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Market Positions of Four Major International Construction Sectors

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Abstract
The market volume of international construction has grown every year and along with it, its importance is being emphasized more than ever. This trend has induced many studies to investigate the characteristics of international construction industry and these studies have contributed in understanding the nature of international construction industry. However, despite the fact that each project type has its own characteristics, many studies have broadly considered the international construction as a single industry unit. This study distinguishes international construction industry into four major sectors, i.e. general building, power plant, industrial process/petroleum plant, and transportation facility. The study analyzes market growth, market entry barrier, and profitability of each industry sector using ENR Top 225 International Contractors and International Contractors Association of Korea (ICAK) databases. Analysis results led to the following findings: 1) a trade-off relationship between market growth and profitability; 2) a positive correlation between entry barrier level and profitability; 3) a negative correlation between entry barrier level and market growth; and 4) different positions and trends of each sector in relation to the three market attributes. Theories from economic and management science were reviewed to provide enhanced knowledge toward supporting these notions. The results of this study can serve as a starting step for seeking attractive markets. It can benefit the international contractors by assisting their decision making process for selecting promising construction sector.

Keywords
International construction, market growth, market entry barrier, market assessment, market concentration

1. Introduction

Many contractors, whether small or large, have long been seeking business opportunities in the international construction market. This movement has induced the market's explosive growth. A number of researchers also turned their attention to this topic and many studies have been undertaken. The research topics broadly include risk analysis and decision modeling, identification of project success factors, joint venture and alliance issues, entry and business strategies, contractual & legal issues, cultural & localization issues, and many other subjects of international construction market. However, in most cases, the researchers have viewed the international construction industry as a single entity despite the

unique and different characteristics of its sub-sectors. For domestic market, Chiang *et al*. (2001) examined the market status of construction industry in Hong Kong by segmenting construction industry into four sectors. They found that building and civil sector showed different traits in market's structural point of view. Needless to say, this approach is also necessary for international construction industry.

So far, there exists only limited discussion about each individual sector of international construction regarding its trend, market growth, market entry barrier, and profitability. Given the lack of current studies, this study considers the three facets of each sector: market growth, market entry barrier, and profitability. The main questions addressed in this paper are: 1) Is there any particular sector in international construction that features high market growth rate as well as high profit rate?; 2) Does a sector that forms weak market entry barrier have a tendency to obtain a low average profit rate and vice versa?; 3) If a market is dominated by a small number of firms and is limited by strong market entry barrier, would the market growth slow down? In search of responses to these questions, previous studies were reviewed and theories from economic and management science were adopted to establish fundamental frameworks for market analysis. The term 'market' hereafter refers to any specific industry sector in international construction.

2. Background

The theoretical background behind this research is based on industrial organization theory. According to the theory, the behaviors of organizations in an industry are influenced by the traits of the industry and thus decide the average performance of that industry (Mason, 1939; Bain, 1956). In short, the performance of firms in an industry is highly affected by the traits of the industry. This assumption establishes the basis for finding the answers to the first and second research question.

Construction industry has been commenced since the start of civilization which makes the construction industry look as if it has reached its maturity. This may be true for domestic construction. However, it is a totally different story for international construction market. As Han and Diekmann (2001) discussed, international construction industry has experienced five critical changes that reshaped the business environment of international construction. The changes have caused barriers between nations to weaken and eventually led to rapid market expansion. International construction market has to be regarded as a new born market since it bears new environment and dynamics that works within. The recent boom of international construction has attracted many new entrants into the market. The evolving pattern of this industry can be seen as the early stage of industry according to Industry life-cycle (ILC) theory. Like any other industries in early phase, there are many entries and exits of firms in international construction (Peltoniemi, 2011). Increase of rivalry work as a catalyst for innovation. Since the competing firms have different backgrounds and technological advantages, they pursue different strategies for innovation (Klepper, 1996). Consequently, this improves the quality and also reduces the price of their product, which promotes an increase in the total sales of the industry (Agarwal and Bayus, 2002). However, the average profit rate of the market would be low, due to the intense competition and price reduction.

