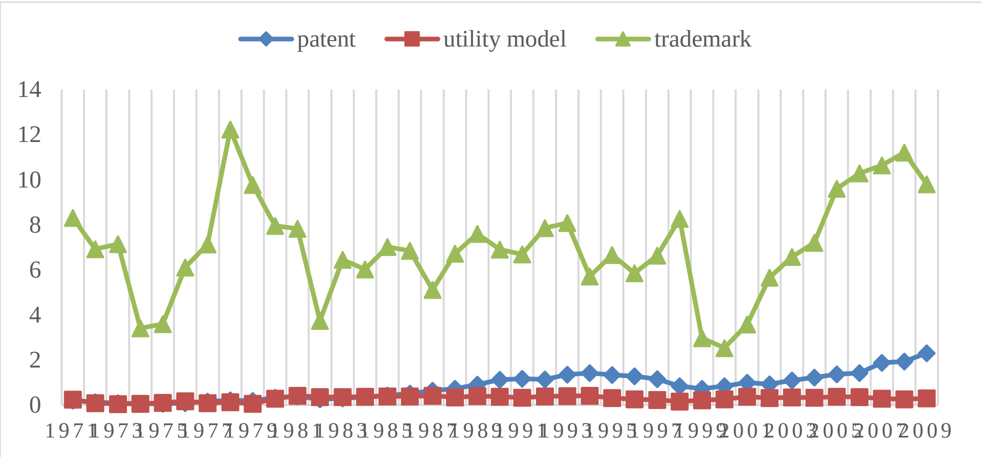
16 Asheim and Coenen (2005) classified electronics have both analytical and Synthetic knowledge base.

as mentioned in previous researches (Levin et al. 1987; Harabi 1995; Arundel and Kabla 1998). Also, firms that regard know-how or secrecy to be an important protection method for innovative products are less likely to apply patents (Arundel and Kabla 1998), and these are types of tacit knowledge. Tacitness refers to the situation in which some technological information about production is embodied in the product or other protector. This kind of knowledge is usually acquired by means of training and interaction with other people or the environment. Tacit knowledge is implicit and idiosyncratic; at the organisational level, it is embedded in routines and capabilities (Teece and Pisano 1994). Generally, tacit knowledge is not expressed in words but instead is embedded in products, such that the name of the product might reflect the quality of the goods. Moreover, tacit knowledge is usually correlated with non-scientific type sectors. Thus, we suppose that in tacit-knowledge-dominant sectors, firms may be likely to apply for IPRs other than patents.

2. Trademark-dominant group and patent-dominant group

Returning to our data, we find in chapter 2 that there are sectoral differences in registering IPRs according to period. At a glance, the most-registered IPR changes depending on technological development. However, we also find that, in some sectors, the trademark is dominant throughout the whole period, whereas in other sectors the dominant IPR changes to the patent beginning in the mid-1990s. To investigate this sectoral difference in registering IPRs, we classify all sectors into two groups. The first group is the trademark-dominant group, which mainly includes light industry (e.g., food, apparel, basic chemicals, and pharmaceuticals). Firms in these sectors registered trademarks more than any other IPRs at any period. This group is similar to Pavitt's scale-intensive and supplier-dominated industry and Asheim's synthetic sector. However, it is not the same as these categories, because in our classification pharmaceuticals is in the trademark group. The difference on pharmaceuticals is because of Korea's rapid growth from the underdevelopment stage and typical industrial circumstances of reverse engineering of advanced medicine from other countries.

[Figure 3-1] Trademark-dominant group (average of firms' registrations per year)



[Table 3-3] Trademark dominant group: Ratio of patents to trademarks (patent/trademark)

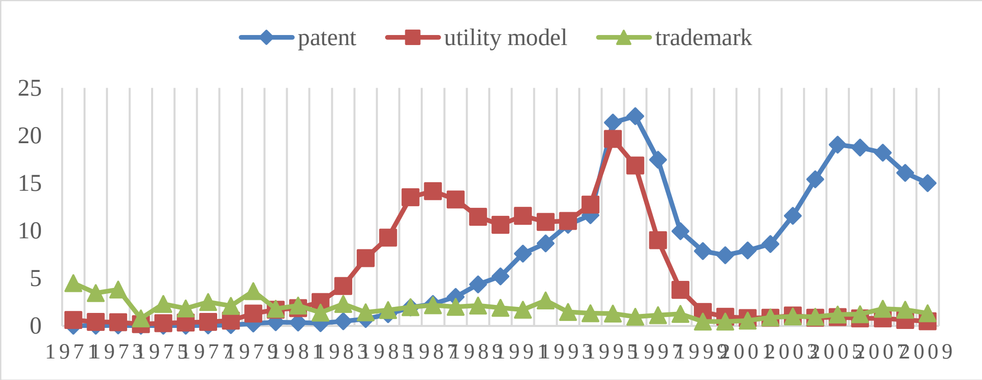
Trademark dominant group	1970s	1980s	1990s	2000s	Number of firms
Food and Beverage	0.010	0.025	0.070	0.054	363
Textile & Fabric Weaving	0.003	0.062	0.203	0.277	251
Apparel	0.000	0.012	0.005	0.012	239

Leather & Shoes	0.000	0.000	0.013	0.043	87
Wood & Furniture	0.000	0.022	0.004	0.233	31
Paper	0.200	0.078	0.199	0.158	112
Printing	0.000	0.000	0.008	0.032	169
Oil Refining	0.000	0.346	0.361	0.298	25
Basic Chemicals	0.024	0.121	0.281	0.440	348
Pharmaceuticals	0.022	0.034	0.091	0.124	174
Rubbers (except tires) & Plastics	0.066	0.060	0.362	0.865	330
Cement & Non-Metals	0.022	0.449	0.847	0.549	187
Other Manufacturing (toy, sport goods, ornaments)	0.000	0.022	0.073	0.172	227

The second group is the patent-dominant group, mainly including heavy industry or technology-intensive industry (e.g., synthetic chemicals, iron/steel industry, and electronics). The firms in these sectors changed their main IPR from trademarks to patents after the mid-1990s. This group is similar to Pavitt's science-based and specialized supplier industry and Asheim's analytical sector. Like pharmaceuticals in the trademark-dominant group, the inclusion of the automobile sector in the patent-dominant group is in contrast to Pavitt's or Asheim's classification. This is due to the technological development of automobiles after 1990s and the IPR strategy of Korean oligopolistic automobile firms[17] (i.e., Hyundai motors and Kia motors).

[17] Hyundai motors developed the α-engine independently in 1991 and established a private research center in 1996 (http://pr.hyundai.com/#/Pages/Intro/Report/ReportList.aspx). Kia motors was acquired by Hyundai motors in 2000.

[Figure 3-2] Patent dominant group (average of firms' registrations per year)



[Table 3-4] Patent dominant group: Ratio of patents to trademarks (patent/trademark)

Patent - dominant group	1970s	1980s	1990s	2000s	Number of firms
Synthetic Chemicals	0.024	0.187	0.665	2.636	108
Rubber Tires	0.000	0.025	2.079	2.947	6
Iron & Steel Manufacturing	0.131	1.365	7.810	9.969	226
Fabricated Metal	0.021	0.044	0.508	1.312	385
Machinery	0.028	0.133	1.516	3.347	979
Computers	0.000	0.018	0.518	1.539	156
Electrical Machinery	0.107	0.826	2.843	3.050	414
Electronics	0.078	1.125	14.842	16.632	1004
Optical & Medical Instruments	0.000	0.356	2.226	2.564	255
Automobile	0.030	0.139	10.575	13.057	454
Ship Building & Vehicles	0.000	0.707	4.143	3.772	79

At the beginning of economic development, firms had no capability to produce complex or scientific products. Because there is no need to describe a technological invention in the registration of a trademark, the main IPR was the trademark in every sector to protect these companies' products in the market at that time. After reaching a technologically advanced period, firms in the patent-dominant group applied for patents more than any other IPR. In detail, the utility model exceeded the trademark beginning in the early 1980s, and then the patent became the most frequently registered IPR after the mid-1990s in the patent-dominant group. However, firms in the trademark-dominant group have registered trademarks more than any other IPRs regardless of their development level. That is, the difference between the two groups is exposed after firms in the sectors absorb technological capability from advanced countries. In table 3-3 and table 3-4, the trademark-dominant group and patent-dominant group are presented as the ratio of the number of patents to the number of trademarks. This ratio is calculated using the total number of registered patents in each sector of each year divided by the total number of registered trademarks in each sector of each year. According to the result, it is apparent that the two groups differ in their use of IPR, and we suppose that this difference might arise from different knowledge bases within the sector.

