The Impact of Convergence on Business Performance: An Empirical Study on Korean ICT Sector

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Abstract

The Information and Communication Technologies (ICT) sector is undergoing a fundamental transformation. Determinant factors in this transformation process are deregulations and technological advancements. From the value chain perspective, industry convergence plays the most crucial role in the transformation of the established telecommunications and media industries. The objective of this paper is to validate the impact of convergence on the business performance using empirical data. To identify the various effects driven by industry convergence, we analyzed the relationships between firm's degree of convergence and the business performance using regression analysis. From the empirical result with the 2002-2005 data, it was found that the convergence across ICT sectors improves the business performance measured by Tobin's q significantly and this is only a recent phenomenon. These results are consistent with the conjecture that higher degree of convergence is becoming more associated with higher market value.

Keywords: Industry convergence, ICT sector, Business performance

Introduction

Convergence has been widely used in the area of business strategy, technology management, and industry organization for ICT (Information and Communication Technologies) sector during the past decades. The root of the term convergence originated in the mid 70s for the most part from technological perspective, for example, the convergence between machine tools and electronics in the 70s (mechatronics), convergence of computer & communications (C&C), and bio-informatics (Lind, 2005). After expansion of its usage in the scholarly papers and business practices, now it is used anything that had to do with new services and products for IT related technologies and new business models. Especially, in association with events in Internet, telecommunications, finance, automobile, and broadcasting, the convergence is considered as the momentous and innovative process for value creation in recent economy.

Determinant factors in the convergence process are deregulation policies and technological advancements. With these phenomenons, the ICT sector is undergoing a radical transformation, creating exciting new opportunities and new challenges. Convergence is in the center of radical innovations resulting from these changes. Issues regarding convergence, however, have been discussed primarily in technological perspectives so-called the technological convergence such as device convergence, fixed-mobile convergence, voice-data convergence, and network convergence. Despite many researches and much discussion in practice and academic literature on this topic, the study of convergence would be incomplete without the analysis of strategic integration between firms in the telecom, broadcasting, and Internet industries (Chan-Olmsted, 1998).

From the business strategy perspective, industry convergence can be understood as the process of M&A, joint ventures, and strategic alliances to provide the convergence services and products in converged market. In this paper, we study the industry convergence, a process by which the mobile telecommunications, fixed telephony, terrestrial broadcasting, cable industry, Internet, and entertainment industries may be converging towards one huge value chain. After this, we examine the relations between industry convergence and business performance. Although there has been plentiful research and practical cases, the relationship between implementation of convergence strategy and its payoff is not yet proven. The reasons for that are, of course, the difficulties in measuring the degree of convergence. Measuring how firms and industries are related to others is critical in industrial organization, finance, and management research. However, objectively measuring relatedness on a large sample is difficult (Fan and Lang, 2000).

Industry convergence has many similar characteristics with firms' related and unrelated diversification strategy. And various attributes of relations between diversification and performance are well established in the strategic management disciplines (Montgomery, 1982; Rumelt, 1982; Venkatraman and Ramanujam, 1986; Gambardella and Torrisi, 1998; Fan and Lang, 2000; Chatterjee and

Blocher, 1992 Robins and Wiersema, 2003). In this paper, we employ empirical data on the firm's equity investment relations to measure the degree of industry convergence both in a firm-level and industry-level. The degree of convergence and other explanatory variables for business performance are selected and applied to our regression model to examine the impact of convergence on the business performance. With the business performance indicator, dependent variable of regression model, the approximation of Tobin's q ratio is measured and adopted to our sample companies during the period 2004-2005.

Background

Convergence and Diversification

Definition of Convergence

The recent literatures on the convergence are mostly starting with the emphasis on the usage of the term "convergence." It is because that the term "convergence" has many meanings and possibly leading to confusion in determining the appropriate contexts of application. Briefly saying, there are three views of convergence; those are technological perspective, market or industry specific perspective, and overall regulatory perspective. From the technological perspective, convergence can be defined as the process by which different industries come to share similar technological bases (Rosenberg, 1976). Another viewpoint is business or market convergence. From this, convergence did motivate aggressive diversifications and firm restructurings. However, the relationship between established theories about firm's inter- and intra-industry relations and the convergence is still mostly an uncovered area in the academic community (Lind, 2004).

