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Product Diversification Deciphered

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Abstract
Purpose: Since researchers from different streams have used varied methodologies, that are complex to measure a firm's level of corporate diversification, the primary purpose of this paper is to provide practicing managers a range of alternate measures of diversification that can be computed with ease, from data that are available in their day-to-day management information systems.
Design/ methodology/ approach: Using a sample of large companies listed in the Bombay stock exchange, unrelated diversification index based on entropy measure is calculated. Five, alternative measures of diversification are developed from the same data set. Using hierarchical regression, this study explores as to which of the product diversification measures developed, explains the unrelated diversification measure calculated based on the Entropy measure.
Findings: The study provides the practicing managers three alternate measures of diversification, the proportion of the largest two-digit industry sales to total firm sales (DIVH2D), the number of products a firm produces (DIVNP) and the proportion of the 'number of two-digit industry codes to the number of four-digit industry code' (DIV2B4). These help managers gauge their firm's extent of unrelated diversification.
Research limitations/ implications: The alternate measures of diversification help the managers' benchmark their level of unrelated diversity, without having to go through the pain of calculating diversity through traditional methodologies that are complex and cumbersome.

Keywords: Corporate diversification, product based diversification, entropy measure, hierarchical regression

Introduction

Studies on corporate diversification have long been the mainstay of strategic management research. Most studies examine performance of different diversification types and the institutional contexts in which such relationships hold good (Weston, 1970; Khanna & Palepu, 1997; Fauver et al., 2003; Michael & Richard, 2003; Wan 2005). Results show that unrelated

diversification in institutionally developed economies will erode firm performance (Wan, 2005) and it could enhance firm performance in emerging economies (Chakrabarti et al., 2007; Mishra and Akbar, 2007), including in India (Khanna and Palepu, 1997; Ghemawat and Khanna, 1998). With institutional context in India fast developing (Mohan, 2007), a key research question of enormous interest is, will diversified companies continue to be profitable? Measurement of corporate diversity, hence gains prominence in this context.

Measuring corporate diversity has always remained the central theme in the diversification firm performance research (Christensen & Montgomery, 1981; Rumelt, 1974; 1982; Palepu, 1985; Amit & Livnat, 1988; Kakani, 2002). Researchers have measured diversity, differently, in the past, and the concept of measuring corporate diversity has evolved over the period (Varadarajan & Ramanujam, 1987). Prior studies measure corporate diversification from the perspective of products and markets a firm operate in (Ansoff, 1957; 1965). Studies also examine diversification from the perspective of technology a firm deploys, the customer function it seeks to satisfy and the customer segment it serves (Abell & Hammond, 1979). Prior studies predominantly use Standard Industry Classification (SIC) scheme to measure the firm's corporate diversity (Rumelt, 1974; Palepu, 1985; Varadarajan & Ramanujam, 1987). Herfindahl index (Berry, 1971) and Entropy measure of diversification (Jacquemin and Berry, 1979) became the most popular SIC based diversification measures that were extensively used by researchers. In spite of being cumbersome, diversification studies have adopted this methodology due to the ease in comprehension, objectivity in approach and easy availability of product related information in the public domain. A number of other methods have also been used in literature to measure corporate diversity (Varadarajan & Ramanujam, 1987). Recent studies continue to use entropy to measure to establish corporate diversification (Park and Jung, 2014; Lien and Li, 2013; Hautz et al., 2013; Chen and Chu, 2012 and David et al., 2010)

The theoretical motivation for this study stems from two perspectives. First, with different approaches documented for measuring corporate diversification, this study proposes to examine the strengths and weakness of the existing traditional diversification measures and recommend a measure of diversity that would be most appropriate, given the circumstances. Second, given the extensive data requirement and the complications in computing the traditional indices of corporate diversity, practicing managers today are apprehensive in using the traditional measures of corporate diversity. This study questions if it is possible to provide practicing managers, a set of simplified set of alternate diversity measures, which are less cumbersome to calculate. More importantly, these alternate measures should be capable of being calculated from routinely available data in their management information systems and at the same time, not compromise on the accuracy of the diversity measure, to a large extent. From the review of past and recent literature, it is clear that there is a lack of studies that help practicing managers' with a simple set of diversity measures for them to benchmark the unrelated diversity position of their company against the competitors, at any given in time.

The alternate measures we develop are intended to help practicing managers understand the extent and type of diversity of their companies without having to go through the hardships of calculating the traditional diversity measures.

This study uses a sample of large companies listed in the Bombay stock exchange. Unrelated diversification index based on entropy measure (Jacquemin and Berry, 1979) is calculated for the sample companies. Five, alternative measures of product diversification are developed for the same data set. Using hierarchical regression model, this study explores as to which of the alternate product diversification measures developed, explains the unrelated diversification measure calculated based on the entropy measure.

