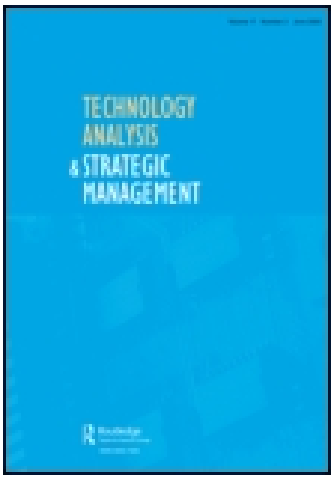

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The effect of a firm's strategic innovation decisions on its market performance

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The effect of a firm's strategic innovation decisions on its market performance

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Until recently, different types of innovation strategy have been introduced in innovation studies. However, their effects on firms' market performance have been underexplored. To overcome this limitation, we empirically examined the effect of different innovation strategies on firms' market performance using the panel data for 2496 firms obtained from Korea Innovation Survey (2010). In doing so, we categorise firms depending on whether their products are new to the firm or to the market and whether they are incremental and radical, giving us a 2×2 matrix of innovation strategy. We found that, in high-tech industries, an innovation strategy of 'new product targeting existing markets' and 'improved product targeting new markets' was less effective for increasing sales growth than 'improved product targeting existing markets'. However, in the case of medium-high tech industries, an innovation strategy of 'new products targeting existing markets' was the most effective strategy.

Keywords: innovation strategy; market performance; imitative innovation; creative imitation; existing products for new markets

1. Introduction

Innovation in the high-tech industry has been a concern to academic scholars as well as practitioners for many years. Despite this, ever since Schumpeter (1942), defining 'newness' in innovation has been one of the most prominent questions for academia as well as for corporate entrepreneurs. In addition, determining where to place priority has also been a topic of interest, particularly whether to develop a new product for an existing market or move to a new market. Many scholars have addressed these questions as well as endeavoured to explain the types of innovation. For example, Christensen (2002) argued that not all new products were innovative, and products that were consumer-oriented were more innovative. Also, innovative corporations generally attempt to rapidly expand the horizon of their businesses by creating new markets and ecosystems, rather than just pursuing technological breakthroughs. An example is the Galaxy S, the smartphone

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manufactured by Samsung Electronics, which is a globally successful model, even though it is not a new product in the smartphone market. Google is looking into the automobile industry and Microsoft is venturing into the nuclear power generation business. Another example is the way in which Apple incorporated a data processing device into mobile phones to pioneer a new smartphone market.

These examples go beyond the previous dichotomous perspective, which distinguished only between newness of products or markets, to a new perspective where coordination between products and markets is the key factor for successful innovation (Bores, Saurina, and Torres 2003; Islam and Miyazaki 2009). In other words, through market fusion and redeployment of existing technologies, many firms are attempting to create new markets and product ecosystems. Innovations like this can certainly disrupt the previous concept of innovation. Therefore, this study aims to empirically examine the effect of firms' different types of innovation strategy on their market performance, which has been explored limitedly in the previous innovation studies.

Especially, a majority of researchers considered the development of new technologies and products to be one of the critical components in innovation (Slater and Narver 1998). In addition, only a limited number of studies examined the heterogeneous effects of different types of innovation strategies on firms' market performance. For example, Aghion, Bronfin, and Eliezer (2001) argued that in theory, a little imitation is almost always growth-enhancing, but too much imitation is unambiguously growth-reducing. Bessen and Maskin (2009) also argued that an inventor's prospective profit may actually be enhanced by competition and imitation. The few empirical studies generally focused on one industry. For example, the Indian pharmaceutical industry has followed a trajectory from duplicative to creative imitation, and the basic and intermediate technological capabilities gained from this trajectory gave firms a basis for the development of competence (Kale and Little 2007).

To overcome these limitations, this study suggests a 2×2 dimension of innovation and aims to examine the effect of different types of innovation strategies on firm performance. We considered two basic innovation strategies, incremental and radical innovation, and analysed their effects on firm performance focusing on profit and revenue growth. In doing so, we further subdivided incremental and radical innovation depending on whether the product developed and supplied by a firm is new to the firm or new to the market, giving us a 2×2 matrix of innovation.

Consequently, we can understand the different effects of different innovation strategies of firms from the product innovation perspective. By doing so, we can suggest valuable implications for firms, which have not previously been explained. In addition, this study also considers industry categories in examining the effect of firms' innovation strategies such as high-tech, medium-high, medium-low, and low-tech industry, in order to understand the effects more fundamentally.

The remainder of this paper is organised as follows: Section 2 presents the theoretical foundations. We also review the growth of Korean industries and develop testable hypotheses. In Section 3, we describe the empirical setting, data, and methodology applied in the empirical analysis. Section 4 presents the results of the empirical analysis, which tests our propositions. Finally, Section 5 provides a discussion on the implications for strategy and innovation theories in addition to concluding remarks.

2. Literature review

Since Levitt (1966), several scholars have argued that imitation should be regarded as another type of innovation (Fagerberg and Godinho 2005; Sadowski and Sadowski-Rasters 2006; Sandberg 2007). They use the term 'imitative innovation' as a comparative concept to creative innovation.

