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ABSTRACT

The advantages and disadvantages of diversification and its impact on productivity or performance of a firm have been debated upon by academics and business professionals all over, although views on the topic still differ widely. While popular views are that related diversification increases value and unrelated diversification decreases value, the results of research conducted on the effects of overall diversification (without distinguishing between related and unrelated diversification) on productivity are of conflicting nature.

This paper focuses on this relationship in the context of the Indian manufacturing sector. Along with this, it also expounds on the existence of an optimal diversification point for the Indian context. Data used is obtained from CMIE Prowess for the period 2003 to 2014 and standard econometric analysis on panel data is carried out to find the stated relationship. Tobin's q is used as a measure of performance of the firm. The results show that highly diversified firms perform poorly on account of vertical diversification while horizontal diversification has a positive effect on performance.

Keywords: productivity, diversification, Tobin's q, related, unrelated
JEL Classification: L25, D22

1. INTRODUCTION

Corporate diversification is a strategy that involves choosing to structure a company's operation in such a way that it promotes the involvement of the firm in a wider range of revenue producing activities. It could involve production of goods and services associated with the business, or rearranging the investment portfolio. This strategy was popularized by conglomerates in the 60s and 70s (Lang & Stultz 1994). The goal of diversification in any industry is to diversify production and assets over a range of activities, thereby increasing the chances of returns while also minimizing the potential for failure or loss.

There are three types of diversification: Concentric, Horizontal and Conglomerate. When the firm diversifies into an industry which has a technological similarity with the industry it is currently involved in, it is said to have employed concentric diversification strategy. Horizontal diversification is when a firm develops or acquires new products that different from its core business or technology, but which may appeal to its current customers. This strategy is implemented when a firm believes that offering a broader range of goods and services to an existing loyal customer base would bring in large revenue. It requires that the present customers are loyal to the current products and new products are well promoted, well priced and of good quality. It could also be when a firm enters a new business (related or unrelated) at the same stage of production as its current operations. Finally, conglomerate diversification is where a firm enters (either through acquisition or merger) an entirely different market that has little or no synergy with its core business or technology. The motive is to attract new customers hence improving profitability & flexibility of the company as well as reception in capital markets as the company gets bigger. While this strategy is risky, if successful, it is believed to provide increased growth and profitability. Theoretically, the advantages of this strategy are stated as potential for profits and a boost in market power. The disadvantages are an inability to provide a synergy between the new entity and the old one and the concern that the firm may devote

too much energy into the new aspects of its business which may devour some of the resources that made the initial business strong.

According to literature, diversification has been found to result in synergies, enabling the single diversified entity to achieve greater efficiencies through co-operation and better risk management (Chang et al. 2001). However, evidence on the effectiveness of diversification is mixed. In the earlier years, there was strong consensus that diversification destroyed value and diversified firms suffered from a 'diversification discount' (Lang and Stultz 1994, Berger and Ofek 1995, Servaes 1996). However, later studies questioned the data and methodology used in these studies (Villalonga 2004a, Campa and Kedia 2002, Martin and Sayrak, 2003). The impact of diversification on productivity, which in turn impacts performance of a firm, was pioneered by Lichtenburg (1992) who claimed that if diversification is beneficial (detrimental) to the firm, it should result in higher (lower) productivity for diversified firms. With the use of the US Census Bureau's data on manufacturing plant-wise data, Lichtenburg showed that diversification impacts firm productivity negatively. Schoar (2002) used a similar, but larger data set from the US Census Bureau's Longitudinal Research Database and found a positive correlation between diversification and performance of the firm. An explanation for this difference in opinion was ventured by Chang et al. (2011) as the lack of differentiation between related and unrelated diversification. They used this concept to build upon a paper to relate the performance of a firm and diversification, while keeping the distinction between related and unrelated diversification clear using the Entropy Measure and its decomposed components as proxies. They use the Data Envelopment Analysis (DEA) method to measure a firm's relative productivity and conclude that related (unrelated) diversification contribute to the increase (decrease) of productivity.