Conceptual Framework and Research Questions

Corporate diversity measures the extent to which a firm is present in different industries. Montgomery (1979) and Amit & Livnat (1988) defined diversification as extent to which firms classified in one industry produce goods classified in another. Ramanujam & Varadarajan (1989) define diversification as entry of a firm into new lines of activity which entail changes in the administrative structure, systems and management process. Industrial organization scholars were the earliest to study corporate diversity. Gort (1962) defined diversity in terms of heterogeneity of output of a firm based on the number of markets that the firm served. He categorized two products to serve separate markets if their cross elasticity of demand were low and if in the short run, the necessary resources employed in the production and distribution of one cannot be shifted to the other. Most studies used a simple count of industries in which a firm operated, as a measure of diversity (Arnould, 1969). Firms operating in more number of industries, irrespective of whether the industries were related or unrelated to one another, were considered to be more diversified as compared to firms that operated in lesser number of industries (Markham, 1973).

Concentration ratio, being the ratio of firm's primary industry output to its total output, was developed by Berry (1971) to establish Herfindahl index of product concentration. Although Herfindahl index captured the extent of diversity, had the advantage of ease in computation and simplicity in comprehension it failed to distinguish between 'related' and 'unrelated' components of corporate diversification.

Wrigley (1970) remedied this shortcoming by distinguishing between 'related' and 'unrelated' components of diversification by developing a 'four category' diversification index. Developing this further, Rumelt (1974) created nine categories of diversification based on relatedness of products, markets and technologies. He subsequently revised his taxonomy to seven categories (Rumelt, 1982), which is considered to be a milestone in the study of diversification strategy that laid the foundation for the strategic management researchers to study the diversification performance relationship. Rumelt's categories clearly differentiated 'single business' firms, on one end of the spectrum, through 'related-constrained' business (firms that diversified relatedly by building on a single strength or resource associated with its original business) to totally 'unrelated' business (individual business that are not related to one another) on the other end of the spectrum. This categorization helped researchers in the strategic management field to examine a firm's diversity not only by its extent, but also by related and unrelated components. Although Rumelt's 'seven category' classification was a powerful tool in capturing the subtleties of the diversification types, its biggest shortcoming was the lack of publicly available information based on which such categorization can be assembled making the process of classification laborious.

Jaquemin and Berry (1979) developed the entropy measure which decomposes the total diversity into related and unrelated components through the use of SIC, which is a numerical system developed by the federal government of United States for classifying all types of activity within its economy. Entropy method captures three critical elements that are important for classifying a firm's corporate diversity; the number of product segments in which the firm operates, the distribution of the firm's total sales across product segments, and the degree of relatedness among the various product segments. Entropy measure overcomes the limitations of the earlier diversification indices and provides three components; measure of total diversification, unrelated diversification and related diversification (Palepu, 1985). It has the advantage of being objective, replicable and easily amenable to various statistical techniques. Entropy is hence popular in strategic management research (Raghunathan, 1995; Akar & Sankaran, 1999). A number of recent studies use entropy measure (Park and Jung, 2014; Lien and Li, 2013; Hautz et al., 2013; Chen and Chu, 2012 and David et al., 2010).

The entropy measure, or for that matter any SIC based product measure of diversification has limitations. The fundamental assumption is that although the 4-digit segments within broader 2-digit industry groups could be expected to be more similar than 4-digit segments from different 2-digit groups, the numerical differences cannot be interpreted on an interval or ratio scale (Montgomery, 1982). In effect, closeness between 2-digit or 4-digit groups necessarily does not imply closeness in terms of relatedness. Robins & Wiersema (1995) argued that the SIC system is a weak source of information on substantive relationships among industries and in consequence, SIC coding offer only limited information on the types of strategic interrelationships between corporate business portfolios that are important in the theory of the multi business firm. Despite their apparent shortcomings, product-count measures do have advantages over Rumelt's measure. Product based measures, being more objective, lend themselves better to large sample, quantitatively operationalized research designs. Also, product based measures, being continuously scaled, provides opportunity for investigating performance differences 'within diversification strategy groups' as well as differences 'across diversification strategy groups.' Product based measures, therefore, may allow greater discriminatory power to highlight finer distinctions in the strategy concept (Lubatkin et al., 1993). Furthermore, Hoskisson et al. (1993) established strong construct validity for the entropy measure. However, Sambharya (2000) found little evidence to support the construct validity of the diversification measures and highlighted that the convergent, discriminant, and predictive validity of SIC-based continuous measures were low to moderate, at best.