This imitative innovation serves as another type of innovation that incorporates the concept of 'new to the firm', in contrast to 'real innovation', which denotes a new product to the market (Sadowski and Sadowski-Rasters 2006). Here, imitative innovation covers the application of existing methodologies or products to other organisations (Sandberg 2007). Previous works stressed that, if the first creative innovator does not release the product to the market quickly, early imitators can instead play the important role of redefining and creatively disrupting the market. Furthermore, if the early imitators hold a large market share, their leadership in the market for the imitative product will be even greater and they will command a greater competitive advantage (Dickson 1992).

Nevertheless, there are several limitations to these arguments about imitative innovation because the discussion overlooks the important role of creative ideas leading to cost reductions and the creation of new products in the market. Therefore, the concept of 'creative imitation' has been defined to overcome such limitations. This is the process of forging new processes or performance standards while retaining a similar-looking product. Such imitation can take place through simple benchmarking or a strategic partnership. The growth of firms in developing countries such as Korea uses creative imitation, as it is characterised by enormous investments in R&D in order to reduce the production cost or upgrade product quality (Kim 1997). It has been argued that creative imitation is a better strategy than 'true' innovation for generating profit, as it reduces the risks accompanying the development of new products (Kim 1999).

If we separate our view of these innovation types into supply-side and demand-side, both concepts actually consist of a new product innovation targeting an existing market, once we include price reduction as an innovative product attribute. However, there is another type of imitative innovation or creative imitation that targets new markets with existing products or technology. This creates new products by combining existing products or technologies and this is seen more and more often. This is an important innovation category as previous studies already pointed out that novel technologies came into being as fresh combinations of existing ones (Schumpeter 1934; Constant 1980; Basalla 1988; Fleming 2001; Arthur 2007). In other words, many scholars have proposed that recombination provides the important source of novelty (Schumpeter 1939; Usher 1954; Henderson and Clark 1990). We can therefore modify the current categorisation of innovation to include not only creative innovation or creative imitation, but also this type of innovation in which existing products are being improved to target new markets.

In addition, revolutionary circumstantial changes in the current product market also require us to examine the effect of different types of innovation strategy on firms. In other words, existing technologies are converging, and partnerships are forming among firms in order to create new markets and also disrupt existing markets (Kim, Lee, and Kim 2005). In addition, owing to the advancements in communication technologies, the concepts of time and space have become compressed and products often draw consumers' attention for a day and then attention moves on, bringing higher competition into product markets (Gawer and Cusumano 2002). Therefore, firms are pressured to focus more on choosing the right innovation strategy in order to gain a high return on investment.

In these circumstances, the dichotomised consideration of innovation seems to have inherent limitations in analysing the effect of firms' innovation strategy on firms because the definition of new product is ambiguous, depending on whether it is viewed from the supply-side or the demand-side. An existing product can be used in a new market with a different purpose or with different functional combinations, and can then be defined as a new product from a market perspective, although it is an existing product from a supply-side perspective. In addition, products are becoming more complex, with different technological modules from different industries. For

example, smartphones consist of communication, optic (camera), and other technologies. This complex development makes it difficult to define a 'new' product, since those components use existing technology, although the whole product is quite new.

In this regards, Ansoff (1957) introduced the matrix that focused on the firms' present and potential products and markets in order to describe alternative corporate growth strategies. He considered growth strategy via existing products and new products as well as in existing and new markets giving us four combinations of product-market matrix. Sharing the same view, we separate our view on innovation into the supply-side and demand-side view. However, on the supply-side, we consider different dimensions and differentiate with Ansoff matrix: whether a product is new or 'improved'. In other words, in the perspective of the demand-side, our categorisation of innovations shares a common view with Ansoff's matrix, while we newly categorise *improved* products rather than existing products. Therefore, in our categorisation, a firm's innovation strategy of introducing an 'improved' product that can be defined as incremental innovation into an existing or a new market has different strategic implications. Therefore, this new categorisation enables us to identify different requirements in the firm's resource base (Wernerfelt 1984; Barney 1991) and innovation strategy, for example, compared to the case of targeting existing or new market with existing product.

Often, innovation results from the employment of not necessarily novel knowledge or technology. Previous studies found an inverted *U*-shaped effect of knowledge maturity on the scientific value of new innovations (Katila 2002; Nerkar 2003; Heeley and Jacobson 2008; Messeni Petruzzelli, Rotolo, Albino 2012; Capaldo, Lavie, and Messeni Petruzzelli, in press). These evidences strongly support the important role of new dimensions, especially the improved products targeting new market, in innovation activities. Figure 1 shows this 2 × 2 matrix. Through this categorisation, we can differentiate the incremental and radical innovation depending on whether the products are new to the firm or not and according to different market conditions. In our view, most products can be included in one of the categories in Figure 1.

A strategy of 'radical innovation' would be 'new product launching to new markets', while 'incremental innovation' would be 'improved product launching to existing markets' or 'improved product launching to new markets'. 'Improved product launching to existing markets' probably has the market characteristics of higher competition and incremental innovation. Therefore, this

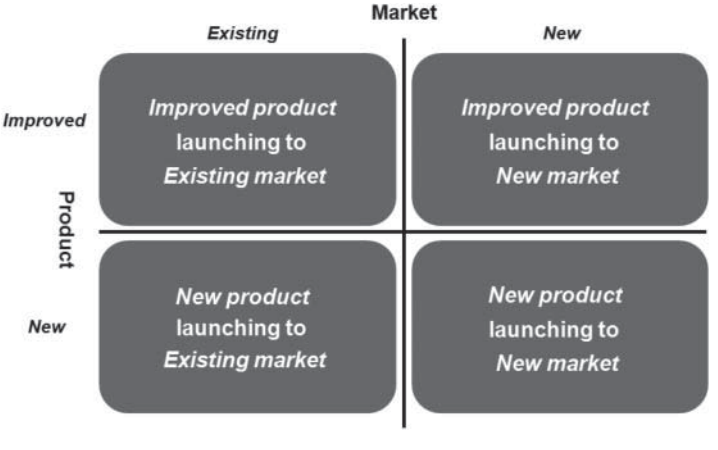

Figure 1. Innovation categories based on product- and market-side view.

categorisation enables us to have a better understanding of firms' strategic innovation decisions on product development.

