Unraveling the relationship between entrepreneurship and open innovation: A Study on one of Modern Technology Evolution Channel

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<Abstract>
While the idea of Open innovation has become popular as an idea for enhancing innovation in firms, open innovation in the context of entrepreneurship is not well understood. Our research topic is about the role of entrepreneurship in open innovation process. In research related to innovation, issues of entrepreneurship and open innovation have become important topics. The relationship between entrepreneurship and open innovation has not researched and fully understood. It is expected that the different entrepreneurship practices will use different open innovation channels, which in turn will have different open innovation effects. In addition, nobody opens the ‘open innovation black box’ in small and medium enterprises (SMEs).

In the papers by Chesbrough (2003, 2006), one could understand open innovation from cases such as IBM, P&G, Intel, Merck and 3M. In each case, the role of CEOs such as Lou Gerstner in IBM, and Gordon Moore and Robert Noyce in Intel was identified as very important for the success of open innovation. But there appears to be no studies about the heads/owners of SMEs – their role and importance in open innovation. Thus it can be said that there is not much known about the relationship between entrepreneurship and open innovation in SMEs practically and theoretically.

For this paper we conduct our study in the IT convergence industry sector in South Korea – the study is done to examine the relationship between entrepreneurship and open innovation. The methods adopted for this study is based on a survey. Regression analysis is used to study the relationship between entrepreneurship and open innovation. The questionnaire is developed from the Frascati manual question lists about manufacturing firms innovation survey. In addition, we added question lists about Entrepreneurship which are from Global Entrepreneurship Monitor. The questionnaire was sent to around 400 South Korean firms in the “IT convergence” sector. From the date collected through this survey, the aim is to find out the role of entrepreneurship in open innovation process of SMEs.
Our main research question is simple. What is the relationship between entrepreneurship and open innovation? For this research, a survey is conducted about entrepreneurship, open innovation, business models, and mean sales from about 400 Korean SMEs in the IT convergence sector. Findings drawn from analysis using regression method will be presented and discussed. In this study attempt will be made to prove the moderating effect of the entrepreneurship on open innovation. Elements of Open innovation (multiple of depth of open innovation and width of open innovation) will be independent variables. Control variable includes firm year, firm size, and, firm’s internal R&D investment. Entrepreneurship will be the moderating variable. And, firms’ mean sales, or the number or new introducing of business model will be dependent variables.

Keywords: Open innovation, Entrepreneurship, Moderating effect, Business model, Technology evolution channel
1. Introduction

Since the advent of industrial society, the amount of the knowledge that exists in this world is rapidly increasing due to the improvement of global education system and the expansion of R&D investment. For example, the number of patent application to U.S. Patent and Trademark Office increased from 130 cases in 1960 to 52,475 cases in 1970 and further to 144,921 cases in 2008. Furthermore, the number of the thesis and published books is also explosively increasing. Besides, not only the amount of the knowledge but also the speed of knowledge distribution is also rapidly increasing due to the development of Internet and recent distribution of Smart devices. In other words, new innovation paradigm appeared in the world as the knowledge amount and distribution speed concurrently increased. This is what we call ‘Open Innovation’.

Open Innovation (OI) addresses the opportunity to commercialize both external ideas and internal ideas externally, as useful knowledge resides external to firms for appropriation and leverage (Hughes and Wareham, 2010). It is defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively (Chesbrough et al. 2006). Research in evolutionary economics also suggests that a firm’s openness to its external environment can improve its ability to innovate (Laursen, and Salter 2006). Evolutionary economists highlight the role of search in helping organizations to find sources of variety, allowing them to create new combinations of technologies and knowledge (Nelson, and Winter 1982).

Chesbrough, who first developed the concept of Open Innovation, suggested ‘The Open Innovation Paradigm’ as the means for Managing Industrial R&D (Chesbrough 2003). Interestingly, models of open innovation offer the promise that firms can achieve a greater return on their innovative activities and their intellectual property(IP) by loosening their control over both (West and Gallagher 2006). In contrast to earlier models and ‘fully integrated innovators’ like AT&T(now Lucent) Bell Labs and IBM which conduct basic research through in house R&D, open innovation celebrates success stories like Cisco, Intel, and Microsoft, which succeed by leveraging the basic research of others (Chesbrough 2003). Targeting the U.K. manufacturers, i.e. SMEs in manufacturing area, the relationship between the Open Innovation level of the firms and their performances was quantitatively analyzed by applying the concepts of Depth of Open Innovation and Breadth of Open Innovation to the questionnaire survey for SMEs on the basis of Oslo Manual (Salter and Laursern 2006). That is, the case-focused Open Innovation research was extended to survey-focused research. Through these researches, it was demonstrated that predicted relationship between innovative performance and the breadth of search through external sources and predicted relationship between innovative performance and the depth of search through external sources all assumed the inverted U-shape. In other words, the relationship between the Open Innovation of the firms and their performances was demonstrated on the basis of quantitatively measured performances rather than single cases, showing that the direction as well as the degree of the performance can change according to the level of Open Innovation rather than to the work direction. This research triggered the subsequent researches on the relationship between the various factors such as company scale, technology innovation cycle, innovation communities or innovative networks, firm’s absorptive capacity, industrial characteristics, the modules, and the entrepreneurship and the Open Innovation (Parida Westerberg and Frisbammmar 2012; Harryson 2008; bianchi, Cavaliere, Chiaroni, Frattini, and Chiesa 2011; Ficher 2009; Ili, Albers and Miller 2010; Chen and Liu, 2004). In addition, the innovation directions from pioneers to mainstream, from high to low tech, from large firms to SMEs, from stage gate to probe-and-learn, from standalone to alliances, from amateurs to professionals, are recently emerging as the new trends of Open Innovation (Gassmann, Enkel and Chesgrough 2010). In the meantime, it also turned out through the analysis of Asset-intensive industries that the Closed Innovation is converted to Open Innovation through Unfreezing stage, Moving stage, and Institutionalizing stage in 4 aspects of Networks, Evaluation processes, Organizational structures and Knowledge management system (Chiaroni, Chiesa, and Frattini 2010). The process of gradual conversion to Open Innovation makes us interested in the role of CEO in the firm. One step further, the analysis of the specific factors influencing the effect of Open Innovation and the level of the influences was attempted through the study of environmental factors such as Patent Protection, Technological Turbulence, and Transaction Rate in the process of Outbound Open Innovation of the firms (Lichtenthaler 2009). All these studies are focusing on Open Innovation research which analyzed the controlling effect of the specific company management factors such as entrepreneurship and marketing ability on the performances of the firms (li, Zhao, Tan, and Liu 2008; Kim, Cable, Kim, and Wang 2009; Kim, Cable, and Kim 2005). Accordingly, the core subject of management research starts to deal with the enhancement of academic and practical value of Open Innovation through the analysis of the factors influencing Open Innovation effects (Yun, JHJ., and A. Mohan 2012). In the theoretical framework of Open Innovation itself, there exist such Outside-in and Inside-out Dimensions of Open Innovation, Process of Adoption of Open Innovation such as
Un-freezing, Moving, and Institutionalizing, and Networks, Organizational Structures, and Evaluation Processes, and Managerial Levers for Open Innovation of KM System(Chiaroni, Chiesa, and Frattini 2011; Spithoven, Clarysse, and Knockaert 2010). Any firms’ Open Innovation portfolio includes uncertain knowledge arbitrage in external networks and bidirectional capability building altogether which means absorptive capacity (Hughes and Warham 2010). The theoretical discussion of Open Innovation is developing to the stage of internal management that already escaped the range of direction. Open Innovation is not the maximization of technical utilization but a part of the optimization process of technical commercialization where a firm brings its products onto the market or makes the most proper entity bring them onto the technical market through the integrated utilization of Product market and Technology market to maximize the profits with certain technologies (Lichtenhtarler 2010).