Other notable studies include Villalonga (2003) who used two different databases and showed that studies based on one of them showed evidence of a diversification discount, while research on the other supported the hypothesis of a diversification premium. She explained that the former database showed unrelated (conglomerate) diversification while the latter showed related diversification. These new studies claimed that diversification

discount was non-existent and there was actually a premium to diversification, implying that under certain circumstances, diversification creates value. Fan and Lang (1999) use commodity flow data in U.S. input–output tables to arrive at the same conclusion as Villalonga as do Maksimovic and Philips (2001) who used plant-level data to examine the growth and efficiency of firms and their business segments.

In the Indian context, Khanna and Palepu (1999) proposed that diversification serves to replicate functions of institutions that are missing in emerging markets (such as mitigating failures in product, labor, and financial markets) which is particularly important in emerging and less developed markets and show that businesses increased diversification in products and geographic scope after 1991. In 2000, they published results showing an initial decline and subsequent increase (beyond a threshold level of diversification) in stock market- and accounting-based measures of firm perm performance. They revealed a quadratic relationship between firm performance and group diversification on regressing their self-constructed industry-adjusted group Tobin's q on group size and group product diversification. However, this analysis was proven to be weak empirically as their work on aggregate group performance was not exhaustive. Anagol and Pareek (2013) conducted their analysis on business group owned mutual funds in India to find that funds that concentrate on group-related industries earn close to 50 basis points more per month than those that focus less on related industries. Gair and Kumar (2009) conducted their analysis on a sample of 240 Indian firms considering return on sales (ROS) and return on assets (ROA) as their dependent variables and degree of internalization and group affiliation as their independent variables to find that degree of internalization had a positive effect on firm performance while affiliation to a group impacted the relationship between degree of internationalization and firm performance negatively such that highly internationalized firms were found to perform better if they were not affiliated to a business group.

In light of previous literature, the objective of this study can be described as three fold- to examine the relationship between diversification and performance in the context of the Indian manufacturing sector, to distinguish between the contributions of vertical and

horizontal diversification to the performance of a firm and to detect the existence of an optimal point of diversification, if any, before which diversification leads to a decrease in productivity and beyond which diversification has a positive effect on productivity.
On analysis, we find a negative relationship between diversification and performance of the firm. Also, the optimal number of 4-digit industries/segments for a firm to be involved in, assuming the firm is considering the diversification strategy, is found to be 5. We find that the mean return on equity and mean return on assets for firms who are involved in lesser than 5 4-digit industries is lower than the mean return on assets for firms who are involved in greater than the same.

The next section describes the hypothesis of the study, data sources and the variables included in the study along with justifications for their inclusion. Section 3 consists of a basic summary of the data and patterns followed by it. Section 4 presents the empirical findings of the analysis and Section 5 concludes.

2. DATA AND RESEARCH METHODOLOGY

DATA

The data for this study was obtained from the Prowess database published by the Centre for Monitoring the Indian Economy (CMIE). This database contains detailed information on the financial performance of companies in India, complied from their profit and loss accounts, balance sheet, and stock price data. The database also contains background information on ownership pattern, product profile and board of directors of the companies. This database has formed the basis of several empirical studies on the Indian corporate sector, including Khanna and Palepu (2000a), Sarkar and Sarkar (2000), etc.

The period of study is from March 2003 to March 2014 and the frequency of data is annual, derived from the Annual Financial Statements of the firms, reported on Prowess Database. After a thorough cleaning of the data (deletion of non-reporting firms), we arrive at two different sample data sets. The first sample consists of all manufacturing firms reporting essential data. This sample consists of 4257 firm-year observations. The second sample consists only of those firms that have reported segment sales in the financial statements. This sample consists of 274 firm-year observations. The data used for analysis is unbalanced panel data. The definitions of the variables used in the study are given in Table 1.

