Firms' Diversification Strategy and Long-Term Performance

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Abstract

A firm's business composition and the sales volume of each business segment are subject to change depending, to a considerable extent, on the firm's business strategy. These changes were weighted and represented as a single index, referred to by scholars in strategic management and industrial organization research fields as "firm entropy" then its impact on firms' profitability was assessed over twelve years. The performance differences between contractor and non-contractor firms, as well as focused and diversified firms, were compared through a Longitudinal Data Analysis Technique within a Hierarchical Linear Modeling framework. Hypothesis was formulated based on firm diversification theories and previous research findings. The hypothesis was tested according to the modeling outcomes, and implications are presented. The research findings indicate that the level of firms' long-term profitability supports the argument that the construction industry is highly competitive and mature.

Keywords: Diversification Strategy; Profitability

1. INTRODUCTION

Entropy, in general, refers to a measure of the amount of disorder in a system; high entropy means high disorder while low entropy represents orderly status, and thus the higher the entropy the more chaotic the system. Yet, entropy is subject to diverse measurement forms and different meanings depending on the research discipline. Because the entropy concept has been applied in a wide variety of academic disciplines (McClean and Abodunde, 1978), it has been invoked in empirical studies in economics as well as in management, marketing, finance, and accounting (Attaran and Zwick, 1989). The following are a few examples from a vast body of literature. McClean (1986) measured the continuous time entropy of labor stability in measuring the stability of a firm. In finance, Buchen and Kelly (1996) applied the entropy concept to asset modeling under the information theory. Demetrius and Ziehe (1984) applied the concept to measuring the rate of increase of effective population size.

This study is organized as follows. To begin with, the use of entropy in measuring industry concentration and the level of firm diversification is reviewed. Then both the theories and the empirical research findings regarding firms' diversification strategy and performance are presented. Based on the theories and previous research findings, hypothesis is formulated. Next, the sources of data and sample of this study are described, followed by the measurement method of firm diversification level and modeling technique. Then, the analyses of modeling outcomes and interpretations are detailed. Finally, a summary of research findings and implications drawn from this study are presented, as well as a future research agenda.

1.1 Firm/Market Entropy

In thermodynamics or gas dynamics, the entropy of particles is described in a closed idealized system. The system consists of numerous molecules, and there is no interaction with anything outside. In contrast, firm entropy may be a function of the number of business segments and the size of each segment's sales volume, business environment, or the change of market demand. On the other hand, market entropy is a function of the number of firms in either the product or geographical market. However, the major distinction between thermodynamics and firm/market entropy is reversibility. The second law of thermodynamics states that "the entropy of a closed system shall never decrease and shall increase whenever possible." However, firm or market entropy may change depending on the firm's business strategy and environment. Put differently, firm/market entropy can be increased or decreased.

1.1.1 Entropy as a Measure of Industry Concentration

Entropy measures within the industrial organization and management research fields have been used to analyze either industry concentration or the degree of firm diversification. At the industry level, there are several alternative indices available to gauge

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industry concentration, including "ogive, national average, portfolio, McLaughlin, and information theoretic" (Attaran and Saghafi, 1988). However, the entropy measure is superior to other measurements in that "entropy can be decomposed into additive elements which define the contribution of diversification at each level of product aggregation to the total" (Jacquemin and Berry, 1979; Attaran and Zwick, 1987). Accordingly, "entropy has frequently been used to measure the degree of industrial concentration and thus competition within an industry" (McClean and Abodunde, 1978).

However, Hart (1971) argues that the entropy measure is inappropriate for business concentration and advocates the use of a statistical distribution parameter, such as the variance of the logarithms. Nonetheless, the use of entropy has been widespread in a variety of industry sectors in analyzing industry concentration. One example is Ng's (1995) analysis of industrial concentration and competition; in his study, a higher entropy index meant the existence of a large number of participants, and represented a lower concentration and thus consequently higher competition in the industry. Other examples include Attaran and Saghafi's (1988) analysis of the concentration and profitability of the U.S. manufacturing sector using Theil's entropy measure; Meller's (1978) work on Latin American manufacturing sector concentration; Horowitz's (1970) study of industrial concentration; and Horowitz and Horowitz's (1968) study of brewing industry competition.