In the meantime, Open innovation has received increasingly attention in scientific research, but so far it has mainly been analyzed in large, high-tech multinational enterprises(MNEs) drawing on in-depth interviews and case studies(Van de Varde, V. et al. 2008). SMEs are clearly different from larger firms with respect to how they can utilize open innovation activities for innovation outcomes(Parida, Westerberg, and Frishammar 2012). SMEs are specifically and directly carrying out their Open Innovation in overall context of their firms and generating the performances through their bridging capabilities based on External Relationships, Innovation Partners, the Role of Networks, Open Source Community, and Strong Ties with the outside and the through the role of Hub firms (Lasagni 2012; Classen, Van Giles, Bammens, and Carree 2012; Gronum, Verreyenne, and Kastelle 2012; Piva, Rentocchini, and Rossi-Lamastra 2012; Lowik, Rossum, Kraaijenbrink, and Groen 2012; Gardet, and Fraiha 2012).

In the papers by Chesbrough (2003,2006), one could understand open innovation from cases such as IBM, P&G, Intel, Merck and 3M. In each case, the role of CEOs such as Lou Gerstner in IBM, and Gordon Moore and Robert Noyce in Intel were identified as very important for the success of open innovation. But there appears to be no studies about the heads /owners of SMEs – their role and importance in open innovation. Thus it can be said that there is not much known about the relationship between entrepreneurship and open innovation in SMEs practically and theoretically.

Accordingly, this article addresses the following critical question, which has not been analyzed in prior studies. What is the relationship between open innovation and entrepreneurship in SMEs? Firstly, we analyze how is the relationship between inbound Open Innovation and firm performance among SMEs in Korean IT convergence industry. In the process of answering the same questions, this study also analyzed the introduction of new business models by the firms as well as the performances and the ratio of new products. In addition, this study additionally analyzes the difference of Open Innovation of SMEs according to their regional and industrial characteristics by analyzing the possible effects of differences between S/W and H/W within IT Convergence Industry and the regional difference between Seoul and Daegu Gyeongbuk on the relationship between Inbound Open Innovation of the firms and their performances, through which the verification of Open Innovation Effects of general SMEs may be possible. Secondly, we examine how entrepreneurship affects the relationship between open innovation and firm performance. Specifically, we examine moderating effects that derive from firm CEO’s entrepreneurship. Of course, for the same research tasks, the introduction of new business models was also analyzed together with the ratio of new products as the indexes of the performances of the firms. In the process of analyzing the controlling effects of the entrepreneurship and marketing ability of the firms on their performances, the Open Innovation controlling effect of entrepreneurship was studied indirectly through Entrepreneurial Orientation(EO), it did not directly target the controlling effect of entrepreneurship on Open Innovation (Li, Zhao, Tan, and Liu 2008).

On this basis, the article offers several contributions. It is among the first quantitative empirical analysis of open innovation effect of Korean IT SMEs. Korean IT industry is receiving the global attention with the expansion of global market share of the 2 Korean conglomerates such as Samsung and LG together with the world highest rate of Internet distribution and the presence of the consumer groups of the refined world famous IT devices. The Open Innovation characteristics of some Korean IT enterprises were analyzed (Spithoven, Clarysse, and Knockaert 2011). But in existing studies, there is no analysis of Open Innovation of Korean IT SMEs that are developing through the close relationship with Korean conglomerates. Therefore, this study will provide the foundation for in-depth understanding of the overall Open Innovation process of Korean IT SMEs where they acquire new knowledge, develop new products and add the new business models.

Second, this study will quantitatively examine the effect of entrepreneurship of SMEs on the relationship between Open Innovation and their performances. In many Open Innovation case studies as well as in initial studies on Open Innovation, the entrepreneurs, the leaders of Open Innovation, were considered as the target of the studies, but there was no research that independently examined the effect of entrepreneurship on the Open Innovation (Chesbrough 2003; Dodgson, Gann, and Salter 2006). This study can provide the practical implication for the
specific roles of entrepreneurs when SMEs establish their strategies for open technologies and management innovation, by promoting various Open Innovation activities of the firms owned by SME entrepreneurs and by objectively suggesting the entrepreneurship necessary for improvement of their performances.

2. Theory and hypothesis

2-1. Open Innovation and Firm Performance

The book Open Innovation describes an innovation paradigm shift from a closed to an open model (Chesbrough 2003). Inbound open innovation, which is the practice of leveraging the discoveries of others talks to us that companies need not and indeed should not rely exclusively on their own R&D, and outbound open innovation suggests that rather than relying entirely on internal paths to market, companies can look for external organizations with business models that are better suited to commercialize a given technology (Chesbough, and Crowther 2006). It is an emerging innovation management paradigm comprised of two dimensions: (i) inbound Open Innovation, which is the practice of establishing relationships with external organizations or individuals with the purpose of accessing their technical and scientific competences for improving internal innovation performance and (ii) outbound Open Innovation, which is the practice of establishing relationships with external organizations with the purpose of commercially exploiting technological knowledge (Chiarioni, Chiesa, and Frattini 2010). Laursen and Salter (2006) identify two variables that describe the characteristics of open innovation, namely its search breadth, which is defined as the number of external sources or search channels that firms rely on, and its search depth, which is defined as the extent to which firms draw from the different external sources or search channels. As the variables measuring the firm performances promoting Open Innovation, this study uses the ratio of 3 new products, i.e. the new products of the relevant industries, the new products of the relevant firm, and the new products including the product in gradual improvement. Laursen and Salter (2006) proved that the breadth and depth of Open Innovation do not unilaterally increase the firm performance but they have the relationship of the inverted U-shape. Their research opened the black-box of Open Innovation researches, in other words, they triggered the various subsequent researches on the effect of Open Innovation on firm performances. The managerial factors promoting the Open Innovation includes the establishment of extensive networks of inter-organizational relationships with a number of external actors, in particular universities and research institutions, organizational systems focused on accessing and integrating the acquired knowledge into the firm’s innovation processes, new evaluation criteria to focus more on external sources of innovation, and the use of knowledge management systems which are able to support the diffusion, sharing and transfer of knowledge within the firm and with the external environment (Chiarioni, Chiesa, and Frattini 2010). In other words, the 4 managerial factors such as Network, Organization, Knowledge Assessment System, and Knowledge Management System, are mostly associated with the will of firm entrepreneurs.