According to Fowler (2002), convergence, viewed from a business rather than a technology standpoint, is related to the products and services that can be offered to customers. But he restricted the term convergence to the context of telecommunications industry. His suggestions about the level of convergence in telecommunications are delicate to apply common phenomena in ICT sector. However, the definition – convergence has come to mean a moving towards the use of one medium as opposed to many – is particularly well suitable to explain the recent convergence phenomena and observed tendencies which are taking place in Korean ICT sector.

Industry convergence is triggered by technology, deregulation, and product service offering and related to the merging of previously separated fields (Wirtz, 2001). Frequently, in the stages of convergence, industry convergence drives technological convergence or market convergence, and vice versa. One aspect of industry convergence is redefining market and blurring boundary of established industry. To analyze the industry convergence, therefore, a deeper understanding with holistic view of market, service, technology, and strategic alliance is required.

Industry Convergence and Diversification

There are many reasons behind the industry or business convergence in ICT sector. According to Bores at al. (2003), these are the need to cope with technological uncertainty (trying to impose a standard), market uncertainty (create demand with the supply of content and get the rents where margins are higher), and huge investments (the need of complementary resources). In addition, Wirtz (2001) suggests three drivers of industry convergence of ICT sectors. These are the technological drivers, deregulation, and demand-related drivers. Technological drivers are composed of digitalization, the development of intelligent network structures, and the technical convergence of media platforms. Among these technological drivers, the digitalization is the primary factor since this allows various platforms to be united in a common format.

Deregulation is also concerned as a key factor in advancing the industry convergence by many researches (Chon et al., 2003; Chan-Olmsted, 1998; Shin, 2005; Delmas and Tokat, 2005; Tadayoni and Skouby, 1999; Li and Whalley, 2002). It is true that the deregulations such as appeasement policy on cross-ownership between telephone and cable companies, removal of the restriction on the cross-market entry, are foster the convergence between ICT-related industries.

In addition to these discussions, we can explain the convergence as phenomena which are derived from convergence needs of customers'. Viewed from customer's perspective, convergence is a no more than a reaction strategy conducted by companies to cope with changes in customer's needs. Of course, it must be supported by technological feasibilities, such as intelligent network technology, transmission technology, software technology, and other electronic technologies.

The valuable framework including all aspects of convergence (supplier side, customer side, and regulatory side) is the value chain concept. The value added chain (commonly, value chain) is the process by which technology is combined with material and labor inputs, and then processed inputs are assembled, marketed, and distributed (Kogut, 1985). From this perspective of value chain, convergence can be defined as relationship between value chain stages or between value chains of many industries.

As the Internet and information technologies are evolve, the industry structure of ICT sector is experiencing the radical transformation, which is characterized by many scholars as reconfiguration of value chain (Wirtz, 2001), unbundling of value chain (Anderson and Williams, 2004), value network (Allee, 2000), deconstruction of value chain (Li and Whalley, 2002), destruction of boundary (Kang and Johansson, 2000), and industry convergence (Wirtz, 2001; Chon et al., 2003; Chan-Olmsted, 1998).

Viewed from the corporate strategy not from technology, market, and regulation, the convergence has many similar aspects as compared with firm diversification, which is well established in management strategy and finance management field. However, there is a fundamental difference between convergence and diversification. The first is difference in viewpoint and second is concerns of

scope. The diversification can be defined as a firm's expansion beyond the borders of its home industry or value chain stage across different industry or neighboring stages. Based on the degree of relatedness, diversification is classified into several categories (Rumelt, 1982; Fan and Lang, 2000; Montgomery, 1982). But in the literatures on diversification, there is no concern about its boundary limit; the subject of investigation is whole economy. On the contrary, convergence strategy has meanings in a restricted scope, which are determined by customer's needs. In addition to this, the viewpoint of diversification is extremely supplier driven rather than customer driven approach. These differences between diversification and industry convergence are presented in Figure 1.

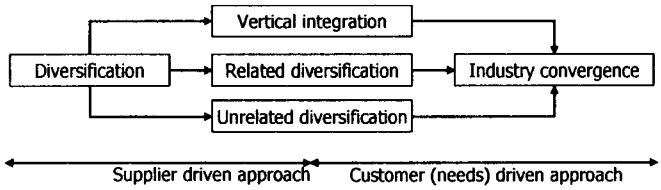

Figure 1 - Industry convergence and diversification

Convergence Strategy and Business Performance

Measurement of Convergence Strategy

Measuring how industries, firms, or business units within firms are related is critical in industrial organization, finance, and management research. However, objectively measuring relatedness on a large sample is difficult (Fan and Lang, 2000). Industry convergence has many similar aspects to firm's degree of diversification. Hence, in this section, researches on the measurement of relatedness or diversification are surveyed to develop appropriate method in measuring the degree of convergence.

