Trademarks, Own Brand Manufacturing, and Firm Growth at Different Stages of Development in Korea

Raeyoon Kang and Keun Lee

This study attempts to verify the linkages between trademark registration and firm growth based on the different stages of development and two groups of sectors by using Korean firm data. Two different paths of firm growth in Korea are identified. In the trademark-dominant group, trademarks serve as a useful device for firm growth at the early stage of development, with technology at a low level, and then firms execute technological innovations to file more patents. In the patent-dominant group, utility models serve as a useful device for firm growth at the early stage of development, in which technology advancement is a prominent feature. Then, the sales growth of firms becomes positively associated with both patents and trademarks, the latter representing the effects of their brand power or the full transition to own brand manufacturing. Combined with the findings from the literature, this study finds that various types of intellectual property rights (IPRs) manifest differently for firms, from innovation to business growth, at different stages of economic development. A key lesson for catching-up economies is for conventional patents to not only consider the IPR type at the early stage of development in certain sectors but also take into account other IPRs, such as trademarks and utility models, to recognize and stimulate imitation and/or innovation. Innovation policy should be tailored not only toward the different stages of development and capabilities but also toward sectoral heterogeneity.

Keywords: Trademark, Own brand manufacturing, Original equipment manufacturing, Innovation, Korea, Patent

JEL Classification: O3; O4; O1

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I. Introduction

An increasing volume of the literature has tried to find the relationship between economic development and the role of not only the strength but also diverse forms of intellectual property rights (IPRs). A pioneering study is Kim *et al.* (2012), who find that simply strengthening patent rights does not promote innovation in developing countries, whereas other forms of IPR, such as utility models, have a significant impact on innovation.[1] They find that at the early stages of development, utility models can serve as a primary vehicle to absorb technology and promote imitative innovations involving a limited degree of inventiveness. Typical middle-income developing countries face the challenge of transitioning from input- or imitation-based growth to innovation-driven growth. Therefore, effective strategies and policies must be identified to promote innovation at different stages of development within the context of different forms of IPR (Kang *et al.* 2020). Beyond the role of the patent or utility model, the next question pertains to the roles of other IPR forms, such as trademarks and

[1] Utility models offer second-tier protection for minor inventions embodying practical or functional advantages over existing inventions. Utility models are usually sought for marginal innovations that do not meet the criteria for patentability (Bently and Sherman 2001; Beneito 2006). In other words, patents protect innovations of relatively high inventiveness, whereas utility models protect innovations of limited inventiveness.

designs.

Regarding the role of designs for Korean firms, Lee *et al.* (2022) find that design-intensive sectors tend to be more export oriented and that firms' sales growth is significantly associated with the design intensity of firms. Such an association is found only during the later stages of economic development in Korea when product differentiation becomes critical, in contrast to the earlier stage that designs are not that important at an early stage of development specializing in the mass production of low-cost goods by low-wage workers.

This study asks a similar question for the role of trademarks. Recently, trademarks have been recognized as another proxy measure of innovation, complementing or substituting patents (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; Flikkema *et al.*, 2010; Block *et al.*, 2015). Trademarks are used to protect and appropriate the value of innovations in sectors or for products manufactured using tacit knowledge; thus, patents are not a viable option (De Vries *et al.*, 2017).

In the context of upgrading and catching up by latecomer firms from emerging countries, registration of trademarks may represent firms' effort to establish their own brands by switching to the own brand manufacturing (OBM) mode, compared with the early or low-value-added mode called own equipment manufacturing (OEM). OEM is a specific form of subcontracting using a vendor's exact description of the product, and the products are sold using the buyer's own distribution channels and brand name (Hobday 2003). Given that marketing and branding bring in more value-added and profit margins, upgrading from OEM to OBM is considered a desired but challenging path of upgrading for firms in emerging countries (Lee *et al.* 2015).

Transition to OBM can be identified when firms start filing more trademarks, as transition from imitation to innovation can be identified by firms' filing of utility models versus regular patents (Kim *et al.* 2012). By using Korean firm data, Kim *et al.* (2012) find that the number of utility models is positively associated with sales growth in earlier or imitation-based stages, whereas the number of patents is positively associated with sales growth in later or innovation-based stages. Thus, one of the motivations of this study is to determine the linkage from trademark registration to firm growth.

More specifically, this study extends the literature on the two paths

of technological development of latecomer firms, namely, the one relying more on patents and the other relying more on trademarks (Lee 2019; Kang *et al.* 2022). This study finds that among the manufacturing sectors in Korea, some sectors have filed more trademarks than patents since the early days, such as the 1980s. These sectors tend to be less technologically advanced and more domestic market oriented, and their innovation tends to involve more tacit knowledge and thus less patentable than codifiable knowledge, which can be filed as patents. However, Kang *et al.* (2022) stopped at verifying these two paths only at the sectoral level and did not explore the direct linkage at firms from trademarks to firm performance or growth.

This study uses firm-level panel data of Korean manufacturing sectors covering the 4 decades from 1971 to 2010. This dataset is unique because it has all four major forms of IPRs classified into each firm, such as regular patents, utility models, designs and trademarks, and has been used in the research discussed above, such as Kim *et al.* (2012), Kang *et al.* (2020), and Lee *et al.* (2022). Following these works, the four decades are divided into three subperiods representing different stages of economic development and levels of firms' technological capabilities. In trademark-driven sectors, trademarks or the transition to OBM tend to be positively associated with firm growth from the earlier stage of development. In contrast, in patent-driven sectors, trademarks tend to be associated with firm growth only at later stages because firm growth tends to be associated with utility models or patents at earlier stages of development. Although there does exist some empirical research on the role of trademarks in firm performance in diverse countries, such as Sandner and Block (2011) and Mehrazeen *et al.* (2012), none of them address this question of trademark registration interpreted as representing upgrading effort by latecomer firms toward OBM from OEM.

In what follows, Section 2 provides an overview of technological development in Korea, focusing on the transition path of OEM–own design manufacturing (ODM)–OBM. Section 3

II. Technological Development of Latecomer Firms in Korea: Upgrading with the Three Stages of OEM–ODM–OBM

Korea represents a successful catching-up development relying on human capital and innovation, given its poor endowment of natural

resources. Lee (2013: 25) suggested a capability-based view of Korean and Asian economic development, which is 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 and to advance successive entries into new promising industries (Lee 2013).