But the SMEs-specific Open Innovation shows the characteristics completely different from those of the conglomerates or the big existing manufacturers (Van de Vrande, Jong, Vanhaverbeke, and Rochemont 2008; Parida, Westerberg, and Frishammar 2012; Bianchi, Campossall’Orto, Frattini, and Verscesi 2010; Raymond, and St-Pierre 2010). But in the relationship between the independent R&D of SME manufacturers and their performances, the medium and low level technical industries showed no significant effect of R&D on their performances compared to the cutting-edge industries (Raymond, and St-Pierre 2010). Raymond and St-Pierre(2010) said that Entrepreneurial Problem of SME manufacturers as well as independent R&D also plays very important role in new product or new market development. Open Innovation of SMEs is also divided into Technology exploitation as Outbound Open Innovation and Technology exploration as Inbound Open Innovation. The former channel includes Venturing, Outward IP licensing, and Employee involvement, and the latter channel includes Customer involvement, External networking, External participation, Outsourcing R&D, and Inward IP licensing (Van de Vrande, Jong, Vanhaverbeke, and Rochemont 2008). All of these are virtually included in Open Innovation Channel surveyed by Laursen and Salter (2006) on the basis of Oslo Manual. SMEs are clearly different from larger firms with respect to how they can utilize open innovation activities for innovation outcomes such as lack of resources for R&D, unstructured innovation processes, and underdeveloped internal capabilities (Parida, Westerberg, and Frishammar 2012).

As the motives of Open Innovation, particularly of inbound open innovation, such motives as ‘increased customer satisfaction’ and ‘the acquisition of new knowledge’ were concurrently suggested as well as the economic motives such as growth and revenue (Chesgrough and Crowther 2006; Lichtenhaler, and Frishammar 2009). However, many of the researches that analyzed the Open Innovation results suggested the advent of new products that covers both the ‘radical innovation’ and ‘incremental innovation’ as the Open Innovation results of the firms,
conceptualizing them specifically in the ratio of new products (Laursen, and Salter 2006; Parida, Westerberg, and Frishammar 2012; Lichtenthaler 2009). In other words, the research covered all radical innovation products in relevant industry and a little radical new products in the relevant firm and incremental innovation new products that improved the existing products. The researches of Laursen and Salter(2006) that operated the ratio of radical innovation and incremental innovation new products in all the products as the specific indexes were also used in most of the questionnaire survey on Open Innovation results( Parida, Westerberg, and Frishammar 2012; Lichtenthaler 2009). Also, through the individual case analysis and interview researches, it was confirmed that the significance of Open Innovation results is intuitively understood by the firms as the addition of revenue generated by the sales of new products and the addition of new business models (Yun, and Mohan 2012b; Ili, Albrs, and Miller 2010; Bianchi, Cavaliere, Chiaroni, Frattini, and Chiesa 2011; Van de Vrande, Jong, Vanhaverbeke, and Rochemont 2008).

Hypothesis 1-1: As the Open Innovation of SMEs in Korean IT Convergence Industry increases, the ratio of the new products of the firm also increases.

Hypothesis 1-2: As the Open Innovation of SMEs in Korean IT Convergence Industry increases, the new business models are added to the firms.

These hypotheses were established by applying the relationship between the Inbound Open Innovation of SMEs and their performances studied in above discussions to IT Convergence industries which are representative Korean industrial areas. Through the testing of above hypotheses, this study will suggest the systematic analysis result of the Open Innovation effects of Korean SMEs in IT Convergence areas. This study will also provide the in-depth understanding of Korean IT industries that receive global attention and will examine Open Innovation characteristics of Korean SMEs in IT Convergence areas.

2-2. Entrepreneurship and Moderating effect

As the economic entities who carry out specific innovations such as creation of new products, development of new production method, new market development, and development of new raw material sources, the Entrepreneurs who competitively carry out the innovations for much profit are completely different from normal managers who only conduct the routine businesses (Schumpeter 1947).

Entrepreneurs who are the subject of entrepreneurship act according to the dream of constructing their own dynasty, the will to succeed, and the joy of creation rather than economic motives (Schumpeter 1942). Entrepreneurship is the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic, and social risks, and receiving the resulting rewards of monetary and personal satisfaction and independence(Hisrich, Peters , and Shepherd 2008, 8).

Entrepreneurial Orientation(EO) can be defined as the propensity of a company’s top management to take calculated risks, be innovative, and be proactive(Morris and Paul 1987). Entrepreneurial Orientation(EO) has been characterized by the dimensions of innovativeness, risk taking, and proactiveness, all with the possibility of promoting firms’ technological innovation and performance(Li, Zhao, Tan, and Liu 2008). Market-oriented firms focusing on articulated customer needs may opportunities for developing new products that customers cannot articulate, unless they also develop entrepreneurial orientations to ensure a proactive focus on innovations that meet emerging and unarticulated customer needs (Li, Zhao, Tan and Liu 2008). The curvilinear moderating effect of Entrepreneurial Orientation on the relationship between Market Orientation and performance that the synergistic effect of MO and EO on performance will be greater with a moderate level of EO, a relationship resembling an inverse U-shaped curve(Bhuian, Menguc, and Bell 2008).

The of Outbound Open Innovation on firm performance is influenced by environmental factors such as patent protection, technological turbulence, transaction rate, and competitive intensity(Lichtenthaler 2009). The effects of Open Innovation of the firms on their performances, i.e on Return on Sale are modulated by environmental factors. Lichtenthaler(2009) analyzed the moderating effects on Open Innovation through statistical analysis method. Of course in this case, the moderating variables are environmental and institutional factors, but his thesis is the study case that directly showed the moderating effects on Open Innovation.

Also the Internal Open Innovation Attitude that shows the level of internal acceptability of the new ideas, knowledge and the products, also influences the effect of Open Innovation of the firms on their performances (Yun, and Mohan 2012b). In other words, the Moderating effects of liberal environment of the firm, practice, procedure or
the system on the effects of Open Innovation on the performance were proved. In fact, the procedure and system factors among the liberal attitudes of company inside are the ones that are dependent on the entrepreneurship of the firm leaders.

Gerstner determined that IBM’s dominant logic forward would have to focus on IBM’s customers, moving from an “in order to do anything, we have to do everything” approach to a “do whatever the customer needs us to do, and work with what the customer already has” approach(Chesbrough 2003, 102). Lou Gerstner, the CEO of IBM who was scouted by the company for the first time from outside in 1993 when the company was faced with crisis, adopted the strategy of acquiring the idea sources from the outside, particularly from the consumers, while carrying out the production of new products and new businesses jointly by all divisions, escaping from the strategy of individual production and business carried out by individual divisions (Chesbrough 2003, 101). This open innovation support strategy promoted by new IBM CEO created the tremendous profit through the external sales of unutilized technologies and conversion of product groups to S/W and solution focused product groups according to the requirements and ideas of the outside customers. Chesbrough(2003) proved, through individual case studies, that the entrepreneurship promoted the Open Innovation of the firms and it had the moderating effect of connecting it with their performances.

Moore, along with Noyce, made an important decision: “Although the semiconductor industry depends on research breakthroughs for continued progress, Intel will operate without any formal research organization (Chesbrough 2003, 115-116).” The founders of Intel directly experienced the long time of commercialization of hi-tech research results of Fairchild because it had no linkage with any business division. So they tried to make their research results directly connected to the production and to make all the ideas of global semiconductor areas directly connected to the production the most promptly in the world by establishing some basic research departments jointly with production departments rather than establishing them independently. In other words, the entrepreneurship of Intel made the Open Innovation system where the new ideas are directly connected to production, thus creating the profit for the firm.