Through a plenty of researches on the firm diversification, many methodologies to evaluate and classify the diversification strategy have been developed. These literatures can be summarized by three research streams. The first is traditional approaches to measure an enterprise's product-market diversification and these are built on the Standard Industrial Classification (SIC) system. The SIC system is a numerical system developed by the government for classifying all types of economic activity within the whole economy. In SIC system, firms are classified according to its primary business activity (or product class), typically using 2-digit and 4-digit industry codes (Rumelt, 1982). The representative measure based on the SIC scheme, the objective measure, is Berry-Herfindahl index, the continuous measure of diversification. With basic idea, Herfindahl index computed from the sales or assets of a firm by segment. This index is the sum of the squared values of sales (or assets) per segment as a fraction of total firm sales (or assets). If a firm has only one segment, then its Herfindahl index is one, and if a firm has 10 segments that each contribute 10 percent of the sales, then its Herfindahl index is 0.1. Therefore, the Herfindahl index falls as the degree of diversification increases (Lang and Stulz, 1994).

These measures are commonly employed product-count measures of diversification (Bass et al., 1978) and directly applied to M&A research. It has also been used to construct more sophisticated diversification measures, such as the entropy measure and the concentric index (Berry, 1974; Palepu, 1985; Wernerfelt and Montgomery, 1988). In SIC based system, to capture relatedness or diversification, researchers classify two businesses as unrelated if they do not share the same 2-digit or 4-digit SIC code, and vice versa. These measures have both strengths and weaknesses at the same time. The advantages of these measures are concreteness and replicability (Rumelt, 1982; Chatterjee and Blocher, 1992; Fan and Lang, 2000). The weakness, on the other hand, is that they cannot measure relatedness between different groups at both 2-digit and 4-digit SIC levels. Also, they cannot measure the degree of relatedness because of its property of discreteness. These shortcomings are originated in varying degrees of breadth in the SIC classes and the implicit assumption of equal dissimilarity between distinct SIC classes (Rumelt, 1982).

The second stream of research on the measure of diversification is development and application of categorical measure. In his classic study of firm diversification, Rumelt (1974) uses a combination of objective and subjective criteria to classify firms to categorical framework. Rumelt's classification system uses a two-tier breakdown to assign a firm to 1 or 10 diversification categories. To classify a firm to diversification category, he calculated the specialization ratio using the percentage of a firm' s total sales that can be attributed to a 'discrete business area'. In Rumelt's system, the first tier consisted of single business, dominant business, related diversification, and unrelated diversification. The second tier has ten categories with break down from first tier. With a carefully conceptualized categorical measure of diversification, Rumelt was able to demonstrate a link between diversification and performance (Chatterjee and Blocher, 1992).

Although there are substantial literature that are still using Rumelt's classification system and measures, the diversification literature has increasingly seen the use of other measures, mainly continuous ones, which are the third stream of diversification research. This stream has an objective to develop a measure which is easier to compute or analyze than Rumelt's classification measures. The representative and early research is done by Lemelin (1982). In his research, he develops a pair of inter-industry relatedness coefficients. Successively, using the framework of vertical relatedness and complementarity, more sophisticated measures are developed by Fan and Lang (2000) and Varadarajan and Ramanujam (1987). In addition to these researches, the exertions to develop a measure and to apply this to various aspect of business strategy are still ongoing. In line with the trials that develop measures of diversification and apply to firm's strategic action, this research is in a same trajectory of former researches. The researches on relationship between diversification and performance are briefly summarized in Table 1.