1.1.2 Entropy as a Measure of a Firm's Diversification Level

At the firm level, the entropy concept has been employed as a measurement of firm diversification. Jacquemin and Berry (1979) argue that the Herfindahl index is a more meaningful measure of industrial concentration, while an entropy measure is more appropriate for corporate diversification. The entropy measure, which was proposed by Jacquemin and Berry (1979), identified three elements of a firm's operation diversity: "the number of product segments in which the firm operates; the distribution of the firm's total sales across the product segments; and the degree of relatedness among the various product segments" (in Palepu, 1985).

Palepu advanced and differentiated Jacquemin and Berry's entropy measure by decomposing a firm's total diversity into two additive components: an unrelated component that measures the extent to which a firm's output is distributed in products across unrelated industry groups, and a related component that measures the distribution of the output among related products within industry groups.

The present study, based on Palepu's entropy measure, examined the diversification strategy and its impact on firm performance within construction industry research settings. Accordingly, the domain of this study is confined to the construction industry (U.S. public construction firms), and the level of analysis was set at the firm level. The aim of the author was to attempt to shed some light on strategic decision making for management of construction firms based on the results drawn from this study.

1.2 Diversification Strategy and Firm Performance

Considering its significant impact on firm performance, a firm's diversification strategy is a fundamental issue that should be addressed rigorously by any industry. Stated another way, it is the firm strategy that determines a firm's overall business portfolio, which consists of various projects. It involves decisions that will guide a firm into areas the firm should compete in and with what kinds of products. Therefore, "the relationship between a firm's diversification strategy and its economic performance is an issue of considerable interest to both academics and managers" (Palepu, 1985).

It is well known that the construction industry has been struggling to improve low profitability, and high competition has been regarded as a predominant feature of the industry. Thus, in this study, the relationship between the changes of firm diversification and the profitability of construction firms was analyzed over a relatively long-range time period. To accomplish this, it was necessary to review the theoretical issues of diversification strategy and the evidence drawn from empirical studies so that appropriate hypothesis could be formulated within construction industry research settings.

Theories, in general, support focused rather than diversified strategy based on a firm's core competency perspective, regardless of the industry. Even for diversification oriented firms, it is argued that "demonstrating distinctive competence in a specialized area provides a firm with an important competitive advantage in today's marketplace" (Heney 1985), implying that a firm has to increase its core competency and, if necessary, diversify its business into the areas that are related to the current core competency of the firm. In non-construction research fields, regarding diversification issues, Schmalensee (1985) cites a lesson from Peters and Waterman's (1982) work concerning diversification and firm profits - "wise firms do not diversify beyond their demonstrated spheres of competence."

On the other hand, in the construction industry, Heney (1984) suggests, regarding specialization versus diversification strategy, combining the best of both diversification and focus approaches, i.e., looking for many diverse market segments where specialized capabilities give a competitive advantage over the less focused and general practice firms. Hillebrandt *et al.* (1995) also claimed that managers viewed their core business as "where the firm has had a long-standing interest and has built up a considerable expertise" (in Langford and Male, 2001). Langford and Male assert a different view in stating that "specialized firms may suffer from a temporary shortage of work in their area and there may be barriers preventing them from transferring to more buoyant sectors of the market," while construction researchers generally support specialization rather than diversification. In short, theoretically, both in construction and non-construction industry, it is generally recommended that firms focus rather than diversify.

The evidence drawn from other industries does not providea clear-cut agreement with the diversification strategy. While some conclude that there is no evidence between firm diversification and performance, others showed that firms that sought related diversification strategy outperformed firms that diversified into unrelated business. However, it should be noted that to a large extent, the research findings provide different results depending on research samples and methodologies. For example, industrial organization studies (Gort, 1962; Arnould, 1969; Markham, 1973) reported no significant relationship between diversification and firm performance, while the strategic management studies (Rumelt, 1974, 1982; Christensen and Montgomery, 1981; Montgomery, 1982; Palepu, 1985) indicated that firms that diversified into related business were more profitable than other firms (in Amit and Livnat, 1988).