A few years ago, research comparing IPRs in Korea was conducted. Kim et al. (2012) analyze and compare patent and utility model data according to the period. They examine the effect of Korean patent and utility model data on firm performance and find that both forms of data can explain Korean firms' performance. However, the effects of the utility models and patents on firm performance differed according to the firms' level of technological development. Specifically, at a less developed level, utility models performed the role of acquiring technological capability, while at a more developed level patentable innovations have positive and significant influences on firm growth. From this result, the authors conclude that the utility model is a stepping-stone for further technological advances. However, they examine the differences only with firm-level data, not sector-level data. Moreover, they did not classify the sectors, because both patents and utility models deal with technological or scientific invention or improvement. In contrast, the trademark is not a technology-friendly IPR like the patent or the utility model; rather, it is a market-friendly IPR which expresses the name of a product. Because we focus on patents and trademarks, it is necessary to classify the sectors by the registration patterns of patents and trademarks and investigate the differences between the groups.

Recently, researchers in diverse countries have focused on the role of trademarks as a measure of complementing patents or a proxy of innovation (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). However, in all but one or two cases, they analyzed the effect of trademarks with firm-level data. As far as we know, no study exists using sector-level analysis to analyze the difference between patents and trademarks. Therefore, we will use sector-level data to identify where the sectoral differences come from, and we will attempt to apply an empirical analysis to verify the differences between the groups.

III. Hypothesis development

When we examine the groups categorized by registration of patents and trademarks, there are two issues to take into account. First, it is obvious that there was little difference in registering IPRs in the underdevelopment stage. Second, the division of the two groups appeared only after the mid-1990 (i.e., after a certain level of technological development was achieved). To find out what makes the differences in registration of trademarks versus patents between manufacturing sectors, we borrow Pavitt's and Asheim's sectoral classification of knowledge bases.

If the technological knowledge of a sector can be easily formulated, firms in the sector can apply for a patent to protect their new invention. However, if the knowledge is hard to codify, firms must find another protection method. In other words, different degrees of knowledge explicitness affect the extent of patent registration. Explicit knowledge is usually described as patentable because the information can be explained in words, while tacit knowledge is rarely protected by patents because a patent application with this knowledge would be vague or misleading (Arora 1997). Thus, the patent system is effective in protecting explicit knowledge (Pitkethly 2001). In our data, the patent-dominant group changed its main IPR to patents after the mid-1990s because the knowledge in this sector is scientific, technologically intensive and explicit. On the other hand, if the product is made according to tacit knowledge, it is difficult for competitors to imitate, because tacit knowledge is exposed only through its productive activity (Grant 1996). However, a lack of clear legal protection may result in uncertainty regarding the ownership of knowledge in the market. Therefore, many firms try to find an appropriate method to protect their products made using tacit knowledge. In addition to protection, acknowledgment of the quality or function of the product to the customers is also important to the market strategy. Thus, tacit knowledge is usually represented via symbols, diagrams, or various techniques of expression (Stewart 1997; Nonaka 2008). Among such representations, we treat the trademark as a defense mechanism to protect tacit knowledge. The trademark is treated as a brand strategy, as the name can contain the value of the product (Economides 1987). A trademark encourages firms to make good products and to adhere to a consistent level of quality. Thus, a product made with the use of tacit knowledge can be protected and distinguished from competitors in the market and can establish market power through the registrations of a trademark.

Seen from this point of view, we raise our first question: Can tacit knowledge be better represented in trademark registrations while explicit knowledge is represented in patents or utility models? Firms in the trademark-dominant group have mostly registered trademarks, even in the developed period, whereas firms in the patent-dominant group changed to patents as their main IPR. Is it thus correct to conclude that technological development occurred only in the patent-dominant group? We do not think this is the case. Rather, it is reasonable to suppose that technological development would have occurred in every manufacturing sector, but there would be some differences in the features of development. In other words, firms' technological capability might be revealed as the registration of trademarks in the trademark-dominant group because of the different knowledge bases in this sector. In light of this notion of the sectoral differences in knowledge, we develop the first hypothesis as follows.

When firms invent a new technology or product, they usually apply for a patent or utility model to protect their findings. However, if the new technology is not easy to codify or not sufficiently unique to treat as a completely new technology, it is difficult for firms to obtain a patent to protect it. In that case, firms look for other ways to guard their invention, and in some cases trademarks can be used as an alternative way to protect their properties. It should also be noted that at the beginning of Korea's industrial development, trademarks were the main IPR in almost all sectors. As we can see in figure 2-27 and figure 2-28, manufacturing firms registered trademarks more than other IPRs until 1980s. In Korea, the main industry shifted from light industry to heavy industry in the 1970s by the economic plan of government, but the technology remained immature. Nearly all industry had just left the entry stage or was still in that stage. Many firms depended on OEM contracts or FDI firms to learn basic technology. In the meantime, firms registered trademarks more and more; in fact, until 1985, the ratio of trademark registration to total IPR registration by firms was more than 50%. In light of this history, we might suppose that trademark registration is less relevant to the level of technology than that of patent. In fact, a trademark is just a name or symbol to represent a product, requiring no technological explanation in the application document. For this reason, SMEs and start-up firms can register trademarks even if their technological ability is not sufficient to apply for a patent.

Meanwhile, according to our data, the firms in the trademark-dominant group continue to register trademarks more than other IPRs in the developed period. When we divide the whole manufacturing sector by the ratio between trademark and patent registration, difference appear from the mid-1990s, as mentioned earlier. Thus, the sectors in the trademark-dominant group may not be as sensitive to technological development as those in the patent-dominant group are. We can therefore suppose that the registrations of trademarks and patents are related to different sectoral knowledge bases and technological abilities:

Hypothesis 1

The differing levels of registration of trademarks and patents among sectors are affected by sectoral differences in knowledge base and level of technological ability.

To verify this hypothesis, we first adopt the definition of explicitness from Jung and Lee (2010). They calculate explicitness using patent registration data and the amount of R&D investment of each year. Including explicitness, they establish their model with other variables to identify the determinants of total factor productivity (TFP) catch-up by Korean firms compared to that of Japanese firms from the view of the sectoral systems of innovation. This measure of knowledge explicitness is built on the idea that more patent applications per unit of R&D expenditure correspond to higher explicitness across sectors and that tacitness is in contrast to the concept of explicitness[18] (Jung and Lee 2010).

Explicitness = number of patents registered in each sector in each year/R&D expenditure in each sector in each year.

In fact, explicitness refers to the rate of the number of patents to R&D expenditure in a sector. It does not have any relation with trademark. Thus, it may be unacceptable to connect tacitness with trademarks at a glance. However, this may be possible if we acknowledge that a trademark symbolically represents an idea and the knowledge base of trademark dominant group. If it is possible to express tacitness with legal protection, the way to do so would be through trademarks. Since tacitness is the opposing concept to explicit knowledge, we set the regression model including explicitness and interpret the result in reverse.

Secondly, we collect sectoral export share data for each year to confirm the effect of technological level on different IPR registration in each sector. At the beginning of development, most firms in the manufacturing sector in Korea adopted a policy to increase exports in consumer goods industry which manufactured with low cost of labor-intensive. However, in the developed stage, the merit of low cost is no longer significant, and exports of technology-intensive goods have become more profitable. In order to deal with the

[18] This definition of explicitness is based on Gonzalez and Mariano's (2007) findings. They explain that firms that mainly use explicit knowledge choose the patenting system as a protection method, while those that rely more on tacit knowledge are inclined to remain private rather than use patents.

competition and survive in the international markets even after achieving development, the quality of products is increasingly important. To confirm the relative technological growth of sectors according to period, we use sectoral export share, which calculates each sector's share of Korea's total manufacturing exports. If a sector become more competitive in the global market, the export share of the sector is expected to increase. With this variable, we will verify the relation between the technological level and different registration patterns of each group.

IV. Data and Methodology

1. Data and Descriptive Statistics

To analyze sectoral differences in the Korean manufacturing sector, we use sector-level data covering 1971-2010. Patent and trademark data are downloaded from the KIPRIS (Korea Intellectual Property Rights Information System). To build the financial data on Korean external auditing or listed companies, we use the financial database of the Center for Economic Catch-Up (CEC) until 1979 and the Korea Information Service (KIS) from 1980 through 2010. Because both the IPR data and the financial data are downloadable as firm value, we modify the sector-level variable to the total sum of individual firm-level data in each sector. To include data of extinct firms, we use the 8th

Korean Standard Industrial Classification. Moreover, we exclude the tobacco sector (D16) and the recycling sector (D37), because these two sectors do not fit our analysis. After matching IPR data and financial data by corporation code, we build sector-level panel data with 138 sectors classified by the KSIC 4-digit industry code. The sectors are divided into the trademark-dominant group and patent-dominant group, which are described in tables 3-3 and 3-4. The period covered is divided into three sub-periods – 1971-1986, 1987-1997, and 1998-2010 – chosen by reference to important episodes in recent Korean economic history. Since the mid-1980s, Korea has emphasized in-house R&D in the private sector, and considerable public-private joint R&D has been set up to conduct R&D projects (Lee 2013). Also, in 1987, the patent law was revised extensively, including substance patents. Following Kim et al. (2012), we identify 1986 as the first division of the three periods. The second division is the year of the financial crisis. The effect of the crisis was huge, so it is an inevitable selection for dividing the latter period. In table 3-5, other variables are described.