Table 1 – Researches on diversification and performance[1]

Study	Research issue	Findings
Alfonso Gambardella and Salvatore Torrisi (1998)	Technological diversification and business performance Downstream operations and business performance	Performance is positively correlated with technological diversification Companies that focused their downstream operations had better performance
Montgomery and Wernerfelt (1988)	Diversification and performance Firm's diversity in response to excess capacity of factors	As firms diversify widely their returns decline
Wernerfelt and Montgomery (1988)	Are widely diversified (less-focused) firms less able to transfer their competencies to different markets? Does a firm's return decrease as they diversify further a field?	More focused (narrow diversified) firms outperform less focused firms
Palepu (1985)	Examines diversification-performance relationships distinguishing between related and unrelated diversification Hypothesizes that related will outperform unrelated	Firms with related diversification outperform firms with unrelated diversification

There are many indexes and measures, as we reviewed above, both with objective and subjective perspectives. However, it is difficult and ambiguous to apply these to the context of convergence. The SIC code based measures are inadequate in fast shifting convergence environment, especially in ICT sector. The classification schemes, such as Rumelt's system, are also inappropriate in computing the degree of convergence. Hence, we develop our own method to measure the degree of convergence from both firm level and industry level.

Measurement of business performance

Recently there has been growing recognition of the importance of assessing convergence strategies in determining a firm's competitive health and capacity for future business performance. Performance itself is a recurrent theme in most branches of management and it is of interest to both academic scholars and practicing managers (Venkatraman and Ramanujam, 1986). In order to evaluate and assess firm's strategic action, defining and measuring the business performance or effectiveness is indispensable.

Before proceed toward detailed discussions on firm performance, we need to examine the issue about the scope of business performance and organizational effectiveness. This issue was addressed by Venkatraman and Ramanujam (1986). In their research, they provide comprehensive elucidation on the domain of firm performance.

From their perspective, the narrowest conception of business performance is simple outcome-based financial indicators. Typical examples of this financial indicator are sales growth, return on investment, return on sale, return on equity, and earnings per share. However, these indicators have some significant problems. The first shortcoming is that these indicators only reflect past information and are not forward looking. Second, these are distorted by temporary disequilibrium effects, tax laws, and accounting conventions.

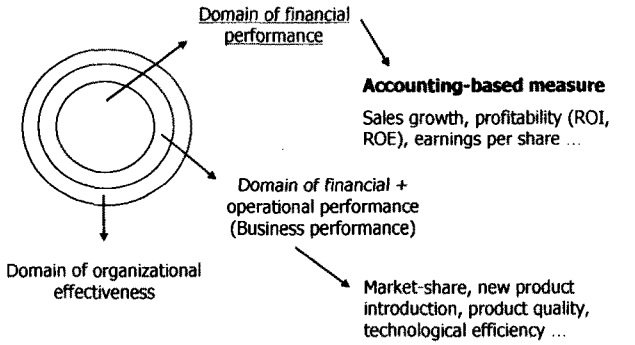

Figure 2 - Domain of firm performance[2]

Additionally, these indicators are not adjusted for risk and insensitive to the time lags necessary for realizing the potential of strategy implementation (Bharadwaj and Konsynski, 1999).

However, if we consider the market-based and value-based measurements to simple financial indicator, then it can be more appropriate than accounting-based measures (Hax and Majluf, 1984; Venkatraman and Ramanujam, 1986). The typical example of this indicator is Tobin's q which is the ratio of market value of a firm to the replacement cost of its assets (Lindberg and Ross, 1981).

The middle of the domain of performance is operational performance in addition to indicators of financial performance; market share, product quality, marketing effectiveness, and technological efficiency. In a strategy research, of course, consideration of both operational performance and financial indicators simultaneously is the best solution. But always, securing primary or secondary data is restricting the applicability of these indicators. For this reason, we selected the Tobin's q, which is a financial indicator reflecting the market and value-based approach, as a company performance indicator.

Tobin's q ratio was first introduced in 1969 by James Tobin as a predictor of a firm's future investments (Tobin, 1978). The Tobin's q ratio has been employed particularly by manufacturing firms to explain a number of diverse financial interactions and corporate phenomena, such as cross-sectoral differences in investment and diversification decisions, the relationship between managerial equity ownership and firm value, the relationship between managerial performance and tender off gain, investment opportunities and tender offer responses, and financing, dividend, and compensation policies (Chung and Pruitt, 1994). By definition, it is the ratio between the market value of the firm's assets and the replacement value of

[1] Adapted from Robins and Wiersema, 2003

[2] Adapted from Venkatraman and Ramanujam, 1986

those assets calculated as follows:

$$q = \frac{(MVS + MVD)}{RVA} \quad (1)$$

where MVS is market value of all outstanding stock, MVD is market value of all debt, and RVA is replacement value of all production capacity (Wolfe and Sauaia, 2003). This equation to calculate Tobin's q is a simple expression of basic idea derived from the definition. The more theoretically correct equation is Lindenberg and Ross (1981)'s equation.