In Korea, firms have strengthened their capabilities through diverse channels, including licensing, OEM, foreign direct investment (FDI), strategic alliance, and collaborative 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 systems are the most cost-effective methods for obtaining capabilities in manufacturing production at the lowest stage of technological development (Ernst and O'Connor 1989; Ernst 1998). OEM facilitates technological learning and knowledge transfer because in that process, OEM firms produce 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 the 1960s, the 1970s, and even the 1980s, most of the firms in Korea were under technical guidance and learning from foreign OEM buyers, which enabled firms to generate income and to learn and build know-how and some technological capability. While the OEM mode worked effectively in certain stages, it entailed long-term limitations.

As noted in Lee and Mathews (2012), because any success with OEM at the lower tier of GVC tends to cause wage rates to rise accordingly, the profit margin of OEM business tends to decrease. At the same time, new cheaper labor sites in "next-tier down" countries can emerge to replace a concerned country's position in global value chains (GVCs). For instance, while there used to be more than 500 OEM firms that make plush toys in Korea, most of them have had to move their factories abroad due to rising domestic rates or to close down factories in Korea (Lee *et al.* 2015). The footwear sector in southern Brazil had to face a sudden setback due to the rise in China as an alternative site offering cheaper wage rates since the mid-2010s (Lee *et al.* 2018).

The above situation forces firms to move up to higher value-added activities (Lee *et al.* 2018). Thus, in the debate on upgrading within

GVCs, particularly functional upgrading, the three stages of OEM-ODM-OBM have often been the key framework of understanding (Hobday, 2003). ODM is the second step of catch-up where manufacturers can depart from simple jobs, such as assembling, and begin involvement in production design. Own brand manufacturing (OBM) is the last step and refers to when these manufacturers independently perform all functions of production, design, marketing, channel management, and research and development (R&D).

Despite its intrinsic merit, this kind of upgrading transition, especially for one OBM, involves several risks and costs. Most of all, there are often interference or even counterattacks from flagship firms in existing GVCs or incumbents against small and medium enterprises pursuing OBM. For instance, in the case of consumer goods, former vendor companies (brand owners) often stop giving OEM orders to destroy the company that has begun to sell their competing brands (Lee *et al.*, 2015). In the case of capital goods, incumbent companies suddenly charge predatory prices in the market once they realize that latecomer firms have become successful in developing their products, which poses the threat of competition against the products of the incumbent. In certain cases, the incumbent reacts by filing lawsuits against the latecomers and claiming that the latter copied their products (Shin *et al.* 2016).

This complex and uncertain nature of the costs, risks and benefits of OEM versus OBM can be considered a dilemma. According to Hobday *et al.* (2004), some Korean firms indeed found themselves in the "innovation dilemma," debating whether to continue relying on global leaders for their brands and marketing channels or to try to compete with them in the international stage by deploying in-house R&D to develop their own leading-edge products and brands. Some of the largest and more advanced producers, such as Samsung and Hyundai Motors, have gradually transitioned to OBM. By contrast, some companies emphasize OEM even though they have the ability to make their own products; for instance, Youngwon Corporation is a famous maker in leisure products, such as outdoor wear and backpacks, which have kept the OEM mode until now. They produce and supply high-quality garments, such as North Face, NIKE, POLO, among others. In other words, if the profits from the OEM are acceptable to firms, then the decision of converting to OBM will likely be delayed for them.

Overall, transition toward OBM is not a binary event, as many

enterprises mix both modes of OEM and OBM in diverse degrees and over time. Therefore, transition itself is a gradual process, if not stopped or failed in the middle. In general, the profits from a pure OEM have gradually decreased since the late 1980s or 1990s because of the entrance of other OEM firms into other countries. Since then, some firms have tried to convert to OBM and tried to use trademarks to protect their own products in the market.

Given this background, this research attempts to determine the performance impact of such efforts to try to increase sales by using their own brand or to transition toward OBM. In particular, in terms of econometrics, this study tries to verify the effects of trademark registration on firm performance in each development stage.

A. Patent-Driven vs. Trademark-Driven Paths and Hypotheses

In Korea, almost all sectors registered trademarks regardless of their level of technological capability or innovation. This phenomenon can be attributed to the registration of trademarks not requiring a submission of a blueprint of an invention, so any firms that want to register their product's name can register a trademark. However, one of the key findings of Kang *et al.* (2022) is that sectors can be divided into two groups, namely, one group in which many more trademarks are registered than patents and the other group in which the dominant form of the IPR tends to be regular patents. The first group, the trademark-dominant group, includes typical light industry (*e.g.*, food and apparel), some chemicals and pharmaceuticals. Firms in these sectors registered trademarks more than any other IPRs throughout the whole period. The second group, the patent-dominant group, includes most of the heavy industries (*e.g.*, synthetic chemicals, iron/steel industry), the information technology industries of electrical product and electronics, and automobiles. Tables 1A and 1B present the detailed list of sectors in each group over the decades and the ratio of the number of patents to the number of trademarks. This ratio is calculated using the total number of registered trademarks (patents) in each sector of the trademark-dominant group divided by the total number of registered patents (trademarks) in each sector of the trademark (patent)-dominant group. Clearly, the two groups differ in their uses of IPR forms.

In the trademark-dominant group, firms tend to file many more trademarks than patents throughout the whole period or over the four

decades. The ratio of trademarks to patents was 33.1 in the 1980s, decreased to 26.7 in the 1990s, and further decreased to 10.4 in the 2000s (Table 1A). The continued decrease implies that although trademarks are dominant over the periods, the firms in this group have also ended up filing gradually more patents as their level of technological capabilities increased over time.

In the patent-dominant group, firms tend to file more patents than trademarks (Table 1B). The ratio of patents to trademarks was 0.4 on average in the 1980s but increased to 4.3 in the 1990s and to 5.5 in the 2000s. The somewhat low ratio in the 1980s is consistent with the notion that firms used to file mostly utility models rather than patents, given their low level of technological development, as discussed in Kim *et al.* (2012). Since then, firms' technological capabilities have increased to file more patents and trademarks.

Furthermore, Table 1C shows that firms in the trademark-dominant group register trademarks more than in the patent-dominant group in all periods; for instance, 6.84 *vs.* 1.72 during the second period or the 1987-1997 period. The average number of trademarks in the trademark-dominant groups tends to be stable at approximately 7.0, with a slight increase in the most recent period. In the patent-dominant group, the average number of registered trademarks decreased from 2.4 during the 1971-1987 period to 1.7 during the second period and to 1.03 during the last period, from 1998 to 2010.