VARIABLES

While many papers including Schoar (2002) and Lichtenburg (1992) use Total Factor Productivity to measure productivity of the firm, Villalonga (2004) uses Tobin's q as a measure of firm value, which according to literature is one of the main areas of impact of diversification.

In this paper, I propose to use Tobin's q as the dependent variable, which is measured following Chung and Pruitt and some Indian studies (e.g. Pandit and Shiddharthan, 2003; Chadha and Oriani, 2009; Bhattacharyya and Saxena, 2009) as:

$$q = \frac{\textit{Market Value of Firm's Equity + Book Value of Debt}}{\textit{Book Value of Total Assets - Miscellaneous Expenses and Depreciation}}$$

For diversification, two proxies are favored widely- the Herfindahl Index and the Entropy Measure. Chang et al. (2011) prefers to use the entropy measure as it is capable of differentiating between related and unrelated diversification. Most research in this area use the Herfindahl Index, where segment weights are either total value of shipments or total capital shock (Schoar 2002).

We propose to use the Entropy Measure to keep the distinction between related and unrelated diversification unambiguous.

The Entropy Measure is calculated as follows:

$$\textit{Total Entropy} = E_T = \sum_i P_i \ln \frac{1}{P_i}$$

$$\textit{Within Industry/Firm Entropy} = \left[\sum_i \frac{P_i}{P_s} \ln\left(\frac{P_s}{P_i}\right) \times P_s \right]$$

$$\textit{Between Industry/Firm Entropy} = \sum_s P_s \ln \frac{1}{P_i}$$

$$P_s = \sum_i P_i$$

where

P_i is the share of the ith firm/industry in the total sales

s is the group

The firm's total entropy (its measure of diversification) into two components – the entropy that exists *between or across* industry groups and the entropy that exists *within* industry groups. This index takes a value of zero when production is concentrated entirely within a single industry. At the other extreme, if the firm's production is spread evenly across K industries, the firm's entropy is maximized at log (K).

Apart from Entropy, we use the Herfindal Index or Concentration Index as well, which is calculated as follows:

$$H = \sum_{i=1}^{N} s_i^2$$

where

s_i is the market share of the i^{th} firm in the market

N is the number of firms

The Herfindahl Index, also known as the Herfindahl-Hirschman Index (HHI), measures the market concentration of an industry's firms in order to determine if the industry is competitive or nearing monopoly. The Herfindahl index ranges from a low of 0, indicating perfect competition, to a higher of 10,000, indicating complete monopoly. Greater values mean greater concentration, less competition, and more market control held by individual firms.

At the low end, a 0 Herfindahl index means perfect competition or at the very least monopolistic competition i.e. extremely competitive. The number of firms is so large that sum of the square of the market shares is 0. At the high end, a 1 Herfindahl index means monopoly. This value is only achieved if one firm has a market share of 100 percent. Between these two extremes, the Herfindahl index can fall into low, medium, and high concentration.

1. Low Concentration: A Herfindahl index of 0 to 0.5 is commonly interpreted as an industry with low concentration. Monopolistic competition falls into the bottom of this with oligopoly emerging near the upper end.
2. Medium Concentration: A Herfindahl index of 0.5 and 0.8 is considered an industry with medium concentration. These industries are very much oligopoly.
3. High Concentration: An industry with a Herfindahl index of 0.8 to 1 is viewed as highly concentration. Government regulators are usually most concerned with industries falling into this category.

Besides these, we use the number of 4-digit-segments that a firm is involved in as an indicator of diversification.