[Table 3-5] Description of variables

Variable	Description
Group dummy	1 if the sector is in Trademark dominant group
Group gummy2	1 if the restarted numbers of trademark are larger than the registered number of patent in each sector in each year
Explicitness	number of patents registered in each sector in each year/R&D expenditure in each sector in each year
Export_share_ratio	total export of in each sector in each year /total export of whole sector in each year

Export_GDP_ratio[19]	total export of in each sector in each year/ GDP in each sector in each year
Ind_Ad_Inten_ratio	total advertising cost of firms in each sector in each year/total sales in each sector in each year
Ind_Topsales_ratio	top 5 firms' sales in each sector in each year/total sales in each sector in each year
Ind_Sales_ratio	total sales of firms in each sector in each year/total sales of all firms in each year
Ind_R&D_Inten_ratio	total R&D of firms in each sector each year/total sales of firms in each sector in each year

As mentioned before, export share ratio is the proxy for the technological development level of the sector. As international trade becomes increasingly competitive, the quality and price of trade goods are crucial to control the international market, and technological capability is an important factor to determine the quality of goods. Of the top 10 export items from 2009 to 2012, most are technology-based goods. If the export share ratio of the sector increases, we can suppose that the technological level of the sector also increases.

[Table 3-6] Top 10 export items (unit: million dollar)

	2009		**2010**		**2011**		**2012**	
	Item	**Amount**	**Item**	**Amount**	**Item**	**Amount**	**Item**	**Amount**
1	Ship	37,223	semiconductor	51,464	Ship	56,588	petroleum goods	56,098
2	wired or wireless telephones	29,531	Ship	47,112	petroleum goods	51,600	semiconductor	50,430
3	Electronic integrated circuits	24,384	wired or wireless telephones	37,567	semiconductor	50,146	Automobile	47,201
4	liquid crystal devices	23,390	petroleum goods	31,862	Automobile	45,312	parts and fittings of marine vessels	39,753

19 We build this variable with UN comtrade database(http://comtrade.un.org/data/) and Korea Trade Statistics Promotion Institute database (http://www.trass.or.kr/service/statistic/StatisticsViewServlet?mainServiceURL=P02M02D021).

5	Automobile	22,399	Automobile	31,782	Flat Panel Display and sensor	28,733	Flat Panel Display and sensor	31,291
6	petroleum goods	22,145	liquid crystal devices	29,577	wireless communications apparatus	27,325	parts for vehicles	24,610
7	parts for vehicles	10,926	parts for vehicles	18,963	parts for vehicles	23,088	wireless communications apparatus	22,751
8	parts for broadcasting receiver	5,704	Plastic goods	16,462	Steel Plates	20,972	Steel Plates	19,729
9	special ship	5,208	organic-inorganic compound	14,448	synthetic resins	19,555	synthetic resins	19,558
10	parts for office	5,075	home appliances	13,618	Computer	9,156	electronic apparatus and instruments	8,583
The amount of export of top-10 item	-	185,985	-	292,855	-	332,475	-	320,004
Share of total export (%)	-	51.2	-	62.8	-	59.9	-	58.4

Source: Korea Customs Service

Table 3-7 presents the descriptive statistics between the trademark-dominant group and the patent-dominant group from 1971 to 2010. The table shows that the mean values of explicitness, investment ratio, top sales ratio, sales ratio, and R&D intensity ratio of the patent-dominant group are higher than those of the trademark-dominant group. Only the advertising-intensity ratio of the trademark-dominant group is higher than in the patent-dominant group. T-test results of the two groups are also described in the table. To examine period-related differences, we compare the group statistics by the three periods.

The results are shown in tables 3-8, 3-9, and 3-10. In period 1, average IPR registrations in each sector were below 40 cases. Among IPRs, the trademark was the most registered IPR in the total data, but after classification the utility model was the most registered in the patent group and the trademark in the trademark group. In period 2, registrations of both patents and utility models were more frequent than in the previous period, especially in the patent group; specifically, in the patent group, registration of patents were nearly 28 times and registration of utility models were 43 times much larger than those of trademark group. In period 3, registrations of utility models diminished, but the scale of other IPR registrations became bigger in each group. The different features in variables between two groups are consistent regardless of period. The correlations between variables are presented in table 3-11.

[Table 3-7] Descriptive statistics: Trademark dominant group vs. Patent dominant group (entire period, sector level)

	Total		Patent group		Trademark group		T-test	
Variable	Mean	SD	Mean	SD	Mean	SD	t	p-value
Number of Patent	171.012	1438.088	400.563	2258.972	19.469	88.937	8.872	0.000***
Number of Utility model	62.897	650.288	147.399	1025.330	7.111	20.107	7.202	0.000***
Number of Trademark	66.199	193.084	31.687	87.908	88.983	235.576	-9.957	0.000***
Explicitness	0.000	0.007	0.000	0.010	0.000	0.000	1.568	0.110
Export_share_ ratio	4.173	4.511	6.242	5.747	2.809	2.704	27.208	0.000***
Export_GDP ratio	0.000	0.001	0.001	0.001	0.000	0.000	20.626	0.000***
Advertising_ sales_ratio	0.011	0.022	0.003	0.004	0.017	0.027	-20.699	0.000***
Top_sales_ ratio	0.216	0.161	0.254	0.161	0.191	0.156	13.116	0.000***
R&D intensity	0.007	0.085	0.012	0.131	0.004	0.024	2.928	0.003***
Number of sector	138		84		54			

[Table 3-8] Descriptive statistics: Trademark dominant group vs. Patent dominant group (period 1, sector level)

	Total		Patent group		Trademark group		T-test	
Variable	Mean	SD	Mean	SD	Mean	SD	t	p-value
Number of Patent	2.789	30.683	5.368	48.063	1.061	4.353	2.599	0.009***
Number of Utility model	15.747	266.130	36.372	419.527	1.933	5.013	2.395	0.000***
Number of Trademark	22.360	69.680	9.658	31.181	30.868	85.322	-5.686	0.0168**
Explicitness	0.000	0.004	0.000	0.006	0.000	0.000	1.234	0.220
Export_share_ ratio	4.362	5.217	6.083	6.965	3.213	3.121	10.541	0.000***
Export_GDP ratio	0.000	0.000	0.000	0.001	0.000	0.000	12.022	0.000***
Advertising_ sales_ratio	0.008	0.017	0.003	0.004	0.012	0.021	-9.522	0.000***
Top_sales_ ratio	0.305	0.207	0.345	0.179	0.276	0.219	5.988	0.000***
R&D intensity	0.009	0.161	0.017	0.251	0.003	0.009	1.494	0.135
Number of Sector	125		75		50			

[Table 3-9] Descriptive statistics: Trademark dominant group vs. Patent dominant group (period 2, sector level)

	Total		patent group		Trademark group		T-test	
Variable	Mean	SD	Mean	SD	Mean	SD	t	p-value
Number of Patent	130.168	1179.866	309.404	1857.786	11.972	39.816	4.482	0.000***
Number of Utility model	143.434	1118.842	348.625	1755.887	8.124	20.543	5.43	0.000***
Number of Trademark	60.415	158.647	28.714	78.957	81.32	191.253	-5.929	0.000***
Explicitness	0.00002	0.00053	0.00004	0.00082	0.00001	0.00005	1.156	0.2481
Export_share_ ratio	4.072	4.135	6.124	5.337	2.719	2.236	15.879	0.000***
Export_GDP ratio	0.00041	0.00044	0.00061	0.00057	0.00028	0.00024	14.295	0.000***
Advertising_ sales_ratio	0.014	0.022	0.004	0.004	0.021	0.026	-14.723	0.000***
Top_sales_ ratio	0.195	0.128	0.224	0.149	0.175	0.107	6.872	0.000***
R&D intensity	0.006	0.017	0.009	0.012	0.004	0.019	5.233	0.000***
Number of Sector	137		83		54			

[Table 3-10] Descriptive statistics: Trademark dominant group vs. Patent dominant group (period 3, sector level)

	Total		patent group		Trademark group		T-test	
Variable	Mean	SD	Mean	SD	Mean	SD	t	p-value
Number of Patent	326.429	2013.323	767.171	3149.018	38.416	132.42	7.794	0.000***
Number of Utility model	42.802	330.599	92.556	521.236	10.288	25.409	5.313	0.000***
Number of Trademark	103.338	259.519	50.657	115.015	137.763	315.846	-7.211	0.000***
Explicitness	0.00024	0.00934	0.00059	0.0147	0.00001	0.00008	1.26	0.2078
Export_share_ ratio	4.102	4.171	6.445	4.937	2.57	2.63	22.099	0.000***
Export_GDP ratio	0.00054	0.00073	0.0008	0.00087	0.00037	0.00056	13.094	0.000***
Advertising_ sales_ratio	0.011	0.024	0.003	0.005	0.017	0.03	-12.314	0.000***
Top_sales_ ratio	0.17	0.115	0.209	0.124	0.145	0.101	12.385	0.000***
R&D intensity	0.008	0.026	0.011	0.014	0.006	0.032	4.426	0.000***
Number of Sector	137		83		54			

[Table 3-11] Correlation result

	Group dummy	Explicitness	Export share ratio	Ind_ Topsales ratio	Ind_Ad_sales ratio	Ind_R&D Inten_ratio
Group dummy	1					
Explicitness	-0.0347	1				
Export_share ratio	-0.2541	0.0304	1			
Ind_Topsales_ ratio	-0.123	-0.0099	0.2373	1		
Ind_Ad_sales_ ratio	0.2456	-0.0122	-0.2027	-0.2484	1	
Ind_R&D_Inten ratio	-0.2173	0.0084	0.1348	0.1347	-0.0319	1

2. Methodology

In this analysis, our purpose is to identify the different knowledge base of each group and to examine whether explicitness or tacitness of knowledge would be a factor of classification among them.. For this analysis, we estimate a probit model appropriate for a qualitative binary dependent variable. The probit regression is usually applied to predict probability values of a two-sided test in parentheses. In our analysis, the value of the group dummy is fixed as 1 if the sector is in the trademark-dominant group and 0 if the sector is in the patent-dominant group, regardless of the year. Thus, we estimate the result as a pooled probit regression model.