Regarding the market entry barrier, the study investigates how oligopoly can hinder the growth of market. It is a natural phenomenon that capable firms survive and less-capable firms are forced out of market in a competitive environment. According to Klepper and Miller (1995), at early stage of industry evolution, industry can experience rapid growth in the number of firms then at a certain point after reaching its peak, the numbers can continuously decline while the total market output still grows. This phenomenon is termed "shake-out". In addition to this, the market entry barrier formed by incumbents may act as an obstacle to candidate entrants. In the same context, weak market entry barrier would attract more entrants and cause over-competition. Eventually this would worsen the profitability of market.

3. Research method

This study analyzes data from two sources. The first data is ENR Top 225 International Contractors which is issued by Engineering News Records every year. It provides relevant information on the major players of international construction, i.e. their rank, nation, domestic & international revenue, amount of new contracts, and percentage of revenue from each construction industry sector. Since it is almost impossible to include all the international contractors into this research, top 225 international contractors are set as the subject of analysis. Top 225 international contractors are known to occupy 60-70% of the whole international construction volume (ICAK, 2007). Although it may not seem to offer enough coverage for the objective of this study, previous studies (Han *et al*., 2010; Ye *et al*., 2009; Low *et al*., 2004; Ofori, 2003) evidently used the ENR data for understanding the situations in international construction market. Therefore, another assumption is made for this study, that is, the outcomes of the top 225 international contractors are assumed to be similar as the outcomes of the whole international construction market. ENR classifies construction industry into 9 different sectors as follows: general building, manufacturing, power, water supply, sewerage/solid waste, industrial process/petroleum, transportation, hazardous waste, and telecommunications. In order to avoid complication and draw clear and meaningful result, this study focuses on four major sectors (general building, power, industrial process/petroleum, and transportation) which in general, account for more than 80% of the total international construction market.

The second data were collected from International Contractors Association of Korea (ICAK). Any Korean contractor engaging in overseas construction project is obligated to report to ICAK, as stated in the "Act for Promotion of Overseas Construction". The reports include the profit performance of overseas projects. In this manner, information on projects executed by Korean international contractors is compiled with an aid of ICAK database from which international projects ranging from 1994 to 2009 are collected for this analysis. A total of 2,028 projects, consisting of 624 general buildings, 435 powers, 495 industrial process/petroleum, and 474 transportation projects, were collected and analyzed. Although the data is based on Korean international contractors' specific experience, the authors are confident that it also reflects the general trend of international construction market, as those projects were widely executed under the particular traits of each industry across the world.

ENR data were used to calculate the average market growth rate of the four industry sectors for the analysis period between the years of 1995 to 2009. ICAK data were also used to analyze the average profit performance of Korean contractors in each of the corresponding sectors for the same period of time. The market growth rate and profit rate of each sector were then divided by the average value of the international construction market, as shown in Figure 1. This figure depicts relative position of the four major industry sectors with respect to average performance of the entire international construction market. Therefore, if a sector is plotted at the reference point (1, 1), the sector is considered to have exactly same growth rate and profit rate as the average value of international construction market.

Market entry barrier in this paper can be interpreted as market concentration. One of the conventional approaches to measure concentration include quantifying the market shares of incumbents (Bajo and Salas, 2002; Egghe, 2005). The basic idea of this approach is that when a market is dominated by few leading firms, it is deemed having weak competition whereas a market with no specific dominating firm is taken as highly competitive market (Boone, 2001). Therefore, level of competition intensity is used to indirectly assess concentration. Concentration ratio (CR_n), Herfindahl index (HI_n), entropy (EN) and Gini coefficient (GINI) are commonly used to estimate concentration (Ye *et al*., 2009). Among the four indices, concentration ratio (CR_n) was chosen for this study. CR_n is the most widely used index because it is simple and requires least amount of data. CR_n can be obtained by calculating the cumulative sum of market shares occupied by *n* largest firms in a given market. CR_4 is usually used to estimate the competitiveness of market. CR_4 value ranges from 0 to 1, in which the value closer to 0 implies highly competitive environment while the value closer to 1 signifies monopoly.