We have also constructed various dummies to denote the level of diversification. These dummies are defined as follows:

$$\text{Diversification Class 1: D0} = \begin{cases} 0; \text{if diversification is in 2 digit classification} \\ 1; \text{if there is no diversification} \end{cases}$$

The control variables that I use in this paper are included to throw light on the implications of decisions concerning firm's growth on the firm's performance. Among these variables are external factors such as characteristics of the firm's industry and internal factors which define the constraints and opportunities placed in the firm by its resource base. The variables considered are adapted from the resource-based research by Penrose (1959), which states that the firm's optimal expansion path is governed by factors internal and external to the firm. It assumes the following hypotheses based on works by eminent economists[1]:

- *Hypothesis 1*- The profitability of the principle industry in which the firm operates is negatively related to the extent of diversification.

[1] Delios and Beamish (2001)

- *Hypothesis 2*- The extent of product diversification is negatively related to the firm performance.
- *Hypothesis 3a*- The extent of product diversification is negatively related to the R&D intensity of a firm.
- *Hypothesis 3b*- The extent of product diversification is negatively related to the advertising intensity of a firm.
- *Hypothesis 4a*- The R&D intensity (technological assets) of a firm is positively related to its geographic scope.
- *Hypothesis 4b*- The advertising intensity (marketing assets) of a firm is positively related to its geographic scope.
- *Hypothesis 5*- The geographic scope of a firm is positively related to corporate performance.
- *Hypothesis 6a*- The R&D intensity (technological assets) of a firm is positively related to corporate performance.
- *Hypothesis 6b*- The advertising intensity (marketing assets) of a firm is positively related to corporate performance.

The result of the above study was that while the full sample explained 14.5% of the variation in the performance of the firms, only 5 of the 9 hypotheses were accepted.

- Hypothesis 4a was supported as R&D expenditure was positively and significantly associated with the geographic scope of the firm.
- Geographic scope was significantly and positively related to performance, supporting hypothesis 5.
- R&D expenditure was statistically significant in its relationship with performance, supporting hypothesis 6a.
- The path coefficient testing hypothesis 1 was found to be significant.
- The path coefficient testing hypothesis 3a was also found to be significant.

On the other hand,

- Marketing expenditure was not significantly related to firm performance, thus rejecting hypothesis 6b.

- Extent of product diversification was not significantly related to firm performance, thus rejecting hypothesis 2.
- Extent of product diversification was not related to intensity of R&D expenditures.
- Extent of product diversification was not related to firm performance.

Based on the above results and other existing research, the variables used are defined as follows:

Table 1: Definition of Variables

VARIABLE	SYMBOL	DEFINITION
Tobin's Q	Q	$\frac{\text{Market value of firm's stock} + \text{Book value of debt \& preferred stock}}{\text{Book Value of Assets}}$
Age of the Firm	Age	Year of study – Year of Incorporation of the Firm
Size of the Firm	Size	ln (Sales in Millions of Rs)
Advertisement Intensity	AI	$\frac{\text{Advertisement Expenditure}}{\text{Net Sales}}$
Export Intensity	EI	$\frac{\text{Export Earnings}}{\text{Net Sales}}$
Research and Development Intensity	RDI	$\frac{\text{Research \& Development Expenditure}}{\text{Net Sales}}$
Interaction Dummy Between RDI and Multinational Dummy	RDIM	$\text{RDI} \times \text{MNE}$
Multinational Dummy	MNE	$= \begin{cases} 1; \text{if the firm is multinational} \\ 0; \text{otherwise} \end{cases}$

3. DESCRIPTIVE STATISTICS

The descriptive statistics of sample 1 are presented in Table 2. It shows that the dependent variable, Tobin's q, which has a mean of 0.8320. This shows that the average Tobin's q of manufacturing firms is fairly high as q takes a value between 0 and 1. This implies fairly high profitability in the manufacturing sector. It has a standard deviation of 0.3805 and standard error of 0.0206.

Similarly, the Herfindahl Index has a mean of 0.1365 with standard deviation 0.4516 and standard error 0.0069. This falls in the low concentration category, implying that on an average, firms in the manufacturing industry are not highly diversified.