Based on this categorisation, we explore the effect of different types of innovation strategy on firms' financial performance at the industry level. This is an important strategic issue from the firm's perspective since strategic innovation decisions centre on whether to innovate incrementally or radically and whether to move first or later. In this study, we examine the effects of different types of innovation strategy on Korean industries and suggest some important implications.

3. Methods

3.1. *Data*

Based on the issues in the literature review, we utilised firm-centric survey data covering the innovativeness of corporations to test which is more efficient, innovation as it pertains to markets or to products. The data utilised for this research were obtained from the 2010 version of the 'Korea Innovation Survey – Manufacturing Sector' (KIS), a survey carried out and released by the Science and Technology Policy Institute (STEPI) in Korea. It is regarded as a more suitable source for innovation pattern analysis than R&D characteristics or patent output. The population count for this survey is 4001, and among these, 2496 entities deemed relevant to this study were subjected to analysis. The 2010 KIS data cover the innovation activities of manufacturing firms with at least 10 employees for 3 years beginning in 2008.

We established a research design focusing on the perspective of products and markets under the industrial classification system. In other words, the strategic combination of a product and a market is subject to industrial characteristics and types of businesses based on the technological level. Therefore, first we developed a conceptual model of product and market aspects for our empirical tests. Second, we classified industries according to their technological level.

KIS contains both questions about differences in corporations' new products and improved products, and the distinction between new-to-market and new-to-firm. In the survey, the question related to new products was 'Did your company make a new product?' If the answer was 'yes', we regarded the firm as one that makes new products. If the answer to the question 'Did your company make an improved product?' was 'yes', we regarded the firm as one making improved products. An entirely new product, as defined by KIS, means that, whether using new or existing technology, a method to generate new uses has been applied or other functional characteristics have changed significantly. New models with design changes but similar technological capacities or levels are not considered to be new products.

The questions on marketing innovation were designed to find corporations that released their products before competitors. Corporations that were not first in the market but nonetheless released new products answered different questions. In these instances, the corporations leading the market by releasing their new products to a new market possess the characteristics of market leaders (or dominators). Corporations releasing new products in an existing market are described as participating in that market. Based on such questions, we can identify four areas of grouping based on products and the market, as shown in Table 1. Based on the 23 classifications of 9th Standard Industrial Classification System, revised by the Ministry of Knowledge Economy of Korea in 2008, we excluded tobacco-manufacturing industries and renewable processed raw materials production industries, as OECD also do, before we assigned the remaining 21 industries into the four categories. Regardless of this industry categorisation, the definitions of new and

Table 1. Industries in Korean Standard Industrial Classification (KSIC) according to four categories by technological intensity level.

Category	KSIC industry
High tech	Medical engineering, computer, electronics, aerospace engineering, nuclear engineering
Medium-high tech	Chemicals, chemical products, other machinery equipment, medical precision, optical devices, automobile trailers, other transportation equipment
Medium-low tech	Cork, petroleum refined product, nuclear fuel, rubber, plastic products, non-metallic mineral products, primary metals, assembled metal products, ships, boats, others
Low tech	Food products, fabric products, apparels, leather products, leather bags, shoes, lumber and wooden products, pulp and paper products, publication and printing, recording media, duplication, furniture

existing market are consistent without any uncertainties related with customer segments, extent of pre-existing market penetration, etc.

3.2. *Korean industry*

Over the past few decades, Korea has repeatedly achieved unprecedented levels of growth by employing rapid imitation or fast catch-up strategies in its product development. However, such growth has not been easily explained by existing innovation theories or models and it has been regarded as a manifestation of a new model by many scholars (Hobday 1995; Kim 1997; Mathews 1997). Some scholars suggested that Korea has developed a new economic growth model that constructs a unique corporate governance system enabling massive in-house R&D investment (Lee, Lim, and Song 2005; Sohn and Kenney 2007). For example, along with the notable growth, Korea's market share in world machinery exports has also increased from 0.7% in 1990 to 3.1% (ranked 9th in the world) in 2010.

This noteworthy growth of the Korean machinery industry is unique in the world, because it was achieved when Korea was considered to be a 'Less Developed Country' in terms of capital goods, which are more or less monopolised by advanced countries (Kim and Lee 2009). By 2003, Korea had even caught up to Taiwan, which had led the economic growth in East Asia Newly Industrialising Economies during the period 1965–1990 (Kim and Lee 2009). Significant investment in IT infrastructure in Korea helped firms to obtain and absorb technological knowledge and business-related information, which led to catch-up and improvement in technical efficiency. Becchetti, Andres Londono Bedoya, and Paganetto (2003) support the role of IT investment in improvement of efficiency by an empirical study on Italian small and medium enterprises. In the case of Korea, according to the IMD World Competitiveness Yearbook (2008), Korea ranked third for broadband subscribers per 1000 people in the world. Furthermore, average internet connection speed in Korea ranked top in a survey by Akamai (2008).