Pitts & Hopkins (1982) highlight that the choice of the measure should be guided by the research question at hand. Diversification should be treated as a continuous variable, rather than a bivariate or developing categories based on arbitrary cutoff points (Ramanujam & Varadarajan, 1989). Other studies questioned the traditional ways of measuring relatedness and concluded that strategic relatedness is superior to product-market relatedness in predicting when related diversifiers outperform unrelated diversifiers (Markides & Williamson, 1994). Various other diversification measures evolved over the time, which were marginal modifications to the then existing diversity measures. Varadarajan & Ramanujam (1987) developed Mean Narrow Spectrum Diversity (MNSD) as a two-dimensional measure of categorical diversity that builds on the work of Berry (1971) and Wood (1971). Contrastingly, Nayyar (1992) argued that the potential for benefits from relatedness does not ‘imply’ that those benefits will ‘actually’ be realized. Similarly, No single measures of diversity combines and captures all possible types of diversification.

Given the positives and limitations of the various diversification measures, Montgomery (1982) empirically established that Rumlet’s categorical measure and SIC based continuous product count measures are highly correlated. Similar evidence was provided by Amit & Livnat (1988) where entropy measure found strong correspondence with Rumlet’s measure, which indicated that easy to calculate measures are equally appropriate when compared to intensive and laborious measures, especially when the study involves large samples. An additional confirmation comes from the study of Lubatkin et al., (1993) which shows a high degree of correspondence between MNSD measures (Varadarajan & Ramanujam 1987) and Rumelt's categorical measures, suggesting that both tap a common underlying theoretical concept.

In summary, measuring corporate diversity lies at the heart of diversification firm performance research (Christensen & Montgomery, 1981; Rumelt, 1974; 1982; Palepu, 1985; Amit & Livnat, 1988; Kakani, 2002). While the outcome of the diversification performance studies hinged on the type of diversification measure used, researchers have used different types of diversity measures in the past. More importantly, the concept of corporate diversity does not lend itself to easy conceptualization and measurement (Rangarajan & Varadarajan, 1989). Rumelt’s categorical measure is complex and cumbersome. The entropy measure quantifies the

extent of diversification but fails to capture the direction of diversification (related or unrelated), both, under one single construct Hence based on the above arguments, we put forth the following research question:

> Research Question (1): What are the advantages of developing a categorical diversification measure, based on continues measure of product diversification?

Measuring corporate diversification needs to be simplified by using measures that practicing managers can comfortably comprehend and which are less laborious to calculate. In order to propose alternate measures of corporate diversity, we first measure the index of unrelated diversification of the sample companies based on the entropy measure (Jacquemin and Berry, 1979). We use National Industry Classification (NIC) scheme published by the government of India, NIC being the Indian counterpart of the SIC scheme of the US. The Entropy measure captures three indices for each sample firm, the index of related diversification (DR), the index of unrelated diversification (DU) and the index of total diversification (DT), such that DIVDT = DIVDR + DIVDU. Entropy measure and the methodology for calculating DR, DU and DT are detailed in Table 1.

We then develop five alternative measures of product diversification for the same data set. Product count, being the number of products a firm sells (DIVNP) is the first measure. Although the industrial organization researchers used the number of markets served (Gort, 1962) as a diversification measure, product count takes into account the differing capabilities organization needs to build for diversified products, even though they are positioned within the same industry. The expectation is that more the number of products, higher will be the level of unrelated diversification. Second, the proportion of the largest product sales to total firm sales (DIVHPP) which is intended to capture the importance of a particular product within a firm. Although Rumelt's (1974) measures were based on product revenues using which nine types of diversification categories were defined, it involved complicated subjective criteria in establishing the relatedness among such product groups. DIVHPP, we develop is simple and easy to calculate. The more the value for this construct, the lesser the firm is expected to be unrelatedly diversified. Third, the proportion of the largest two-digit industry sales to total firm sales (DIVH2D). This measure is intended to capture the importance of the firm's particular set of products in the two-digit NIC code like say, chemicals. The more the value for this construct, the expectation is that higher is the focus of the firm into a particular industry segment (chemicals, in this case) and hence lesser the firm is expected to be unrelatedly diversified. Fourth, the proportion of the largest four-digit industry sales to total firm sales (DIVH4D) which is intended to capture the importance of the firm's particular set of products in the four-digit NIC code, like say, pesticides (within the broader two-digit industry code of chemicals). The more the value for this construct, the expectation is that higher is the focus of the firm into a particular segment of the industry and hence lesser the firm is expected to be unrelatedly diversified. Fifth, the proportion of the 'number of two-digit industry codes to the number of four-digit industry code' (DIV2B4) which is intended to capture the proportion of being active in unrelated areas. A higher value for this construct signifies that the firm is into more unrelated areas, or in lesser related areas (either operations in two-digit industry codes are high, or operations in four-digit industry codes are low) and hence the firm is expected to be more unrelatedly diversified.