(1) $Group\ dummy = \beta_0 + \beta_1 Explicit_{t-1} + \beta_2 (Export\_share\_ratio_{t-1}) + \beta_3 (Ad\_inten\_ratio_{t-1.}) + \beta_4 (Topsales\_ratio_{t-1.}) + \beta_5 (R\&D\_inten\_ratio_{t-1.}) + \varepsilon$

However, it is insufficient to regress with a pooled probit to verify the hypothesis; thus, we create another dummy variable, Group dummy 2. Because, in the pooled probit model, the group dummy is fixed according to the group to which the sector belongs, to find out the panel effect in the sector group dummy2 is set as 1 if the number of trademark registrations is larger than the number of patent registrations in the sector in a given year, and 0 otherwise. Thus, the value of group dummy 2 is 0 or 1 according to the variation of the ratio of patent to trademark per year, even in the same sector. With group dummy 2, we run a panel random probit model regression to check sector-specific effects according to period.

Another regression is combined with firm-level and sector-level data. To find out the relation between trademarks and explicitness, we set the model as follows:

$$(2)\ Trademark_{i,t}=\beta_0 + \beta_1 Explicit_{I,t-1}+\beta_2(Export\ share\ ratio_{I,t-1})+\beta_3(Topsaleratio_{I,t-1.}) + \beta_4 Employees_{i,t-1} + \beta_5 Investment_{i,t-1} + \beta_6(R\&D\_inten\_ratio)_{i,t-1.} + \beta_7 Firm\ age + \varepsilon$$

In this model, explicitness, export share ratio and top sales ratio are sector-level variables, and employees, investment, R&D intensity and firm age are firm-level variables. The dependent variable is the number of registered trademarks of firms. Through this regression, we will confirm the relation of explicitness and trademark.

V. Regression Result

The results of the pooled probit regression are presented in table 3-12. The dependent variable is the group dummy, which is fixed according to group. To check the effect of explicitness on other variables, we also regress without explicitness. The results are almost same regardless of the variable. Because the group dummy represents trademark-dominant group, we suppose that explicitness is negatively related to the trademark group, since explicitness is the opposite concept of tacitness. The probit regression result show that explicitness has a negatively significant relation with trademark group, as we expected.

Another point to confirm is the relation between the trademark group and export share ratio which is related to sectoral differences in technological development level. According to the data, registrations of trademark in the trademark group are always greater in number than those of other IPRs; thus, we suppose that the sectors in the trademark group are less relevant to the level of technological ability than patent group. The results show that the export share rate has negatively significant relation with trademark group. As we regard export share rate as positively related to the level of technological ability, it is obvious that sectors in the trademark group are less relevant to technological level. To confirm the relation between level of technological capability and exports, we made another variable – ratio of exports to sectoral product (sectoral GDP). If this rate is high, then the sector is good at exporting, and it is supposed that the technological level of the sector is high enough to compete in the global market. With this variable, we run a pooled probit regression, and the results are almost same as with the export share ratio. Also, we try an alternative measure of explicitness[20] applied in Jung and Lee (2010). They reason that a sector's knowledge can be regarded as more tacit if the sector applies for fewer

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[20] *Explicitness 2 = (patent/employee)/(R&D/sales)*
= (number of patents registered in each sector in each year/number of employees in each sector in each year)/(R&D expenditure in each sector in each year/Total sales in each sector in each year)

patents per worker given the same degree of R&D intensity (R&D/sales ratio). From the result, explicitness 2 is negatively related to trademark group but is not significant. Among other explanatory variables, advertising intensity is positively related to trademark dominant group, whereas R&D intensity and the top sales ratio are negatively related to trademark dominant group. The regression results are presented in table 3-13.

[Table 3-12]Pooled probit regression 1

VARIABLES	Model (1) Pooled probit	Model (2) Pooled probit	Model (3) Pooled probit	Model (4) Pooled probit
Explicitness(t-1)	-0.603*	-0.637**		
	(-1.826)	(-1.998)		
Export_share ratio(t-1)	-0.112***	-0.132***	-0.112***	-0.132***
	(-18.259)	(-22.525)	(-18.240)	(-22.510)
Ind_Topsales_ratio(t-1)	-0.781***		-0.776***	
	(-4.917)		(-4.888)	
Ind_Ad_sales_ratio(t-1)	65.240***		65.342***	
	(17.098)		(17.135)	
Ind_R&D_Inten_ratio(t-1)	-3.456***		-3.416***	
	(-4.228)		(-4.179)	
Period_2	-0.294***	-0.016	-0.294***	-0.017
	(-4.690)	(-0.310)	(-4.700)	(-0.326)
Period_3	-0.141**	0.013	-0.144**	0.009
	(-2.396)	(0.269)	(-2.458)	(0.192)
Constant	0.635***	0.802***	0.628***	0.797***
	(9.067)	(18.404)	(8.981)	(18.330)
Observations	4,199	4,399	4,199	4,399

Note *** p<0.01, ** p<0.05, * p<0.1, z-statistics in parentheses
Period dummy: 1971-1996, 1987-1997, 1998-2010.

[Table 3-13]Pooled probit regression 2

VARIABLES	Model (1) Pooled probit	Model (2) Pooled probit	Model (3) Pooled probit	Model (4) Pooled probit	Model (5) Pooled probit	Model (6) Pooled probit
Explicitness (t-1)	-0.519*	-0.535*				
	(-1.734)	(-1.879)				
Explicitness 2 (t-1)			-0.001	-0.001		
			(-0.830)	(-1.292)		
Export gdp ratio(t-1)	-0.899***	-0.886***	-0.897***	-0.874***	-0.944***	-0.911***
	(-16.109)	(-18.538)	(-16.026)	(-18.262)	(-17.602)	(-20.014)
Ind_Topsales_ ratio(t-1)	-0.388**		-0.276		-0.419***	
	(-2.022)		(-1.417)		(-2.585)	
Ind_Ad_sales_ ratio(t-1)	83.864***		85.751***		79.048***	
	(19.486)		(19.381)		(19.693)	
Ind_R&D_Inten ratio(t-1)	-9.383***		-9.800***		-10.015***	
	(-6.004)		(-6.059)		(-6.459)	
Period_2	-0.025	0.141**	-0.039	0.093	-0.148**	0.132**
	(-0.336)	(2.195)	(-0.516)	(1.391)	(-2.305)	(2.504)
Period_3	0.236***	0.280***	0.224***	0.228***	0.111*	0.246***
	(3.268)	(4.572)	(3.007)	(3.588)	(1.788)	(4.937)
Constant	0.092	0.435***	0.071	0.476***	0.288***	0.485***
	(1.120)	(8.187)	(0.848)	(8.520)	(4.247)	(12.237)
Observations	3,539	3,540			4,119	4,332

Note *** p<0.01, ** p<0.05, * p<0.1, z-statistics in parentheses
Period dummy: 1971-1996, 1987-1997, 1998-2010.

Table 3-14 shows the result of panel random probit regression. In this regression, the dependent variable is group dummy 2, which represents trademark dominancy in registration in each year of the sector. The result is not different from the pooled probit regression with the fixed group dummy dependent variable. The regression result with export to sectoral GDP ratio is shown in table 3-15. In the random probit result with export to sectoral GDP ratio, explicitness is insignificant, but the direction is also negative.