In sum, both theories and empirical evidence tend to support the idea that firms engaging in specialized areas outperform those that diversify into unrelated business, with few exceptions.

2. RESEARCH HYPOTHESIS

In the previous section, theoretical arguments and empirical findings regarding diversification strategy were discussed, and the conclusion was that related diversification is favored over unrelated diversification. However, the hypothesis constructed here was based on empirical findings so that the author could compare the current study with previous ones.

The hypothesis to be tested concerned the profitability growth rate. The empirical research findings suggest that the performance of related diversifiers turned out to be higher than that of unrelated diversifiers. In a similar sense, the profitability growth rate of focused firms should be higher than that of diversified firms. The above arguments led to the following hypothesis:

H: The profitability growth rate of focused firms is higher than that of diversified firms over a long-term period.

Along with the above hypothesis, a general perception of low profitability trend in the construction industry was examined. The rationale for doing so is based on the theories: low profitability results from high competition within an industry or market; a mature industry has low profitability due to the large number of players compared to a low number of players in a growing industry. Thus, the arguments concerning industry competition and stage of development could be examined by observing the trend of performance.

3. DATA SOURCES AND SAMPLE DESCRIPTIONS

To obtain samples, first, lists of public firms were identified from Dun & Bradstreet's Million Dollar and Value Line Database. Because the two sources provide different lists of public firms, the sample includes only the firms for which business segment sales data are available from the COMPUSTAT database. Each business segment's sales volumes for firms and the data needed to compute profitability were obtained from Standard & Poors COMPUSTAT database for the years 1990-2001. Specifically, under the four-digit SIC classification scheme, the sales volume of each business segment was collected as well as net income and net sales.

However, some firms had a shorter life span than the analysis period. Consequently, only limited data were available for these firms, for which the analysis automatically induced missing data. Further, some of the data were deliberately eliminated to prevent misleading research results if the profitability of specific year within a firm was considered to be an outlier. The total number of firms included in this study was 108. Of the 108 firms, 59 firms were contractors and the remaining 49 firms were non-contractors.

The classification of contractor and non-contractor firms was based on the firm's primary SIC code scheme, i.e., three two-digit SIC codes (15,16,17) classified as contractor group based on operational characteristics, field operation. The other group represented manufacturing firms because they manufacture and supply products such as steel, cement, prefabricated trusses, pipes, and so on for construction field operations. Architectural engineering and environmental firms were also classified into the non-contractors group. Therefore, in this study, non-contractors represented firms that operate in more controlled environments and support field operations over the life of a project.

In grouping focused and diversified firms, if a firm had extremely low total diversification entropy, it was regarded as a focused firm; i.e., the author regarded zero entropy firms as focused firms and non-zero entropy firms as diversified firms. In this study, the diversified firms imply unrelated diversifiers because most diversified firms sought the unrelated diversification strategy. Table 1 summarizes the sample composition of this study at the firm level.

Table 1: Sample Composition

	Contractors	Non-Contractors	Total
Focused Firms	24	24	48
Diversified Firms	35	25	60
Total	59	49	108

This sample is biased in a statistical sense because the samples were not drawn randomly from the population but collected based on available data. However, considering the total number of public construction firms in the U.S., the sample well represents the population. Recall the research domain of this study, U.S. public construction firms.

4. METHODOLOGY

4.1 Measure of Firm Entropy

In this section, the author outlines a way to measure a firm's diversification entropy that is based on the work of Jacquemin and Berry (1979) and Palepu (1985). First, related and unrelated diversification entropy measures are defined. Then the measurement of total firm diversification entropy is presented. To define the entropy index, suppose a firm is operating in N business segments and P_i is the sales share of the ith segment in the firm's total sales. Further, let the N business segments of the firm aggregate into M industry groups. Then RD_j can be defined as the related diversification arising out of operating in several business segments within an industry group j. Yet, if a firm operates in several industry groups, its total related diversification is the sum of RD_j. Likewise, UD can be defined as unrelated diversification if a firm is operating in several industries. In mathematical form, equations (1) through (3) represent RD_j, RD, and UD, respectively.