4. Data analysis

4.1 Market growth & Profitability

Average performances of the major sectors are displayed in Figure 1. Industrial process, petroleum, and power sector are placed at the upper right quadrant of the diagram. This means that these sectors have outperformed the other sectors at a glance in terms of both growth rate and profit rate. While transportation sector has recorded the highest growth rate, its profit performance has been the lowest. General building sector have failed to surpass the average performance of international construction market in any dimension.

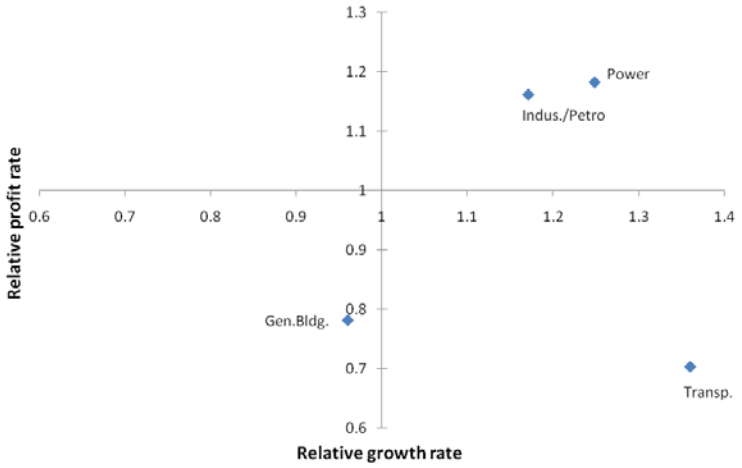

Figure 1 : Relative Position of the four major sectors (1995-2009)

Figure 2 shows a comparison of the major sectors between two different time periods on a three-year basis. Table 1 tracks the path of each sector for the concerned time periods. All the sectors indicate same relationship between growth rate and profit rate. The growth rate of general buildings and industrial process/petroleum decreased, while their profitability increased. Power and transportation showed the opposite direction. Their growth rates were heightened whereas the profit rate dropped. Although the four sectors show various degree and slope in their movements, they all exhibit trade-off relationship between growth rate and profit rate.