[Table 3-14] Panel random probit regression 1

VARIABLES	Model (1) Random probit	Model (2) Random probit	Model (3) Random probit	Model (4) Random probit
Explicitness(t-1)	-0.308**	-0.301*		
	(-2.008)	(-1.957)		
Export_share ratio(t-1)	-0.072***	-0.079***	-0.074***	-0.083***
	(-5.599)	(-6.086)	(-6.609)	(-7.747)
Ind_Topsales_ratio(t-1)	0.622		0.711*	
	-1.383		-1.799	
Ind_Ad_inten_ratio(t-1)	27.539***		25.818***	
	-4.902		-4.908	
Ind_R&D_Inten_ratio(t-1)	-9.880***		-8.589***	
	(-4.519)		(-4.662)	
Period_2	-0.995***	-0.986***	-0.966***	-0.988***
	(-9.041)	(-9.827)	(-9.568)	(-11.515)
Period_3	-1.753***	-1.800***	-1.715***	-1.787***
	(-15.353)	(-17.822)	(-16.639)	(-21.225)
Constant	2.296***	2.672***	2.286***	2.690***
	(11.643)	(17.31)	(12.532)	(19.472)
lnsig2u	0.287	0.490***	0.216	0.365**
	(1.56)	(2.894)	(1.223)	(2.252)
Observations	3,600	3,633	4,118	4,398
Number of industry	138	138	138	138

Note *** p<0.01, ** p<0.05, * p<0.1, z-statistics in parentheses
Period dummy: 1971-1996, 1987-1997, 1998-2010.

[Table 3-15] Panel random probit regression 2

VARIABLES	Model (1) Random probit	Model (2) Random probit	Model (3) Random probit	Model (4) Random probit
Explicitness(t-1)	-0.022	-0.021		
	(-1.233)	(-1.189)		
Export_ gdp ratio(t-1)	-0.197***	-0.186***	-0.159**	-0.171***
	(-2.911)	(-2.701)	(-2.554)	(-2.793)
Ind_Topsales_ratio(t-1)	-0.689**		-0.728***	
	(-2.011)		(-2.837)	
Ind_Ad_inten_ratio(t-1)	28.063***		19.191***	
	(6.705)		(6.485)	
Ind_R&D_Inten_ratio(t-1)	-10.882***		-9.586***	
	(-4.918)		(-4.507)	
Period_2	-0.197**	-0.067	0.046	0.221***
	(-2.378)	(-0.872)	(0.651)	(3.652)
Period_3	-0.592***	-0.511***	-0.280***	-0.109*
	(-6.993)	(-6.831)	(-3.916)	(-1.898)
Constant	0.783***	0.793***	0.513***	0.332***
	(5.282)	(6.463)	(4.130)	(3.433)
lnsig2u	-0.211	0.319**	-0.230	-0.032
	(-1.254)	(2.034)	(-1.445)	(-0.220)
Observations	3,539	3,540	4,119	4,332
Number of industry	138	138	138	138

Note *** p<0.01, ** p<0.05, * p<0.1, z-statistics in parentheses
Period dummy: 1971-1996, 1987-1997, 1998-2010.

Table 3-16 shows the result of the regression with combined sector level and firm level. In OLS and the fixed effect regression result, explicitness is negatively related to the number of registered trademarks, though this relation is significant only in the OLS result. Both export share ratio and export to sectoral GDP ratio are negatively significantly related to registration of trademark, and the result is the same with the probit regression.

[Table 3-16] Regression result with OLS and Fixed effect

VARIABLES	Level	Model (1) OLS	Model (2) Fixed effect	Model (3) OLS	Model (4) Fixed effect
Explicitness(t-1)	Sector	-2.160*	-0.305	-2.200*	-0.364
		(-1.739)	(-0.342)	(-1.768)	(-0.409)
Export share ratio(t-1)	Sector	-0.012***	-0.011***		
		(-20.078)	(-8.406)		
Export_ gdp ratio(t-1)	Sector			-75.068***	-23.393***
				(-13.536)	(-3.529)
Topsales ratio(t-1)	Sector	-1.001***	-0.071	-1.217***	-0.146**
		(-33.564)	(-1.244)	(-46.673)	(-2.555)
Employees(t-1)	Firm	0.320***	0.144***	0.316***	0.140***
		(102.171)	(29.002)	(100.918)	(28.310)
Investment(t-1)	Firm	0.004***	0.002***	0.004***	0.002***
		(9.612)	(6.094)	(9.562)	(5.999)
R&D_Intensity(t-1)	Firm	0.009***	0.001***	0.009***	0.001***
		(20.188)	(3.128)	(19.203)	(2.970)
Firm age	Firm	0.029***	-0.131***	0.036***	-0.131***
		(5.794)	(-11.859)	(7.199)	(-11.871)
Constant		-1.000***	-1.184***	-0.982***	-1.213***
		(-7.842)	(-12.724)	(-7.690)	(-13.036)
Observations		73,337	73,337	73,337	73,337
R-squared		0.218	0.081	0.216	0.080
Hausman test			1805.79		891.38
Number of firms			6,613		6,613

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

From these regression results, we can interpret that, since explicitness is negatively related to the trademark-dominant group, the sectors in the trademark group are positively related with tacitness. Moreover, the trademark-dominant group (or firms' registration of trademarks) is negatively related to export share ratio and export to sectoral GDP ratio;

we can interpret this to mean that trademark registrations of sectors in the trademark-dominant group are less relevant to technological capability level than patent group. Thus, H1 is accepted.

VI. Chapter conclusion

In this chapter, we investigate sectoral difference in registration of IPR, focusing on trademarks and patents, and analyze the feature of the trademark-dominant sector compared to the patent-dominant sector. From the perspective of features of technological knowledge, we classify all manufacturing sectors into the trademark-dominant group and patent-dominant groups and analyze the sectoral differences using sector-level data from 1971 through 2010. The difference between the trademark-dominant group and paten-dominant group appears in the mid-1990s, when, in the patent group, patent registrations overtook trademark registrations. We focus on the trademark-dominant group because even in the advanced period, the firms in this group registered trademarks more than other IPRs. Assuming that the trademark conveys the idea of goods, we set our hypothesis to examine the relatedness of trademarks and tacit knowledge. Tacit knowledge is difficult to express in words but is embedded in the product, in contrast to explicit knowledge, which is easily codified and registered as a patent. To verify the first hypothesis empirically, we adopt Jung and Lee's (2010) definition of explicitness, which is measured as the patent/R&D ratio. Because the regression results indicate that the trademark group and explicitness are negatively related, we infer that the trademark-dominant group is positively related to tacitness. In addition, to identify the characteristics of the sector in the trademark-dominant group regarding technological level, we examine the relation of the trademark group with export share ratio and find that they have a negatively significant relation. Because the sectoral export share ratio represents the level of technological capability, which is sufficient to compete in the global market, we conclude that the characteristics of the sector in the trademark-dominant group are less relevant to technological development level. In the next chapter, we will investigate firm-level differences between the groups.

Chapter 4. Impact of Trademark and Patent Registration on Firm Performance at Different Stages of Development

I. Introduction

Korea is the model of a successful developing country beginning its development with poor resources, and its main growth power is its technological ability. The remarkable achievements of Korean firms are the result of assimilating and adapting technology of other advanced countries while developing their own abilities. Lee (2013: 25) described the capability-based view of the Korean and Asian experience in the catching-up development process. This approach can be considered 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). Because development is considered a process of learning and capability, the success of growth is usually determined by technological achievement.

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 product is then sold using the buyer's own distribution channels and brand name (Hobday 2003).

Before the early 1970s, many firms in Korea were taken technical guidance from foreign OEM buyers. The skill related to OEM was not complex, and the buyer did not intend to pass on high technology to the subcontractors. However, this simple repeated assembly enabled firms to build know-how and capability. Because many firms made a certain amount of profit from OEM, they did not 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 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 will achieve higher profits and growth than would be possible in the OEM system.

Meanwhile, as shown in chapter 2, trademark registration is found in almost all sectors at the starting point of development, 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 in the trademark-dominant group have continued to register trademarks more than any other IPRs even in the developed stage. Having found in chapter 3 that sectors in the trademark-dominant group are less relevant to the level of technological capability than patent-dominant group, we suppose that the trademark has 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 in 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. If the firms apply for patents or utility models in order to keep their technological abilities, trademark applications protect 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 returns, allowing firms to invest R&D to invent new technology more actively.

Second, firms with their own brands are seen even in the underdevelopment stage; thus, we examine the mechanism by which trademark may help to build up the firms' capabilities 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 reproduction products but 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 Korea's 1960s and 1970s strategy was largely associated with duplicative imitations, producing on a 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.

Because we classify the sectors into the trademark-dominant group and patent-dominant group, the role of trademarks on firms' performance in each group may differ. We will compare the impact of trademarks and patents on firms 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 considered to be among 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 products are made according to precise specifications, and vendors provide specific guidance and teaching (Romijn 1999; Amsden 1989). This learning process leads to standard levels of skill and productivity (Hobday 1994; Kim and Lee 2002).

In OEM systems, subcontractor firms do not take risks, and they remain dependent on large client firms. Although this mode may guarantee a certain level of growth, it involves considerable uncertainty about further growth, because new latecomer firms that offer lower wages and costs continue to emerge from the latecomer countries (Lee and Mathews

2012). To achieve more development, many subcontractor firms that accumulate technological capabilities try to transition to OBM. OBM firms work comprehensively on their own brands by designing and manufacturing new products, conducting R&D on their products and production process, and conducting sales and distribution.