The entrepreneurs who place the most basic value on the openness and sharing promote the open learning of the employees through open communication, open support, and open innovation (Li 2011). Anderson, the CEO of BestBuy, is creating the numerous innovation results through the promotion of unlimited creative participation of the employees by making Twelpforce. Allen G Lafley who was the CEO of P&G decided to open the company and to lead the innovation by new methods by accommodating the external ideas and restored the company that was faced with the crisis in 2000 to the global enterprise by the time he retired in 2010 by suggesting the goals of Open Innovation results to find the ideas of more than 50% of the new products from the outside. In other words, it was confirmed that the entrepreneurship promoted the relationship between the Open Innovation of the firms and their performances through the case of CEO of BestBuy who established the specific Open Innovation system and thorough the case of former CEO Laflley of P&G who suggested the goals of Open Innovation results (Li 2011).

By examining the factors that hinder Inbound or Outbound Open Innovation, the necessity for entrepreneurship is sometimes reversely raised as the remover or controller of the relevant hindrance factors. The core elements that correct “Not Invented Here” Syndrome that objects to the commercialization of the technologies that were not developed by the company and the tendency of higher evaluation of the possibility of R&D risk and failure than its own R&D, creating and operating the objective system, are dependent on the entrepreneurship of the leaders of the firms (Chesbrough 2006, 23-25). Companies think that if they cannot find a profitable use for their technology, no one else will either, and if they don’t sell any their own technology, no one should sell it (Chesbrough 2006, 32). The tendency to decide that other outside firms can not commercialize the technologies only because they themselves could not commercialize the technologies they developed for themselves, or the intention to hide the incompetency of the commercialization departments when the other outside firms succeeded in commercialization, exist in each department of the firm. In this situation, it is the entrepreneurship of CEO that aggressively leads the Open Innovation to secure the company profit.

A more robust approach rather than relying only on firm’s excellent service to sustain competitive advantage as a service provider is to turn the firms’ service into a platform (Chesbrough 2011, 160). The strategy of not falling into the Commodity Trap that puts the manufacturers or service providers in severe completion with the imitation firms is to establish Open Business Platform that makes external firms or individuals carry out their businesses using the business platform of the firms. To make other firms carry out their businesses on the platform of the firm, escaping from the strategy of conducting their own businesses is the decision that requires the entrepreneurship of the leader.

Even though OI can provide new ideas and technologies as well as new market channels, OI itself comes with its own unique set of issues and challenge. Business leaders must eventually depart from those processes, reward
systems and cultural attributes that were once viewed as desirable but, in reality, work against the very idea of OI (Sloane 2011, 124). In other words, only when the company leaders convert the existing procedure of company management, compensation system or the cultural factors through entrepreneurship to be suitable for Open Innovation, can the Open Innovation of the firm be connected to their performances.

The extent to which strong ties can be sustainable sources of new knowledge depends on the application of bridging capabilities by the focal firm in combination with the innovativeness of the partner firm (Lowik, Rossum, Kraaijenbrink, and Groen 2012). Tie Strength of the firms are known to have the inverted U-shaped relationship with the acquisition of new technology and knowledge, but it also has the moderating effect that can mitigate the effect of technology and knowledge acquisition produced by Overembebedness Effect through the Relational Capabilities necessary for the firms to acquire the technology and knowledge. Systematic meetings with customers, or suppliers, Getting reacquainted with customers or suppliers, Internationally establishing relationships with customers or suppliers, and organizations to get access to their large networks are the Observed Specific Relational Capability, which is dependent on the entrepreneurship of the leaders of the firms (Lowik, Rossum, Kraaijenbrink, and Groen 2012).

Through the analysis of previous researches, the moderating effect of entrepreneurship could be diversely identified directly or indirectly in individual case analysis as well as the moderating effect of entrepreneurship on the effect of Open Innovation on the firm performances in quantitative analysis itself.

Hypothesis 2-1: Entrepreneurship positively moderates the relationship between Open Innovation and firm performance in Korean IT Convergence related firms, as measured through the ratio of new products of the firms.

Hypothesis 2-2: Entrepreneurship positively moderates the relationship between Open Innovation and firm performance in Korean IT Convergence related firms, as measured through the introduction of new business models by the firms.

In other words, it is assumed that the entrepreneurship will have positive effect on the enhancement of firm performances with the ratio of new products covering both of radical innovation new products and incremental innovation new products. Compared to the individual analysis of the moderating effect of entrepreneurship in existing researches, this study will directly analyze the moderating effect. Further, this study will analyze the moderating effect of entrepreneurship by establishing as the dependent variable the addition of new business model which is the most direct factor that the firms perceive as firm performances.

Based on above discussions, this study established the Conceptual Model as Figure 1.

Figure 1. Conceptual Model
3. Methods

3-1. Sample and data collection

The empirical study has concentrated on small and medium sized IT convergence industrial firms in Korea to avoid confusing different effects of open innovation on small and large companies (Lichtenhaller 2009; Lasagni 2012; Bianchi 2012). The main business of these firms is open innovation, i.e., the inbound or outbound application of technology in their own products. These companies consider open innovation as a key activity, which is essential to their business (Campodall’Orto, Frattini, and Vercesi 2010). SMEs are usually less bureaucratic, more inclined to take risks possess more specialized knowledge, and are faster in reacting to changing market demands, which all together enables them to be better at gaining from open innovation activities compared with larger firms (Parida, Vesterberg, and Frishammar 2012). Korean SMEs IT Convergence Industry areas are always paying attention to the external technologies and knowledge and react very sensitively to proactively cope with rapidly changing market and the requirements of the high level of technology from the conglomerates such as Samsung, LG, KT, and SK (Ryu 2012; Yun, and Mohan 2012). As a consequence, these firms actually make ‘internally or open’ innovation because they are able to internally exploit or externally exploit technologies. Accordingly, open innovations become major channels of knowledge funnel from which firms acquire several sources of innovation.

For our analyses, we relied on two data sources. Firstly, we used survey data for which we surveyed from September 19th to October 18th in 2011. Secondly, theses data were combined with performance data from financial databases, annual reports and interviews results from 10 firms which were collected from September to November in 2011. The data collection for the survey was undertaken via questionnaires which made after OECD innovation survey questionnaire which have bases from the Oslo manual (Laursen and Salter 2006). To enhance the response rate, the study was supported by the Korea Industrial Technology Association (KOITA). All KOITA members in IT convergence industry in Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province were directly contacted by mail, phone and e-mail. After carrying out the survey on the randomly selected 1000 firms in each of Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province, the answers were received from 504 firms. Excluding the survey sheets that have no relevant responses, survey was conducted for the answer sheets received from 401 firms. As shown on Table 1, the regional characteristic of Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province made it possible for HW and SW industries and the firms with more than or less than 10 years experience to be evenly distributed over the regions. A test for non-response bias and for a KOITA membership bias showed no significant differences. By conducting the interview with the representatives of 5 firms in Daegu-Gyeongbuk Province and Seoul-Gyeonggi Province, the survey correction work was carried out in advance to qualitatively improve the reliability and feasibility of the survey questionnaires. To avoid common method bias, objective data on the financial performance of the participating firms were collected from financial databases and annual reports as supplementary data of firms’ performance.