Table 2: Summary Statistics for Sample 1

Variable	Mean	Standard Deviation	Standard Error (Mean)
AGE	36.5056	21.9042	0.3357
AI	0.0073	0.0211	0.0003
HI	0.1365	0.4516	0.0069
EI	0.0212	0.1028	0.0016
Size	8.6781	1.7391	0.0267
Q	0.8320	0.3805	0.0058
RDI	0.0045	0.0158	0.0002

We now show the descriptive statistics of the second sample i.e. the sample which contains only firms reporting segment sales data.

Table 3: Summary Statistics for Sample 2

Variable	Mean	Standard Deviation	Standard Error (Mean)
AGE	38.9491	20.5500	1.2415
AI	0.0089	0.0213	0.00123
HI	0.1751	0.6914	0.0418
EI	0.0132	0.0541	0.0033
Size	9.2047	1.3282	0.0802
Q	0.7395	0.3259	0.0197
RDI	0.0043	0.0112	0.0007
Entropy	0.2319	0.1423	0.0086
Wentropy	0.0424	0.1594	0.0096
Bentropy	0.1965	0.1146	0.0069

The above table shows us that the mean age, size and AI of firms reporting segment sales are higher than that of the whole sample. This suggests that diversified firms are older, larger and invest more in advertising. On the other hand, these firms seem to export lesser on an average and have a lower q, implying lower firm value on average. We verify this in Table 3.

Total Entropy of the firms in the sample has a mean of 0.2319. It has a standard deviation of 0.1423 and standard error of 0.0086.

Within-Industry Entropy of firms has a mean of 0.0424 with standard deviation 0.1594 and standard error of 0.0096. Between-Industry Entropy has a mean of 0.1965, which is significantly higher that the within-industry entropy. It has a standard deviation of 0.1146 and standard error of 0.0069. The between-industry entropy is higher than within-industry entropy on average suggesting that there is higher diversification between-industry and lower diversification within-industry.

Similarly, the Herfindahl Index has a mean of 0.1751 with standard deviation 0.4516 and standard error 0.0069. This value, although marginally higher than the value of the index for all manufacturing firms, falls in the low concentration category.

In Table 4, we categorize the summary statistics of the variables on the basis of the variable D0, which tells us if the firm is diversified at the 2-digit level or not.

It shows us that on an average, diversified firms are older, larger, export more marginally, and invest more on advertising and R&D. Diversified firms also have a moderately larger value of q. This means that diversified firms are slightly more profitable than firms that are not-diversified.

The have a larger Herfindahl Index. This conforms to our assumption that firms that are diversified at the 2-digit level are diversified at 3- and 4-digit levels as well. Hence, firms that are diversified at the 2-digit level have a larger Herfindahl Index than those that are not.

Table 4: Summary Statistics for 2-digit- Diversified and Non-Diversified Firms

D0	Diversified			Non-Diversified		
	Mean	Standard Deviation	Standard Error(Mean)	Mean	Standard Deviation	Standard Error(Mean)
Age	37.2911	22.8218	0.4852	35.8192	20.8426	0.4608
AI	0.0075	0.0221	0.0005	0.0068	0.02	0.0004
EI	0.0229	0.1067	0.0023	0.0206	0.0983	0.0022
RDI	0.0051	0.0194	0.0004	0.0041	0.0105	0.0002
HI	0.1429	0.3799	0.0081	0.1407	0.5181	0.0115
Size	8.8168	1.7323	0.0368	8.6326	1.7413	0.0385
Q	0.8427	0.3780	0.0080	0.8223	0.3837	0.0085

Note : The diversification dummy D0 takes the value 1 if the firm is diversified at the 2-digit level and 0 otherwise (non-diversified). Firms that are diversified at the 2-digit level are also diversified at the 3- and higher-digit levels.

Next, we categorize summary statistics with respect to domestic and multinational enterprises.