Using hierarchical regression model, this study explores as to which of the product diversification measures developed, explained the unrelated diversification measure calculated based on the entropy measure. This leads us to the next research question:

Research Question (2): Which of the firm's product related diversification measure, i.e. (i) number of products (DIVNP), (ii) proportion of the largest product sales to total firm sales (DIVHPP), (iii) proportion of the largest 'two digit' industry sales to total firm sales (DIVH2D), (iv) proportion of the largest 'four digit' industry sales to total firm sales (DIVH4D), (v) the proportion of the number of 'two digit' industry codes to the number of 'four digit' industry codes in which the firm is operating (DIV2B4), explains the extent of a firms unrelated diversification strategy as measured, using the Entropy method?

Methodology

Sample Selection

We have selected a large sample of companies, in existence for more than fifteen years. Smaller companies or companies with lesser longevity are unlikely to be conducive for studying diversification patterns (Michael and Richard, 2003). The sample firms were selected using the following criteria. The largest 200 firms, by sales for the year 1991 and the largest 200 firms by sales for the year 2005, listed in the Bombay stock exchange, was the first criteria for the firms to satisfy, in order to find a place into the sample frame. From the total of 400 firms, those that existed in 1991 but did not exist in 2005 were eliminated. Similarly, firms that existed in 2005 but were not in existence in 1991 were also eliminated. This resulted in a final sample of 228 firms in 2004-05. The primary products of the final sample firms belonged to 157 'four digit' industry codes under the NIC scheme, 2004, with a well-balanced representation from a wide range of industries. The database provided by the Center for Monitoring the Indian Economy (CMIE) formed the basis for the data for this study.

The average net sales of the companies for the sample is Rs. 3,200 crores (around US$ 710 million at an exchange rate of US$1 = Rs.45) and represents 48% of population, which is larger than the sample size used in other studies (Palepu, 1985; Michael and Richard 2003).

Variables

We use entropy measure of diversification that was developed by Jaquemin & Berry (1979) which provides three indices for each firm, DR, DU and DT. The methodology for calculating diversity measures under the entropy method is detailed under Table 1. Since these three measures of diversification, per say, do not capture the extent of diversification, and the direction of diversification (related or unrelated) under one single construct, this study creates a categorical taxonomy of firm diversity, inspired by the work of Palepu (1985). From DU and DR, four diversification categories are created; Concentrated Operators (CONDIV), Related Diversifiers (RELDIV), Unfocussed Operators (UNFDIV) and Unrelated Diversifiers (UNRDIV). Table 2 details the methodology that has been adopted for categorizing the sample firms into four diversification categories. In parallel, five alternative measures of product diversification DIVNP, DIVHPP, DIVH2D, DIVH4D and DIV2B4 are developed for the sample firms.

Analysis

Using hierarchical regression model, this study explores as to which of the product diversification measures developed i.e. DIVNP, DIVHPP, DIVH2D, DIVH4D or DIV2B4, explained the unrelated diversification measure (DIVDU) calculated based on the Entropy measure.

Results

(i) What are the advantages of developing a categorical diversification measure, based on continues measures of product diversification?

Answering the research question (1), this study develops a categorical taxonomy of diversification from the index of Related Diversification (DR) and Unrelated Diversification (DU); concentrated operators (CONDIV), related diversifiers (RELDIV), unfocussed operators (UNFDIV) and unrelated diversifiers (UNRDIV). In order to provide a flavor of the sample firms categorized under different diversification categories, Table 3 lists top ten sample firms in each of the above diversification categories. These four categories of firms that have clearly differentiated diversification strategies, taking into account both the related and unrelated index of diversification calculated based on the entropy measure. Concentrated operators (CONDIV) do not have any element of related or unrelated diversification component. They are purely focused into one single four-digit NIC code (say, Hero Honda Motors Ltd. in our example which is focused only into motorcycle). Related Diversifiers (RELDIV) have ventured out of their basic industry, but are close to their core area of operation (say, HMT Ltd. in our example which is into manufacture of agricultural machinery like tractors, also has ventured into a related area of manufacturing food processing machinery). Unrelated diversifiers (UNRDIV) have ventured into more than one two-digit NIC codes, without any related component of diversification (EID Parry is into sugar, sanitary ware and fertilizers). Unfocussed operators (UNFDIV) have both a related as well as unrelated components of diversification (ITC Ltd. is into cigarettes, paper, stationery and agriculture). This categorical taxonomy thus provides a rich classification of firms based on their diversification strategy, which a pure 'continuous' measure like the index of unrelated diversification (DIVDU) or the index of related diversification (DIVDR) does not capture. Hence, developing a categorical diversification measure, based on continues measures of product diversification, is essential to represent the extent and type of diversification under one construct.