$$RD_j = \sum_{i \in j} P_i^j \ln(1/P_i^j) \quad (1)$$

$$RD = \sum_{j=1}^{M} RD_j P^j \quad (2)$$

$$UD = \sum_{j=1}^{M} P^j \ln(1/P^j) \quad (3)$$

where P_i^j is defined as the sales share of the business segment i of the industry group j's total sales; P_j is the sales share of industry group j of the firm's total sales; and DR is a function of DR_j, $j=1,\ldots,M$. Therefore, the total related diversification, RD, represents the weighted sum of the shares of each of the industry group's related diversifications within a firm. Also, the unrelated diversification, UR, is the weighted sum of each industry sales share in the firm's total sales if a firm is operating in multiple industries. Finally, a firm's total diversification entropy (TD) is defined as follows.

$$TD = \sum_{i=1}^{N} P_i \ln(1/P_i) \quad (4)$$

Equation (4) is a weighted average of the segments' sales share, the weight for each segment being the logarithm of the inverse of its share. The measure, thus, takes into consideration two elements of diversification: 1) the number of segments in which a firm operates, and 2) the relative importance of each of the segments in the total sales. With some algebra it is shown that $RD + UD = TD$ (See Palepu [1985] for more elaborated calculation examples). Thus, the total diversification is a weighted average of the firm's diversification within sectors plus the firm's diversification across the sectors (Jacquemin and Berry, 1979).

4.2 Modeling Method

Technically, the data set for this study has both cross-sectional and time series properties. Each firm has twelve measurements taken during the analysis period unless there were missing data. Stated another way, the individual repeated measurements for each firm constitute the first level, then each set of measurements nested in a firm, and finally each firm affiliated in a group. Accordingly, there exist three multiple hierarchies in the data structure. Using Kreft and De Leeuw's (2000) term, this is a "contextual model that consists of micro and macro levels." More insight can be illustrated using the example of students' math achievement.

Returning to the data structure of this study, the annual repeated measurements are nested in a firm and firms are nested in groups. Thus, the total error variation can be decomposed into measurement errors, firm level errors, and group differences. Clearly, given the data structure, a 3-level hierarchical modeling is appropriate. However, it is better to specify a 2-level model for easier interpretation by treating the group as a dummy variable at the second level modeling because there are only two different groups to compare for each model. In general, higher-level models are harder to interpret because the number of parameters needed to be estimated increases as the levels increase. The data structure of this study and a multi-level modeling example are illustrated in Figure 1.

Level-1 (Measurements)

$$Y_{ti} = \beta_{0i} + \beta_{1i} ** (X)_{ti} + R_{ti}$$

where Y_{ti} and X_{ti} have twelve measurements for each firm; R_{ti} is a level-1 error term

Level-2 (Firms)

$$\beta_{0i} = \gamma_{00} + \gamma_{01} * (D)_i + U_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11} * (D)_i + U_{1i}$$

where D_i is a group dummy variable; U_{0i} and U_{1i} are level-2 errors

Figure 1: HLM Modeling Scheme

The level-2 regression models in Figure 1 imply that the coefficients of the level-1 model regressed on level-2 variables; and by specifying error terms (U_{0i} and U_{1i}), both dependent variables of level-2 models are allowed to vary randomly around fixed means (γ_{00} and γ_{10}). The model given in Figure 1 is called a random intercept and slope model because both U_{0i} and U_{1i} terms are included. Of the estimated parameters, γ_{00} measures the mean of the intercept at the beginning of measurement and γ_{10} captures the average slope of Y while U_{0i} and U_{1i} represent the fluctuations of β_0 and β_1 around γ_{oo} and γ_{10}, respectively.

Alternatively, the variance of the random part of equation (5) that is not accounted for by the fixed part is given by

$$Var(X_{ti}U_j + R_{ti}) = X_{ti}\tau X_{ti}' + \sum \quad (5)$$

where $Var(U_j)$ = τ, $Var(R_{ti})$ = Σ, and it is assumed that the expected values of error terms have zero means and there is no covariance between two level error terms (e.g., between R_{ti} and U_{0i} R_{ti} and U_{1i}).