However, it is not clear whether this new model is sustainable and whether it can be successfully transformed into an innovation form. Such concerns have been supported by the slowdown in Korea's economic growth since the economic crisis in 1998, when average annual gross domestic product growth dropped below 5%. In addition, it has been argued that Korea is facing a strategic dilemma as the country undergoes a transition from a catch-up economy to a 'leading and innovative' economy (Hobday, Rush, and Bessant 2004). Therefore, many Korean firms, such as Samsung Electronics and Hyundai Automobiles, are facing an important phase as they decide

whether they to maintain the current fast catch-up model, designed to pursue rapid imitation and incremental innovation while reducing costs and avoiding risks, or take a bold step by developing new products that could lead in new markets.

3.3. *Empirical model and variables*

The data have horizontal sectional attributes as well as time-series attributes, so we introduced a model for panel data analysis using random effect model. Here, one thing to note is that the KIS data have the time-series nature in its survey considering the lagged and cumulated characteristics of the measures for the previous 3 years. The analysis was performed while distinguishing the reduced form of the model as follows:

$$\begin{aligned}\ln \mathrm{Pf}_{it} = {} & \beta_0 + \beta_1\, \mathrm{InnoStrat}_{\mathrm{specs}} + \beta_2\, \mathrm{lnwage}_{it} + \beta_3 \mathrm{lnprom}_{it} \\ & + \beta_4\, \mathrm{lncost}_{it} + y\ \text{variesign and Data collection} \beta_5\, \mathrm{lnsurvival}_{it} + \beta_6 \mathrm{inhouse}_{it} \\ & + \beta_7 \mathrm{lnoutsourcing}_{it} + \eta_i + \lambda_t + \varepsilon_{it},\end{aligned}$$

where the InnoStrat variables as *independent variables* represent firm's innovation strategy based on the innovation categorisation in the previous section and includes 'IN' (improved product and new markets), 'NE' (new product and existing markets), and 'NN' (new product and new markets), where 'IE' (improved product and new markets) is base dummy. All the variables and the detailed explanations in the regression model are summarised in Table 2.

Dependent variables. Information such as profits and revenue growth are also regarded as a result of innovation, as are technological achievements such as patents (Cordero 1990; Rogers 1998; Smith 2005). Here, we used sales and operating profits as dependent variables to demonstrate the effects of firms' strategies while focusing on the product and the market.

Control variables. Explanatory variables were obtained from the financial statements of the corporations subjected to KIS. From a corporate perspective, firm size and age are often utilised as variables to explain innovation. Data pertaining to R&D investments and personnel, such as employee headcount and payroll expenses, are also frequently used as a proxy for investment in

Table 2. Variables used in the panel model and the explanations.

Dependent variable	lnPf	Dependent variable for operating performance, the log values of sales profit
'InnoStrat' variables (dummy variables)	IE	Improved product and existing market (base dummy)
	IN	Improved product and new market
	NE	New product and existing market
	NN	New product and new market
Control variables	lnwage	Log of wages to sales
	lnprom	Log of promotion costs to sales
	lncost	Log of the cost of sales to sales
	lnsurvival	Log of the expected product life
	inhouse	Research and development variable internal to the corporation (in-house)
	Outsourcing	Outsourcing external to the corporation

Note: Three variables other than 'IE' (improved product and existing market) group were applied when performing the analysis: IN, NE, and NN.

innovation. In the case of R&D investment, the KIS data considered the accumulated effect of R&D investment in the survey. In addition, we used the ratio of payroll expenses to corporate sales as the main indicator. The payroll expense against sales amount and the employee headcount are the same indicator, and their mutual auto-correlation is a significant variable. However, payroll expenses (wages), rather than the employee headcount, are used more broadly as an indicator for corporate innovation activities. Promotion of sales is recognised as the most important factor in corporate innovation-marketing activities (Aaker 1973; Little 1975).

The ratio of sales to manufacturing cost is the most important variable explaining the cost structure of a firm, and it explains profitability as well as variability. However, as the sample count is severely limited and cannot be considered entirely reliable, the research and development indicators of these sample firms will be ignored. In addition to data shown in the financial statements, this research also extracted product durability expectations and used a questionnaire regarding internalisation and externalisation of R&D personnel from the surveys, to use this information as variables. Product lifecycle expectancy is a variable indicating firms' expected sentiments regarding their products; it is regarded as a necessary variable when developing strategic products (Hofer 1975; Kotler 1984; Schendel 1985). Internal product development or differentiating through outsourcing also has direct implications on firm product strategies.

Table 3 shows the descriptive statistics of the variables. Interestingly, the mid-low tech sector shows highest the sales and the operating profits. In addition, although the sales of the high tech sector are second highest after the mid-low tech sector, its operating profits are much lower than that of mid-low tech sector. This can be somewhat explained from the statistics of wage to sales, product survival time, and in-house as well as outsourcing R&D costs from the table. In other words, technological characteristics of the sectors largely determine the operating profits of each sector and, consequently, the order of sectors' operating profits does not match with that of the sales.