From this categorization, we find that multinational firms are older and hence better established, advertise more and are more profitable as they have a higher q value. Naturally, these firms export lesser than domestic establishments. Multinational firms are also seen to be smaller in size on average, invest lesser in R&D and have a lower H-Index. This means that firms that are multinational are less diversified than those that are domestic.

Table 5: Summary Statistics for Domestic and Multinational Firms

MNE	Domestic			Multinational		
	Mean	Standard Deviation	Standard Error(Mean)	Mean	Standard Deviation	Standard Error(Mean)
Age	36.4318	22.1560	0.3988	39.6577	18.0708	1.7152
AI	0.0056	0.0179	0.0003	0.0071	0.0191	0.0018
EI	0.0245	0.1127	0.0020	0.0069	0.0332	0.0032
RDI	0.0037	0.0133	0.0002	0.0029	0.0037	0.0004
HI	0.1532	0.5098	0.0092	0.1302	0.1952	0.0185
Size	8.6603	1.7528	0.0315	7.7314	1.1947	0.1134
Q	0.6523	0.1916	0.0034	0.7000	0.2005	0.0190

Note: The multinational dummy MNE takes the value 1 if the firm is multinational (foreign) and 0 otherwise (domestic).

4. RESULTS

In this section, we focus on the regressions and estimated results of the study. One of the definitions of diversification is borrowed from Caves et *al.* (1980) as the Concentric Index, defined as

$$D_i = \sum_{j=1}^{n} m_{ij} \sum_{l=1}^{n} m_{ij} r_{jl} \tag{1}$$

where

m_{ij} is the percentage of firm i's sales in industry j

$$r_{jl} = \left\{ \begin{array}{c} 0 \text{ if j and i have same 3-digit code} \\ 1 \text{ if j and i have different 3-digit code but same 2-digit code} \\ 2 \text{ if j and i have different 2-digit codes} \end{array} \right\}$$

In this study, we further diversify D_i into D0, D1 and D2 to capture the extent of optimal diversification.

The estimation process follows the standard panel data econometrics. We estimate four regression equations which are as follows:

$$q_{it} = \beta_1 AI_{it} + \beta_2 EI_{it} + \beta_3 Age_{it} + \beta_4 Size_{it} + \beta_5 RDIM_{it} + \beta_6 Seg_{it} + \beta_7 Seg_{it}^2 + \varepsilon_{it} \tag{2}$$

$$q_{it} = \beta_0 + \beta_1 AI_{it} + \beta_2 EI_{it} + \beta_3 Age_{it} + \beta_4 Size_{it} + \beta_5 RDIM_{it} + \beta_6 HIndex_{it} + \beta_7 HIndex_{it}^2 + \varepsilon_{it} \tag{3}$$

$$q_{it} = \beta_0 + \beta_1 AI_{it} + \beta_2 EI_{it} + \beta_3 Age_{it} + \beta_4 Size_{it} + \beta_5 RDI_{it} + \beta_6 Entropy_{it} + \beta_7 Entropy_{it}^2 + \varepsilon_{it} \tag{4}$$

$$q_{it} = \beta_0 + \beta_1 AI_{it} + \beta_2 EI_{it} + \beta_3 Age_{it} + \beta_4 Size_{it} + \beta_5 RDI_{it} + \beta_6 Bentropy_{it} + \beta_7 Bentropy_{it}^2 + \beta_8 Wentropy + \beta_9 Wentropy_{it}^2 + \varepsilon_{it} \quad (5)$$

The independent variables are drawn from the review of literature. Some of the proxies for diversification, namely Seg, DI and HIndex, cannot be differentiated for firms that are vertically diversified. In these cases, we use the diversification dummy D0 and run separate regressions for the two cases i.e. when the firm is horizontally diversified and when it is only vertically diversified.

The model used for estimation is one of Random Effects [2] as number of segments that a firm is involved in, R&D intensity are whether or not a firm is multinational are largely fixed over the chosen time period.

