Does Market Competition Stimulate Innovation?
: Evidence from Korean Firms

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Abstract

This paper empirically investigates whether or not for relationship between innovation activity and competition of Korean manufacturing firms listed on Korea stock exchange market (KOSPI). This paper use patent activity data as proxy for innovation and also industry adjusted price-cost margin and HHI as product market competition measure for the period 1981-2014. We match innovation data from Korean intellectual property office and financial data. In previous paper, there are two competition views which are positive and negative relationship between competition and innovation, and one mixed view which is positive relation from escape competition effect and negative relation from Schumpeterian effect. This paper examines two possibilities that my overturn trade off.

Keyword: Innovation, Patent, HHI, PCM

1. Introduction

This paper investigates the relationship between competition and innovation for the Korean manufacturing firms listed in the Korea stock exchange market (KOSPI). Innovation is a core driver of improving sustainable growth of firm, but very difficult to implement in real situation. Study on relationship between competition and innovation has long been of interest to economists and motivated numerous studies, both theoretical and empirical, over the past three decades (Grossman and Helpman, 1991; Cameron, 1991; Cameron and Trivedi, 2005). In this paper, we attempt to provide empirical explanation based on model and new empirical evidence relating market competition to the nature of innovation activity for Korean manufacturing firms.

We acknowledge that innovation could be crucial for firm survival. Exploration and development of new products and processes from innovation help firms to access new markets and sources of value. Innovation, however, is a high risk activity and therefore requires commitment of a firm's resources and managerial talent. In order to develop and advance more, firms should have innovation in all fields relating to firm's activities.

The linkage between competition and innovation is faced in very controversially theoretical and empirical issues. Is competition conducive or detrimental to innovation? There have been two competing views on the relationship between competition and innovation, which are creative destruction called Schumpeter's view and fitted survival called Darwin's view. On the one hand, with starting, Schumpeter (1934) claims that competition stimulates innovation. This view is theoretically supported by studies from Arrow (1962) and Scherer (1980). On the other hand, Schumpeter (1942) posits that higher competition discourages innovation by diminishing monopoly rents. By contrast, Aghion, Harris, Howitt and Vickers (2001) assert that competition may foster innovation as firms attempt to escape competition. Based on this conjecture, some empirical studies find an inverted U pattern between competition and innovation (Aghion and Griffith, 2005; Aghion, Bloom, Bludell, Griffith, and Howitt, 2005).

Generally economic theory documents that competition brings about allocative efficiency gains by forcing price to converge to marginal cost. This implies that firms subject to intense competition will take advantage on any opportunity to produce as long as price exceeds marginal cost.

Recently Aghion, Bloom, Blundell, Griffith and Howitt(2005) find that using the UK data, the relationship between competition and innovation is an inverted-U shape. In line with this result, a trade-off between both drivers of productivity may exist (Boone, 2000). Also innovation and competition can be at odds with each other when focused on realizing higher productivity. This implies that stimulating competition beyond a certain level might have a negative effect on innovation, and subsequently on productivity. Aghion et al. (1997, 2001) and Aghion and Howitt (2009) suggest step-by step innovation models. These models predict that competition stimulate innovation in neck-and-neck firms at the same technological level. For these firms, high competition reduces pre-innovation rents, thereby increasing the incremental profits from innovation. This is called as the escape-competition effect. On the other hand, these models also predict a negative the relationship between competition and innovation. That is, increased competition reduces the post-innovation rents of laggard firms in unlevered industry and thus their incentive to catch up with the leader. This is known as Schumpeterian effect. This explanation is able to explain an inverted-U relationship between competition and innovation, wherein an escape competition effect initially dominates until competition reaches a sufficient level at which the rent dissipation effect thereafter prevails.

For Koran firms, empirical evidence for relationship between innovation and competition is scarce. Especially there is no study using patenting activity as innovation in Korea. Korea is the highest ranking R&D expenditure country among worldwide countries. This is first study by using patenting activity data in examining between innovation and competition even though Jung, Baek, Jung, and Lee (2014) study this relationship using R&D intensity as innovation and find U relationship between competition and innovation in high technology industries. We securitizes in detail to find ambiguous connection between competition and innovation by using patenting activity as firm innovation.

This paper contributes to the empirical literature on relationship between innovation and competition in different ways. First, it examines the existence of an inverted-U curve between innovation and competition for the Korean manufacturing Industry based on Korea standard industry classification 9th (KSIC). Second, compared to Jung et al. (2014), we use better measures for innovation as patent activities. By contrast to Jung et al. (2014), our study analyzes the entire economy, whereas Jung et al. (2014) only look at high technology industries.

If we find the inverted U curve, this finding is inconsistent with empirical result of Jung, Baek, Jung, and Lee (2014) which use R&D intensity as innovation and find U shape relationship between competition and innovation for the high technology industries.

The rest of this paper is organized as follows. Section 2 gives a brief theoretical and empirical background of the relationship between innovation and competition. In section 3, we provide how to measure innovation and competition. In section 4, sample and its statistics are provided. In section 5, empirical analyses are provided and also results are interpreted and compared to the result of other study. In section 6, it is reached to conclusion and implication is provided.

2. Literature Review and Hypothesis Development

For a long time, whether or not competition raises innovation has been an ongoing debate and a challenging an important topic since Schumpeter's remarks (1934, 1942). Economic theory did not provide the empirical and theoretical findings clearly even though many studies have tried to take into account the relationship between innovation and competition. Predictions of theoretical models are mixed about the question on innovation and competition.

Schumpeterian view of market competition and innovation documents that competition is rather detrimental to innovation and technological progress. This implies that if firms in more concentrated industry are more active in innovative activities because of less market uncertainty and more profits, competitive pressure would reduce their incentives to invest in R&D activity.

Using a Schumpeterian endogenous growth model, Aghion and Howitt (1992) show that an increase in product market competition has a negative effect on productivity growth by reducing the monopoly rents that reward innovation. This result is consistent with Romer (1990) and Grossman and Helpman (1991). This empirical result is also supported by Hamber (1964), Mansfield (1964), Kraft (1989), Porter (1990), and Symeonidis (2001). The intuition of this finding is that because the expectation of high profits drives innovation, an increase in competition will discourage innovation if it results in lower profits.