Table 4 shows the correlation matrix of all the variables. Interestingly, when we examine the correlation between innovation types and sales or operating profits, highest positive values can be found in the case of IN followed by NE. However, surprisingly, we found negative correlations of NN and IE with the sales as well as the operating profits. Therefore, correlation analysis suggests the importance of IN-type innovation in the market performance of firms.

4. Results

We analysed the effect of firms' innovation strategy on their operating outcomes within the four industry categories, based on technological intensity level. In general, operating outcomes were assessed by considering two aspects: total sales and operating profit. Total sales are an indicator of how much a firm has grown as a whole and operating profit is an indicator of how much profit is generated through the firm's operating activities. The sales amount was used as the primary indicator. The pattern and the degree of the effect of innovation strategy on firms' operating outcomes could then be designated. Dividing each industry by pattern led to the results in Tables 5 and 6.

Our results show that, in high-tech industries, the coefficients of NE (New product to existing markets, $\beta = -1.42$, $Z = -2.05$) and IN (Improved product to new markets, $\beta = -1.25$, $Z = -1.79$) show negative relationships with total sales. NE also shows a negative relationship with operating profits ($\beta = -1.27$, $Z = -1.78$). In low-technology industries, the firms which used the innovation strategy of 'new products to existing markets' (NE) also saw a negative effect on operating profits ($\beta = -1.09$, $Z = -1.96$). However, in the medium-high technology sector, we found a positive relationship between strategies of NE and IN, and total sales ($\beta = 0.43$, $Z = 1.71$

Table 3. Descriptive statistics of the variables.

Variables		Tech pattern	Obs. #	Mean ($)	s.d.
Dependent variable	sales	High tech	878	321,000,000	2,270,000,000
		mid-high tech	5777	271,000,000	1,230,000,000
		mid-low tech	182	978,000,000	3,660,000,000
		low tech	2117	149,000,000	414,000,000
	operating profits	High tech	885	10,800,000	91,500,000
		mid-high tech	5791	20,800,000	186,000,000
		mid-low tech	184	40,300,000	177,000,000
		low tech	2119	8,330,000	28,200,000
Independent variables	wage to sales	High tech	877	0.13	0.50
		mid-high tech	5764	0.05	0.32
		mid-low tech	182	0.06	0.04
		low tech	2108	0.06	0.05
	Promotion to sales	High tech	799	0.02	0.03
		mid-high tech	4974	0.00	0.02
		mid-low tech	166	0.01	0.02
		low tech	1919	0.01	0.04
	cost to sales	High tech	878	0.98	0.01
		mid-high tech	5775	0.99	0.01
		mid-low tech	182	0.99	0.01
		low tech	116	0.99	0.01
	Product survival time (months)	High tech	900	34.19	54.16
		mid-high tech	9180	31.95	42.62
		mid-low tech	666	63.54	84.80
		low tech	4686	46.80	63.40
	In-house R&D	High tech	1338	0.78	0.41
		mid-high tech	13,374	0.62	0.49
		mid-low tech	1038	0.48	0.50
		low tech	7800	0.42	0.49
	outsourcing R&D	High tech	1338	0.42	0.49
		mid-high tech	13,374	0.24	0.43
		mid-low tech	1038	0.14	0.35
		low tech	7800	0.11	0.31

and $\beta = 0.63$, $Z = 2.68$, respectively), whereas NN shows a negative relationship with total sales ($\beta = -0.86$, $Z = -2.37$). This positive relationship also appeared between NE and operating profits ($\beta = 0.53$, $Z = 1.74$) in the case of medium-high technology sector.

5. Discussion and conclusion

More and more, a new perspective of coordination between products and markets is requested in the study of innovation. Therefore, it is important for firms to identify appropriate innovation strategy in order to secure return on innovation. Therefore, we empirically examined the effect of different types of innovation strategy on firms' market performance. In order to do so, we considered a 2×2 dimension of innovation by subdividing incremental and radical innovation depending on whether the product developed and supplied by a firm is new to it or to the market. In

Table 4. Correlation matrix of variables.

	Sales	Operat. profits	Wage to sales	Promot. to sales	Cost to sales	Prod. survival time	In-house R&D	Outsourcing R&D	IN	IN	NE	NN
Sales	1											
Operating profits	0.8061	1										
Wage to sales	−0.4405	−0.2735	1									
Promotion to sales	0.0454	0.158	0.5512	1								
Cost to sales	0.1877	−0.085	−0.6575	−0.573	1							
Production survival time	−0.0743	−0.0552	0.0029	−0.0389	0.0281	1						
In-house R&D	−0.1708	−0.1636	0.09	−0.0508	0.0012	0.7239	1					
Outsourcing R&D	0.0674	0.0562	−0.0183	0.0281	0.0196	0.3167	0.3296	1				
IE	−0.0296	−0.0371	−0.0383	−0.0607	0.0360	0.0395	0.0667	−0.0080	1			
IN	0.0431	0.0318	−0.0204	0.0232	0.0081	−0.0164	−0.0198	−0.0414	−0.3098	1		
NE	0.0110	0.0235	0.0186	0.0216	−0.0773	0.0074	−0.0447	−0.0581	−0.1147	−0.0308	1	
NN	−0.0471	−0.0227	0.0369	0.0062	−0.0522	0.0032	0.0256	−0.0047	−0.0829	−0.0181	−0.018	1

Table 5. Results of the panel analysis (dependent variable: sales).