Under OBM, a latecomer firm carries out all the steps of production and innovation, including manufacturing, new product design and R&D for materials, 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 the products that they produce. Moreover, producers can collect technology royalties and reduce production costs. However, marketing and channel management still depend on multinational vendor firms. OBM is the last step, as these manufacturers are now able to independently 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 from developed countries with name-value products. However, if the latecomer firm does not develop the ability to produce and sell its own brands for fear of failure, it becomes 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.

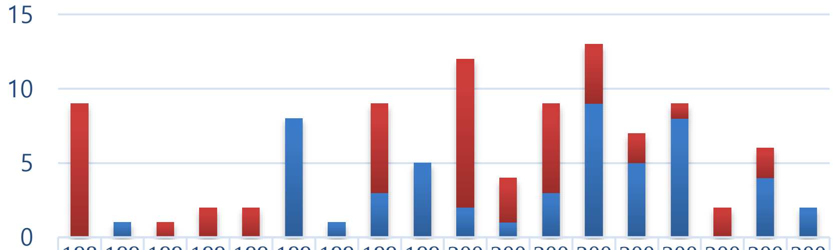
Case 1. Aurora World[21]

Aurora World is a toy company established in 1981. The firm achieved OBM status after going through the OEM and ODM stages, and it has now caught up with the leading brands in the global market. The firm converted to OBM in 1991 to overcome difficulties in the toy industry and enhance its profitability. However, beginning this process 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. During its early stage of OBM, Aurora World concealed itself and registered a new name in the United States so that the previous vendors could not notice its independent marketing. In addition, by hiring marketing experts from the host country and establishing design research centers 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-dominant sector, the firm has registered trademarks and designs to protect

[21] This case is brought from Lee et al.(2015).

its goods in the market.

[Figure 4-1] 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

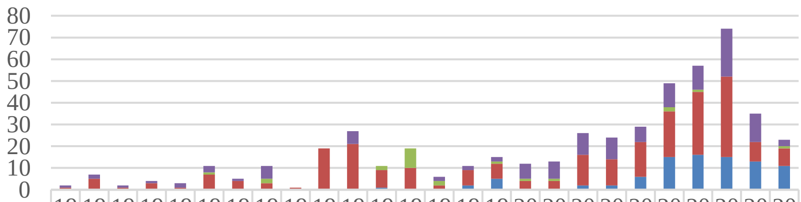
Case 2. Cuckoo Electronics[22]

Cuckoo Electronics is a producer of rice cookers which began as an OEM firm in 1978 and later successfully entered the OBM stage. Cuckoo offered its consumers new products that effectively combined gas pressure technology with old electric rice cooker technology to deliver rice cookers that have the convenience of an electric cooker and the quality of a gas cooker. When they prepared to enter the OBM stage, Cuckoo never publicly disclosed their plan of developing new products. 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

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

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 patent-dominant 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 4-2] 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 develop their own brand with their own capabilities, begin research to develop their products, and find their market by themselves. Fortunately, they have accumulated abilities through OEM, making it possible for them to produce their own products as they intend. Also, from the OBM stage, they apply a trademark to secure their product in the market competition. Trademarked products signal to customers that the product has a certain level of quality and is produced by a reliable manufacturer. In Korea, the registration of trademarks has increased steadily since the early stage of economic development. In this respect, we treat the transition to OBM as the registration of trademarks in the developed stage.

Researchers in diverse countries have paid attention to the role of trademarks in firm performance (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 listed in table 4-1.

[Table 4-1] 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 local technological capability caused Korean firms to depend heavily on reverse engineering and imported equipment and machinery (Lee et al. 2003). Most Korean manufacturing firms contracted OEM with advanced firms in other countries and accumulated their abilities through OEM starting in the 1960s.[23] However, the profits from OEM have decreased since the 1990s because of the competition among OEM firms from underdeveloped countries. Since then, some firms have tried to convert to OBM, and trademark registration has followed 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 are 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,

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

even the most advanced producers such as Samsung and Hyundai Mobis still produce large quantities of products under basic OEM arrangements. Some companies emphasize OEM even though they have the ability to make their own products. 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.

In the trademark-dominant group, the number of trademark registrations is always larger than that of other IPRs, but in the patent-dominant group, patent application surpasses trademark registration only after the mid-1990s. The reason for the difference in sector level is verified in previous chapter. In this chapter, we investigate the different impacts of trademark on firm performance according to group and period.

[Table 4-2] Average number of trademark registrations of firms in each group

Period	Trademark-dominant group	Patent-dominant group
Period1	6.97	2.39
Period2	6.84	1.72
Period3	7.13	1.03

As shown in table 4-2, firms in the trademark-dominant group register trademarks more than firms in the patent-dominant 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-dominant group, because in the patent-dominant group the average number of registered trademarks declines according to period. Even so, we suppose that converting to OBM occurs in both the trademark-dominant group and patent-dominant group as technological development increases. OBM in the patent-dominant group would be particularly likely to be related to the level of technological capability, so a firm will likely have its own brand after a certain cumulate level of technology is reached to produce technological products. On the other hand, in the trademark-dominant 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 2

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

Hypothesis 3

In the patent-dominant 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 it may encounter. Without the guidance of OBM vendors, the firm struggles to succeed in OBM. In order to transition successfully, the cumulative ability or absorptive capability of the firm to conduct independent marketing is required. The transition from subcontracting to independent marketing is a major challenge for firms seeking to enter the OBM stage, catch up with incumbent firms, and enter the global market (Lee et al. 2015).

In the patent-dominant group, firms usually apply for a patent because it is the most influential and protectable IPR, since the knowledge base of the sector is mostly codified and scientific. However, with only a patent, firms cannot make a profit. Firms must produce goods and sell their products on the market if they want to develop. Among IPRs, the trademark is market-friendly and is one of the elements that compose a brand. In management, marketers identify and distinguish their products through the use of trademarks. Brands and trademarks are firms' most valuable assets (Schewe and Smith 1979). Especially when a product is standardized, trademarks or labels can be the deciding factor in promoting business. Thus, the value of a brand is increasingly important even in the technologically advanced period.

Meanwhile, in the trademark-dominant group, firms generally 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 has to develop its goods more conveniently and keep up with consumer trends, because brand management is more than merely the choice of a name or symbol for a product. Contrary to the firms in the patent-dominant group, firms in the trademark-dominant group emphasize technological relations to seize attention. For example, we can easily find food or cosmetic companies that advertise their application for patents or utility models.

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

Hypothesis 4

In the technologically developed period, the registration of trademarks will positively affect firm performance in the patent-dominant group, and the registration of patents will positively affect firm performance in the trademark-dominant 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 covering 1971 through 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[24] 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 years of data. 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[25] in 2009 but revised according to period. The analysis of trademark data is somewhat different from the patent or utility model. We use registered IPR data in this analysis, but in patents, the assignee invents or develops the product before he or she applies with the description. Thus, it is common for granted patents to be counted from the application date. However, trademarks are valid only after approval from the office, so they are counted from the granted date.

24 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.

25 Firms with fewer than 300 employees are classified as SMEs.

When running a regression analysis, we use IPR intensity. Greenhalgh and Rogers (2007) use trademark intensity rather than simply the number of trademarks to control for the fact that large firms often have more trademarks than smaller firms. To examine the effect of IPRs registration itself focusing on trademarks, we run a regression with an IPR dummy that indicates whether or not the firm applies for the IPR in a given year. Greenhalgh and Rogers (2007) explain that the dummy for trademark indicates a change in the firm's activities from one year to another, and it could describe the managerial ability of firms. As the decision of whether or not the firm has its own brand is crucial for surviving in the market, we will examine the "registration effect" of trademark and other IPRs.

[Table 4-3] 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
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)			

[Table 4-4] 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

[Table 4-5] 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 $\text{rate}_{\text{i,t}}$

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

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

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

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 the decision of IPR registration, focusing on firm performance. The decision of trademark registration indicates that the firm has 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 4-6, 4-7, and 4-8.

[Table 4-6] 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

[Table 4-7] Registration effect of each IPR on firm performance: Trademark dominant 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

[Table 4-8] Registration effect of each IPR on firm performance: Patent dominant 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. We supposed that whether or not the firm registered an IPR (especially a trademark) in the current year is a signal of building the firm's brand, but the fact that the firm registered a trademark alone is not significantly 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, we analyze the whole sector to confirm the periodical different influence of IPR registration on firm growth. The results are shown in table 4-9; 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.

[Table 4-9] 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[26]

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

We investigate the influence of IPRs on firm performance in the trademark-dominant group. According to the regression result, from 1971 to 1997 trademark registrations affected the trademark-dominant group's firm performance, but in later, more technologically mature periods, patents and utility models (and not trademarks) affect firm performance in the trademark-dominant group. It would be very remarkable result that in period 1 and period 2 the growth of firms in trademark group can be described with registration of trademark. As we know, a trademark is the name of a good and is not particularly related to technological ability. However, firms can register the names of applied manufacturing goods by a process of imitation. Latecomer firms are good at imitating developed goods. 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 also accumulate their capability by imitating or reverse engineering 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-dominant group developed their capability by managing the domestic market until the 1990s. This may be considered another effect of owning a brand that differs from the original – that is, the development of non-technological outcomes like imitative innovation (Levitt 1966, Kim 1997). Second, 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 in the trademark-dominant 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.