$$q = \frac{PREFST + VCOMS + LTDEBT + STDEBT - ADJ}{TOTASST - BKCAP + NETCAP} \quad (2)$$

where PREFST is defined as the liquidating value of a firm's preferred stock, VCOMS is the price of the firm's common stock multiplied by the number of shares outstanding at the close of the year, LTDEBT is the value of the long-term debt adjusted for its age structure, STDEBT is the book value of the firm's current liabilities, ADJ is the value of the net short-term assets, TOTASST is the book value of the firm's total assets, BKCAP is the book value of the firm's net capital stock, and NETCAP is the firm's inflation-adjusted net capital stock (Lindenberg and Ross, 1981). As the usage of Tobin's q with a proxy indicator of firm performance become prevailed in strategy and finance field, a number of innovative experiments to simplify the computational procedures are suggested. The representative trial is Chung and Pruitt's (1994) research. They argue that despite its influence over many important aspects of corporate finance, discussions with several senior financial managers suggest little reliance upon Tobin's q in real-world decision analysis. Also they emphasized the unfamiliarity and complexity of computational procedure as a barrier of its usage diffusion. Based on these discussions, they suggested a simple approximation of Tobin's q.

The q ratio has a number of advantages in investigating the relationship between strategy and performance. As summarized by Bharadwaj et al. (1999), the issues to which the q ratio can be applied are;

- An alternate measure of business performance (Chen and Lee, 1995)
- A predictor of profitable investment opportunities (Lang and Lichtenberger, 1989)
- A measure of the capitalized value of monopoly rents (Salinger, 1984)
- A measure of returns from diversification (Lang and Stulz, 1994; Wernerfelt and Montgomery, 1988; Gambardella and Torrisi, 1998; Kumari, et. al., 2006)
- An indicator of a firm's intangible value (Hall, 1993; Megna and Klock, 1993)
- A measure of brand equity (Simon and Sullivan, 1993)
- A measure of the value of technological assets (Cockburn and Griliches, 1988; Hall, 1993)
- A measure of market power on performance
- A measure of IT effects on firm performance (Bharadwaj et. al., 1999).

In this paper, hence, we use the approximation of q as an indicator of firm's business performance under the condition of assumptions that financial markets are efficient and that a firm's market value is an unbiased estimate of the present value of its cash flows.

Measuring the Degree of Convergence

We develop a measure to capture and analyze the convergence phenomena in a cross-firm and cross-industry relations. Viewed from a single-firm perspective, the cross-firm relation itself formed by equity investment has two attributes; outbound relations and inbound relations. The outbound relations can be understood as results of firm's action strategies to dominate the other firms with capital investment. These investments are explained and justified by economies of scale and scope, theories of innovation and transaction cost, and means to enter into different market. At any rate, firms which have direct connections to other firms can exercise and control the resources and assets, such as technological patents, production facilities, human resources, sales and service networks of controlled firms. Hence, the convergence through outbound investment relations can be defined as positive convergence strategies.

On the contrary, inbound relations viewed from a controlled firm can be understood as results of attraction of investment. From an investor's point of view, a firm which has valuable resources or capabilities, that is indispensable in driving the convergence strategies, is concerned as an expedient means to capture complementary assets, such as distribution channel and customer base. Therefore, we can take the strength of inbound relations for one of the passive convergence strategies of the controlled firm. Putting these discussions together, if the index of positive convergence, which is the value of outbound investment on inbound investment for specific industry, is higher than other industries', then we can interpret former industry plays a leading part in industry convergence. On the other hand, industry with higher score in index of passive convergence can be understood that this industry possesses indispensable resources or valuable resources for convergence service/product offering and has relatively lower power. The detailed process of modeling to compute the index of industry convergence is as follows.

Let us first consider a simple situation. There are two separated value chain and each value chain is constructed by 4 stages. Firm i and j is operates its business in one stage of each value chain and two firms are connected by equity investment relation. Let firm i denote the controlling firm and firm j denote controlled firm, then the link value established between firms can be measured by multiplication of the percentage of share and capital or total sales or market capitalization price of controlled firm.