	High tech		Medium-high tech		Medium-low tech		Low tech	
Sales	β	Z	β	Z	β	Z	β	Z
NE	−1.42	−2.05*	0.43	1.71^{+}	−0.74	−1.25	0.04	0.08
IN	−1.25	−1.79^{+}	0.63	2.68**	1.44	1.22	0.11	0.18
NN	0.10	0.12	−0.86	−2.37*	0.50	0.56	0.62	0.55
Wages to sales	−0.80	−17.68**	−0.72	−32.55**	−0.60	−4.47**	−0.53	−13.29**
Promotion to sales	−0.01	−0.44	0.00	0.62	−0.07	−1.74^{+}	0.03	2.87**
Cost to sales	−9.92	−4.27**	−5.86	−3.52**	−12.94	−1.02	−8.90	−3.47**
Product survival time	0.09	0.90	0.06	1.71^{+}	0.16	0.96	−0.08	−1.19
In-house R&D	−0.92	−1.93^{+}	−0.95	−5.35**	−0.20	−0.20	−0.24	−0.82
Outsourcing R&D	0.37	1.49	0.39	4.33**	0.45	1.01	−0.02	−0.11
Constant	22.84	69.14	22.89	163.94	21.37	20.97	23.47	87.26
# of observations	666		3683		104		1024	
Overall R^2	0.24		0.36		0.66		0.20	

*$p < 0.05$.
**$p < 0.01$.
$^{+}p < 0.1$.

Table 6. Results of the panel analysis (dependent variable: operating profits).

	High tech		Medium-high tech		Medium-low tech		Low tech	
Sales	β	Z	β	Z	β	Z	β	Z
NE	−1.27	−1.78^{+}	0.53	1.74^{+}			−1.09	−1.96*
IN	−0.69	−0.96	0.44	1.54	2.3	1.17	−0.15	−0.23
NN	−0.72	−0.81	−0.49	−1.1			−0.02	−0.02
Wages to sales	−1.57	−12.32**	−1.34	−25.82**	−1.48	−2.89**	−0.93	−9.41**
Promotion to sales	0.11	2.62**	0.05	3.21**	−0.1	−0.81	0.12	4.38**
Cost to sales	−65.81	−10.21**	−104.86	−21.54**	−127.89	−2.55*	−75.26	−10.5**
Product survival time	0.12	1.16	0.05	1.02	0	0	0.06	0.76
In-house R&D	−0.94	−1.91^{+}	−0.84	−3.84**	0.47	0.28	−0.71	−2.12*
Outsourcing R&D	0.38	1.52	0.32	2.87**	1.1	1.44	0.03	0.12
Constant	17.67	34.76	17.15	67.82	13.57	5.74	18.84	40.66
# of observations	552		3198		90		936	
Overall R^2	0.23		0.2804		0.57		0.29	

*$p < 0.05$.
**$p < 0.01$.
$^{+}p < 0.1$.

our examination, we classified industries into four different sectors depending on the technological intensity. This allowed us to consider the characteristics of different sectors.

High-tech sector. In the high-tech industry sector, NE and IN innovation strategies show statistically significant negative correlations with total sales. In other words, these innovation strategies, 'new product development targeting existing markets' (NE) and 'improved product targeting new markets' (IN), are less effective for firms' sales growth than 'improved product targeting existing markets' (IE), which is the base dummy. This is not true in the case of other industries with different

technological intensity. This is somewhat unexpected, when we consider the highly competitive market environment with a high return on investment. The relative importance of an innovation strategy of 'improved product targeting an existing markets' (IE) emphasises the importance of updating our understanding of innovation to include this new category.

Medium-high tech sector. This segment accounts for the majority of Korea's exporting businesses, and therefore has the largest number of corporations, which tend to have strong operating results. The uniqueness of this industry is especially striking in the NE group. This shows significantly positive results in terms of both total sales and operating profits compared with all other groups. It appears that an innovation strategy of 'new products targeting existing markets' is the most effective strategy for firms classified in this segment. On the other hand, the NN group shows a strong negative correlation with total sales, and a fairly weak correlation with operating profit. This suggests that there is no first-mover advantage in this industry, in terms of not only operating profit but also sales growth. Another characteristic of the businesses in this sector is that outsourcing showed a stronger positive correlation in terms of profitability and sales compared with other sectors. This suggests that corporations in these industries are better off outsourcing the execution of difficult technological developments.

One interesting finding in this segment is the positive and significant results for IN for total sales growth. These results emphasise the importance of the new innovation category we suggest, 'improved product targeting a new markets' (IN). This is also an important finding because this new innovation category is especially relevant for medium-high tech industries, not high-tech industries. This is interesting when we consider our general understanding that the high technology sector is more turbulent than any other, with continuous introduction of new products creating new markets. However, our results show that a strategy of 'improved product targeting existing markets' (IE) is a relatively more important one in the high-tech sector, while 'improved product targeting new markets' (IN) is more significant in the medium-high technology sector. More importantly, the finding that the 'improved product targeting new markets' (IN) strategy has a more significant effect on sales growth than 'new product development targeting existing markets' (NE) suggests important strategic insights and implications for current innovation literature and practices, because much of the previous discussion emphasised new product development or new market creation. Therefore, our results open an important avenue in innovation study centring on the firm's product innovation strategy.