Kang *et al.* (2022) confirm by sector-level regression analysis that trademark-dominant groups are sectors involving either more tacit knowledge-based manufacturing or firms with a low level of technological capabilities with domestic market orientation. Footwear or toy makers can be an example of sectors with more tacit knowledge than typical information technology sectors, whereas pharmaceutical firms in Korea used to be weak in technological capabilities and thus are oriented toward trademarks targeting the domestic market.

An example of firms in this trademark-dominant group is a plush toy maker, Aurora World, who studied an example of a successful transition from OEM to OBM (Lee *et al.* 2015). Figure 1 shows that this company has no patents but filed mostly either designs or trademarks. The year 1991 is the first time this company started to sell some products on its own brand, Aurora, while it kept producing in parallel at OEM modes until recently. In other words, the transition to OBM had been gradual, faced many challenges and took more than 10 years, during which the

company has kept registering more and more trademarks (Figure 1). At the same time, this company has filed many designs that are required to go for global markets (Lee *et al.* 2022).

The other or alternative path of technological development is the patent-driven path, typically involving firms in IT sectors, including consumer electronics. An example firm is Cuckoo, which produces rice cookers for global markets. As also analyzed in Lee *et al.* (2015), this firm had to go through critical rounds of patent litigation with an incumbent firm. Figure 2 clearly shows that the main IPR form for this firm was utility models for the early period, filing 21 utility models in 1994 but zero patents before 1994. Only in 1995 did this company file its patents, and the number of patents increased to 6 in 2004 and 15 in 2007. While the number of utility models has shown some ups and downs, the number of patents has increased to match that of utility models. In contrast, the number of trademarks has always been either 0 or 1, except in one year. Such a sequence from utility models to patents is exactly what is confirmed by a bigger dataset in Kim *et al.* (2012).

The identification of these two paths is important because it implies the existence of an alternative path of economic development by latecomer firms in different sectors, in addition to the "utility model

Table 1A
Trademark-Dominant Group: Ratio of Trademarks to Patents (Trademark/Patent)

Trademark-dominant group	1980s	1990s	2000s	Number of firms
Food and Beverage	26.641	9.651	14.926	363
Textile & Fabric Weaving	12.68	3.126	3.013	251
Apparel	54.6	137.088	56.928	239
Leather & Shoes	120.333	51.267	14.625	87
Wood and Furniture	4	7.625	2.563	31
Study	7.87	4.034	4.583	112
Printing		101.13	19.296	169
Oil Refining	24.833	2.599	3.011	25
Basic Chemicals	1.241	2.88	2.563	348
Pharmaceuticals	14.85	7.217	5.443	174
Rubbers (except tires) & Plastics	106.889	10.4	3.265	330
Cement & Non-Metals	1.795	1.021	1.067	187
Other Manuf. (toy, sport goods)	22.05	9.487	3.426	227
Average (unweighted)	33.149	26.733	10.362	Sum: 2543

Table 1B
Patent-Dominant Group: Ratio of Patents to Trademarks (Patent/Trademark)

Patent-dominant group	1980s	1990s	2000s	Number of firms
Synthetic Chemicals	0.187	0.665	2.636	108
Rubber Tires	0.025	2.079	2.947	6
Iron and Steel Manufacturing	1.365	7.81	9.969	226
Fabricated Metal	0.044	0.508	1.312	385
Machinery	0.133	1.516	3.347	979
Computers	0.018	0.518	1.539	156
Electrical Machinery	0.826	2.843	3.05	414
Electronics	1.125	14.842	16.632	1004
Optical/Medical Instrument	0.356	2.226	2.564	255
Automobile	0.139	10.575	13.057	454
Ship Building & Vehicles	0.707	4.143	3.772	79
Average (unweighted)	0.448	4.339	5.530	Sum: 4066

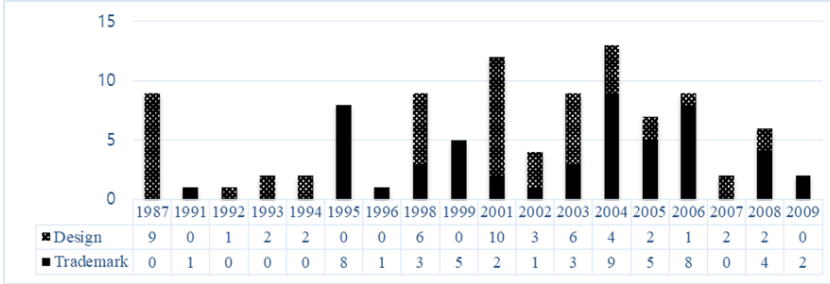
Table 1C
Average Number of Trademark Registrations of Firms in Each Group

Period	Trademark-dominant group	Patent-dominant group
Period1 (1971-1986)	6.97	2.39
Period2 (1987-1997)	6.84	1.72
Period3 (1998-2010)	7.13	1.03

Source: Calculations using the authors' database, which is also used in Kang *et al.* (2022)
Note: Number of firms refers to the number of unique firms in the sample.

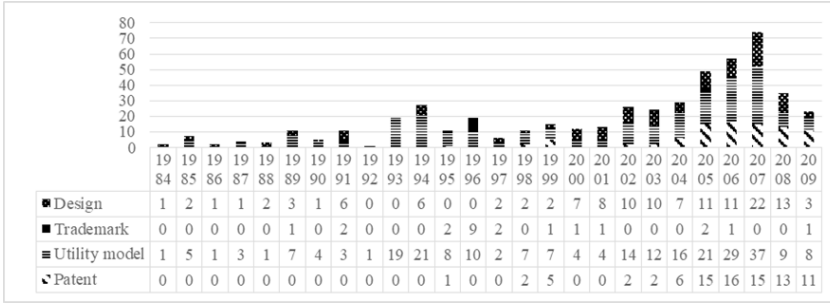
to patent" path, which is already verified in Kim *et al.* (2012). Then, empirical analysis in this study will attempt to capture the effects of either of the two types of business models involving trademarks on firm growth.

Thus, our overall hypothesis is that trademarks also matter for firm growth across all sectors, in addition to patents. Then, a more specific hypothesis is that trademarks matter more in the trademark-dominant group, whereas in the patent-dominant group, patents matter more than trademarks.