First, to assess the relationship between Number of segments and Tobin's q, we run a Random Effects regression as in (2). The results are given as follows:

Table 6: Regression of number of segments on Tobin's q

Q	Coefficient	Standard Error	t-statistic	P-Value
Age	-0.0009	0.0006	-1.51	0.130
Size	0.0188	0.0058	3.27	0.001
EI	-0.3077	0.0671	-0.46	0.646
AI	1.5126	0.3854	3.93	0.000
RDIM	-4.8956	9.6075	-0.51	0.610
Seg	-0.0512	0.0208	-2.46	0.014
Seg2	0.0047	0.0025	1.91	0.056
Constant	0.7967	0.0559	14.21	0.000

The significant negative coefficient shows us that there is a negative relationship between number of segments and performance of the firm. This is in agreement to Villalonga's theory which states that unrelated diversification has a discount on productivity while

[2] This model turns out to be more appropriate as per Hausman test.

related diversification has a premium. The discount has a greater effect on most firms due to which the coefficient in this regression turns out to be negative. However, the positive coefficient on the squared term, Seg_{it}^2, indicates an optimal level of diversification beyond which firm performance improves.

This optimal level of diversification was found to be at 5.4 4-digit segments in the Indian case. Now, we supplement this by the partition of the data set into 2 divisions, one with D0=0, indicating related diversification, and the other with D0=1, indicative of unrelated diversification. The results of the regression are as given below:

Table 7: Regression of number of segments on Tobin's q while accounting for related and unrelated diversification

	When D0=0				When D0=1			
q	Coeff	Standard Error	t-stat	p-value	Coeff	Standard Error	t-stat	p-value
Age	-0.0001	0.0008	-0.09	0.930	-0.0013	0.0007	-1.86	0.062
Size	0.0308	0.0083	3.73	0.000	0.0144	0.0075	1.93	0.054
EI	0.1433	0.1115	1.29	0.198	-0.0856	0.0861	-0.99	0.320
AI	0.8017	0.4975	1.61	0.107	2.5791	0.5859	4.40	0.000
RDIM	-7.9854	11.7597	-0.68	0.497	0.1839	16.2585	0.01	0.991
Seg	0.1038	0.0282	3.68	0.000	-0.0151	0.0253	-0.60	0.551
Seg^2	-0.0118	0.0036	-3.30	0.001	0.0005	0.0029	0.18	0.859
Constant	0.7010	0.0769	9.11	0.000	0.7894	0.0739	10.68	0.000

This shows that in the case of vertical diversification, increase in the number of segments leads to better performance up to a certain point. Hence, the marginal increase of productivity on increasing the number of segments in the same industry is decreasing. For horizontal diversification, we see that there is a fall in firm performance with increase in

number of segments. There is, however, a point beyond which the firm performance improves with the number of segments.

The same was repeated for the regression indicated in equation (3), the results of which are indicative below. These results are in tandem to those of the number of segments. Vertical or related diversification shows a positive impact on Tobin's q and horizontal diversification shows a negative impact on it.

Table 8: Regression of Herfindahl Index on Tobin's q while accounting for related and unrelated diversification

	When D0=0				When D0=1			
q	Coeff	Standard Error	t-stat	p-value	Coeff	Standard Error	t-stat	p-value
Age	0.0008	0.0009	0.82	0.411	-0.0016	0.0007	-2.26	0.024
Size	0.0349	0.0099	3.50	0.000	0.0245	0.0076	3.24	0.001
EI	-0.0126	0.0848	-0.15	0.882	-0.0843	0.1129	-0.75	0.455
AI	0.5301	0.5111	1.04	0.300	2.9606	0.6110	4.85	0.000
RDIM	-2.9298	11.5896	-0.25	0.800	-1.0038	18.4635	-0.05	0.957
HIndex	0.4244	0.1732	2.45	0.014	-0.5851	0.1530	-3.82	0.000
$HIndex^2$	-0.3735	0.2247	-1.66	0.096	0.7237	0.2109	3.43	0.001
Constant	0.5893	0.0813	7.24	0.000	0.6895	0.0677	10.18	0.000

For equations (4) and (5), we run the regressions without segregating the data as done for the other variables. This is because the Entropy variable is capable of segregating firms into vertically and horizontally diversified firms as stated above.