With competing view, competition forces firms to innovate in order to survive. Recent empirical studies provide positive relation between market competition and productivity growth or innovation. This logical reason is theoretically supported by studies from Schumpeter (1934), Arrow (1962), and Scherer (1980). In line with this view, it is thought that competition stimulates an incumbent to innovate otherwise the firm is forced to leave the market and the potential entrant will win the race.

This entrant will win this race if the replacement effect for the incumbent is stronger than its efficiency effect (Arrow, 1962). When the incumbent innovates, the incumbent monopolist replaces its own profits while the potential entrant has no pre profits to replace at all. Aghion and Howitt (1999) suggest these mechanisms in a theoretical model. That is, more intense competition raises innovation activities, because it reduces incumbent's pre-innovation profits more than it lowers its post innovation profits. The empirical evidence for supporting this view is more dominated than first view. Geroski (1990), Nickell (1996), Blundell, Griffith and van Reenen (1995), Blundell, Griffith and van Reenen (1999), and Carlin, Schaffer and Seabright (2004) provide a positive relationship between competition and innovation.

Aghion and Howitt (1998) and Aghion et al. (1999) offer theoretical prediction where competition is indeed conducive to innovation and growth through Darwinian effect, neck-and-neck competition, and mobility effect. Intense market competition forces managers to adopt new technologies to avoid loss of control rights due to bankruptcy. Therefore, firms should innovate to survive under competitive pressure (Porter, 1990).

Neck-and-neck competition implies that in a model of creative destruction, the incumbent firms unlike new entrants have no incentives to innovate. With incumbent firms engaged in step-by-step innovative activities, market competition could increase innovation. More intensive market competition between firms with neck-and-neck technologies will increase each firm's incentive to acquire or increase its technological lead over its rivals. Mobility effect says that in the learning-by-doing model of endogenous growth, the steady state rate of growth may be increased if skilled workers become more adaptable in switching to newer production lines. In this case, more competition between new and old production lines will induce skilled workers to switch from old to newer lines more rapidly (Aghion and Howitt, 1996).

In another view, both a positive and a negative relationship between competition and innovation are shown in recent literatures. That is, the linkage between competition and innovation might be characterized as an inverted-U curve. Aghion et al. (2005) develop a model with reconciling theory and empirical evidence. This model provide a reasonable intuition that low (high) levels of competition have a positive (negative) effect on innovation, suggesting an inverted-U shape.

In order to explain this fact, there are two types of competition effect on innovation, which are escape-competition and Schumpeterian effect. In low level of competition, the escape competition effect dominates. Increasing competition will raise the incentive of neck-and-neck firms to innovate because firms become the single leader if they innovate while pre-innovation profits are decreased. However, if market competition further intensifies, the balance between the two effects is changed. Eventually the Schumpeterian effect will dominate. This fact generates the negative part of the inverted-U curve between competition and innovation. Competition intense reduces the post innovation rents for laggard firms to become neck-and-neck with the leader again.

As a result, the inverted-U curve arises due to a change in the composition of firms. Aghion et al. (2005) suggest the idea of neck-and-neck industries where the difference in performance is small across firms as they have the same technology, whereas in leader-follower industries firms have different technologies and different productivity levels. Due to more neck-and-neckness, the inverted U shape becomes steeper as the escape competition is larger. That is, initially when competition is low, industries are most often leveled. If competition increases, firm become more frequently unleveled, whereas the chance that they become leveled again reduces as for laggards it is increasingly difficult and costly to catch up. Then, when competition is really higher, industry will be remained in leveled situation. Consequently, as the innovation is lower in unleveled situations, beyond certain level of competition, innovation will be reduced, which generates the inverted U shape between competition and innovation. This explanation is in line with trade-off between process and product innovation when competition raised (Boone, 2000).

The empirical evidence for an inverted U curve between competition and innovation is rarely. Scott (1984) and Kilponen and Santavirta (2007), and Aghion, Bechtold, Cassar, and Herz (2014) provide a significant evidence of the inverted U curve. For Korean manufacturing firms, Jung et al. (2014) find the U shape curve. Reason is that Korea's condition of initial competition is showing unlevelled industry because of technology gap between large firms and SMEs. Therefore, Schumpeter effect happens first at the initial condition of competition. As competition increases, escape effect dominates. This result is inconsistent Aghion et al. (2005). Similary, Aghion et al. (2005) do not find a statistically significantly inverted U-shape when they use R&D expenditures as indicator for innovation. Tingvall and Poldahl (2006) find strong support for the inverted-U relationship using Herfindahl-Hirschman index(HHI). However, if this concentration indicator is replaced by PCM(Price-Cost-Margin), then they do not find support for this relationship. As a result, these findings depend on types of innovation and competition measure. Lee (2005) finds that a positive relationship is predicted for low-appropriable industries, where market concentration supplements low R&D appropriability, while a negative or an inverted U-shape relationship for high-appropriable industries using five digit KSIC level.

3. Measuring Innovation, Competition and Model

3.1 Measuring Innovation

In this paper, we use three proxies for firm's innovation. First, as previous researchers used, we use number of patient right as logarithm of number of patent right. In previous papers, R&D intensity and patenting activity are the most commonly used measure for innovation. Second, in contrast to Aghion, et al. (2005), following Gu(2005), we use the average size-weighted number of patent activity taken out by firms in an industry as innovation activities, and to reflect the heterogeneous value of patents depending on firm size as total asset. We weight each patent by the total asset it has been used in business operating. This measure is similarly to Aghion, et al. (2005), but different because we do not observe patent data cited by another patent in real situation. We compute the average size-weighted number and sale-weighted number of patent as follows:

$$APIndex_{i,t} = \left(\frac{Asset_{i,t}}{\sum_{i=1}^{N} Asset_{i,j,t}} \right) \times \sum Patent_{i,t} \quad (1)$$

$$SPIndex_{i,t} = \left(\frac{Sale_{i,t}}{\sum_{i=1}^{N} Sale_{i,j,t}} \right) \times \sum Patent_{i,t} \quad (2)$$

3.2 Measuring Competition

In many empirical papers, the ambiguous empirical results with regard to competition may partly be related to doubtful indicators for competition like how to measure competition.