If we use the total sales of controlled firm to compute the link value, then the market situations of specific year and managerial capabilities of target firms are reflected to the value which captured by controlling company's

convergence strategy. This is not an appropriate approach in the long run. Also, market capitalization price of controlled firm is not a proper indicator of controlled firm's net value because Korean stock market is relatively small and susceptive to the influence of other factors which can not be controlled. Hence, in our model the capital of controlled firm is used in measuring the value of each link. Let β_{ij} denote percentage of share from firm i to firm j and a_j denote capital of firm j, then the link value, denoted by L_{ij}, is computed by

$$L_{ij} = \beta_{ij} \times a_j \tag{3}$$

The link value computed by formula (3) may be interpreted in various ways. If firm i and firm j are belongs to same stage of one industry value chain, then the relation between firm i and firm j is characterized to lateral relation within industry boundary, therefore the link value can be used in measuring the degree of vertical integration.

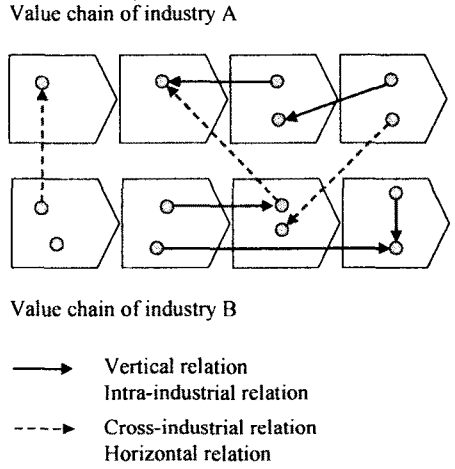

Figure 3 - The intra-industrial and cross-industrial relations

Also, as mentioned before, if firm i and j are belongs to neighboring stages, respectively, within industry specific value chain, then the relation is also interpreted vertical integration. On the other hand, if firm j is belongs to separated value chain from value chain of firm i, then the link value can be used in calculating the degree of industry convergence of firm i. (The diagram of the cross-firm and cross-industry relations is presented in Figure 3)

In this way, we can compute the degree of vertical integration and horizontal integration in a firm level by three steps. First step is to classify all firms which have more than one connection with other firms to 6 separated industry sector. Second step is to compute all link value. Finally, grouping these links by vertical and horizontal attribute, and then calculating the convergence level of each firm. If firm i belongs to value chain of industry p, that is, $i \in E(p)$, then the degree of industry convergence (sum of horizontal relations) of firm i can be represented as

$$\rho_i = \frac{\sum_{i \in E(p), j \notin E(p)} L_{ij} + \sum_{j \notin E(p)} L_{ji}}{\sum_{all\ j} L_{ij} + \sum_{all\ j} L_{ji}} \tag{4}$$

Where ρ_i is a degree of industry convergence of firm i, and L_{ij} is a value of investment from firm i to firm j.

In this research, we measure the degree of convergence using these simple formulations and apply the computational results in examining the relationship between convergence and performance.

Methodology

Research Model and Variables

Research Model

The main purpose of this study is to examine the relationship between firm performance and the degree of convergence in the context of ICT sector. We have discussed the various methods to measure the degree of convergence and firm performance. Also, we surveyed the literatures on relationships between degree of diversification and firm's value. In those researches, while the effects of firm diversification have been found to be important, the effects of industry convergence have been overlooked.

Derived from past researches on strategy and performance, we set up the relationships between implementation of convergence strategy and performance. Followings are our proposed hypotheses on the relationship between convergence and performance. In addition to these hypotheses, various explanatory variables will be discussed.

Hypothesis 1: the degree of convergence will be related to the firm performance

Hypothesis 2: the degree of convergence will be positively related to the firm performance

Data Collection

In order to analyze the relationship between convergence and business performance, first, we collected data on companies, which are at least having more than one connection with other firms and listed in KOSPI or KOSDAQ. Second, we collected detailed data of these firms on the amount of total equity investment, the percentage of share for each link, and other financial indicators during the period 2002-2005. To our knowledge, there are only two sources for data related to the present state of company's assets, equity investments, percentage of share, and other accounting-based indicators which are used

in computing Tobin's q. The first is the annual report issued by each company and the second is the audit report issued by chartered accountants. We obtained these data from DART (Data Analysis, Retrieval and Transfer System) which is managed and serviced by FSS (Financial Supervisory Service) in Korea. Also, complementary information is collected through KIS (Korea Information Service) company database. Heuristic approaches are adopted in selecting sample firms and classifying these firms to 6 industry categories (mobile telecommunications, fixed telecommunications, terrestrial broadcasting, cable, Internet and Entertainment industry). The sample is consisted of 86 ICT companies that are all listed on KOSDAQ and KOSPI.