The measurement scales and questionnaire followed Oslo manual, OECD SMEs innovation survey questionnaire, and GEM (Global Entrepreneurship Monitor) directly (Laursen and Salter 2006; Parida, Vesterberg, and Frishammar 2012; Lichtenhaller 2009; Bosma, Wennekers, and Amoros 2011). Informants rated all items on five-point scales with anchor points ‘I strongly disagree’ (=1) to ‘I strongly agree’ (=5). Internal consistency reliability was examined in the way of Cronbach’s alpha (Nunnally 1978). Generally, 0.70 or higher is considered to be agreed value for Cronbach’s alpha reliability (Li, Zhao, Tan, and Liu 2008; Nunnally 1978). As shown in Table 2 and Table 4, Cronbach’s alpha values in 16 items in open innovation, and 15 items in entrepreneurship were well above 0.70, so the results are acceptable. Convergent validity exists if a group of indicators are measuring one common factor. Convergent validity can be assessed at the construct levels. Convergent validity of our analysis can be accepted according to Table 2 and Table 4 because constructs levels are above 0.70 in open innovation and entrepreneurship.
Table 1. Composition of Sample

<table>
<thead>
<tr>
<th>Area</th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Seoul-Gyeonggi Area</td>
<td>205</td>
<td>51.1%</td>
</tr>
<tr>
<td>Daegu-Gyeongbuk Area</td>
<td>196</td>
<td>48.9%</td>
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<tr>
<td>HW/SW</td>
<td></td>
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<tr>
<td>HW Orientation</td>
<td>204</td>
<td>50.9%</td>
</tr>
<tr>
<td>SW Orientation</td>
<td>197</td>
<td>49.1%</td>
</tr>
<tr>
<td>Firm Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shorter than 10 years</td>
<td>188</td>
<td>46.9%</td>
</tr>
<tr>
<td>Longer than 10 years</td>
<td>213</td>
<td>53.1%</td>
</tr>
</tbody>
</table>

Table 2. Reliability of open innovation and source of knowledge in Korean IT convergence SMEs (n=401), 2010

<table>
<thead>
<tr>
<th>Construct Level</th>
<th>Cronbach’s Alpha</th>
<th>.922</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Innovation Sources</td>
<td>Percentages</td>
<td>individual Cronbach’s Alpha</td>
</tr>
<tr>
<td>Not Used</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Utilization of external private research center</td>
<td>5.5.</td>
<td>24.9</td>
</tr>
<tr>
<td>Technical collaboration between university and institution</td>
<td>2.7</td>
<td>21.4</td>
</tr>
<tr>
<td>Technical collaboration with national/public institution</td>
<td>5.7</td>
<td>20.9</td>
</tr>
<tr>
<td>Utilization of non-profit institution</td>
<td>7.7</td>
<td>36.2</td>
</tr>
<tr>
<td>Benchmarking of global enterprises in the same line of business</td>
<td>1.7</td>
<td>11.7</td>
</tr>
<tr>
<td>Utilization of competitors in the same line of business</td>
<td>0.7</td>
<td>14.7</td>
</tr>
<tr>
<td>Supplying firms</td>
<td>1.0</td>
<td>19.7</td>
</tr>
<tr>
<td>Customer or User</td>
<td>1.0</td>
<td>14.5</td>
</tr>
<tr>
<td>Consulting business firms</td>
<td>4.2</td>
<td>31.9</td>
</tr>
<tr>
<td>Utilization of newly employed external manpower</td>
<td>4.0</td>
<td>19.5</td>
</tr>
<tr>
<td>Utilization of external patent information</td>
<td>5.5</td>
<td>25.7</td>
</tr>
<tr>
<td>Fair, exhibition, and seminars</td>
<td>3.2</td>
<td>16.0</td>
</tr>
<tr>
<td>Mass media and information network</td>
<td>1.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Utilization of the firms in other line of business</td>
<td>1.5</td>
<td>20.9</td>
</tr>
<tr>
<td>M&amp;A of external firms and research centers</td>
<td>17.0</td>
<td>25.2</td>
</tr>
<tr>
<td>Utilization of external technology licensing</td>
<td>11.2</td>
<td>26.2</td>
</tr>
</tbody>
</table>
1.2. Dependent variable

At first, we use three proxies aimed at reflecting various types of innovative performance altogether. Various types include the fraction of the firm’s turnover relating to products new to the world market, the fraction of the firm’s turnover pertaining to products new to the firm, and the fraction of the firm’s turnover pertaining to products significantly improved (Laursen, and Salter 2006). The ratio of 3 kinds of different innovation products in 3 years against the 2010 sales was used as the first dependent variable. The variable includes all of 3 kinds of dependent variables used by Laursen and Salter (2006).

In addition, the addition of the virtual economic revenue created by the sales of new products was established as another dependent variable. As the result of the analysis of many previous individual cases, it was indirectly confirmed that the Open Innovation results are recognized as the virtual addition of economic revenue (Yun, and Mohan 2012b; Ili, Albrs, and Miller 2010; Jong, Vanhaverbeke, and Rochemont 2008). Further, in the interview survey of 5 firms in each of Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province carried out in the process of this study, the Open Innovation results perceived by individual firms were intuitively considered to increase the virtual economic revenue created by the introduction of new products. So, according to the core contents of this study based on questionnaire survey, the addition of new business model due to the increase of virtual economic revenue according to the introduction of new products which are intuitively recognized by individual firms was conceptualized and added as another dependent variable.

The purpose of establishing these 2 different dependent variables is to measure the Open Innovation results of the firms more dimensionally through the objective and intuitive method.

3.3 Independent variables

As determinants of innovative performance, we introduced two new variables such as breadth of open innovation and depth of open innovation reflecting openness in terms of external search strategies of firms like Laursen and Salter(2006). Breadth of Open Innovation is constructed as a combination of the 16 sources of knowledge or information for innovation listed in Table 2 of this paper. The number of the sources that answered with more than 3 scales out of 5 scales was established as the Depth of open innovation of the relevant firms. It is the same method adopted by previous s researches that established the number of the channels used as Open Innovation sources, i.e. the number of the sources with the highest scores out of 4 scale measurement as Breadth of Open Innovation. This study has 16 channels and all the channels themselves have more than 0.7 of Cronbach’s alpha coefficient with internal consistency.

External search depth is defined as the extent to which firms draw intensively from different search channels or sources of innovative ideas(Laursen, and Salter 2006). Depth of open innovation is constructed using the same 16 sources of knowledge as those used in constructing Breadth. In this case, every firm established the mean value of the scales of 16 channels out of 5 scale measurement as the Depth of Open Innovation. It revised and complemented the values established as Depth of Open Innovation among 8 external partners that received 4 scales out of 4 scale measurement. Depth of open innovation in this research come in mind that firms that use average degree of open innovation in 16 sources are more ‘open’ with respect to search depth than firms that are not. As the Cronbach’s alpha coefficient of the depth of open innovation exceeds 0.7, including the cases where all sources record 5 scales, the depth of open innovation of this study also has internal consistency.