Medium-low tech sector. Our empirical results demonstrate that there is no statistically significant innovation strategy which performs better than 'improved product targeting existing markets' (IE). In other words, no particular innovation strategy makes any difference to sales growth and profitability in this sector.

Low-tech sector. The businesses in this industrial categorisation have similar results to those in the high-tech sector. The NE group shows negative correlation with operating profit, whereas the IN and NN groups display no correlation. Therefore, it appears that profitability in this sector becomes worse on introducing new products to existing markets than on introducing improved products to existing markets, indicating that the market is stable and saturated with existing technologies (Kim and Lee 2009). Corporate technology development, in-house development, and outsourcing all appear to be statistically insignificant. This is a category in which the promotion cost to sales ratio is more meaningful than any other category, especially with the significant negative effect of cost to sales.

Overall, we found that, in the high-tech sector, strategies of 'new product targeting existing markets' (NE) and 'improved product targeting new markets' (IN) were less effective than 'improved product targeting existing markets' (IE) in improving firms' sales growth. In the medium-high

tech sector, we found that the strategy of 'new products targeting existing markets' (NE) was the most effective strategy for improving both sales growth and operating profit. Another interesting finding in this segment was the positive and significant effect of 'improved product targeting new markets' (IN) on total sales growth. This emphasises the importance of the new innovation category we suggest, IN, which has not previously been clearly identified. The results for the low-tech sector were similar to the high-tech sector. The profitability here was worse for 'new products in existing markets' than for 'improved products in existing markets', indicating that the market is stable and saturated with existing technologies.

Our study enables us to understand the effects of innovation strategy on firms' performance more deeply by separating it into supply- and market-side. The empirical results emphasise the importance of the category called 'improved product targeting new markets', especially in the medium-high technology sector, where it positively affected the sales growth of firms. Previously, this dimension of innovation strategy has not been clearly identified and has instead been broadly discussed as part of imitative innovation or creative imitation. However, the current paradigm shifts in innovation, as technology converges, and the market environment becomes saturated, significantly emphasise this dimension of innovation. Therefore, our results contribute to a more fundamental understanding of innovation and its strategic role in firms' performance.

The limitations of our study open other opportunities to explore further, especially, the reasons for our findings, the characteristics and effects of innovation strategy. Regarding the reasons of our findings, qualitative case study research on individual firms or groups of firms will be able to suggest the reasons why, for example, in the high-tech sector, strategies of NE and IN are less effective than IE in improving firms' sales growth. In addition, further analysis considering the correlation between the sectoral characteristics and innovation type will suggest possible reasons for our findings in the future study. In addition, our empirical exploration was only on the Korean industry. Further exploration with data from other countries such as the United States will help to generalise our results and enable us to understand the new innovation category more fundamentally. In addition, further exploration of the dynamic patterns of innovation in each category may suggest other interesting issues relating to industrial heterogeneity. More microanalysis for specific industries and sectors will reveal more detailed patterns and effects of innovation strategies on firms' market performance.

Other limitations also come from the KIS data. Since the period covers only three years, our analysis could capture the effects of innovation strategy only in the case of specific periods of time. Therefore, considering longer periods of time will enable us to examine the dynamic effects of innovation strategy on firms' market performances. In addition, firms with more than 10 employees have been censored in the data. Therefore, we should note that the effects of innovation strategy for small firms such as venture firms are ignored in our analysis. It seems to be also interesting to examine the case only for those small and medium-sized firms related with the effects of innovation strategy since a significant portion of those firms, especially, in IT industry is innovation intensive. Overall, although there are some limitations, our study suggests a new perspective on innovation strategy that has not been previously identified.

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References

Aaker, D.A. 1973. Toward a normative model of promotional decision making. *Management Science* 19, no. 6: 593–603.

Aghion, E., B. Bronfin, and D. Eliezer. 2001. The role of the magnesium industry in protecting the environment. *Journal of Materials Processing Technology* 117, no. 3: 381–85.

Akamai Report. 2008. The state of the internet. http://www.akamai.com/stateoftheinternet/.

Ansoff, I. 1957. Strategies for diversification. *Harvard Business Review*, September.

Arthur, B. 2007. The structure of invention. *Research Policy* 36: 274–87.

Barney, J. 1991. Firm resource and sustained competitive advantage. *Journal of Management* 17, no. 1: 99–120.

Basalla, G. 1988. *The evolution of technology*. Cambridge: Cambridge University Press.

Becchetti, L., D. Andres Londono Bedoya, and L. Paganetto. 2003. ICT investment, productivity and efficiency: Evidence at firm level using a stochastic frontier approach. *Journal of Productivity Analysis* 20, no. 2: 143–67.

Bessen, J., and E. Maskin. 2009. Sequential innovation, patents, and imitation. *The RAND Journal of Economics* 40, no. 4: 611–35.

Bores, C., C. Saurina, and R. Torres. 2003. Technological convergence: A strategic perspective. *Technovation* 23: 1–13.

Capaldo, A., D. Lavie, and A. Messeni Petruzzelli. in press. Knowledge maturity and the scientific value of innovations: The roles of knowledge distance and adoption. *Journal of Management*.

Christensen, J.F. 2002. Corporate strategy and the management of innovation and technology. *Industrial and corporate change* 11, no. 2: 263–88.

Constant, E.W. 1980. *The origins of the turbojet revolution*. Baltimore: Johns Hopkins University Press.

Cordero, R. 1990. The measurement of innovation performance in the firm: An overview. *Research Policy* 19, no. 2: 185–92.