This study effort focused on assessing group effect without harming the hierarchical data characteristics of samples, to borrow Taris' (2000) term, "capturing the trend at aggregate level," and then comparing two groups is the critical concern. Therefore, in the case of the example model in Figure 1, the parameter estimates of D_i (γ_{01} and γ_{11}) and its significance are the central interests of this study because significance of this parameter indicates that there is a difference in Y_{ti} (e.g., profitability) between focused and diversified firms (or contractors and non-contractors).

5. ANALYSIS AND DISCUSSION

Using HLM 5.0, both fixed and random parameters were estimated for the models specified in Tables 2 and 3; then the long-term firm diversification trend and its impact on firm profitability was assessed. Due to the high first-order autocorrelations between adjacent measurements, first-order autoregressive models were selected for analyses. Moreover, deviance statistics also favor the first-order autoregressive model over the unrestricted and homogeneous co(variance) error structure model. As noted in the preceding section, longitudinal data analysis allows decomposing the parameters effectively into fixed and random parts. Thus, the fixed parameter estimation results were analyzed first, and the interpretation of random parameters followed.

5.1 Fixed Component Analyses

Table 2 summarizes the relationship between the total diversification entropy and profitability for the periods between 1990 and 2001. The β_{0i} measures the profitability at the beginning of the measurements while β_{1i} explains the impact of total diversification entropy on profitability and β_{2i} explains profitability growth rate over the analysis periods. For the all-sample model, the average profitability (γ_{00}) in 1990 and the average profitability growth rate (γ_{20}) over the analysis period were not significantly different from zero. There are moderate differences between contractors and non-contractors (γ_{11}): specifically, the impact of total diversification on profitability turned out to be higher in non-contractors than in contractors based on the negative sign and significance of γ_{11}. Over time, since 1990, the average profitability growth rate (γ_{20}) has been at a minimal level, and the contractors' growth rate was lower than that of non-contractors (γ_{21}).

For the contractor firms, none of the coefficients were significantly different from zero, which implied that the average profitability was extremely low and there were extremely small changes over time. It is worthwhile observing the sign of the coefficient estimate of γ_{11}, which indicates that focused firms have shown better performance even though it is not statistically significant. In general, the contractors' profitability growth rate (γ_{20}) decreased and the growth rate for focused firms was lower than for diversified firms, thus failing to support the formulated hypothesis.

For non-contractor firms, however, the average profitability (γ_{00}) was significantly different from zero in 1990, which implied that non-contractors enjoyed some degree of profitability at that time. Next, the average impact of total diversification entropy had no impact on profitability (γ_{10}). However, differences were observed between focused and diversified firms at a moderately significant level (γ_{11}). Meanwhile, on average, the firms that diversified into unrelated business had higher profitability growth rates than focused firms (γ_{21}), accordingly rejecting the hypothesis.

Table 2: Profitability Model and Fixed ParameterEstimates

Model

Level-1: $PF_{ti} = \beta_{0i} + \beta_{1i}^{*}(TD)_{ti} + \beta_{2i}^{*}(Time)_{ti} + R_{ti}$

Level-2: $\beta_{0i} = \gamma_{00} + \gamma_{01}^{*}(D)_i + U_{0i}$

$\beta_{1i} = \gamma_{10} + \gamma_{11}^{*}(D)_i$

$\beta_{2i} = \gamma_{20} + \gamma_{21}^{*}(D)_i + U_{2i}$

where: PF=Profitability Ratio; TD=Total Diversification Entropy; D=a dummy variable equal to 1 if the firm is a contractor, 0 otherwise. A dummy variable for the contractor and non-contractor model is equal to 1 if the firm is a focused firm, 0 otherwise.