This research include 8 external sources such as suppliers, clients or customers, competitors, consultants, commercial laboratories/R&D enterprises, universities or other higher education institutes, government research organization, or private research institute like Laursen and Salter(2006). Although all of the channels in the survey are not completely comprehensive, it is clear that they include Open Innovation knowledge channels and they are established on a wide and mutually exclusive basis.

In order to simplify the level of Open Innovation, this study estimated the level of Open Innovation by multiplying the Depth of Open Innovation by Breadth of Open Innovation (Yun and Park 2012; Yun and Mohan 2012a). This simple concept also secured the reliability on the basis of each reliable variable. As the 2 existing Open Innovation variables contain each different aspect of Open Innovation, this method can include both of the Depth and Breadth of Open Innovation and it is also useful in securing the single measurement values of the level of Open Innovation. Compared to the very close inter-relationship between the Depth and Breadth in the existing study by Laursen and Salter(2006), this study has different relationship so it can concurrently show the different aspects of Open Innovation through the multiplication of both concepts.
Entrepreneurial Orientation has been characterized by dimensions of innovativeness, risk taking, and proactiveness (Li, Zhao, Tan, and Liu 2008). Leadership Characteristics of a Corporate entrepreneur consist of 7 factors such as understanding the environment, being visionary and flexible, Creating management options, Encouraging teamwork, encouraging open discussion, building a coalition of supporters, and Persisting (Hisrich, Peters, and Shapherd 2008). Global Entrepreneurship Monitor (GEM) Group carries out the questionnaire survey that measures the entrepreneurship of the relevant countries targeting the enterprises, governments, and public institutions of the global members. GEM’s entrepreneurship global questionnaire survey actually provides the most universal survey frame that is globally conducted. Among GEM’s questionnaire survey items, the Entrepreneurship related items were categorized into business inception opportunity, business operation, and social environment, etc were established as moderating variables of this research as on Table 3. The 15 detail items all have internal consistency by exceeding Cronbach’s alpha coefficient of 0.7. This is the utilization of existing researches on survey method used by major countries of the world as the method to measure entrepreneurship.

Table 3. Reliability and convergent validity of entrepreneurship

<table>
<thead>
<tr>
<th>Construct level</th>
<th>Cronbach’s Alpha</th>
<th>Items</th>
<th>Individual Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Inception Opportunity</td>
<td>.936</td>
<td>Sufficient opportunity for new IT/SW business inception</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More business inception opportunity than people who want business</td>
<td>.931</td>
</tr>
<tr>
<td></td>
<td></td>
<td>business</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Even the individuals can easily have the chance for IT/SW business</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Many opportunities for high level and high growth IT/SW business</td>
<td>.931</td>
</tr>
<tr>
<td>Business Inception and Operation</td>
<td></td>
<td>There are many people who know about IT/SW business inception</td>
<td>.929</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Much knowledge about IT/SW business operation and management</td>
<td>.930</td>
</tr>
<tr>
<td>Social Image of the Business Founders</td>
<td></td>
<td>Much knowledge about resource organization necessary for IT/SW business</td>
<td>.930</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Much knowledge about technology provider and developers necessary</td>
<td>.930</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for IT/SW business</td>
<td>.930</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Much knowledge about legal rights necessary for IT/SW business</td>
<td>.934</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thinks of IT/SW business inception as the proper way to get rich</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thinks of IT/SW business inception as desirable career choice</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Successful IT/SW business founder deserves high position and respect</td>
<td>.932</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequent hear about the successful IT/SW founders from mass media</td>
<td>.931</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IT/SW is an individual who has both the competence and ability</td>
<td>.932</td>
</tr>
</tbody>
</table>

As the ‘construct level Cronbach’s Alpha’ of 0.936 far exceeds 0.7, the entrepreneurship is considered to have ‘convergent validity’ (Li, Zhao, Tan, and Liu 2008).

3.5 Control variables

Laursen and Satler (2006) established R&D intensity, firm size (the number of employee), startup time, the size of the perceived product market, inflow of the innovation from the customers, and the collaboration arrangements on innovation activities, as the control variables. Lichtenthaler (2009) used the Firm size, R&D intensity, industry, and country of origin, as control variables. In some cases, the control variables were diversely established focused on the specific activities of SMEs such as Firm age, firm size, environment, hostility, heterogeneity, product dynamism, market dynamism, and the degree of internationalization (Parida, Westerberg, Frishammar 2012).

According to the interview with Korean IT SMEs, which are the targets of the questionnaire survey in this research, the practical R&D investment was not conducted on minimum level consistently enough to be established as an independent control variable. Accordingly in this study, the R&D investment, which is a practically meaningless variable, was not included in control variables. And the other values that were commonly established as control variables in previous researches such as the mean number of the employees in recent 3 years, firm scale, firm age, the difference of location between Seoul-Gyeonggi and Daegu-Gyeongbuk, and lastly HW or SW researches in IT Convergence industries, were established as control variables.
3.6. Analytical procedures

We relied on linear OLS regression models to study the effects of open innovation on performance and moderating effect of entrepreneurship between open innovation and firm’s performance. For all models, the variance inflation factor was calculated to check for potential multicollinearity (Lichtenthaler 2009; Laursen and Salter 2006; Parida, Westerberg, and Frishammar 2012). To test for moderating effects, moderated multiple regression analyses were used. To reduce multicollinearity between the interaction term and the original variables, we have applied the mean centering procedure that is regularly used in leading journals and that is described in detail in several works (Lichtenthaler 2009; Cohen et al. 2009). In addition, we have only considered one interaction term per model (Lichtenthaler 2009; Cohen et al. 2009). The cross-product term was considered at the basic model in the moderating regression. The regression coefficient and the partial F associated with the resulting change in $R^2$ were examined to test whether or not a moderating effect exists (Lichtenthaler 2009).

In many researches to understand the form of the interaction, they analyzed simple slopes at one standard deviation below and above the mean of the moderator (Cohen et al. 2003; Lichtenthaler 2009; Kim et al. 2005; Kim et al. 2009). This analysis method gives us to understand the relationship between the independent and the dependent variable at different levels of the moderating effects. But this analysis method slightly distorts the actual aspects of the data due to the oversimplification which exceeds the actual aspects of the data in order to show the slope. In addition, if dummy variable is used for dependent variable like in this study, the utilization of this method that uses simple slope is impossible. So, this study will examine the actual contents of moderating effects by studying on the differences and changes of the Open Innovation levels and firm performances of the groups with high moderating effect and low moderating effect in 2 completely different dependent variables.

4. Results

The descriptive statistics in Table 4 show relatively high open innovation level in many firms because 39.345 means that at least 10 channels in breadth of open innovation, and near 4 point in 5 point measure in depth of open innovation are required. This surprising data 39.345 is in the level no lower than Laursen and Salter(2006) that showed breadth 7.22 and depth 0.96, even if the measuring methods were different. As the comparative analysis of the measurement is not statistically important, it is more adequate to analyze the Moderating effect through incremental regression analysis model.

But, it was confirmed on Table 4 that high correlation exists between Open Innovation and Entrepreneurship and between the Ratio of New Product and introduction of New Business Model, so the analysis of Moderating effect needs to be conducted through incremental regression analysis method.