In this paper, due to robustness of empirical result issue, we use several market competition measures which are c as PCM (price-cost-margin), EPCM(excess PCM) based on PCM, and HHI(Herfindahl-Hirschman Index) as market concentration (Datta, Iskandar-Datta, and Sharma, 2011; Aghion et al., 2005 and Nickell, 1996). Aghion et al. (2005) document that this indicator of product market competition has several advantages over indicators such as market share or the Herfindahl-Hirschman concentration index (hereafter HHI). As Aghion et al. (2005) acknowledge, these other measures rely more directly on precise definitions of geographic and product markets, which is particularly difficult in this paper, many Korean manufacturing firms operate in international markets and also Korea is export-orientated country, which means competition in international market, so that market concentration measures based only on Korean firm data may be extremely misleading.

We use the excess price-cost margin (EPCM) (Lindenberg and Ross, 1981; Nickell, 1996; Aghion et al., 2005; Gaspar and Massa, 2006; Datta, Iskandar-Datta, and Sharma, 2011). PCM is defined as operating income before depreciation over sales and PCM formula is as follows:

$$PCM_{i,t} = \frac{Sales_{i,t} - CoGS_{i,t} - SG\&A_{i,t}}{Sales_{i,t}} \tag{3}$$

Sales are total sale, and CoGS is cost of good sold, and SG&A is selling, general and administration expenses. Higher PCM value means less competition in each industry. Note that PCM can take any value from zero to one, with higher values indicating that firms enjoy larger market power.

Our main measure of competition related to PCM is computed as the average of PCM across all firms in a KSIC industry j, as in Aghion et al. (2005).

$$c_{j,t} = \mathbf{1} - \frac{\mathbf{1}}{N_{j,t}} \sum_{i \in j} PCM_{i,t} \tag{4}$$

where $c_{j,t} \in [\mathbf{0},\mathbf{1}]$ is industry adjusted Lerner index, with higher values of index $c_{j,t}$

indicating stronger competition in the industry and $N_{j,t}$ is the number of firms in industry j at year t. In computing this index, as in Aghion et al. (2005), we use the entire sample of Korean stock exchange market listed firms in each industry.

Also Datta, Iskandar-Datta, and Sharma (2011) insist that PCM does not isolate the firm-specific factors that influence product market pricing power from industry-wide factors. That is, because the PCM metric can fluctuate due to industry-specific attributes that are unrelated to a firm's market pricing power. Following Datta, Iskandar-Datta, and Sharma (2011), Aghion et al.(2005), and Gaspar and Massa (2006), we employ the industry value-weighted Lerner Index to capture firm-specific product market competition by subtracting the sale-weighted PCM of all firms within the industry from the PCM as excess price-cost margin (EPCM) as the industry value-weighted Lerner Index.

$$EPCM_{i,t} = PCM_{i,t} - \sum_{i=1}^{N} \omega_{i,t} PCM_{i,t} \tag{5}$$

where $\omega_{i,t}$ is the proportion of sales of firm i to each industry sales at t, and N is the total number of firms in the KSIC code industry in Korea. As a result, EPCM is defined as the difference between a firm's PCM and the value-weighted average PCM of its industry. We control for industry PCM in order to account for inter-industry differences unrelated to market power. A greater value of EPCM indicates a greater ability to extract profits and, hence, a lower intensity of competition. EPCM captures purely the intra-industry market power of a firm based on firm-specific factors, therefore, distilling the effects of industry-wide effects common to all firm a specific industry rom firm-specific factors.

Our second proxy for the intensity of competition is Herfindahl-Hirschman Index (HHI). A higher HHI implies less competition. The HHI is a widely used proxy for competition that is well grounded in industrial organization theory (Tirole, 1988). HHI is measuring industry concentration and calculated as the sum of the squares of the market shares of the firm's sales within an industry. In this paper, we compute HHI measure at the end of each fiscal year. HHI, which contains information of market share of all firms in the industry, is decreasing in the number of competitors and increasing with the variability in firm sales market share within the industry. HHI is measured as follows:

$$HHI_{j,t} = \sum_{i=1}^{N} \left(\frac{Sales_{i,t}}{\sum_{i=}^{N} Sales_{i,j,t}} \right)^{2} \qquad (6)$$

where $Sales_{i,t}$ is the sales market share of firms i in industry j, and N is the number of firms in industry j computed as of the fiscal year end.

3.3 Model specification and estimation

We setup empirical model to find the linear or nonlinear relationship (inverted U-shape) between competition and innovation as we mentioned above. Following Aghion et al. (2005), we specify two models as linear and nonlinear model. First, we implement to test empirical linear model to confirm the effect of competition on the innovation activity in firms as follows:

$$Innovation_{i,t} = \alpha + \beta_1 Competition_{i,t} + \sum \beta X_{i,t} + \varepsilon_{i,t} \qquad (8)$$

where innovation is used as two alternative measures such as patent index based on firm size and excess patent index based on industry adjusted patent. X is a vector of control variables including firm size as logarithm of total asset, capital intensity as (K/L)*market share of sale (K=fixed asset, L=the number of worker employed), leverage as ratio of total debt to total asset, risk (std. of sale scaled by total asset), nominal labor productivity as sale per employee (S/L) (S=total sales, L=the number of employees), industry operating profit ratio as operating profit over sales, industry foreign export ratio, as in Jung (2014) and Lee (2005). Also we include foreign ownership as in Cantwell (1992), Tingvall and Poldahl (2006).