Model	Level 1	Level 2	Coefficient	S.E.	T-ratio	P-value
All Sample (N=108)	β_{0i}	γ_{00}	3.1812	2.8662	1.11	0.267
		γ_{01}	0.9813	3.8658	0.25	0.800
	β_{1i}	γ_{10}	1.7368	0.8241	2.11	0.035[b]
		γ_{11}	-2.7897	1.2388	-2.25	0.024[b]
	β_{2i}	γ_{20}	0.0029	0.1354	0.02	0.983
		γ_{21}	-0.1415	0.1845	-0.77	0.443
Contractors (N=59)	β_{0i}	γ_{00}	3.0223	3.6758	0.82	0.414
		γ_{01}	1.4498	5.7166	0.25	0.801
	β_{1i}	γ_{10}	-1.3256	1.1372	-1.16	0.244
		γ_{11}	1.7058	3.5034	0.48	0.626
	β_{2i}	γ_{20}	-0.0271	0.1894	-0.14	0.887
		γ_{21}	-0.1248	0.2984	-0.42	0.667
Non-contractors (N=49)	β_{0i}	γ_{00}	3.0113	0.9904	3.04	0.004[a]
		γ_{01}	0.3657	1.3728	0.27	0.791
	β_{1i}	γ_{10}	-0.0159	0.6476	-0.025	0.981
		γ_{11}	2.2911	0.9939	2.31	0.021[b]
	β_{2i}	γ_{20}	0.0956	0.0885	1.08	0.286
		γ_{21}	-0.1241	0.1257	-0.987	0.329

a, $p<0.01$; b, $p<0.05$; c, $p<0.10$

In addition to the longitudinal analysis, cross-sectional analysis was also conducted. In this analysis, the 1,128 observations were assumed to be independent, and then the relationship between the level of unrelated diversification entropy (*UR*) and profitability was examined using the *Mann-Whitney Median Test.*

Considering the small number of samples in this subgroup, a non-parametric test was employed because normality could not be assumed. First, the individual observations of diversified firms were grouped by year and the observations in each annual group were sorted in ascending order according to the level of *UR*. This was done for contractors and non-contractors separately. Then these samples were split into two groups, lower and higher than median entropy for each year. Finally, the profitability of the two groups was tested separately for the twelve years of data. According to the *Mann-Whitney Median Test,* no profitability difference was found between lowly and highly diversified groups.

On the other hand, the reasoning concerning unrelated diversification can be found in risk distribution, as noted in an earlier section. If a firm concentrates heavily in either product or market and faces an economic or demand downswing; it is more likely that the firm will experience bad times. However, if a firm has diversified in several different businesses, usually in the form of supplementing the construction life cycle or seasonal fluctuation, then even during an industry downturn, the negative effect is mitigated by distribution of risks.

The above arguments are supported by the negative sign of γ_{21} for both contractors and non-contractors implying that the profitability growth rate for diversified firms was higher than that of focused firms at an insignificant level. The comparison of standard errors of β_{2i} further supports the above argument: i.e., the standard errors for contractors are twice as large than those of non-contractors. The arguments above rest on the fact that non-contractors, in general, were more highly diversified in unrelated businesses than contractors. The author argue this by providing the following as possible reasons. First, the unrelated diversification entropy for non-contractors was higher than that of contractors. This implies that non-contractors could have distributed risks more efficiently by engaging in multiple businesses. In addition, the contractors may have been positioned in a more competitive environment than the non-contractors. Furthermore, the high risk of construction projects to a great extent contributes to the fluctuations in firms' overall profitability.

5.2 Variance Component Analyses

The variance component estimates that constitute the second set of parameters are presented in Table 3. These variance components represent the residual variation of the dependent variable, after its explanation by the fixed parameters. The $\hat{\sigma}_e^2$ measured the first level disturbance that was not explained by the fixed parameter estimates. The variance in the observed distances, which is not accounted for by the time variable, the second level explanatory variable *D*, and the variable specifying the interaction between time and dummy variable *D*, remains unexplained. The terms $\hat{\tau}_0^2$ and $\hat{\tau}_1^2$ denote the estimated variances across individual firms for the random intercept and slope, respectively, that are not accounted for by the dummy variable. Thus, $\hat{\sigma}_e^2$, $\hat{\tau}_0^2$, and $\hat{\tau}_1^2$ are the corresponding parameter estimates of R_{ti}, U_{0i}, and U_{1i} of the model presented in Figure 1.