Source: Drawn using the authors' database, which includes each firm's IPR data available from KIPRIS (http://www.kipris.or.kr/khome/main.jsp)

FIGURE 1
IPR REGISTRATIONS BY AURORA WORLD



Source: Drawn using the authors' database, which includes each firm's IPR data available from KIPRIS (http://www.kipris.or.kr/khome/main.jsp)

FIGURE 2
IPR REGISTRATIONS BY CUCKOO

III. Data, Regression Models, and Results

A. Firm-Level Data with Four IPR Forms

We use the same firm-level database as Kang *et al.* (2022) and Lee *et al.* (2022). It combines data on four types of IPR (regular invention patents, utility models, trademarks, and designs) with data on conventional accounting variables in Korea for the 1971–2010 period. The IPR data are downloaded from the Korea Intellectual Property Rights Information System (KIPRIS) or www.kipris.or.kr and then

classified into their assignee firms for a total of 6,609 externally audited firms. This database is provided by the Center for Economic Catch-Up, which has built a dataset of firms for the period from 1971 to 1979, and classification work is conducted using the information from the Korea Information Service for the 1980–2010 period.[2] After matching IPR data with financial data, we deleted firms with less than three years of data. The dataset has the structure of an unbalanced panel consisting of 6,609

Table 2
Descriptive Statistics of Key Variables

Variables	Description	Observations	Mean	SD
Patent_intensity	Number of patent registration/ sales (billion won) of the firm in each year	92574	0.094	2.991
Utility model_ intensity	Number of utility model registration/sales (billion won) of the firm in each year	92574	0.113	5.063
Trademark_ intensity	Number of trademark registration/ sales (billion won) of the firm in each year	92574	0.083	2.408
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 digits)			

Source: Calculations using the authors' database, which is also used in Kang *et al.* (2022)

[2] The firm-level data of the Center for Economic Catch-Up have been utilized by Choo *et al.* (2009) and Kim *et al.* (2012).

companies. Any sector-level variables are also constructed by taking the sum of firm-level data in each sector. We use the Eighth Korean Standard Industrial Classification (KSIC) to build a panel database with 24 sectors classified by KSIC three-digit industry code.

Table 2 provides basic descriptive statistics of the key variables at the firm level, whereas correlations are provided in an Appendix Table. Registered IPR variables per year refer to the year they are granted. The key variables are trademark intensity, patent intensity and utility model intensity, which is defined as the number of each of these IPR forms divided by a firm's sales revenue. The means of the intensity variable are all approximately 0.1 or at similar levels for the three IPR forms. When running a regression analysis, we use IPR intensity, following Greenhalgh and Rogers (2007). For instance, they use trademark intensity rather than simply the number of trademarks to reflect that large firms often have more trademarks than smaller firms. R&D intensity is 3.7% on average, which is reasonable. The advertising intensity or ratio of advertising expenditure to sales is 1.1% on average.

B. Regression Models

To verify the effects of trademarks on each group over the period of four decades, this study runs regressions for both fixed effect and system GMM estimation, with one-year lagged variables, to examine the relationship between IPR forms and firm performance. To account for the time-dependent effects, a full set of year dummies is included, followed by a full set of industry dummies to capture industry-specific variations. Specific regression models are as follows.

$$\begin{aligned} Performance_{i,t} = {} & \beta_0 + \beta_1 Trademark\ \ Intensity_{i,t-1} + \beta_2 Patent\ \ Intensity_{i,t-1} \\ & + \beta_3 Utility\ \ Model\ Intensity_{\boldsymbol{i,t-1}} + \alpha_1 Investment_{i,t-1} \\ & + \alpha_2 Advertisement\ Ratio_{i,t-1} + \alpha_3 R\ \&\ D\ Intensity_{i,t-1} \\ & + \alpha_4 Employees_{i,t-1} + \alpha_5 Age_{i,t} + \varepsilon_{it,} \end{aligned} \tag{1}$$

where Performance is measured by sales growth rate$_{i,t}$, Investment is defined as ΔFixed Assets$_{i,t}$ / sales$_{i,t-1}$, The advertisement ratio is defined as *advertisement cost*$_{i,t-1}$ / sales$_{i,t-1}$, and R&D intensity is defined as *R&D intensity*$_{i,t-1}$ / sales$_{i,t-1}$

Regressions are conducted in two steps. The first step is for regressions over the full sample of firms in all sectors. The second

step separates the sample into two groups, the one for the trademark-dominant group and the other for the patent-dominant group, to see if we can find any differences as hypothesized above. We take only those coefficients that show statistical significance in both fixed and GMM estimations as robust.

C. Results

Table 3 presents the results for the whole sample, for the whole period and for each of the three subperiods. Three IPR forms, patents, utility models and trademarks, are shown to be significant in the whole period results. In the three subperiod results, both trademarks and utility models are shown to be significant in all three periods. Patents are insignificant in the first periods but become significant in the latter two periods. The insignificance of patents during the first periods is an exact replication of the same results in Kim *et al.* (2012), and it reflects the low level of technological capabilities of Korean firms. During this early period, Korean firms tend to file more utility models or trademarks, given their low level of technological capabilities. The utility model represents a minor level of technological innovation, whereas trademarks serve as an alternative way to express product differentiation other than patents, especially when the involved knowledge is tacit and thus cannot be filed as patents. In some cases, trademarks can be a way to express imitative innovation (Levitt 1966; Kim 1997).

Such effects of trademarks are more clearly shown in the results with the sample of firms belonging to the trademark-dominant group in Table 4A. The coefficient of trademark intensity is shown to be significant from the first period or the 1970s, whereas the coefficients of utility models and patents are not significant during the first two subperiods but become significant only in the third or last period. This situation implies that for this group of firms, trademarks had served as a useful device for firms at earlier stages of development with low levels of technology. With advancements in their technological level, these firms have become able to execute more technological innovations and to file more patents, which have finally become associated with firm growth in the last period or since the 2000s. The insignificance of trademarks during the last period can be interpreted as the diminishing marginal effect of additional trademarks given an increasing stock of trademarks over the periods.