Second, we specify the nonlinear model to find the inverted-U shape found in Aghion et al. (2005) as follows:

$$Innovation_{i,t} = \alpha + \beta_1 Competition_{i,t} + \beta_2 Competition_{i,t}^{2} + \sum \beta X_{i,t} + \varepsilon_{i,t} \qquad (9)$$

Additionally, we divide all firms into two subsamples as dominant and non-dominant and find the effect of competition on the innovation activity for each subsample. As Aghion et al. (2005) mentioned in explaining the result of inverted-U shaped relation between competition and innovation using theoretical model, there is a different innovation pattern on competition from current leaders as dominant and their followers (laggard firms) as non-dominant in product market, and also all occur step-by-step. To show this fact, we do implement using two subsamples. In this paper, dominant firms are defined as firms above median value of sale for firms in each industry, otherwise non-dominant firms.

In estimating the empirical model, we adopt various estimation methods as Poisson regression, sys-GMM(system GMM), fixed effect regression to control firm and time effects, and Tobit regression. Because variation of patent across firms and industry is higher, to reduce the effect of outlier in model, we adopt a Tobit regression technique as in Geroski (1990).

Following Aghion et al. (2005), we use Poisson regression to estimate empirical model. We adopt a set of policy instruments that provide exogenous variation in the degree of industry wide competition as in Aghion et al. (2005) because competition and innovation are mutually endogenous. Thus, we include the industry and time effects in model to control endogenous problem between competition and innovation. As a result, this approach identifies the competition effect through the differential timing of the introduction of policy changes across industries.

To check the robustness of empirical result above, additional we adopt the system generalized method of moment estimator (SYS-GMM) which is two-step GMM estimation method to avoid the endogenous by using instrument variables. The reason is that competition might even be endogenous due to reverse causality with innovation.

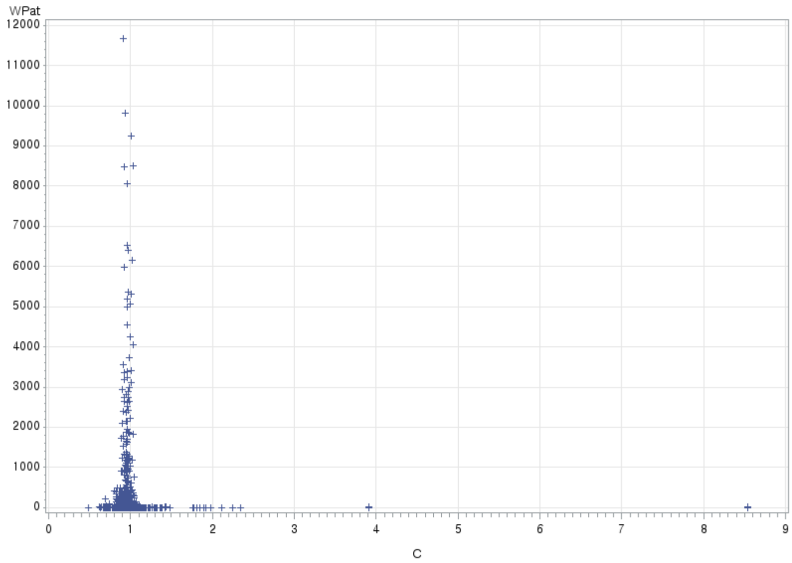
4. Sample and statistics

4.1 Sample

This study uses panel data set of Korean nonfinancial firms listed on the Korean Stock Exchange (KSE). We employ two data sources in our empirical tests. First, it is the Korea intellectual property rights information service (KIPRIS) provided by the Korean intellectual property office (KIPO). It provides intellectual property rights including patent rights, design rights and trademark rights of firms. We use to construct samples of Korean nonfinancial firms listed on the Korean stock exchange (KSE) with number of patient right. Second, it is DataGuide which is both primary sources of financial data and firm information we employ in our analysis. The final sample consists of panel data of total firms over period of 1981 to 2014.

To measure innovation, following Aghion, et al. (2005), we use the average number of patent activity taken out by firms in an industry as innovation activities, and to reflect the heterogeneous value of patents depending on sale and firm size, we weight each patent by the sale and total asset it has been used in business operating.

<Figure > Scatter plot between Patent activity and market competition C(PCM)



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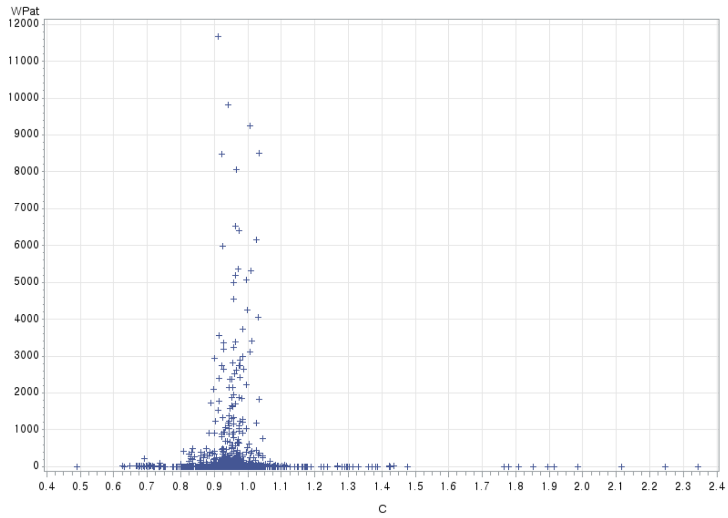
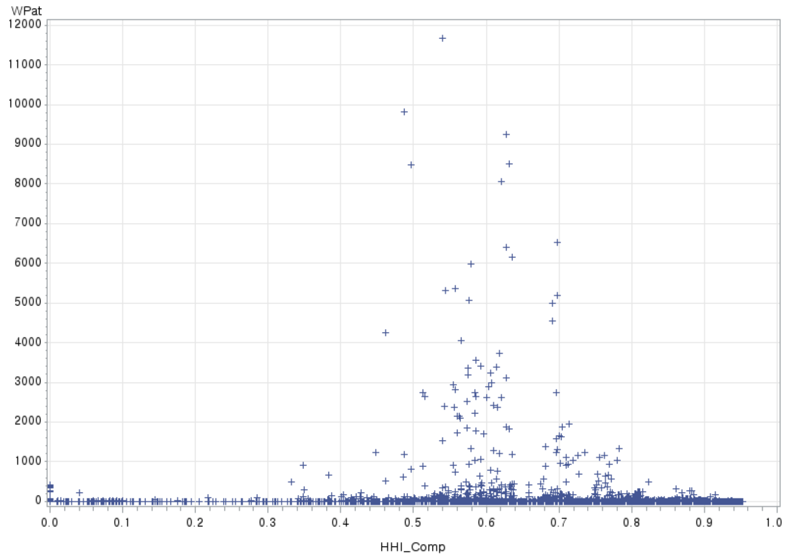