The links applied to our model are having value above 5% of their percentage of share. In Korea, when a company holding or acquiring over 5% of other companies' stock, it must be publicly announced to the Korea Stock Exchange and informed in annual and audit reports. The 5%, also known as the rule of 5%, is a compulsory value by Securities Exchange Act in Korea. Therefore, if one company holds securities of other company's with over 5%, then it means that equity investment is a result of corporate strategies for convergence not for the temporary financial gain.

Dependant Variable

Our dependent variable is the business performance of the firm measured by Tobin's q. Although multiple methods have been proposed for calculating the Tobin's q, the different approaches tend to yield very similar values (Chung and Pruitt, 1994). Therefore, in this study, the approximation of Tobin's q serves as the proxy variable of firm performance. The Approximation of Tobin's q can be calculated by,

$$Approximate\ q = \frac{(MVE + PS + DEBT)}{TA} \qquad (5)$$

Where *MVE* is product of a firm's share price and the number of common stock shares outstanding, i.e., (Closing price of share at the end of the financial year)*(Number of common shares outstanding); *PS* is the liquidating value of the firm's outstanding preferred stock; *DEBT* is the value of firm's short-term liabilities net of its short-term assets, plus the book value of the firm's long-term debt, i.e., (Current liabilities – Current assets) + (Book value of inventories) + (Long term debt), and *TA* is the book value of the total assets of the firm. As noted earlier, all financial data obtained from firm's audit report and annual report.

Independent and Control Variable

The degree of convergence serves as the key independent variable in this study and calculated as the ratio of cross-sectoral (industry) investment to total investment for each firm.

We use two categories of variables as control; firm-specific and industry-specific control. The first firm-specific variable is firm size (FS) which reflecting the effect of economies of scale to business performance. Variable FS measured by the natural logarithm of the number of employees. Additionally, the R&D expenditure ratio, and current ratio included in the study as a firm-specific control variable (Montgomery and Wernerfelt, 1988).

Table 2 – Variables and measures

Variable	Measure
Dependent	
Firm performance	Approximation of Tobin's q
Independent	
Firm's Degree of Convergence	(Sum of investments in lateral relationship)/ (Firm's total investment) * 100
Control	
R&D expenditure ratio	Ratio of firm's R&D expenditure to sales
Firm size	Natural logarithm of the number of employees
Current ratio	(Current assets/Current liability)*100
Industry sector	Dummy variable for 6 industry sectors

Table 3 – Descriptive statistics

Variables		M	SD
Firm performance	FP	1.7346	1.0877
Firm's Degree of Convergence	DC	43.4965	39.6523
R&D expenditure ratio	RD	4.5410	5.6775
Firm size	FS	4.9302	1.5851
Current ratio	CR	5.5956	0.9854
Fixed telecom	DF	0.0698	0.2562
Terrestrial broadcasting	DB	0.0581	0.2353
Cable TV	DC	0.1279	0.3359
Internet	DI	0.2326	0.4249
Entertainment	DE	0.2209	0.4173

These firm-specific characteristics may have an additional impact on firm performance. The objective of including the industry-specific control is to reflect the impact of the characteristics of the industry on the firm performance (Porter, 1985). We include 6 separated industries in the study as 5 dummy variables; for fixed telecom (DF), terrestrial broadcasting (DB), cable TV (DC), Internet (DI), and Entertainment (DE). The explanatory variables and dependent variable are summarized in Table 2 and descriptive statistics of the variables are presented in Table 3.

Estimation Method

Least-squares regression was used to estimate the relationship between degree of convergence and business performance measured by Tobin's q. To identify the impact

of convergence on the performance, we tested the following two regression equations in a hierarchical manner (Bharadwaj et al., 1999)

$$q_t = B_0 + B_1 RD_t + B_2 FS_t + B_3 CR_t + B_4 DF_t + B_5 DB_t + B_6 DC_t + B_7 DI_t + B_8 DE_t + \varepsilon_t$$

$$q_t = B_0 + B_1 RD_t + B_2 FS_t + B_3 CR_t + B_4 DF_t + B_5 DB_t + B_6 DC_t + B_7 DI_t + B_8 DE_t + B_9 DC_t + \varepsilon_t$$

where q_t is our measure of performance in year t, the B's are the parameters to be estimated, RD_t is firm's expenditure ratio of R&D to total sales in year t, FS_t is size of firm in year t, CR_t is current ration of firm in year t, and ε_t is the error term with zero mean.