<table>
<thead>
<tr>
<th>Variables</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Open Innovation</td>
<td>39.345</td>
<td>20.912</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Entrepreneurship</td>
<td>3.107</td>
<td>0.584</td>
<td>.464**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>10.471</td>
<td>6.357</td>
<td>.075</td>
<td>.049</td>
<td>.351**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Area</td>
<td>1.490</td>
<td>0.500</td>
<td>-1.46*</td>
<td>-1.48**</td>
<td>-1.77**</td>
<td>-1.57**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. HW/SW</td>
<td>1.490</td>
<td>0.500</td>
<td>.093</td>
<td>.136**</td>
<td>-1.27*</td>
<td>-1.48**</td>
<td>-0.053</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. New Product</td>
<td>52.556</td>
<td>26.708</td>
<td>.319**</td>
<td>.303**</td>
<td>.140**</td>
<td>.007</td>
<td>-.073</td>
<td>-.036</td>
<td></td>
</tr>
</tbody>
</table>
Through Table 5, it was confirmed that in the cases of dependent variables of Ratio of New Product and Introduction of New Business Model, there was Open Innovation effect both in Step 1 and Step 2. In other words, the Open Innovation effect proved to be meaningful regardless of control variables. So, Hypothesis 1-1 and Hypothesis 1-2 were adopted.

In the meantime, in the cases of dependent variables of each Ratio of New Product and Introduction of New Business Model, Open Innovation, Entrepreneurship and Open innovation * Entrepreneurship proved to be statistically meaningful in Step 3 and Step 4, proving the Moderating effect. The partial F associated with the resulting changes in R2 is significant in Step 4 in 2 dependent variable models altogether. So, the hypothesis 2-1 and 2-2 were adopted. Further, as each step progresses, the values of R2 and adjusted R2 also increase, indicating the definite moderating effect. The R2 values of the model with moderating effect were 0.135 and 0.228 in 2 dependent variables, which was sufficiently meaningful with the level not lower than 0.206 of Li et al.(2008).

Table 5. Results of OLS analyses

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Ratio of New Products</th>
<th>Introduction of New Business Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1</td>
<td>Step 2</td>
</tr>
<tr>
<td>Open Innovation</td>
<td>6.204**</td>
<td>5.463**</td>
</tr>
<tr>
<td>Mean Employee</td>
<td>1.179</td>
<td>.966</td>
</tr>
<tr>
<td>Age</td>
<td>-6.49</td>
<td>-6.85</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Area</td>
<td>-1.83</td>
<td>-0.10</td>
</tr>
<tr>
<td>HW/SW</td>
<td>0.071</td>
<td>-1.28</td>
</tr>
<tr>
<td>Entrepreneurship</td>
<td>2.874**</td>
<td>2.796*</td>
</tr>
<tr>
<td>OI*Entrepreneurship</td>
<td>2.073*</td>
<td>2.538*</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.099</td>
<td>0.103</td>
</tr>
<tr>
<td>$F$</td>
<td>38.492**</td>
<td>7.957**</td>
</tr>
<tr>
<td>$AR^2$</td>
<td>0.099</td>
<td>0.090</td>
</tr>
</tbody>
</table>

**p<.01, *p<.05. OI*Entrepreneurship values were obtained through the multiplication of each standardized value, i.e. through $ZOI*ZEntrepreneurship$

It is not much lower than $R^2$ values of 0.22 or 0.23 of Lichtenthaler(2009), and as the moderating variables are added, the explanatory ability in the form of gradual increase of $R^2$ values in the order of 1,2,3,4, is considered rather greater than in the previous researches.

To understand the form of the interactions simple slope analyses were performed. Figure 2 illustrates the result for entrepreneurship in ration of new product dependent variable model, which positively moderates the relationship between open innovation and ratio of new product. The mean values of Open Innovation and the ratio of new products of 200 firms with low entrepreneurship are 32.02 and 45.84 which are lower than 39.29 and 52.61 respectively, located in lower left part. And for 200 firms with high level of entrepreneurship in the same model, the Open Innovation and the ratio of new products shoed the mean values of 45.56 and 59.38 respectively.
In other words, it was clearly confirmed through Figure 2 that the Open Innovation and the Ratio of new products with lower entrepreneurship were below average but the groups with higher entrepreneurship showed high value of more than average. In other words, the Moderating effect of Entrepreneurship could be clearly identified.

In a similar vein, Figure 3, show positive moderating effect of Entrepreneurship in introduction of new business model dependent variable model. In this case of less than 200 entrepreneurship group, the mean values of open innovation and introduction of new business model stay at 32.02 and 1.17, which are in lower level than 39.29 and 1.31, the mean values of both factors. But in the case of more than 200 entrepreneur group, the values of open innovation and introduction of new business model showed 46.56 and 1.44, definitely higher than total mean value. In other words, Figure 3 clearly shows the Moderating Effect of entrepreneurship change on open innovation and introduction of new business model.

Figure 2. Illustration substitute of simple slope analyses- ration of new product

Figure 3. Illustration substitute of simple slope analyses- introduction of new business model
The present study has analyzed a topic that is critical to SMEs which is rare in R&D investment, new knowledge, and useful inner information, i.e., the relationship between open innovation, entrepreneurship and firm performance. The first major finding is the direct positive effect of open innovation on performance across different location, and different industrial in Korean SMEs. In Korean IT industry that receives global attention, the interest and research are focused only on the conglomerates such as Samsung, LG, KT and SK(Ryu 2011). But it is the conglomerates themselves that continuously carried out their innovation in close relation with SMEs in linkage with their products, technologies, and manpower. This research can find its significance in that it is the first study that objectively examined the Open Innovation of SMEs and their performances in IT convergence area. It is necessary to interpret the technical statistics which shows many Open Innovation activities on the channels like benchmarking of the global firms in the same line of business, universities, customers, and information networks, in linkage with this analysis result. From this, it can be confirmed that Korean SMEs in IT convergence industry are carrying out very active Open Innovation activities with domestic conglomerates like Samsung and LG. In addition, at was also confirmed that Korean SMEs achieve their firm performances by continuously acquiring new knowledge and ideas through the refined consumers or users and various information networks. Also, it proved that Open Innovation of Korean SMEs in IT convergence industry was not much affected by the regional difference between Seoul-Gyeonggi and Daegu-Gyeongbu provinces and the difference between HW and SW. It was confirmed in this study that Korean SMEs are seeking the improvement of firm performances through active Open Innovation activities no matter where they are located and what kind of IT industry they are involved in.

This study can find its significance as the first step to recognize the importance of the effect of Open Innovation of Korean IT Convergence SMEs on their performances and to carry out in-depth analysis research. To understand Korean IT industry, the research is essential for SMEs that are engaged in R&D, innovation, and production in close relationship with the conglomerates like Samsung and LG as well as the direct research on those conglomerates. This study can find its significance in that it analyzed the general characteristics of Open Innovation of Korean IT convergence SMEs. One step further, additional researches are required in the future to analyze the relationship between Open Innovation and firm performances in the perspectives of the relationship between Korean SMEs and the conglomerates, relationship with IT-related universities of high level evenly distributed in Korea, and the relationship with the refined consumers or users based on fast internet culture receiving global attention. This study can also find its value in that the quantitative research is essential on the relationship between the Open Innovation of SMEs and their performances that include various channels, in order to conduct subsequent researches in various channels on Open Innovation characteristics of Korean IT SMEs. Also, the necessity for Open Innovation strategies based on various channels can be suggested through this research to IT SMEs entrepreneurs. It is the practical way to add new business models to SMEs to routinely acquire new ideas, knowledge, and information from the conglomerates that SMEs supply their products, the universities of diverse contacts, and the refined consumers or users and the connect them to new products. According to this study, the leaders of Korean IT convergence SMEs need to construct and operate strategic system that can get new ideas and knowledge continuously from their routine daily contacts such as customers, suppliers, consumers, rather than technology licensing, M&A, or independent R&D of high level that require much time and expense.