<Figure > Scatter plot between Patent activity and market competition HHI



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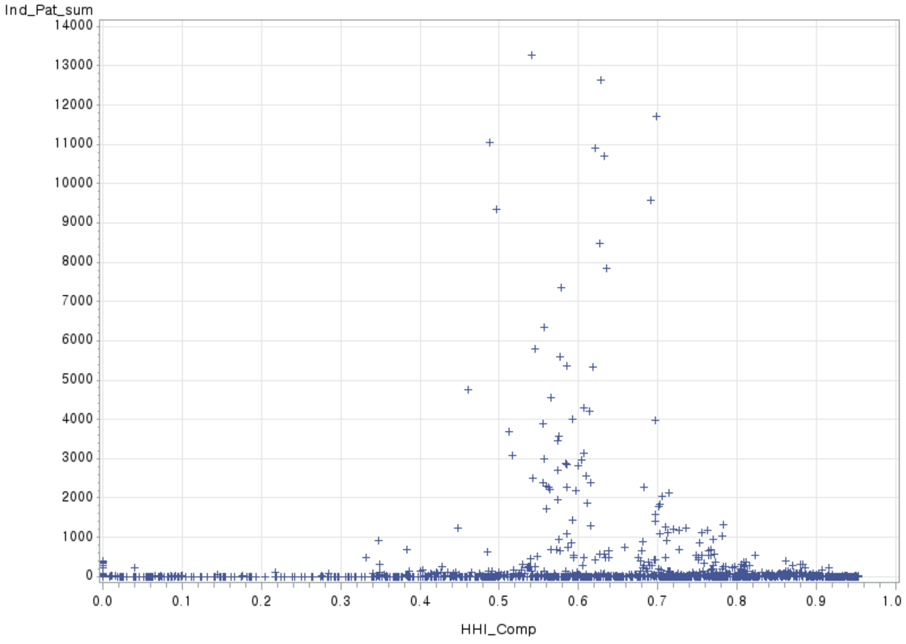


<Table > Pearson Correlation of competition and patent

	C(PCM)	1-HHI	Number of Patent	Industry Sale Adjusted Patent
1-HHI	0.678			
	(<.0001)			
Number of Patent	0.027	0.054		
	(0.0004)	(<.0001)		
Industry Sale Adjusted Patent	0.114	0.218	0.245	
	(<.0001)	(<.0001)	(<.0001)	
Industry Size Adjusted Patent	0.018	0.053	0.930	0.198
	(0.0227)	(<.0001)	(<.0001)	(<.0001)

<Table > Number of Patent by Korea Standard Industry Classification

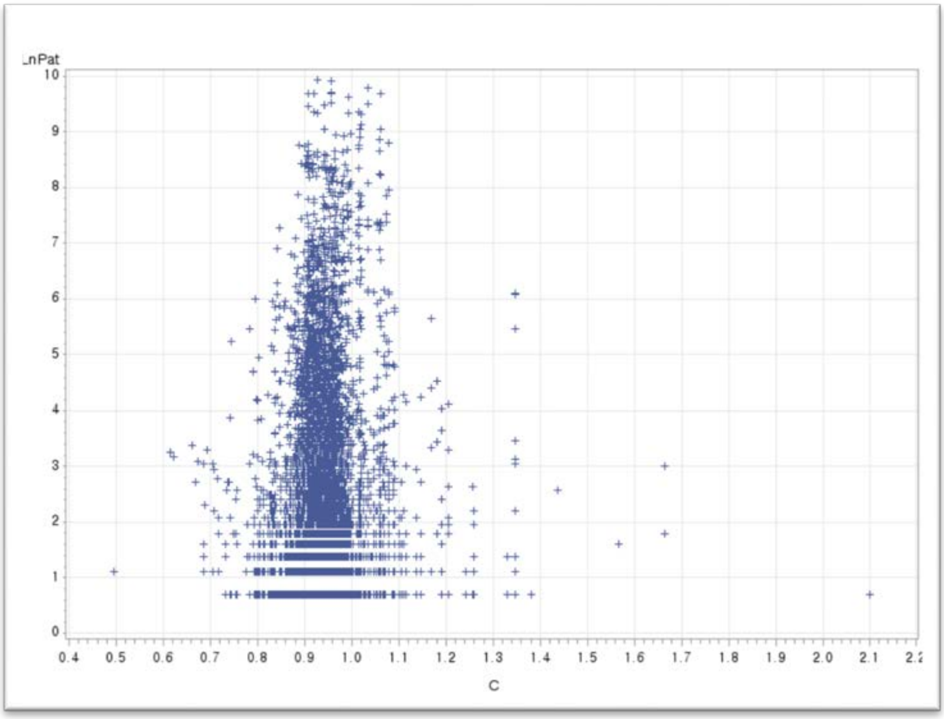
Industry	Industry Name	Obs.	Patent Mean	Patent Median	Patent S.t.d.
3		120	0.475	0.000	1.847
5		30	0.000	0.000	0.000
10		873	3.099	0.000	7.105
11		144	1.410	0.000	2.319
12		20	13.200	14.000	8.835
13		371	5.755	0.000	24.463
14		370	1.297	0.000	4.937
15		121	0.091	0.000	0.342
16		81	0.568	0.000	0.999
17		536	0.433	0.000	1.606
19		117	0.427	0.000	1.379
20		1542	23.019	0.000	153.732
21		999	3.140	1.000	6.208
22		466	12.953	1.000	48.651
23		598	2.306	0.000	6.841
24		1184	39.040	0.000	246.214
25		165	2.182	0.000	3.999
26		991	470.199	1.000	1900.477
27		118	22.602	4.000	39.966
28		443	98.348	2.000	369.693
29		778	29.933	2.000	88.012
30		961	182.039	1.000	1217.516
31		175	210.451	50.000	473.421
32		106	5.651	3.000	7.310
33		29	0.690	0.000	0.967
35		266	1.782	0.000	3.380
41		825	5.962	0.000	19.387
42		51	29.373	7.000	45.141
46		1076	1.996	0.000	8.420
47		280	0.221	0.000	0.709
49		253	0.067	0.000	0.377
50		126	0.000	0.000	0.000
51		54	0.741	0.000	1.519
52		110	0.518	0.000	1.470
56		15	0.133	0.000	0.352
58		104	7.288	2.000	15.205
59		50	1.380	0.000	4.793
60		70	1.486	0.000	3.101
61		70	335.843	231.500	349.049
62		180	8.522	0.000	25.912
63		44	41.364	1.000	78.428