(ii) Which of the product related diversification measure of a firm explains the extent of a firms unrelated diversification strategy as measured using the entropy method?

Table 4 provides descriptive statistics and Pearson correlations. The index of unrelated diversification calculated from the entropy method (DIVDU) is significantly and negatively correlated with DIVHPP, DIVH2D and DIVH4D and significantly and positively correlated with DIVNP. This can be interpreted as, when the proportion of largest product sales to the total firm sales (DIVHPP) is high (correlation -0.431***), the firm's unrelated diversification (DIVDU) is low. When the proportion of the largest 'two digit' industry sales to the total firm sales (DIVH2D) is high (correlation -0.962***) the firm's unrelated diversification (DIVDU) is low. When the proportion of the largest 'four digit' industry sales to the total firm sales (DIVH4D) is high (correlation -0.782***) the firm's unrelated diversification (DIVDU) is low. Table 4 also shows that higher the number of products a firm produces (DIVNP), the higher is the firms unrelated diversification (correlation 0.336***).

Answering the research question (2), Table 5 sets out the results of hierarchical regression. Step 3 in Table 5 shows that DIVH2D significantly and negatively impacts the firm's unrelated diversity (t statistic -52.925***). This means that the proportion of the largest 'two digit' industry sales to the total firm sales has a negative impact on the firm's unrelated diversity. The number of products (DIVNP) a firm produces (t statistic 5.934***) and the proportion of the 'number of two-digit industry codes to the number of four-digit industry code' a firm operates in (DIV2B4) have a positive impact (t statistic 2.584**) on the firm's unrelated diversity. Rest of the variables, DIVHPP and DIVH4D do not have any significant impact on the index of

unrelated diversification and are hence excluded in the hierarchical regression model (Table 5, Step 3).

Analyzing the results in the context of our sample, we benchmark the unrelated diversity of two companies using the alternative diversity measures we have developed. Colgate Palmolive has 100% of its revenue from the two-digit NIC 24, which is 'manufacture of chemicals and allied products', while Wipro's largest sales comes from the two-digit NIC code of 72 being software services, which accounts for only 77% of the firm's total sales while the rest come from a combination of lamps, hardware, toilet preparations and hydrogenated oils. In light of our hierarchical regression results, we can interpret that given Wipro's lower DIV2HD measure, its unrelated diversification is higher than Colgate Palmolive. Our results also show that, more the number of products the higher the level of unrelated diversification. In the context of our sample, L&T and ABB have 27 and 18 products respectively, while ACC has 7 and Cable Corporation of India has only 3. In light of our results, we can interpret that L&T as being the most unrelatedly diversified and Cable Corporation being the least. These results are generalizable across the population the sample represents. Through this methodology, a particular firm can bench mark its unrelated diversity, assessing the extent of its unrelatedly diversity, as compared to other large firms in the country.

Reiterating the hierarchical regression results, Figure 1(a) graphically shows the relationship between the proportion of the largest two-digit industry sales to total firm sales (DIVH2D) and the entropy index of unrelated diversification (DIVDU); a steep increase in the value of the entropy index of unrelated diversification is witnessed with a decrease in the proportion of the largest two-digit industry sales to total firm sales. Figure 1(b) graphically shows the relationship between the number of products (DIVNP) and the entropy index of unrelated diversification (DIVDU); a steep increase in the value of the entropy index of unrelated diversification is witnessed with an increase in the number of products. Figure 1(c) graphically shows a bell shaped curve while depicting the relationship between the proportion of the 'number of two-digit industry codes to the number of four-digit industry code' a firm operates in (DIV2B4); a steep increase in the value of the entropy index of unrelated diversification is witnessed with an initial increase in DIV2B4 and a subsequent fall.

Discussion and Conclusions

This study discusses various corporate diversification measures used by researchers and highlights the advantages of the entropy measure of corporate diversification. Answering the research question (1), the study shows that the entropy measure fails to capture the extent of diversification, and the direction of diversification (related or unrelated), both, under one single construct and hence developing a categorical taxonomy of diversification that distinctively differentiates the sample firms on their components of both, related and unrelated diversification with clearly differentiated diversification strategies is evolved. Sample firms grouped under these four diversification categories distinctively represent concentrated operators who are narrowly focused (CONDIV), related diversifiers having no element of unrelated diversification (RELDIV), unrelated diversifiers having no element of related diversification (UNRDIV) and unfocussed operators who have both related and unrelated components of diversification.