[Table 4-10]Impact of trademark registration on firm performance in trademark dominant 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.

[Table 4-11] Impact of trademark registration on firm performance in patent dominant 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-dominant 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-dominant 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-dominant group become brand owners with their own products in the developed stage.

From this result, we see that the OBM effect, or a firm having its own brand (whether it is original or not), is positively significant in the trademark-dominant group in periods 1 and 2 and in the patent-patent dominant group in period 3. From the results, hypothesis

2 (in the trademark-dominant 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 2 is rejected. On the other hand, hypothesis 3 (in the patent-dominant 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 table 4-12, however, show that neither registration of patents nor registration of trademarks has an impact in the trademark-dominant group. In the patent-dominant group, as shown in table 4-13, 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 4, 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-dominant group. However that period is the starting point of OBM, as we confirmed in previous research on the development of Korean firms, so we conclude that registering both patents and trademarks is effective for firms when they decide to convert to OBM.

[Table 4-12] Interaction effect of trademark and patent in trademark dominant group

VARIABLES	Period 2(1987-1997) OLS	Fixed effect	Period 3(1998-2010) 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

[Table 4-13] Interaction effect of trademark and patent in patent dominant group

VARIABLES	Period2(1987-1997) OLS	Fixed effect	period3(1998-2010) 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. Chapter Conclusion

In this chapter, we investigate the performance of Korean manufacturing firms at different stages of development. Specifically, this study compares each period's performance of the trademark-dominant group and patent-dominant group. In firm-level analysis, we concentrate on how much trademarks influence firm performance according to group and period. In addition, we consider the increase in trademark registration in the advanced period as indicative of the transition to the OBM system. Before the OBM stage, firms do not need to register the name of their product. In the OBM system, on the other hand, firms produce goods with their own name for market sales. Once they have their own brand, firms must maintain the quality of their products. To do so, they pay attention to research and innovation to develop quality to sustain their profits. Based on the empirical results, trademark registration of firms in the trademark-dominant group positively affects firm performance even in the underdevelopment stage, but in the developed period patents and utility models (but not trademarks) affect a firm's performance in the trademark-dominant group. This result explains that it is possible for latecomer firms to develop without invention. By imitation, they can catch up with the incumbent firms. However, in the developed stage, even the firms in the trademark-dominant group should pay attention to technological capability to maintain their brand. In contrast, firm performance in the patent-dominant group has a relation with trademark registration only in period 3, whereas patents and utility models have effects on firm performance in period 1 and period 2, respectively. Regarding the interaction effect, only the patent-dominant group shows an interaction effect between patents and trademarks in period 2.

The first finding in this chapter is that trademarks affect firms in both the trademark-dominant group and the patent-dominant group, with some differences according to period. This means that firms are guaranteed more profits when they have their own brands. However, as we checked previously, the fact that the firm has registered a trademark has no relation to firm performance. The second finding is that, in the trademark-dominant group, the development path is different from that of technological development in the underdevelopment stage. This could be treated as imitative innovation with non-technological catch-up. The last finding is that the interaction effect between trademarks and patents appear in the developing stage (period 2) in the patent-dominant group. From the result, we conclude that utilizing both patents and trademarks is appropriate for firms when they decide to convert to OBM.

Chapter 5. Summary and Conclusions

This dissertation examines the effect of trademarks and patents on firms' performance from the point of view of sectoral difference from the knowledge base. We find that all sectors can be classified into two groups, the trademark-dominant group and the patent-dominant group. With this classification, we set hypotheses and claim that the effects of trademarks on each group differ as much as the effects of different developmental stages differ.

In chapter 2, we described the development of the Korean IPR system and why we focus on trademarks as the measurement of economic development. According to the capability-based view (Lee 2013), the main power behind economic growth is technological ability, and many researchers have studied patents and utility models as key variables for testing technological growth. This study, on the other hand, focuses on trademarks, using Korean long-term IPR registration data. Unlike patents and utility models, trademarks are not directly connected with technology. However, after the technology has matured and the products have been standardized, trademarks become more important for firms to differentiate their products from those of market competitors. Because the Korean IPR system was activated in 1946 and progressed for 70 years, it is possible to perform long-term analysis on IPRs at each development level. We describe all four IPRs – patent, utility model, trademark and design – from 1946 to 2010, focusing on diverse aspects.

In chapter 3, we explored the sectoral differences in IPR registration in the manufacturing sector, especially patent versus trademark. When we look into the IPR application patterns in each sector, we can classify the sectors into two main groups. One is a trademark-dominant group, in which the trademark is the most applied-for and registered IPR in the sector in the entire period, from 1971 to 2010. The other is a patent-dominant group, in which the trademark is initially the most common IPR but is replaced in the mid-1990s by the patent. We began this study with the question of why some firms in some sectors apply for trademarks more than other IPRs, while other firms in other sectors change their main IPR to the patent or utility model. To investigate what makes the difference between the two groups, we examine different features of different sectors' knowledge bases, including explicitness/tacitness. Tacitness is the opposing concept to explicit knowledge and technology. To identify the relation between trademark and tacitness, we measure explicitness as the number of patents registered in each sector in each year/R&D expenditure in each sector in each year (Jung & Lee, 2010). With sector-level data as well as sector-firm combined data, the empirical results reveal that the trademark-dominant sector has a negative relation with explicitness. The first finding from the result is that, unlike the analysis using only the patent, it is necessary to classify sectors according to the patterns of registration of IPRs when using both the patent and the trademark. The second finding is that tacitness might be expressed as the registration of a trademark. Because a trademark protects the commercial parts of production functions, a trademarked product can hold the knowledge behind the product in its name during its usage in the market. Another finding of the sector-level analysis with export ratio is that the sectors in the trademark-dominant group are less relevant to technology than patent-dominant group.

In Chapter 4, we focus on different effects of trademarks and patents on firm performance in each group and period. Concentrating on technology accumulation through OEM and firm conversion to OBM, this study compares each period's performance in the trademark-dominant group and patent-dominant group. From the empirical results, we find that trademark registrations of firms in the trademark-dominant group have a positive effect on performance even in the underdevelopment stage, but in the developed period, patents and utility models (but not trademarks) affect firm performance in the trademark-dominant group. Moreover, from the positive effect of trademarks on firm performance in period 1 and period 2, we can infer that through imitative innovation (non-technological development), latecomer firms in the underdeveloped stage make progress and catch up to the incumbent firms in the trademark-dominant group. Meanwhile, firm performance in the patent-dominant group is related to trademark registration only in period 3; instead, patents and utility models have effects on firm performance with some differences in period. We also find a dynamic effect of patents and trademarks in the patent-dominant group, where trademarks and patents show an interaction effect in the developing stage. This mean that it is more effective for firms to manage trademarks and patents together when they decide to enter into OBM.

The main findings of this thesis are as follows. The first finding is that trademarks affect the firms in both the trademark-dominant group and the patent-dominant group, with some differences according to period. The division of grouping might be explained by the explicitness of the patent group (or the tacitness of the trademark group) as well as relatedness to the level of technology. The second finding is that, in the trademark-dominant group, non-technological development is possible in the underdevelopment stage. This could suggest an additional catch-up route by trademark registration through imitative innovation in underdevelopment stage. The last finding is that trademark and patent registration play an effective role in successful transition to OBM.

The contributions of this dissertation are as follows. First, this study analyzes Korean long-term IPR data and shows the dynamic development of manufacturing firms with registration of trademarks. Second, this study suggests that tacit knowledge could be represented as trademarks. Third, this study attempts to classify all sectors into a trademark-dominant group and a patent-dominant group, providing a different approach for analysis with IPR data. Fourth, this study confirms the different influences of trademarks in each group and each stage compared with patents. Fifth, this study proposes that the development of firms can be measured by trademark registration in the underdevelopment stage of light industry. Finally, with this analysis of the development of Korean IPRs, it would be possible to provide a desirable IPR strategy for other developing countries.