68		29	0.793	0.000	2.366
69		17	0.235	0.000	0.664
71		1437	22.358	1.000	62.488
72		108	9.324	6.000	15.668
73		34	0.147	0.000	0.436
75		96	7.750	0.000	17.636
85		17	2.294	1.000	3.368
91		67	0.000	0.000	0.000
96		25	123.200	52.000	156.272

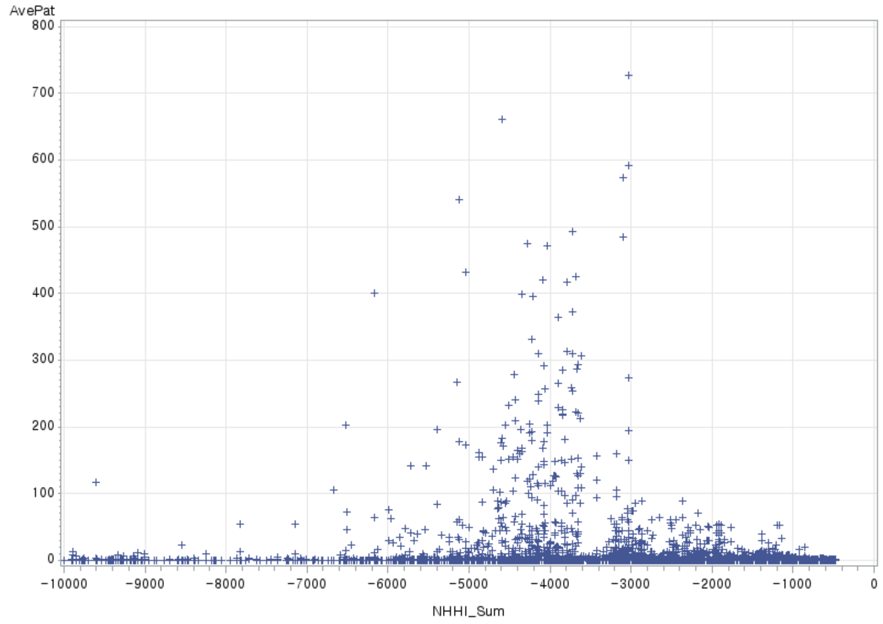
<Table> Summary of basic statistics

변수	Obs.	Mean	Median	Std.	Min	Max
C(PCM)	16,704	0.944	0.943	0.061	0.491	2.345
HHI	16,741	0.250	0.203	0.196	0.047	1.000
Patent	16,742	54.995	0.000	570.805	0.000	20,467.000
Ind. Sale Adj. Patent	16,742	569.930	20.277	1,748.020	0.000	13,261.300
Ind. Size Adj. Patent	16,742	19.077	0.000	265.683	0.000	11,672.480

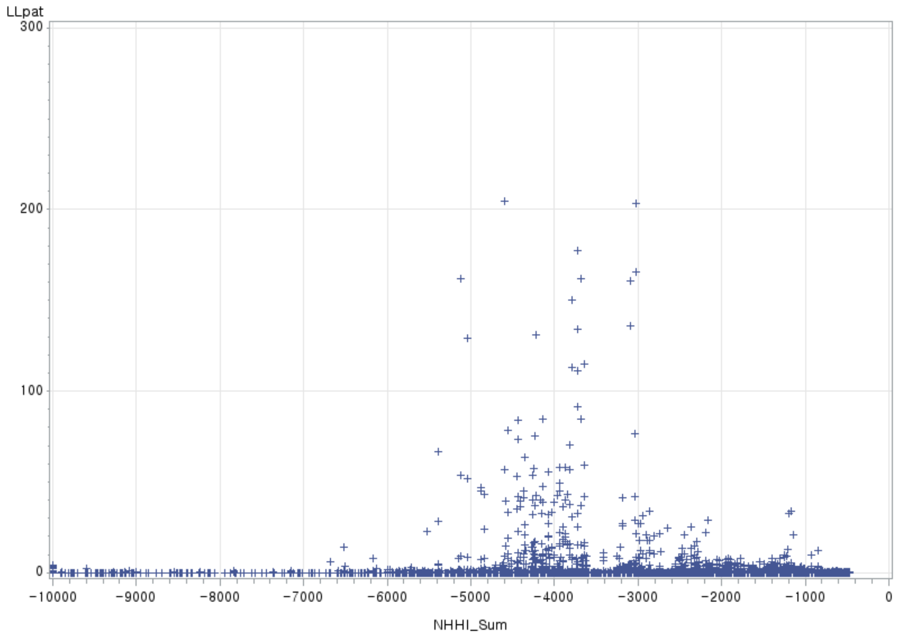
<Figure > Scatter plot between Patent activity and market competition C(PCM)