Answering research question (2), the study provides the practicing managers three alternate measures of diversification; largest two-digit industry sales to total firm sales (DIVH2D), the number of products a firm produces (DIVNP) and the proportion of the 'number of two-digit industry codes to the number of four-digit industry code' (DIV2B4), data for calculating which are not only easily available in their day-to-day management information system but also less

complex to compute. These alternate measures help them gauge and benchmark their firm's extent of unrelated diversification.

Managerial Implications

This study provides a methodology to compute three alternate diversification measures from data that is available in their day-to-day management information system. The measures are also less complex to compute and easy to comprehend in comparison to the traditional diversification measures like entropy. The proposed alternate measures are reasonably a good approximation to the traditional measures of diversification without compromising on the accuracy of the traditional diversity measure, to a large extent. These measures allow the managers to bench mark their level of unrelated diversity, and also provides a direction for them to dwell into further details of related and unrelated diversification specifics through entropy measure, if they seem to sense a larger problem relating to the diversity of their firm.

Limitations and Scope for Further Research

The study does have a number of limitations. The concept of corporate diversification, and more specifically the measurement of corporate diversity, encompasses a wide range of issues that are context and firm specific. Researchers have hence questioned the generalizability of the diversification studies. Hence any claim that the results are totally generalizable will not be realistic. However, an attempt has been made to provide a set of simple measures that helps practicing managers sense their level of unrelated product diversity without having to go through complicated analysis. By simplifying the complexity in coming up with alternate diversity measures, the results of our study can be generalized across the population the sample firms represent. We expect the study to provide a 'back of the envelope' assessment of the firm's diversity, which can then be subjected to a more detailed and robust analysis if the situation warrants. The study has been done primarily using the product diversification concept; a similar analysis can be done using qualitative assessment of relatedness from the perspective of customer served or technology used, though such analysis may get very subjective. This possibly will provide a scope for future research.

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List of Tables and Figures:

Table 1; Entropy Measure of Diversification

The related diversification arising out of operations within an industry is the weighted sum of shares of each of the product segments in the company's sales in that industry. If the company operates in several industries, the net related diversification is the weighted sum of the related diversification within each of these industries. In addition to the related diversification, a company operating in several unrelated industries has a 'Unrelated Diversification' component, which is computed as the weighted sum of shares of each of the industries in the company's total sales. This measure thus provides three indices for each company (i) The index of 'Related Diversification (DR)', (ii) the index of Unrelated Diversification (DU) and the index of Total diversification (DT), such that DT = DR + DU.

$$DT = \sum_{i=1} P_i \ln(1/P_i)$$

Where, a company operates in N industry segments, Pi is the share of the ith segment in the total sales of the firm. The above expression is the weighted average of the shares of the segments, the weight for each segment being the logarithm of the inverse of its share. This measure takes into account both the number of segments in which a company operates and the relative importance of each segment in terms of total sales. In addition to this, the entropy measures take into account the degree of relatedness among various segments within which the company operates. The segments within an industry group are expected to be more related to

one another than segments across groups. If N industry segments of the company aggregate into M industry groups (N≥M), let related diversification DRj be defined as the related diversification arising out of operating in several segments within an industry group j. Following the definition of the entropy measure, DRj can be written as:

$$DR_j = \sum_{I \text{ to } j} P_i^j \ln(1/P_i^j)$$

where P_i^j is defined as the share of segment i of group j in the total sales of the group.Since from our firm operates under several industry groups, its total Related Diversification DR is s function of DR_j , j =1….M. Thus we can define:

$$DR = \sum_{J=1 \text{ to } M} DR_j P^j$$

The unrelated diversification element DUis defined as follows (Palepu, 1985).

$$DU = \sum_{j=1}^{M} P^j \ln(1/P^j)$$

Thus using this methodology, the sample companies have been classified into DT, DR and DU.