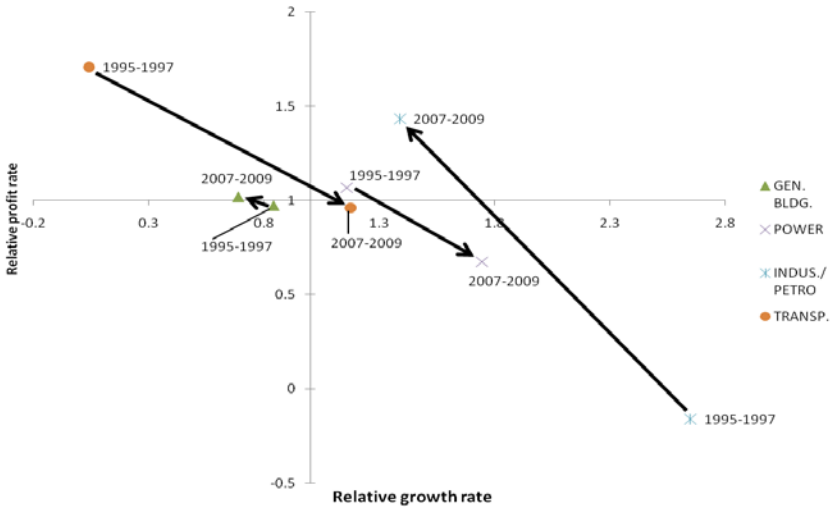

Figure 2 : Comparison between time periods 1995-1997 and 2007-2009

Table 1 : Movement of Each Major Sectors between 1995-1997 and 2007-2009

	GEN.BLDG	POWER	INDUS./PETRO.	TRANSP.
Growth rate	-	+	-	+
Profit rate	+	-	+	-

4.2 Market entry barrier & Profitability

Using the CR_4 measure, chronological trend of market entry barrier is assessed for the major industry sectors in Figure 3. On average, general building has the highest CR_4 value (38.83%) followed by industrial process/petroleum (37.77%), transportation (34.23%), and power (33.95%). Since the time period 2001-2003, the concentration level of all sectors gradually decreased until 2007-2009, implying that the market entry barriers have been continuously weakened in the four major sectors. For each time period, the international construction industry was exposed to different external risk factors related to economical status. For example, there was a financial crisis in Asia region in 1997. Therefore, in order to minimize the effect of external risk factors, analysis was focused on a specific time period. There has been a sudden increase in international construction market volume and competition has been intensified over the last few years. Thus, the time period between 2007 to 2009 was particularly selected for further investigation. As shown in figure 4, there exists an apparent level of positive linear correlation (Pearson correlation coefficient of 0.785) between CR_4 and profitability. The plotted points have tendency to have lower average profit rate as market concentration level decreases.

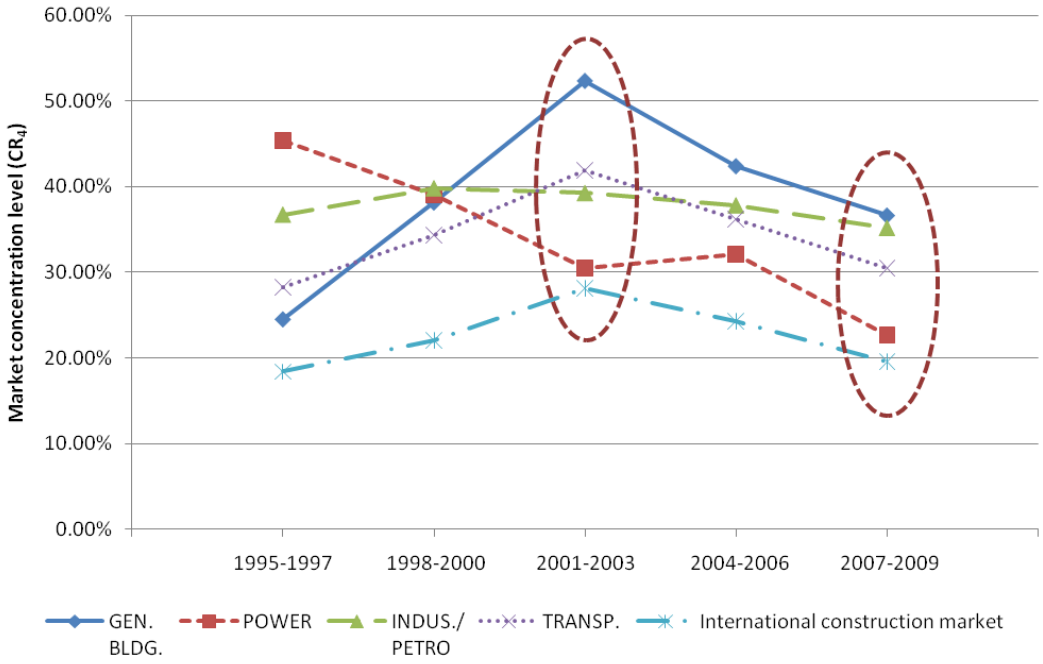

Figure 3: Chronological Trend of Market Concentration (on 3 year period basis)