TABLE 3

IMPACT OF IPR REGISTRATION ON FIRM PERFORMANCE IN ALL SECTORS

	All Period(1971-2010)		Period 1(1971-1986)		Period 2(1987-1997)		Period 3(1998-2010)	
VARIABLES	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM
Sales Growth(t-1)	-0.059***	-0.103*	-0.208***	-0.233***	-0.075***	-0.106**	-0.087***	-0.101
	(-21.980)	(-1.831)	(-7.907)	(-2.717)	(-12.139)	(-2.164)	(-25.207)	(-1.060)
Sales Growth(t-2)	-0.010***	-0.004	-0.037***	-0.058	-0.027***	-0.062*	-0.021***	-0.007
	(-7.479)	(-0.111)	(-3.683)	(-1.068)	(-8.250)	(-1.928)	(-11.444)	(-0.206)
Patent intensity(t-1)	1.357***	1.683***	4.314	6.923	0.293*	1.373*	1.346***	1.363***
	(31.441)	(4.594)	(1.454)	(1.150)	(1.763)	(1.745)	(26.181)	(4.087)
Utility_intensity(t-1)	0.157***	0.105**	1.807**	1.631**	1.344***	1.365***	0.214***	0.512**
	(3.181)	(2.210)	(2.104)	(2.374)	(16.167)	(4.087)	(3.258)	(2.122)
Trademark_intensity(t-1)	0.685***	0.268***	1.687***	2.049***	2.327***	2.030***	0.268***	0.160***
	(20.907)	(8.531)	(6.357)	(4.135)	(27.609)	(4.090)	(5.966)	(3.238)
Investment(t-1)	0.002***	-0.001	0.001	-0.002	0.005***	0.002*	-0.000	-0.003***
	(3.599)	(-1.451)	(0.304)	(-0.609)	(6.925)	(1.926)	(-0.632)	(-3.209)
Employees(t-1)	-0.142***	-0.261***	-0.164***	-0.187	-0.221***	-0.338**	-0.193***	-0.260***
	(-17.634)	(-3.745)	(-3.053)	(-1.357)	(-10.863)	(-2.451)	(-14.426)	(-2.780)
Firm Age(t-1)	-0.322***	-0.740***	-0.299	0.868	-0.263***	1.696	-0.573***	-0.986*
	(-15.090)	(-3.325)	(-0.830)	(0.730)	(-4.749)	(0.884)	(-14.574)	(-1.790)
Advertisement ratio(t-1)	0.038***	0.068***	0.113***	0.110	0.025***	0.016*	0.045***	0.076***
	(12.427)	(7.336)	(3.446)	(0.921)	(3.868)	(1.880)	(10.163)	(6.502)
R&D intensity(t-1)	0.003***	0.006***	0.010***	0.009*	0.003***	0.005**	0.003***	0.005**
	(4.150)	(2.897)	(2.718)	(1.835)	(2.848)	(2.469)	(3.262)	(2.372)
Constant	2.143***		2.413*		2.029***		3.121***	
	(28.338)		(1.805)		(10.962)		(25.035)	
Observations	62,748	55,323	1,880	1,225	15,093	12,335	38,177	31,524
R-squared	0.066		0.202		0.144		0.072	
Hausman test	1262.36		146.06		912.1		1561.13	
AR(2)		0.198		0.316		0.505		0.355
Number of firms	6,190	5,701	634	485	2,653	2,025	5,892	5,333

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period and industry dummies are included, as well as a dummy for each of six ultra-large firms, such as Samsung, LG, Daewoo, POSCO, Hyundai, and Kia.

Now, Table 4B presents the results for the patent-dominant group. Now, in contrast to the results in Table 4A, during the first period, only the utility model affects firm growth positively and significantly, whereas patents start to have impacts from the second period and later, reflecting the enhanced level of a firm's technological capabilities since the second period. These results and interpretations are consistent with Kim *et al.* (2012). In the meantime, trademark registration affects firm growth only in period 3. The significance of both patents and trademarks during the last period since the post-1997 Asian crisis implies that by that time, many firms had realized a transition to OBM

TABLE 4A

IMPACT OF TRADEMARK REGISTRATION ON FIRM PERFORMANCE IN THE PATENT-DOMINANT GROUP

	All Period(1971-2010)		Period 1(1971-1986)		Period 2(1987-1997)		Period 3(1998-2010)	
VARIABLES	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM
Sales Growth(t-1)	-0.069***	-0.078***	-0.224***	-0.231**	-0.141***	-0.087***	-0.169***	-0.103
	(-11.705)	(-4.864)	(-7.409)	(-2.543)	(-11.806)	(-4.876)	(-18.758)	(-1.137)
Sales Growth(t-2)	-0.017***	-0.061	-0.028***	-0.110**	-0.052***	-0.108***	-0.028***	-0.060
	(-6.258)	(-1.619)	(-3.869)	(-2.241)	(-7.859)	(-3.197)	(-8.224)	(-1.082)
Patent intensity(t-1)	2.947	1.442	4.453	1.442	1.234	2.656	1.311***	1.030***
	(1.271)	(1.242)	(1.395)	(1.242)	(1.568)	(1.231)	(13.611)	(2.618)
Utility intensity(t-1)	0.022***	0.025**	-0.595	-3.572	-1.184*	-3.672	0.503***	0.117**
	(4.641)	(2.104)	(-0.390)	(-0.610)	(-1.701)	(-0.541)	(3.278)	(2.363)
Trademark_intensity(t-1)	1.211***	0.938*	1.662***	1.845***	3.499***	1.655***	1.313	0.672
	(12.657)	(1.721)	(9.388)	(3.746)	(33.058)	(15.702)	(1.161)	(0.850)
Investment(t-1)	0.003***	0.001	-0.001	-0.000	0.008***	0.003	0.001	-0.001
	(5.245)	(0.636)	(-0.352)	(-0.075)	(5.368)	(1.638)	(1.325)	(-0.971)
Employees(t-1)	-0.068***	-0.136*	0.005	0.013	-0.339***	-0.636**	-0.090***	-0.089
	(-6.016)	(-1.878)	(0.128)	(0.460)	(-8.075)	(-1.999)	(-5.054)	(-1.359)
Firm Age(t-1)	-0.311***	-1.082***	-0.213	1.019	-0.328***	0.524	-0.658***	-1.616*
	(-9.803)	(-3.532)	(-0.572)	(0.856)	(-2.865)	(0.427)	(-11.282)	(-1.920)
Advertisement ratio(t-1)	0.021***	0.025**	-0.045	-0.137	0.035**	0.010	0.027***	0.035*
	(4.312)	(2.130)	(-1.470)	(-1.427)	(2.526)	(0.508)	(3.980)	(1.809)
R&D intensity(t-1)	0.002*	0.006	0.004	0.012***	0.005*	0.009	0.001	0.001
	(1.934)	(1.492)	(1.263)	(2.792)	(1.892)	(1.530)	(0.788)	(0.435)
Constant	1.540***		0.502		2.898***		2.753***	
	(12.904)		(0.369)		(7.331)		(13.923)	
Observations	21,980	19,811	1,000	661	6,194	5,212	12,038	10,116
R-squared	0.063		0.416		0.225		0.080	
Hausman test	3383.45		118.78		1760.92		3669.58	
AR(2)		0.69		0.481		0.234		0.841
Number of firms	1,856	1,719	326	256	942	794	1,760	1,608

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period and industry dummies are included, as well as a dummy for each of six ultra-large firms, such as Samsung, LG, Daewoo, POSCO, Hyundai, and Kia.

based on their enhanced technological capabilities.