<Figure > Scatter plot between Patent activity and market competition NHHI



<Figure > Scatter plot between Patent activity and market competition NHHI



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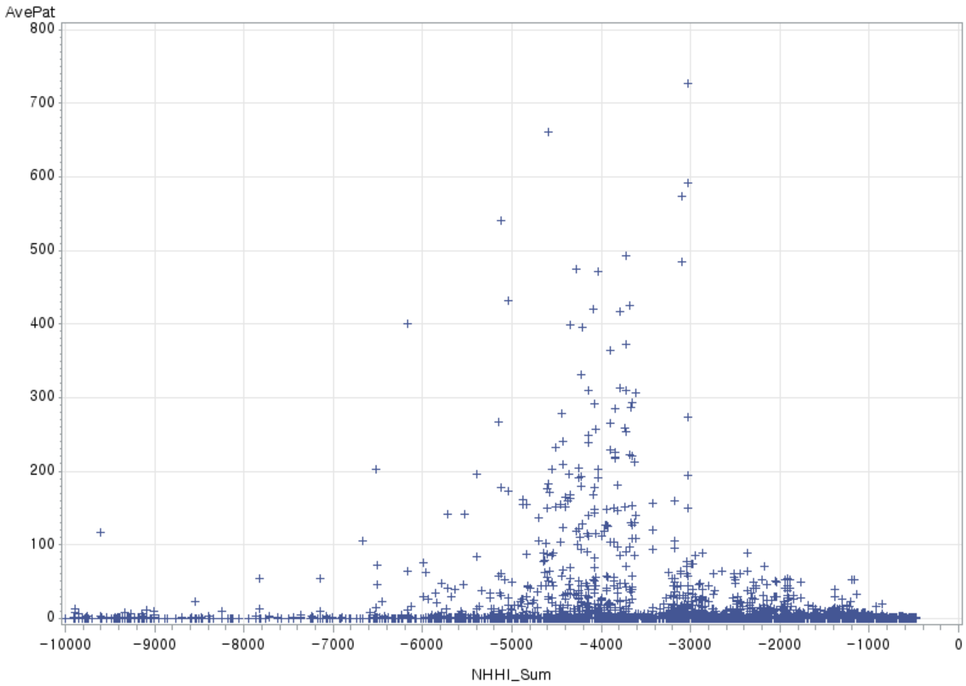

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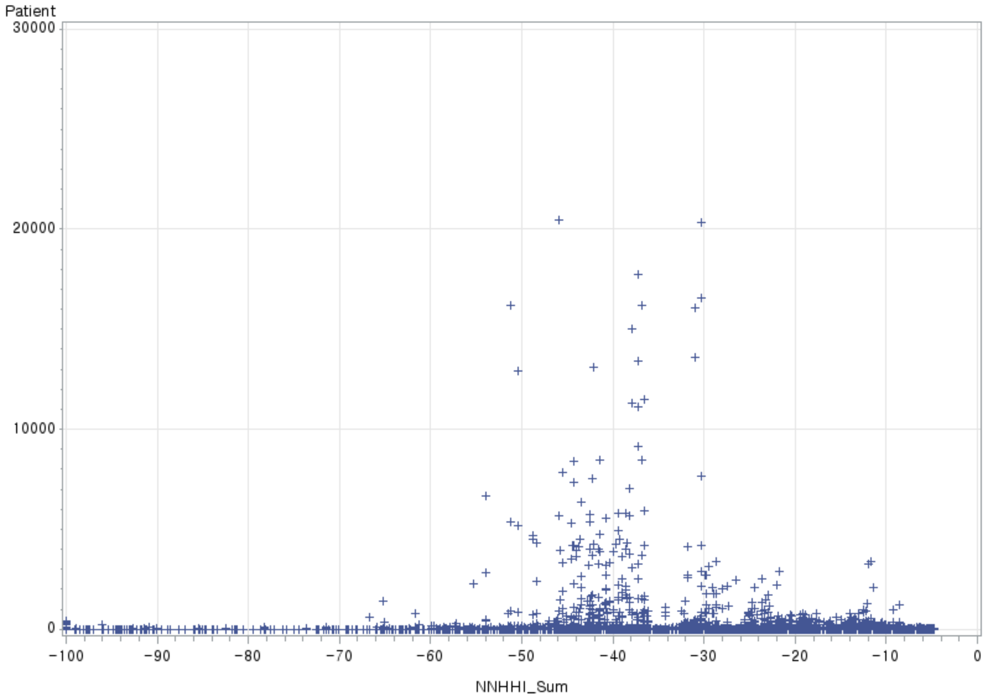

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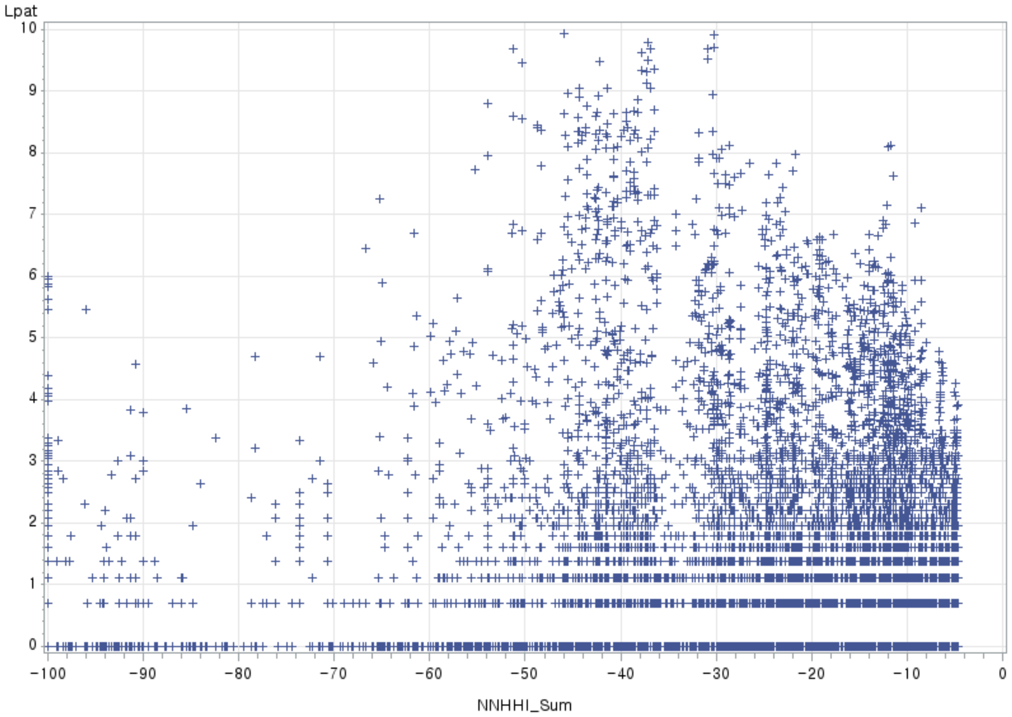