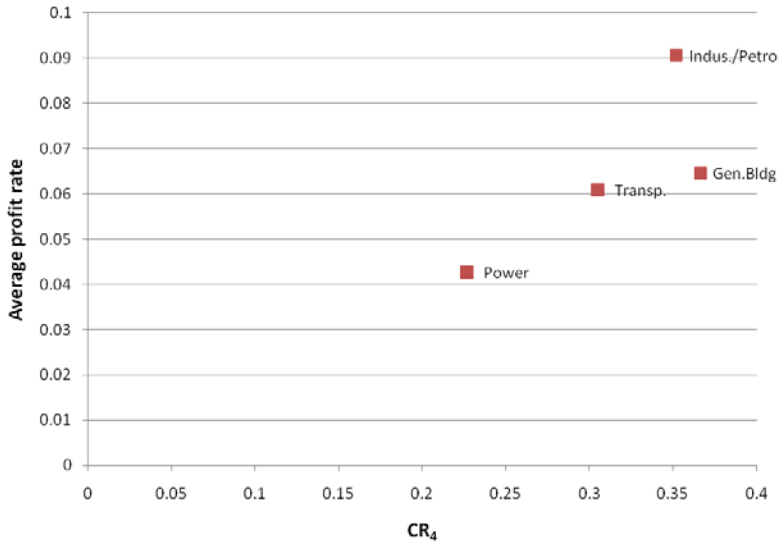

Figure 4 : Comparison of Four Major Sectors Regarding Market Concentration and Profitability

4.3 Market entry barrier & Market growth

The third question concerning whether there exists oligopoly in a market can also be investigated by examining its concentration level. Oster (1999) used CR_4 values to classify competition statuses into four levels; highly concentrated oligopoly (0.75-1.00), moderately concentrated oligopoly (0.50-0.749), oligopoly (0.25-0.499), and atomism (0.00-0.249). Deducing from the average CR_4 values that was discussed in the previous section, all major sectors fall in the oligopoly class. However, the international construction market as a whole has average CR_4 value of 22.49% which satisfies atomism, meaning that the market has been very competitive (Ye *et al*., 2009). The four major sectors have been relatively less competitive due to concentration.

The same time period (2007-2009) was selected again for analysis and the results are displayed in Figure 5. Among the four major sectors, power sector exhibits the most competitive nature compared to the other sectors. General building sector shows the highest concentration level which makes it mostly difficult to enter. Similar results were obtained even when analysis was performed for the different time span of 1995-2009. This implies that the oligopoly suppresses market growth by limiting the new entrants in a given market.

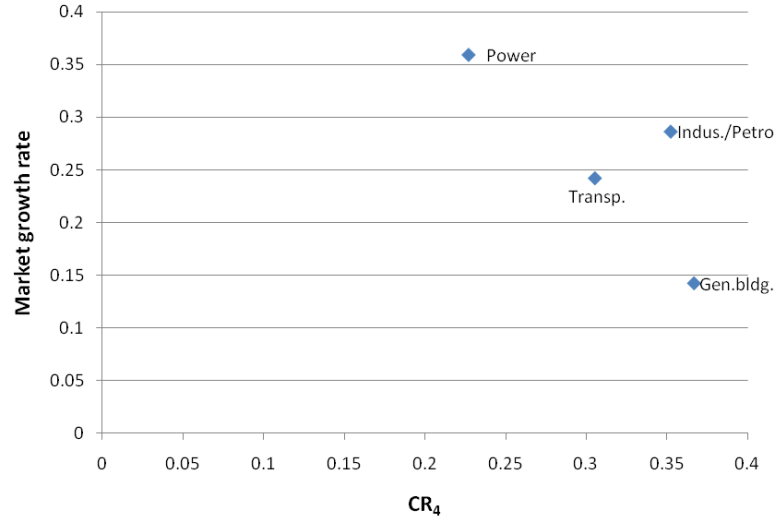

Figure 5 : Change in Market Growth Rate in accordance with Market Concentration level