Overall, the results in Tables 3 and 4 are consistent with the theoretical reasoning and hypotheses discussed in the preceding section. The results in Table 4A for the trademark-dominant groups are consistent with the idea that trademarks can be an effective IPR strategy substituting patents for sectors and firms involving tacit knowledge or facing a low level of technological development at an earlier stage of development. In some comparisons, the results for Table 4B for the patent-dominant group are consistent with the interpretation that firms in this group tended to focus initially on patent-driven technological development and thereby achieved upgrading to the OBM mode as their brand power increased over time.

TABLE 4B

IMPACT OF TRADEMARK REGISTRATION ON FIRM PERFORMANCE IN THE PATENT-DOMINANT GROUP

	All Period(1971-2010)		Period 1(1971-1986)		Period 2(1987-1997)		Period 3(1998-2010)	
VARIABLES	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM
Sales Growth(t-1)	-0.057***	-0.135*	-0.178***	-0.449***	0.002	-0.018	-0.079***	-0.115
	(-18.306)	(-1.702)	(-4.322)	(-2.605)	(0.563)	(-0.855)	(-19.908)	(-1.177)
Sales Growth(t-2)	-0.008***	0.031	-0.065**	-0.062	-0.005**	-0.002	-0.018***	-0.007
	(-5.211)	(0.943)	(-2.314)	(-0.824)	(-2.173)	(-0.260)	(-8.589)	(-0.189)
Patent intensity(t-1)	1.384***	1.507***	-7.363	-2.610	0.209**	0.667***	1.344***	1.567***
	(27.769)	(4.243)	(-1.361)	(-0.844)	(2.474)	(2.710)	(21.867)	(3.485)
Utility_intensity(t-1)	0.141**	0.327**	3.633***	1.609***	0.165***	0.723***	0.158**	0.041*
	(2.545)	(2.424)	(2.926)	(2.760)	(2.601)	(3.37)	(2.087)	(1.721)
Trademark_intensity(t-1)	0.459***	0.465	-0.270	-0.093	0.089	0.057	0.428***	0.485***
	(9.016)	(1.521)	(-0.225)	(-0.173)	(1.365)	(0.971)	(6.205)	(2.549)
Investment(t-1)	0.001	-0.002	0.002	-0.002	0.002***	0.001*	-0.001	-0.004***
	(0.982)	(-1.630)	(0.468)	(-0.707)	(5.521)	(1.794)	(-1.173)	(-3.273)
Employees(t-1)	-0.189***	-0.300***	-0.470***	-0.335*	-0.129***	-0.198***	-0.244***	-0.371***
	(-17.132)	(-3.344)	(-3.766)	(-1.831)	(-9.713)	(-4.088)	(-13.549)	(-2.685)
Firm Age(t-1)	-0.337***	-0.532**	-0.233	-0.792	-0.254***	-0.369**	-0.544***	-0.658
	(-11.840)	(-2.240)	(-0.391)	(-0.824)	(-6.945)	(-2.236)	(-10.685)	(-0.534)
Advertisement ratio(t-1)	0.047***	0.076***	0.250***	0.184	0.020***	0.021***	0.050***	0.086***
	(11.868)	(6.894)	(4.349)	(1.395)	(4.962)	(3.665)	(9.000)	(5.443)
R&D intensity(t-1)	0.003***	0.005***	0.014**	0.001	0.003***	0.005***	0.004***	0.008***
	(3.876)	(4.072)	(2.157)	(0.235)	(4.020)	(4.506)	(3.319)	(3.024)
Constant	2.530***		4.818**		1.498***		3.339***	
	(25.725)		(2.183)		(12.557)		(21.135)	
Observations	40,768	35,512	880	564	8,899	7,123	26,139	21,408
R-squared	0.073		0.192		0.112		0.075	
Hausman test	808.34		82.74		174.26		1010.23	
AR(2)		0.159		0.382		0.913		0.278
Number of firms	4,334	3,982	308	229	1,711	1,231	4,132	3,725

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period and industry dummies are included, as well as a dummy for each of six ultra-large firms, such as Samsung, LG, DAEWOO, POSCO, HYUNDAI, and KIA.

For some check on robustness, we have run additional regressions, and the results are reported in Appendix Table 2. The idea is to reflect the possible multicollinearity associated with a perception that patents and utility models are correlated, patents are correlated with R&D intensity, and trademarks are correlated with advertising intensity. Thus, in these additional regressions, we have removed the three variables of utility models, R&D intensity and advertising intensity. As shown, the results are basically consistent. In other words, trademarks are significant in both fixed effect and GMM estimations during the first two periods in the trademark-dominant group, whereas they are significant in both fixed effect and GMM estimations only during the third period in the patent-dominant group.

V. Summary and Concluding Remarks

This study attempts to verify the linkages between trademark registration and firm growth based on the different stages of development and two groups of sectors by using Korean firm data. By extending the identification of two groups (i.e., patent-dominant group *vs.* trademark-dominant group) of Kang *et al.* (2022), this study confirms the varying growth paths of firms in the two groups. In the trademark-dominant group, trademarks serve as a useful device for firm growth at an early stage of development, depicted by a low level of technology. Then, firms execute technological innovations to file more patents, which finally become associated with firm growth at a later period. In the patent-dominant group, utility models serve as a useful device for firm growth at the early stage of development, with technological advancements being prominent. Then, the sales growth of firms becomes positively associated with both patents and trademarks, the latter representing the effects of their brand power or completion of the transition to OBM.