Table 2: Definition of Diversification Categories

Four diversification categories being Concentrated Operators (CONDIV), Related Diversifiers (RELDIV), Unfocussed Operators (UNFDIV) and Unrelated Diversifiers (UNRDIV) are created from the entropy measure of diversification (Jaquemin and Berry 1979, Palepu 1985) through procedure detailed below:
To arrive at the four-diversification categories, a two-stage process in conducted. The DR and DU of the sample companies are dichotomized respectively into two equal groups, each, based on their respective median value. The sample companies are then divided into four groups, (i) Concentrated Operators, (ii) Related Diversifiers, (iii) Unfocussed Diversifiers and (iv) Unrelated Diversifiers, based on the satisfaction of certain criteria as detailed below:

Group I: Concentrated Operators (CONDIV): Level of DT, DR and DU are all '0'.Companies in this group (Example, Company manufacturing automobile tyres) operate only in one Industry Group (say, Two digit NIC code 25 being 'Manufacture of Plastic and Rubber) and within this industry group, operates only in one segment (say, Four digit NIC code 2511 being 'Manufacture of rubber tyres and tubes; re-trading and rebuilding of rubber tyres).

Group II: Related Diversifiers (RELDIV): Level of DR to be greater than the DR median as well as level of DU to be less than the DU median. This means that the companies falling under this category are high-related diversifiers as well as Low unrelated diversifiers. Companies in this group (Example, Company manufacturing pharmaceuticals as well as man-made synthetic fibres) operate only in one Industry Group (say, Two digit NIC code 24 being 'Manufacture of Chemicals and Chemical products'), but, within this industry group, it operates in more than one segment (say, Four digit NIC code 2423 being 'Manufacture of pharmaceutical Four digit NIC code 2429 being 'Manufacture of chemical products'). Additionally this company had not

diversified into any other two digit Industry Group in order to have an unrelated diversification component.

Group IV: Unrelated Diversifiers (UNRDIV): Level of DU are above the DU median and level of DR less than the DR median. These are predominantly unrelated diversifiers. Companies in this group (Example, Company manufacturing drugs and pharmaceuticals, animal feeds as well as closed circuit televisions) operate three Industry Groups (Two digit NIC code 24 being Manufacture of Chemicals and Chemical products, 15 being manufacture of veterinary feeds and 33 being Manufacture of precision and optical instruments)

Group III: Unfocussed Diversifiers (UNFDIV): All the other companies not covered under the above three groups fall under this category. These are companies where the level of DU is above the DU median as well as the level of DR is more than the DR median. These companies pursue both related and unrelated diversification.

Table 3: Diversification Categories & Top ten sample firms in each diversification category

No.	Concentrated Operator (CONDIV)	Related Diversifier (RELDIV)	Unfocussed Operator (UNFDIV)	Unrelated Diversifier (UNRDIV)
1	Godfrey Phillips	Wimco	Century Textiles	Orient Paper
2	Reliance Energy	Punjab Tractors	L&T	DCM
3	Maruti Udyog	Southern Petro-Chemicals Ltd (SPIC)	Grasim Industries	HEG
4	Bajaj Auto	MRF Tyres	Aditya Birla Nuvo	EID Parry
5	Aventis Pharma	Gujarat State Fertilizers Corporation	Everedy Industries	Ballarpur Industries
6	Thermax	Ashok Leyland	Reliance Industries	Bajaj Electricals
7	Appolo Tyres	Corramandel Fertilizers	ITC	Titan
8	Alembic Chemicals	ICI India Ltd	Surya Roshini	Bharat Forge
9	Infosys Technologies	Dabur India	Godrej Industries	Amirit Basmati
10	Hero Honda Motors Ltd.	HMT	Wipro	Arvind Mills

Table 4: Descriptive Statistics and Pearson Correlation

	Variable	Descriptive Statistics					Pearson Correlation					
		N	Minimum	Maximum	Mean	Std.Dev	1	2	3	4	5	6
1	DIVDU	228	0.00	1.36	0.23	0.32	1.000					
2	DIV2B4	228	0.30	1.00	0.80	0.23	-0.044	1.000				
3	DIVNP	228	0.00	29.00	8.02	5.85	0.336***	-0.453***	1.000			
4	DIVHPP	228	18.78	100.00	67.90	24.09	-0.431***	0.372***	-0.562***	1.000		
5	DIVH2D	228	40.79	100.00	90.85	14.54	-0.962***	0.043	-0.258***	0.418***	1.000	
6	DIVH4D	228	36.78	100.00	85.24	17.73	-0.782***	0.408***	-0.393***	0.597***	0.793***	1.000

Table 5: Impact of various product vise measures on firm entropy index of unrelated diversification (DIVDU): 2004-05

Hirarchichal Regression Results: Dependent Variable DIVDU(entropy index of unrelated diversification)