5. Results and discussions

The study has focused on revealing the three basic aspects of four major sectors and several interesting results were drawn. Each construction sub-sector showed a trade-off relationship between market growth and profitability. In other words, booming industry or rapidly growing industry does not guarantee high profit rate. Profit rate showed a positive correlation with market entry barrier level and this implies that to some extent, higher market entry barrier can result in better profit rate. As discussed previously, a market that has low market entry barrier tends to have greater influx of new competitors and so yield low profit rate due to tight competition. Markets that require high technological competence cannot be easily entered and is less competitive. This naturally motivates the incumbents to enjoy higher markup for their products. While the causal relationship between the three dimensions of market may yet seem uncertain, the findings can still be used as reference for international market assessment. For the timeframe of 2007-2009, the industrial process/petroleum sector stood out as an exceptional case. This sector stands as an outlier because it yields high profit rate despite high growth rate. Also, its growth rate was not hampered by strong market entry barrier. One possible explanation for this is that regardless of its strong market entry barrier, the increase in total volume of industrial sector/petroleum sector was led by growing demand for industrial infrastructures in developing countries of Asia, the Middle East, Africa, and South America (Han *et al*., 2010). General building sector featured very low growth rate and very strong market concentration while its profitability were kept at moderate level. In light of these, general building sector has suffered the biggest damage from the global financial crisis in 2008. Transportation sector has scored average performances in every aspect. In the context of competition intensity, Ye *et al*. (2009) proposed 0.2735 as an idealistic CR_4 value for international construction industry. Minimal level of competition (higher CR_4) can hamper the effectiveness and efficiency of the construction firms, while over-intense competition (lower CR_4) can lead to serious market failure (Akintoye and Skitmore, 1991; Ball *et al*., 2000). For most of the time, general building, industrial process/petroleum, and transportation sectors exceed the given CR_4 value whereas the power sector does not. The closer the CR_4 value is to 0.2735, the more preferable the sector is in terms of both competition and concentration level. Considering the findings in Figure 3, with continuous drop in concentration level over the last decade, the power sector is likely to become over-competitive in the near future while the other sectors are settling down to more preferable level.

Although it has not been introduced in the main sections of this paper, market size is also an important factor for those who make decisions on market entry. For the recent three years (2007-2009), industrial process/petroleum sector accounted for the largest proportion (29.90%), followed by transportation (27.10%), general building (23.57%), and power (7.21%). Generally the bigger markets (general building, industrial/petroleum, and transportation) formed stronger market entry barrier compared to the smaller one (power). The power sector may seem the easiest market to make an entry however, its attractiveness pertaining to the profitability and market size remains questionable.

6. Conclusion

The four major sectors in construction, namely, general building, power, industrial process/petroleum, and transportation were analyzed in three aspects: market growth, profitability, and market entry barrier. Theories from economics and management fields enabled better understanding of the analysis results. The major sectors belong to international construction industry if taken from a macro view. Nevertheless, the recent trend of each sector indicates different unique market conditions. The findings from this study can be used for basic assessment of construction industry sub-sectors and contractors can decide which sector best suits their strategies. However, these results are tentative and hold many limitations. The most critical weakness of this study is that the profitability information was based on the performances of Korean contractors which may reflect significant specificity of the group. In other words, Korean contractors alone do not suffice to fully represent the profitability of the whole industry. Other contractors, or researchers from other nations, can use the ENR data and bind them with their own profit performance

data to grasp market attractiveness from their point of view. Another criticism can be made on the diversity of considered sectors. Only four conventional sectors were included and new emerging sectors such as environmental facility was omitted. Market status associated with its industrial life-cycle phase, may also differ from region to region. For future study, the study will expand its scope to obtain more comprehensive knowledge. The internal dynamics between owner-contractor and incumbent-entrant relationships need to be investigated for every sector. Plus, more attention is required to the regional, organizational, and project level factors as discussed by Han et al. (2007).

7. Acknowledgment

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