Combined with the findings from recently reviewed literature, such as Lee *et al.* (2022) and Kim *et al.* (2012), an emerging notion is that different IPR types affect innovation and firm growth at different stages of economic development. In particular, at the early stage of development, firms' sales growth is associated with utility models in the patent-driven path (Kim *et al.* 2012) and associated with trademarks in the trademark-driven group. In later stages, not only patents but also designs and brands become important, especially for firms targeting the global market. A key lesson for emerging or catching-up economies is that conventional patents are not the only form of IPRs effectively promoting innovation. At the early stage of development in certain sectors, other IPRs, such as trademarks and utility models, can be regarded as effective IPR forms to recognize and stimulate imitation and/or innovation. Successful completion in global markets eventually requires the combination of patents, brands, and designs. Therefore, innovation policy should be tailored not only toward different stages of development and capabilities but also toward sectoral heterogeneity.

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Appendix

Table 1A
Correlation of Variable 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 1B
Correlation of Variable 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

Source: Calculations using the authors' database, which is also used in Kang *et al.* (2022)

TABLE 2A

ROBUSTNESS CHECK ON THE IMPACT OF IPR REGISTRATION IN TRADEMARK-DOMINANT GROUP: RESULTS WITHOUT THE VARIABLES OF UTILITY MODEL, ADVERTISEMENT RATIO, AND R&D INTENSITY

	Entire Period (1971-2010)		Period 1(1971-1986)		Period 2(1987-1998)		Period 3(1999-2010)	
VARIABLES	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM
Sales Growth(t-1)	-0.065***	-0.108	-0.185***	-0.253**	0.002	-0.019	-0.088***	-0.112
	(-20.555)	(-1.362)	(-5.195)	(-2.270)	(0.575)	(-0.826)	(-21.901)	(-1.113)
Sales Growth(t-2)	-0.009***	0.031	-0.073***	-0.030	-0.005**	-0.000	-0.020***	-0.005
	(-5.945)	(0.983)	(-2.897)	(-0.706)	(-2.420)	(-0.021)	(-9.743)	(-0.137)
Patent intensity(t-1)	1.302***	0.999***	-1.291	-1.900	0.314***	0.276*	1.260***	0.965**
	(27.756)	(3.420)	(-0.289)	(-0.909)	(3.737)	(1.658)	(21.733)	(2.530)
Trademark_intensity(t-1)	0.519***	0.390	0.545	0.447	0.106**	0.076	0.528***	0.424*
	(10.186)	(1.350)	(0.609)	(0.972)	(2.083)	(1.601)	(7.691)	(1.650)
Investment(t-1)	0.001*	-0.002	0.003	0.002	0.003***	0.001**	-0.001	-0.003***
	(1.654)	(-1.540)	(0.774)	(0.519)	(6.414)	(2.342)	(-0.931)	(-2.587)
Employees(t-1)	-0.176***	-0.260***	-0.250***	-0.202	-0.114***	-0.189***	-0.230***	-0.305***
	(-16.655)	(-3.422)	(-3.515)	(-1.355)	(-8.804)	(-4.061)	(-13.320)	(-2.619)
Firm Age(t-1)	-0.429***	-0.548**	-0.090	-0.891	-0.257***	-0.399**	-0.728***	-0.916
	(-15.510)	(-2.382)	(-0.247)	(-1.109)	(-7.110)	(-2.577)	(-14.864)	(-0.824)
Constant	2.348***		0.829		1.244***		3.363***	
	(26.387)		(0.522)		(10.996)		(23.244)	
Observations	44,716	40,105	1,106	786	9,214	7,439	29,195	24,853
R-squared	0.066		0.108		0.103		0.069	
Hausman test	937.91		62.88		139.2		1200.74	
AR(2)		0.075		0.376		0.54		0.255
Number of firms	4,481	4,192	320	235	1,754	1,269	4,299	3,970

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period and industry dummies are included, as well as a dummy for each of six ultra-large firms, such as Samsung, LG, Daewoo, POSCO, Hyundai, and Kia.

TABLE 2B

ROBUSTNESS CHECK ON THE IMPACT OF IPR REGISTRATION IN TRADEMARK-DOMINANT GROUP: RESULTS WITHOUT THE VARIABLES OF UTILITY MODEL, ADVERTISEMENT RATIO, AND R&D INTENSITY

	Entire Period (1971-2010)		Period 1(1971-1986)		Period 2(1987-1998)		Period 3(1999-2010)	
VARIABLES	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM	FE	SYS.GMM
Sales Growth(t-1)	-0.079***	-0.132*	-0.160***	-0.124**	-0.046***	-0.038***	-0.164***	-0.064
	(-12.616)	(-1.696)	(-5.837)	(-2.295)	(-3.692)	(-2.603)	(-19.136)	(-0.778)
Sales Growth(t-2)	0.039***	0.130	-0.037***	-0.102***	-0.022***	-0.036*	-0.030***	-0.121
	(14.117)	(1.131)	(-3.217)	(-3.225)	(-3.136)	(-1.901)	(-8.929)	(-1.495)
Patent intensity(t-1)	1.007***	1.142**	5.805	5.161	0.856	0.608	1.286***	1.002**
	(10.254)	(2.337)	(1.552)	(0.425)	(1.046)	(0.606)	(14.418)	(2.554)
Trademark_intensity(t-1)	0.816***	0.808	3.125***	3.820**	2.619***	2.521*	0.210***	0.143
	(20.481)	(1.232)	(13.991)	(2.098)	(24.400)	(1.894)	(4.770)	(1.448)
Investment(t-1)	0.004***	0.002	-0.002	-0.005	0.008***	0.008	0.001*	-0.000
	(5.196)	(1.289)	(-0.769)	(-0.882)	(4.892)	(1.354)	(1.697)	(-0.364)
Employees(t-1)	-0.053***	-0.074**	-0.042	0.005	0.030	-0.049	-0.070***	-0.080
	(-4.610)	(-2.004)	(-0.976)	(0.110)	(0.705)	(-0.273)	(-4.250)	(-1.321)
Firm Age(t-1)	-0.263***	-0.287	-0.417	-2.222	-0.500***	-0.502	-0.642***	-1.885**
	(-7.732)	(-0.639)	(-1.207)	(-0.728)	(-4.103)	(-1.572)	(-11.278)	(-2.346)
Constant	1.154***		1.637		1.154***		2.411***	
	(9.603)		(1.069)		(2.825)		(13.174)	
Observations	23,517	21,536	1,336	999	6,395	5,416	12,908	11,081
R-squared	0.057		0.267		0.116		0.076	
Hausman test	2614.35		128.88		619.04		3908.76	
AR(2)		0.15		0.283		0.931		0.493
Number of firms	1,903	1,780	334	266	962	813	1,813	1,675

Note: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Period and industry dummies are included, as well as a dummy for each of six ultra-large firms, such as Samsung, LG, Daewoo, POSCO, Hyundai, and Kia.