	STEP-1				STEP-2				STEP-3			
	Std.Beta	**t Statictic**	**Sig.**	**VIF**	**Std.Beta**	**t Statictic**	**Sig.**	**VIF**	**Std.Beta**	**t Statictic**	**Sig.**	**VIF**
Included Variables												
DIVH2D	-0.962***	-52.822	0.000	1.000	-0.938***	-52.67	0.000	1.070	-0.934***	-52.925	0.000	1.078
DIVNP	-	-	-		0.094***	5.278	0.000	1.070	0.117***	5.934	0.000	1.354
DIV2B4	-	-	-		-	-	-		0.049**	2.584	0.010	1.268
Excluded Variables												
DIV2B4	Excluded	Excluded	Excluded		Excluded	Excluded	Excluded		-	-	-	
DIVNP	Excluded	Excluded	Excluded		-	-	-		-	-	-	
DIVHPP	Excluded	Excluded	Excluded		Excluded	Excluded	Excluded		Excluded	Excluded	Excluded	
DIVH4D	Excluded	Excluded	Excluded		Excluded	Excluded	Excluded		Excluded	Excluded	Excluded	
F Statistic				**2790.113*** **				**1575.494*** **				**1079.181*** **
Adjusted R^2				**0.925**				**0.933**				**0.935**

*** Correlation is Significant at .01 level, ** Correlation is Significant at .05 level, * Correlation is Significant at .10 level*

Figure 1(a)

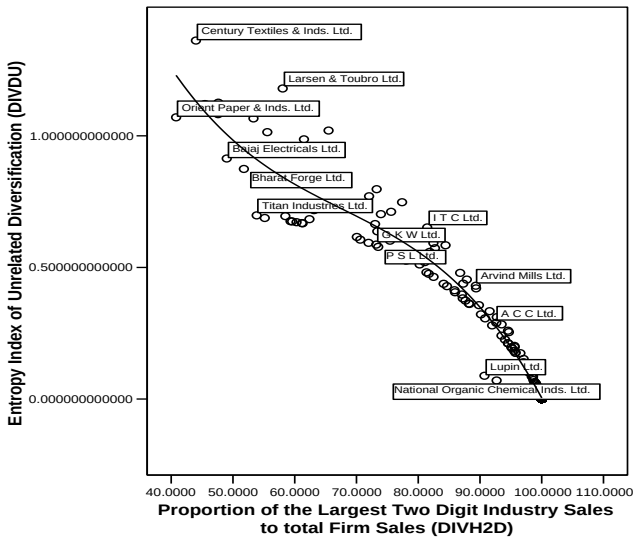


Figure 1(b)

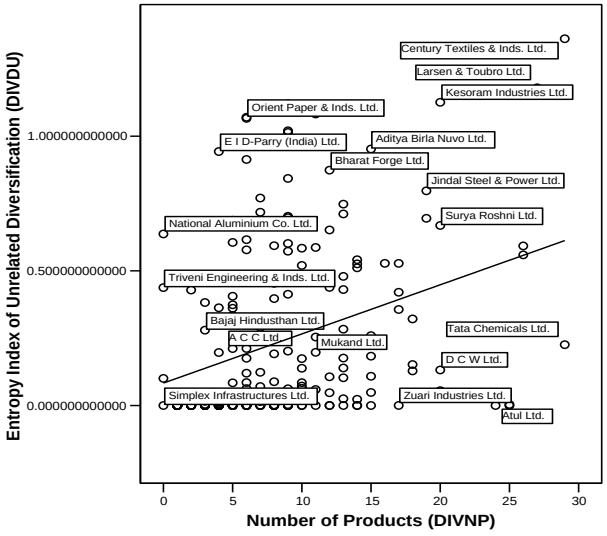
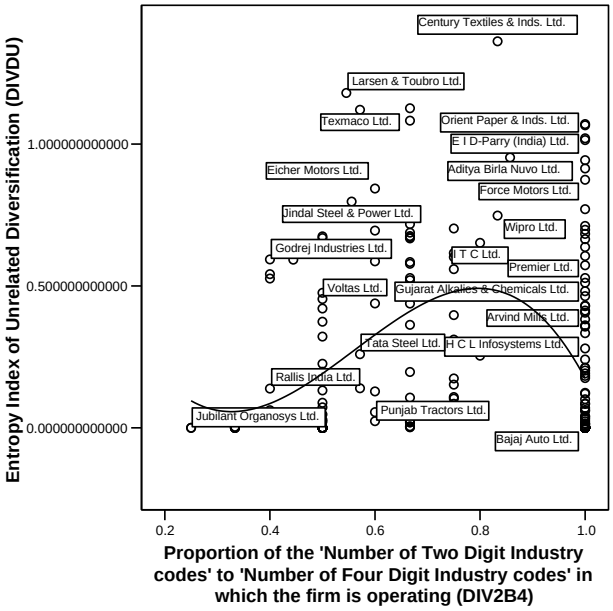


Figure 1(c)



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