The study’s second major finding is that the strength of the positive effect of open innovation depends on entrepreneurship moderators. Through many case studies so far, many cases were identified where the attitudes and leadership of the leaders, or the entrepreneurship, promote the specific Open Innovation of the firms, which was connected to new profit generation (Chesbrough 2003; 2006; 2011; Lowik, Rossum, Kraaijenbrink, and Groen 2012; Li 2011). But in existing case studies, only the qualitative identification was conducted on the moderating effect of Entrepreneurship mainly in conglomerates. Also, it was never identified or examined whether there was Open Innovation moderating effect of entrepreneurship even in SMEs, except some individual case analysis (Lowik, Rossum, Karrijjenbrink, and Groen 2012). It is very meaningful that the entrepreneurship in Korean IT SMEs proves to have moderating effect on the relationship between the Open Innovation and firm performances. In other words, the promotion of entrepreneurship is required first of all prior to the study on individual Open Innovation strategy of
the firms or the construction of Open Innovation system. The fact that, rather than the situation where the entrepreneurship of the leader of the firm is not so high, the reverse situation can much more promote the positive relationship between the Open Innovation of the firms and their performances, can have very important meaning as the strategies of SMEs in the rapidly changing Korean IT convergence industry. Unless the leaders of the firms face the risks with positive attitudes for technical innovation, the Open Innovation of the firms that positively catch up with the rapidly changing technical environment cannot be expected.

It is true that Korean SMEs particularly in IT convergence industry have been accustomed for a long time to the stable and passive management practice in supplying their products to the conglomerates. Nevertheless, if the leaders of the firms do not voluntarily promote the Open Innovation environment and pursue the challenging management philosophy, the acquisition of the technology, knowledge and ideas from outside can reach its limit in this vulnerable independent R&D investment situation, it was analyzed in this research. In particular, the SME leaders in IT convergence industry, where the technology is rapidly changing, need to recognize the difficulty of conducting proactive and aggressive Open Innovation strategies while sticking to their own conservative attitude. Accordingly, the Open Innovation strategies of SMEs need to be focused on promoting the risk-bearing, change in reality oriented, and positive innovation attitudes of the leaders in the first place. Of course, in IT convergence industry with the rapidly changing technology, the SME leaders need to expand their specific, proactive, and aggressive entrepreneurship, and the systematic case analysis and case accumulation are also needed in the process. Through this, it is necessary to find the method to promote the entrepreneurship of individual firm leaders and the practical method the connect it to Open Innovation strategies of the firms. Finally, some limitations of the study need to be considered. Firstly, the sample refers to medium and small sized industrial companies. As such, the results may not directly be transferable to a little large or big companies which has systemic governance system for leader or entrepreneurship. Korean IT conglomerates or the big enterprises are famous for their independent R&D of global level. The research on their Open Innovation strategies, entrepreneurship, and the firm performances are separately required. Secondly, the findings reflect the current situation in Korea. Thus, it would be worthwhile to conduct a similar study in the United States and European Union because IT convergence industry situation in Korea is different from that of US. or EU. Thirdly, more objective method of measuring the Open Innovation, i.e. the more scientific method of data measurement that can replace the present survey is required. Though this is the survey-based research with statistical significance, more objective measurement of Open Innovation needs to be conducted to significantly increase the feasibility and reliability of the research and to secure the objectivity of the research result.

6. Conclusion

This study has shown that open innovation has a positive effect on firm performance in Korean SMES IT convergence industry. It is lamong the first quantitative empirical studies that demonstrates appositive relationship between open innovations and firm performance in IT Convergence industry SMEs firms. This is the first research that analyzed the route of technology and knowledge acquisition of the SMEs that support the Korean IT convergence industry and its effect on firm performances.

Further, it is also almost the first research that quantitatively analyzed the moderating effect of entrepreneurship on the relationship between Open Innovation of the firms and their performances. Another significanc of this research is that it quantitatively analyzed how and what direction the entrepreneurship of CEO can moderate the effect of Open Innovation on firm performances, focusing on individual cases, particularly on conglomerate cases. In particular, this research is analyzing the moderating effect of the entrepreneurship of SMEs in Korean IT convergence industry on Open Innovation. Accordingly, this is almost the first research that also quantitatively analyzed the moderating effect of entrepreneurship of SMEs on Open Innovation.

The specific significance of this research can be described in detail as follows. From the study conducted, firstly it is found that Entrepreneurship has the moderating effect for Open Innovation. Most of all, the entrepreneurial attitude of CEO is found to be crucial for open innovation in SMEs. In firms, especially in SMES, it is found that there is a lot of resistance to open innovation. So, the attitude of CEO is very important for the success of open innovation. In SMEs, CEO should ‘control’ open innovation strategy by themselves in order to gain the benefits related to open innovation. Secondly, Open innovation oriented SMEs in IT convergence seem to different business models. SMEs which practice open innovation more aggressively can build up different business models. From the interview, it was found that higher levels of open innovation trigger more diverse business models. This means that open innovation has direct effect on developing new business models. Thirdly, In IT convergence SMEs, customers seem to be more important as the open innovation channel compared universities or research institutes. So,
in SMEs, CEO should try to build up several customer based open innovation channels by themselves. The following customer related activities – developing a customer innovation community, regular customer open innovation meetings, or customer open innovation festival could be the open innovation channels.

For SMEs in the IT convergence sector - the role of entrepreneurship is very important to succeed in open innovation and increase performance. Among the IT convergence SMEs studied, open innovation channels such as customer could be the main trigger of open innovation success. Hence it is recommended that SMEs should try to build up customer based open innovation system.

Based on our findings, we therefore encourage further research into open innovation in IT SMEs in concrete channels. Open Innovation characteristic of SMEs need to be systematically analyzed according to major open innovation channels. Additional research is required on Open Innovation characteristics of major channels faced by present Korean IT SMEs such as consumers, customers, universities, and big enterprise customers. Second, systematic case analysis research is also needed for Open Innovation channels, status, and characteristics actually utilized by IT convergence SMEs for their Open Innovation. By analyzing the actual cases, the Open Innovation cases of Korean IT SMEs need to be practically examined. Third, the characteristics of dynamic Open Innovation that occur in the process of SMEs carrying out their businesses after establishing specific relationship with Korean conglomerates in IT convergence areas. Analyzing the Open Innovation characteristics of the process where the domestic major IT conglomerates such as Samsung, LG, and SK create the value chain with SMEs is considered a way to more exactly understand Open Innovation characteristics of Korean IT convergence SMEs.

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