Dickson, P.R. 1992. Toward a general theory of competitive rationality. *The Journal of Marketing* 69–83.

Fagerberg, J., and M.M. Godinho. 2005. Innovation and catching-up. In *The Oxford handbook of innovation*, 514–43. New York: Oxford University Press.

Fleming, L. 2001. Recombinant uncertainty in technological search. *Management Science* 47: 117–32.

Gawer, A., and M.A. Cusumano. 2002. *Platform leadership*, 316. Boston, MA: Harvard Business School Press.

Heeley, M.B., and R. Jacobson. 2008. The recency of technological inputs and financial performance. *Strategic Management Journal* 29: 723–44.

Henderson, R., and K. Clark. 1990. Architectural innovation: The reconfiguration of existing product technologies and failure of established firms. *Administrative Science Quarterly* 35: 9–30.

Hobday, M. 1995. *Innovation in East Asia: The challenge to Japan*. Aldershot: Elgar.

Hobday, M., H. Rush, and J. Bessant. 2004. Approaching the innovation frontier in Korea: The transition phase to leadership. *Research Policy* 33, no. 10: 1433–57.

Hofer, C.W. 1975. Toward a contingency theory of business strategy. *Academy of Management Journal* 18, no. 4: 784–810.

IMD. 2008. *World Competitiveness Yearbook 2008*. Lausanne: International Institute for Management Development.

Islam, N., and K. Miyazaki. 2009. Nanotechnology innovation system: Understanding hidden dynamics of nanoscience fusion trajectories. *Technological Forecasting and Social Change* 76, no. 1: 128–40.

Kale, D., and S. Little. 2007. From imitation to innovation: The evolution of R&D capabilities and learning processes in the Indian pharmaceutical industry. *Technology Analysis & Strategic Management* 19, no. 5: 589–609.

Katila, R. 2002. New product search over time: Past ideas in their prime? *Academy of Management Journal* 45: 995–1010.

Kim, L. 1997. *Imitation to innovation: The dynamics of Korea's technological learning*. Boston, MA: Harvard Business Press.

Kim, L. 1999. Building technological capability for industrialization: Analytical frameworks and Korea's experience. *Industrial and Corporate Change* 8, no. 1: 111–36.

Kim, W.J., and J.D. Lee. 2009. Measuring the role of technology-push and demand-pull in the dynamic development of semiconductor industry: The case of the global DRAM market. *Journal of Applied Economics* 7, no. 1: 83–108.

Kim, W.J., J.D. Lee, and T.Y. Kim. 2005. Demand forecasting for multi-generational product combining discrete choice and dynamics of diffusion under technological trajectories. *Technological Forecasting and Social Change* 72: 825–49.

Kotler, P. 1984. *Marketing management: Analysis, planning, and control*. 5th ed. New York: Prentice-Hall.

Lee, K., C. Lim, and W. Song. 2005. Emerging digital technology as a window of opportunity and technological leapfrogging: Catch-up in digital TV by the Korean firms. *International Journal of Technology Management* 29, no. 1: 40–63.

Levitt, T. 1966. Innovative imitation. *Harvard Business Review* 44, no. 5: 63–70.

Little, J.D. 1975. BRANDAID: A marketing-mix model, part 1: Structure. *Operations Research* 23, no. 4: 628–55.

Mathews, J.A. 1997. A Silicon Valley of the east: Creating Taiwan's semiconductor industry. *California Management Review* 39: 26–54.

Messeni Petruzzelli, A., D. Rotolo, and V. Albino. 2012. The impact of old technologies on innovation. The case of the US biotechnology Industry. *Technology Analysis & Strategic Management* 24: 453–66.

Nerkar, A. 2003. Old is gold? The value of temporal exploration in the creation of new knowledge. *Management Science* 49: 211–29.

Rogers, M. 1998. *The definition and measurement of innovation*. Parkville, VIC: Melbourne Institute of Applied Economic and Social Research.

Sadowski, B.M., and G. Sadowski-Rasters. 2006. On the innovativeness of foreign affiliates: Evidence from companies in The Netherlands. *Research Policy* 35, no. 3: 447–62.

Sandberg, B. 2007. Customer-related proactiveness in the radical innovation development process. *European Journal of Innovation Management* 10, no. 2: 252–67.

Schendel, D. 1985. Strategic management and strategic marketing: What is strategic about either one? In *Strategic marketing and management*, ed. H. Thomas and D. Gardner, 41–63. New York: Wiley & Sons.

Schumpeter, J. 1934. *Theory of economic development*. Cambridge: Harvard University Press.

Schumpeter, J. 1939. *Business cycles*. New York: McGraw-Hill Book Company, Inc.

Schumpeter, J. 1942. *Capitalism, socialism and democracy*. New York, NY: Harper and Brothers.

Slater, S., and J. Narver. 1998. Customer-led and market-oriented: Let's not confuse the two. *Strategic Management Journal* 19, no. 10: 1001–6.

Smith, K.H. 2005. Measuring innovation. Doctoral diss., Oxford University Press.

Sohn, D.W., and M. Kenney. 2007. Universities, clusters, and innovation systems: The case of Seoul, Korea. *World Development* 35, no. 6: 991–1004.

Usher, A. P. 1954. *A history of mechanical invention*. Cambridge, MA: Harvard University Press.

Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal* 16, no. 3: 171–74.