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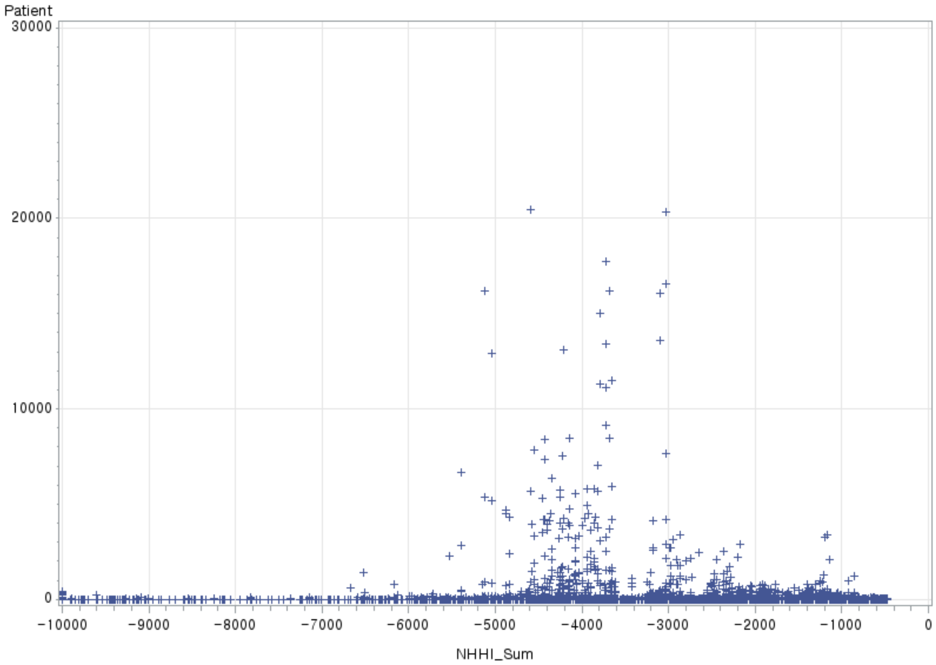
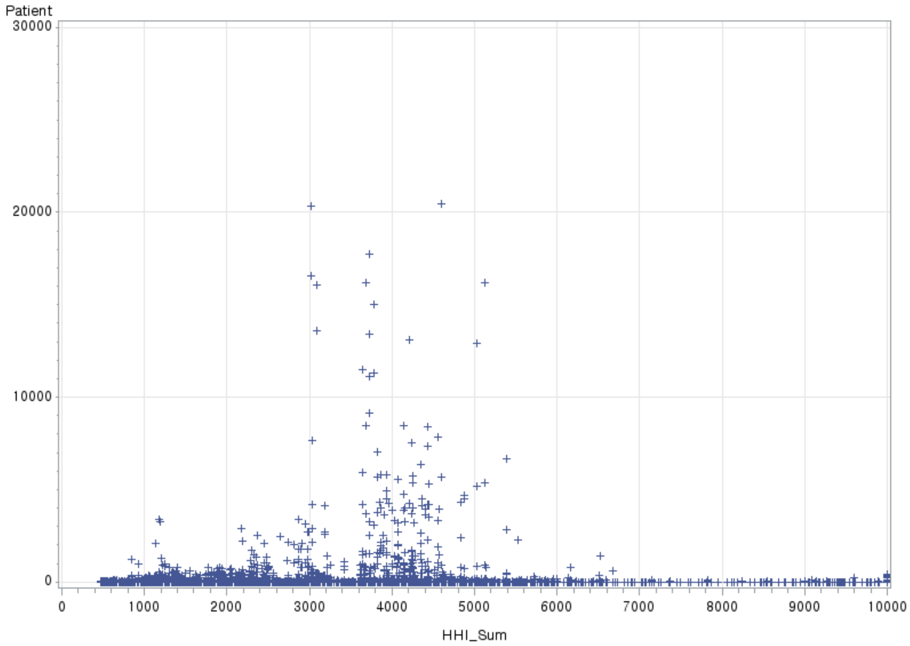

Patient
30000
20000
10000
0
−10000
−9000
−8000
−7000
−6000
−5000
−4000
−3000
−2000
−1000
0
NHHI_Sum


Patient
30000
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HHI_Sum

Empirical Analysis

<Table > OLS Result from PCM

	Dependent: Firm Size Weighted Patent				Dependent: Industry Sale Weighted Patent			
	Model 1		Model 2		Model 3		Model 4	
Intercept	-53.932	***	-220.255	**	-2527.125	***	-9200.738	***
	(-1.68)		(-2.52)		(-12.07)		(-16.18)	
PCM	77.180	**	384.400	**	3282.841	***	15610.000	***
	(2.28)		(2.50)		(14.82)		(15.58)	
PCM_Squ			-138.210	**			-5545.560	***
			(-2.05)				(-12.61)	
F-value	5.19		4.69		219.66		190.43	
Adj.Rsqu	0.0003		0.0004		0.0129		0.0222	

Notice: * and ** denote significant at 1%, 5%, respectively

<Table > OLS Result from HHI

	Dependent: Firm Size Weighted Patent				Dependent: Industry Sale Weighted Patent			
	Model 1		Model 2		Model 3		Model 4	
Intercept	1.146		-32.956	***	82.565	***	-999.946	***
	(0.34)		(-6.45)		(3.86)		(-32.25)	
HHI	71.631	***	325.256	***	1946.896	***	9997.813	***
	(6.83)		(10.60)		(28.88)		(53.67)	
HHISqu			-291.177	***			-9242.920	***
			(-8.80)				(-45.98)	
F-Value	46.69		62.14		834.27		1526.7	
Adj.Rsq	0.0027		0.0073		0.0474		0.1542	

Notice: * and ** denote significant at 1%, 5%, respectively

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