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국문초록

상표권과 특허를 이용한 한국 기업의 장기 성과분석

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강래윤

본 논문은 한국 제조업을 대상으로 한 산업 및 기업의 성장에 속한 연구이다. 한국은 단시간에 급격히 경제성장을 이룩한 대표적인 국가로, 한국의 경제성장에는 기술의 습득을 통한 발전이 큰 역할을 해 왔다. 아무런 기술도 없던 시기에는 외국으로부터 기본 기술을 도입하여 이를 모방하고 상품을 생산했으나, 기술을 습득한 이후에는 실용신안으로 단순한 기술을 성장시켰고 이후 발명을 통한 특허가 증가하면서 특허를 통하여 기업의 성과에 유의한 영향을 끼쳤다(Kim et al. 2012). 그러나 산업의 특성상 특허로 기술을 등록하지 못하거나 특허로 설명하기 부적절한 기술을 가지고 있을 수 있다. 이런 성격의 지식을 암묵적 지식이라 하고, 본 논문에서는 이러한 암묵적 지식이 상표권으로 설명될 수 있다는 점을 확인하고자 하였다. 본 연구는 한국의 지식재산권(특허, 실용신안, 상표권) 데이터와 기업재무자료를 이용하여, 특허와 실용신안을 비교한 Kim et al.(2012)의 연구에 이어 특허와 상표권을 이용한 한국의

기업성과와 산업별 차이에 대한 연구를 진행하였다. 특히 본 연구는 한국 기업의 장기 재무자료와 지식재산권 데이터를 이용하였는데, 경제성장 시기별로 세 시기(1971-1986, 1987-1997, 1998-2010)로 구별하여 분석을 진행하였다.

우선 한국의 경제성장 시기에 따른 지재권 출원데이터를 살펴보면 크게 두 가지 패턴이 나타나는 것을 확인할 수 있다. 기술이 부족한 경제발전 초기단계에서는 지재권의 출원 자체가 많지 않기는 하나 가장 많은 등록이 보이는 지재권은 거의 모든 산업에서 상표권이었다. 그러나 기업의 기술 수준이 높아진 1990 년대에 들어서면 산업별로 지재권 등록에서 차이를 보이고 있다. 경제성장 초기와 마찬가지로 상표권의 등록이 가장 많이 이루어지는 그룹과, 90 년대를 기점으로 특허의 등록이 가장 많이 이루어지는 그룹으로 구분된 것이다. 각 산업 별로 특허와 상표권 등록데이터를 비교한 결과, 80 년대 후반부터 기업의 기술투자가 증가하고 기술이 성숙해짐에 따라 특허의 출원 및 등록이 늘어나는 산업이 생겨난 반면, 여전히 상표권이 가장 많이 등록되는 산업이 있는 것을 확인하였다. 즉, 산업의 특성에 따라 기술을 보호하는 방식에 차이가 있으며, 기술의 특성상 명시성이 높은 산업에서는 특허가 많이 출원되는데, 반면 상표권이 주로 출원되는 산업에서는 기술을 명시적으로 표현할 수 없는 경우가 있다는 점에 주목하였다. 첫번째 가설로는 산업간 특허와 상표의 등록의 차이를 통해 산업별 지식의 성격과 기술 능력과의 관련성이 산업을 구분할 수 있는 지표가 됨을 확인하고자 하였다. Jung and Lee(2010)에서 명시성을 수량적으로 계산한 방식을 적용하여, 명시성의 역개념이라고 할 수 있는 암묵성을 지닌 산업에서 상표권의 출원을 설명할 수 있는 여지를 발견하였다. 또한 상표권은 기술이 부족한 시기였던 경제성장 초기에도 다른

지적재산권에 비해 활발히 등록되었다. 경제 성장 초기에 상표권이 주로 등록되는 것은 그룹 별로 차이가 없었으나 두 그룹의 구분이 일어나는 1990년대 이후에도 상표권을 주로 출원하는 그룹은 어떠한 특성을 가지는가에 대해 확인하였다. 수출점유율을 기술측정의 변수로 보고 그룹의 차이를 분석한 결과 상표권을 주로 출원하는 그룹은 특허권을 주로 출원하는 그룹에 비해 기술발전에 덜 민감한 산업이라는 점을 확인하였다.

다음으로 기술축적과 OBM 으로의 변화를 검증하고자 하였다. 한국에서 경제개발을 시작할 무렵에는 자원과 기술 모두 부족한 상태였는데 각 기업들은 여러 방법을 통해 성장을 꾀하였다. 특히 수출주도형 성장정책으로 큰 성과를 거두었는데, 해외 기업과의 OEM 계약을 맺어 상품을 제작 공급하면서 기술을 축적하는 방식이 많이 도입되었다. 그러나 경제성장과 더불어 임금이 낮은 다른 저개발국가와 OEM 계약에서 경쟁하게 되는 OEM 함정에 맞닥뜨리는 상황을 맞게 되자, 1990 년대에 이르러 많은 기업들은 그 동안 축적된 기술을 이용해 자체 상품을 개발하고 이를 시장에 내놓기 시작하였다. OEM 단계에서는 주문자의 상표를 붙여 납품하면 되기 때문에 OEM 기업은 자기 상표를 가지지 않아도 되지만, 자기상품을 생산하는 OBM 단계에서는 상표권을 출원하는 것이 시장에서 상품을 보호하는 수단이 된다. 본 연구의 두번째 가설과 세번째 가설에서는 상표권을 주로 출원하는 그룹과 특허가 주로 출원되는 그룹에서 각각 특허와 상표권이 기업의 성과에 어떠한 영향을 주는지 확인하였다. 상표권을 주로 출원한 그룹에서는 경제성장(기술 습득) 이전단계에서는 상표권이 기업 성과에 유의하게 나타나고 있었으나 경제 발전 이후시기에는 특허와 실용신안이 기업 성과에 유의한 점을 확인하였다. 특허가 주로 등록되는

그룹에서는 실용신안과 특허로 기업성과를 설명할 수 있던 것이 경제성장 이후시기에는 상표권으로도 기업 성과를 설명할 수 있음이 확인되었다. 특히 경제발전 이전단계의 상표권 그룹에서 상표권으로도 기업의 성과를 설명할 수 있는 점을 모방적 혁신으로 보고, 기술로 설명할 수 없었던 기업의 성과를 상표권으로 설명하고 이를 또 다른 기업 추격의 모습으로 볼 수 있음을 제시하였다.

본 연구의 네 번째 가설은 상표권과 특허의 상호작용이 기업의 성과에 긍정적인 영향을 미치는가를 확인한 것이다. 특히 OBM 으로의 진출이 활발히 개시된 1980 년대 중반부터 외환위기 이전까지의 시기에서 기업의 성과를 높이는 방법으로 특허와 상표를 함께 이용하는 것이 유의함을 동학적 회귀분석을 통해 확인하였다. 이러한 유의성은 특허를 주로 등록하는 그룹에서 나타났다.

본 연구는 여러 점에서 기존 연구와의 차별성을 가진다. 첫번째로, 한국의 장기 지적재산권 등록데이터를 기업 분석에 맞도록 정리하여 기업의 장기 재무데이터를 연결시킨 기업패널데이터(40 년)를 구축하였고, 지식재산권의 등록에서 산업 간 차이를 보이는 것을 확인하기 위해 산업패널데이터도 함께 구축하여 분석하였다. 두번째, 기업의 성과를 분석할 때 지식재산권 중 특허를 주로 이용하던 기존 연구와 달리 상표권을 주요 분석 대상으로 삼았고 특허, 실용신안, 상표를 모두 이용하여 장기에 걸친 한국 기업의 성과를 설명하였다. 세번째로 특허와 상표권을 대비하여 두 권리 중 기술이 성숙함에 따라 특허권이 더 많이 등록되는 산업과 기술이 성숙되는 시기에도 상표권이 많이 출원되는 산업으로 나뉜다는 분석은 기존에는 볼 수 없는 새로운 시도이다. 네번째로 상표권에 대한 기존 연구가 서비스업을 주로 대상으로 한 것과 다르게 제조업

분야에서 기술로 설명할 수 없는 기업의 성과를 상표권으로 설명함으로써 상표권이 혁신의 변수가 될 수 있다는 것을 확인하였다. 마지막으로 경제성장 단계별로 기업 성과에 영향을 주는 지적재산권에 차이가 있다는 동학적 관점을 추가함으로써 지적재산권의 다양한 영향력을 확인하였다.

본 논문의 공헌점은 다음과 같다. 첫째로, 국가의 지적재산권 데이터가 특허, 실용신안, 상표 및 디자인으로 구성되고 그 축적기간이 70 년이 되는 경우가 흔치 않은데, 한국 제조업 분야의 방대한 지적재산권 자료를 데이터화하여 분석함으로써 경제성장단계에 따른 지적재산권의 등록모습을 확인하였다. 둘째로, 산업의 기술 특성에 따라 지적재산권의 등록양상이 다르게 나타나는데, 기술 특성 중 암묵지적 성격이 상표권의 등록으로 드러날 수 있다는 점을 환기하였다. 세번째로 후발기업의 추격에는 기술발명을 통한 추격만 있는 것이 아니라 모방형 신상품을 통하여 시장을 선점하는 것으로도 추격이 나타난다는 점을 상표권이 주로 등록되는 산업(주로 경공업)의 초기발전단계에서 확인함으로써 경제 추격의 또다른 모습을 제시하였다. 마지막으로 다양한 지적재산권으로 산업과 기업을 분석함으로써 경제성장 분석에 대한 새로운 시각을 제시하였다

주요어: 상표권, 특허, OEM, OBM, 기술의 명시성, 기술의 암묵성, 기업 성과, 모방적 혁신

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