In regression model 1, we test the association between explanatory variables and Tobin's q ratio. In model 2, we include our key independent variable, the degree of convergence (DC), to examine the incremental variance explained by convergence strategy. We estimate our equations by OLS regression method.

Empirical Results and Discussion

The results from the OLS regression runs of the suggested two models for each of the 2 years are presented in Table 4. Actually, we run our models for each of 4 years during 2002-2005, but the analytical results in 2002 and 2003 provide no statistical significance of the incremental contribution of convergence to firm's business performance. Hence, we proceed with interpretation of results on 2 years (2004 and 2005).

Table 4 - Results of hierarchical regression analysis[3]

	2004		2005	
	Model 1 β	Model 2 β(t-value)	Model 1 β	Model 2 β(t-value)
Firm Specific Controls:				
R&D expenditure	0.054	0.033 (0.298)	-0.213	-0.207(-1.953)***
Firm size	0.254	0.237(1.796)***	0.050	-0.017(-0.145)
Current ratio	-0.032	-0.075(-0.619)	0.087	0.040(0.361)***
Industry Controls:				
D1	-0.083	-0.145(-1.189)	-0.156	-0.154(-1.478)
D2	0.121	0.101(0.793)	-0.070	-0.011(-0.102)
D3	-0.011	0.005(0.043)	0.168	0.208(1.809)
D4	0.404	0.448(3.406)**	0.366	0.362(3.229)**
D5	0.184	0.143(0.971)	0.320	0.335(2.694)**
Convergence Index		**0.233(2.010)***		**0.281(2.792)****
R^2	0.172	0.217	0.263	0.332
Adjusted R^2	0.090	0.117	0.187	0.253
F value	1.844	2.158	3.442	4.196

* Significant at $p \le 0.01$ **Significant at $p \le 0.05$ ***Significant at $p \le 0.1$

The results of the hierarchical regression analysis, presented in Table 4, are providing a number of implications about the impact of convergence on the business performance. First, it indicates that the inclusion of variable for the degree of convergence (convergence index) increased the variance explained in approximation of Tobin's q significantly (the inclusion of convergence variance increase the R-square from 0.172 to 0.217 in year 2004, and from 0.236 to 0.332 in year 2005), in all of the 2 years. These results say that firm's implementation of convergence is related to firm's market value, as we hypothesized. Also, this indicates that convergence variable provides unique information in explaining variance in Tobin's q. Second, standardized coefficient of convergence index (degree of convergence) is 0.233 in year 2004 and 0.281 in year 2005. These are indicating that firm's convergence strategy has a positive effect on the business performance.

Conclusion

With respect to convergence phenomena in ICT sector, the main questions examined in this paper are existence of relatedness between convergence and performance. In regard to these questions, we analyzed firm's action strategy of convergence, as measured by the ratio of cross-industry investment to intra-industry investment. To identify and measure the action of convergence, we develop and apply the value chain governance model to cross-firm relations. Also, the performance measures, already suggested in strategy and finance disciplines, are surveyed. Through the careful investigation, we select approximation of Tobin's q, a financial-market indicator, as a proxy indicator of firm performance.

In this paper, we empirically examined the relationship between convergence strategy and business performance using various explanatory variables. The results of OLS regression indicate that there was a significant correlation between firm's degree of convergence and firm's market value. In addition, the direction of correlation is empirically supported to positive. This result means that firm's implementation of convergence strategy performed by controlling the other companies, which are doing business in another industries, has influential effect on the firm's future market value.

From the findings in this study, one can conclude that there is a potential opportunity for creating value, sustaining competitive advantage, capturing customer base, offering new product/service, developing innovative technology, and promoting strategic alliance through industry or value chain convergence.

Although there is a necessity to sophisticate the ideas and approaches applied in this study, the methodology and results have a number of implications for scholars and business managers. And above all, more detailed research need to be made into the consequences of convergence, value chain, and performance. This study hopes to provide policy implications and strategic insights to regulators and managers in ICT sector

[3] Standardized regression coefficients are reported, with t-value in parenthesis