References

Allegrezza, S and Guard-Rauch, A. "The determinants of trademark deposits: an econometric investigation (a case study of the Benelux)." *Economie Appliquée* 52 (No. 2 1999): 51-68.

Amsden, Alice. *Asia's Next Giant: South Korea and Late Industrialization.* New York: Oxford University Press, 1989.

Block, J., Fisch, C., Hahn, A., Sandner, P. "Why do SMEs file trademarks? Insights from firms in innovative industries." *Research Policy* 44 (No. 10 2015): 1915-30.

Bosworth, D., & Rogers, M. "Market value, R&D and intellectual property: an empirical analysis of large Australian firms." *Economic Record* 77 (No. 239 2001): 323-37.

Choo, K., Lee, K., Ryu, K., & Yoon, J. "Changing performance of

business groups over two decades: Technological capabilities and investment inefficiency in Korean chaebols." *Economic development and cultural change* 57 (No. 2 2009): 359-86.

De Vries, Geertjan., Enrico Pennings, Joern H. Block & Christian Fisch. "Trademark or patent? The effects of market concentration, customer type and venture capital financing on start-ups' initial IP applications." *Industry and Innovation* 24 (No. 4 2017): 325-45.

Ernst, D., & O'connor, D. *Technology and global competition: the challenge for newly industrialising economie.* OECD, 1989.

Ernst, D. *What permits small firms to compete in high-tech industries? Inter-organizational knowledge creation in the Taiwanese computer industry,* DRUID, Copenhagen Business School, Department of Industrial Economics and Strategy/Aalborg University, Department of Business Studies, 1998.

Flikkema, M. J., de Man, A. P., & Wolters, M. "New trademark registration as an indicator of innovation: results of an explorative study of Benelux trademark data." *Research memorandum* 9 (2010): 1-53.

Greenhalgh, C., & Rogers, M. *Trade Marks and Performance in UK Firms: evidence of Schumpeterian competition through innovation*: Department of Economics, University of Oxford, 2007.

Hobday, M. "Export-led technology development in the four dragons: the case of electronics." *Development and Change* 25 (No. 2 1994): 333-61.

Hobday, M. "East Asian latecomer firms: learning the technology of electronics." *World development* 23 (No. 7 1995): 1171-93.

Hobday, M. "Innovation in Asian industrialization: a Gerschenkronian perspective." *Oxford development studies* 31 (No. 3 2003): 293-314.

Kang, R., Jung, T., & Lee, K. "Intellectual property rights and Korean economic development: the roles of patents, utility models and trademarks." Area Development and Policy 5 (No. 2 2020): 189 - 211.

Kang, R., Jung, T., & Lee, K. "Not patents but trademarks-based path of technological development of latecomers: Evidence from the Korean data." *The Singapore Economic Review* 67 (No. 3 2022): 1071-88.

Kim, L. *Imitation to Innovation: The Dynamics of Korea's Technological Learning.* Boston: Harvard Business School Press, 1997.

Kim, Y., & Lee, B. "Patterns of technological learning among the strategic groups in the Korean Electronic Parts Industry." *Research Policy* 31 (No. 4 2002): 543-67.

Kim, Y. K., Lee, K., Park, W. G., & Choo, K. "Appropriate intellectual property protection and economic growth in countries at different levels of development." *Research policy* 41 (No. 2 2012): 358-75.

Lee, K., & John A. Mathews, "6 South Korea and Taiwan," in Edmund Amann, and John Cantwell (eds), *Innovative Firms in Emerging Market Countries*. Oxford: Oxford University Press, 2012.

Lee, K. "How Can Korea be a Role Model for Catch-Up Development? A 'Capability-Based View," in Augustin K. Fosu (ed.), *Achieving Development Success: Strategies and Lessons from the Developing World, WIDER Studies in Development Economics*. Oxford: Oxford University Press, 2013.

Lee, K., Song, J., & Kwak, J. "An Exploratory Study on the Transition from OEM to OBM: Case Studies of SMEs in Korea." *Industry and Innovation* 22 (No. 5 2015): 423-42.

Lee, K., Szapiro, M. & Mao, Z. "From Global Value Chains (GVC) to Innovation Systems for Local Value Chains and Knowledge Creation." *The European Journal of Development Research volume* 30 (2018): 424-41.

Lee, K. *The art of economic catch-up: Barriers, detours and leapfrogging in innovation systems*. Cambridge: Cambridge University Press, 2019.

Lee, K., Kang, R., & Park, D. "How Industrial Design Matters for Firm Growth at Different Stages of Development: Evidence from Korea, 1970s to 2010s." *Asian Economic Journal* 36 (No. 2 2022): 101-26.

Levitt, T. "Innovative imitation." *Harvard business review* 44 (No. 5 1966): 63-70.

Malmberg, C. *Trademark statistics as innovation indicators?-a micro study*, CIRCLE Electronic Working Paper Series 17, 2005.

Mendonça, S., Pereira, T. S., & Godinho, M. M. "Trademarks as an indicator of innovation and industrial change." *Research Policy* 33 (No. 9 2004): 1385-1404.

Mehrazeen, A. R., Froutan, O., & Attaran, N. "Establishing the relationship between trademark valuation and firm performance: evidence from Iran." *International Journal of Economics and Finance* 4 (No. 6 2012): 181.

OECD. *Technology and Economy: The key Relationship*. Paris: OECD, 1992.

Romijn, H. *Technological Learning in Small Firms: A Quantitative Analysis. In: Acquisition of Technological Capability in Small Firms in Developing Countries*. London: Palgrave Macmillan, 1999.

Sandner, P. G., & Block, J. "The market value of R&D, patents, and trademarks." *Research Policy* 40 (No. 7 2011): 969-85.

Schmoch, U. "Services marks as novel innovation indicator." *Research Evaluation* 12 (No. 2 2003): 149-56.

Shin, W. K. Lee and W. Park. "When an Importer's Protection of IPR Interacts with an Exporter's level of Technology: Comparing the Impacts on the Exports of the North and South." *World Economy* 39 (No. 6 2016): 772-802.