Lastly, $\hat{\tau}_{01}$ measures the covariance between two random coefficients. Note the initial unexplained variations in the entropy model. There are substantial fluctuations around the average intercept ($\hat{\tau}_0^2$), implying that the diversification level significantly differed between firms in 1990. Further, the sign of covariance between intercept and slope ($\hat{\tau}_{01}$) is negative, implying that the higher the initial diversification the lower the rate of change in entropy.

Meanwhile, for the profitability model, the level-1 variations ($\hat{\sigma}_e^2$) that were not explained were substantial compared to level-2 variations except for the non-contractor model, indicating high profitability fluctuations between adjacent observations within a firm. Further, the relatively high $\hat{\tau}_2^2$ for contractors compared to that of non-contractors indicates that there was some degree of profitability difference between firms. For both the entropy and profitability models, the variations around the average time-rate change ($\hat{\tau}_1^2$ and $\hat{\tau}_2^2$, respectively) were extremely small, suggesting that unexplained variance parts are at the minimal level.

Table 3: Random Parameter Estimates

Model	Entropy				Profitability			
	$\hat{\sigma}_e^2$	$\hat{\tau}_0^2$	$\hat{\tau}_1^2$	$\hat{\tau}_2^2$	$\hat{\sigma}_e^2$	$\hat{\tau}_0^2$	$\hat{\tau}_1^2$	$\hat{\tau}_2^2$
All Samples	0.07	0.13	0.00	0.00	391.34	2.14	0.00	0.01
Contractors	0.03	0.07	0.00	0.00	457.29	1.59	0.05	-0.25
Non-contractors	0.08	0.03	0.00	0.00	12.39	8.38	0.00	0.029

6. SUMMARY AND CONCLUSIONS

In the construction industry, strategic management issues have recently gained attention, and executives recognize their importance for firm survival and success. However, the number of strategic management practices in the construction industry that has reached the implementation or measurement stage remains limited at best (Chinowsky, 2001). Thus, the author expected this research to shed some light on the strategic research field in the construction industry and to serve as a guide for business selection criteria for those involved in the construction business.

In this research, attention was directed toward examining the U.S. public construction firms' diversification trend, measured as entropy, and its impact on firm profitability over a long-term period through longitudinal data analysis within a hierarchical linear modeling framework. Heavily built upon theories and previous empirical research findings from research fields other than the construction industry and profitability growth rate hypothesis was formulated. The formulated hypothesis posits that the focused firms outperform the diversified firms. These two statements were tested using twelve years of financial data for 108 firms.

Surprisingly, the profitability growth rate of focused firms was lower than that of diversified firms at the insignificant level for all sample model analysis. The same results were obtained for both contractors and non-contractors. Therefore, the hypothesis cannot be supported. This means that the evidence drawn from other industries in favor of focusing was not convincing for the construction industry. This in turn suggests that subsequent research is necessary to enrich current understanding concerning whether construction firms should seek related or unrelated diversification.

Lastly, the low profitability growth rate of the construction industry was assessed so that the theoretical arguments could be tested. As indicated in the previous discussion, the estimated profitability trend of the construction industry confirmed that this rate has been extremely low. Therefore, the two arguments, high competition and matured industry characteristics, were supported by this study.

7. FUTURE RESEARCH AGENDA

The research findings suggest the possible impact of entropy change on firm performance. However, under the conditions imposed by the data structure of current study, it was not possible to provide a solid answer regarding related and unrelated issues that may have a significant implication on firms' diversification strategy. Therefore, the results of this study can be extended by future research in several directions. First, this type of research methodology requires an extremely complex (co)variance structure estimation based on large samples. If more complete samples were available for future research, more variables could be included in the model specification, providing more robust implications regarding related and unrelated issues.

Second, other important contextual factors, such as firm size and firms' business history, could be examined within a single model as moderating variables in evaluating firm profitability. The impact of these factors on firm performance has already been investigated in various research disciplines. Thus, evaluating these factors simultaneously would provide a more precise entropy effect on firm performance.

Lastly, the strategy related research field is broad, and previous studies are extensive. Because this research covered only a small portion of the strategy research field, this study could be extended to a variety of research contexts, such as financial, economy of scale and scope, market structure, economic cycle, firm growth, and so on within the construction research setting.

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