For equation (4), the results are as follows:

Table 9: Regression of Entropy on Tobin's q

Q	Coefficient	Standard Error	t-statistic	P-Value
Age	0.0017	0.0018	0.95	0.340
Size	0.0166	0.0226	0.73	0.465
EI	0.0625	1.1804	0.05	0.958
AI	0.2647	0.2879	0.92	0.358
Entropy	-0.2108	0.4542	-0.46	0.643
Entropy2	0.2682	0.7147	0.38	0.708
Constant	0.5355	0.2173	2.46	0.014

For equation (5), we have

Table 10: Regression of decomposed entropy on Tobin's q

Q	Coefficient	Standard Error	t-statistic	P-Value
Age	0.0017	0.0018	0.92	0.355
Size	0.0180	0.0229	0.79	0.431
EI	0.1101	1.1873	0.09	0.926
AI	0.2753	0.2864	0.96	0.336
Bentropy	-0.6501	0.6519	-1.00	0.319
Bentropy2	1.7574	1.6559	1.06	0.289
Wentropy	0.2244	0.6338	0.35	0.723
Wentropy2	-0.1753	1.0566	-0.17	0.868
Constant	0.5216	0.2174	2.4	0.016

The above shows us that overall entropy has a negative effect on firm's Tobin's q. However, when the entropy term is split to see the relative influence, between-industry entropy has a negative effect on productivity, while the within-industry entropy has a positive effect. As diversification increases in these relative segments, the effects reverse. Hence, we can conclude that when a firm enters a new industry vertically, diversification initially has a negative effect. As the firm establishes itself in the industry, the effect of vertical diversification becomes positive.

Based on regression of equation (2), we found that the optimal number of industries was found to be greater than 5. Hence, we take a threshold of 6 and construct another dummy

$$DD = \begin{Bmatrix} 1 \text{ when number of segments is greater than } 5 \\ 0 \text{ when the number of segments is less than } 5 \end{Bmatrix}$$

We then calculated the average of two alternative profitability ratios for the 2 sets of data, segregated based on the dummy DD.

Table 11: Average profitability ratios for the sets of data segmented by the dummy DD

DD	Average Tobin's q	Average ROA	Average ROE
0	0.8342	0.0376	2.6258
1	0.8128	0.0576	7.6458

Table 11 shows us that as a firm goes beyond the optimal level of 4-digit industries, while Tobin's q of the firm marginally decreases, the other two profitability measures increase. Hence, we run a t-test to check for the existence of unequal means in the two considered samples.

The results of the test are shown below:

Table 12: Results of T-test for unequal means

Measure	P-Value
ROA	0.0000
ROE	0.0252

The above shows us that while the mean Tobin's q remains the same regardless of the number of segments, the other profitability ratios increase as the number of segments increases beyond the optimal 6 segments.

5. CONCLUSION

The contribution of this work lies in identifying the relationship between diversification and firm performance in the Indian context, while keeping the distinction between horizontal and vertical diversification clear, so as to assess their individual effects separately. Apart from this, this paper also contributes to finding an optimal number of 4-digit-segments for a firm to be involved in so as to ensure optimal performance.

On locating this optimal point of diversification, we turn to two alternative profitability ratios to investigate if they are significantly different for the two sets firms to find that firms that are diversified beyond this optimal point experience a premium while firms that haven't yet reached this point experience a discount on diversification. Hence, we deduce that horizontal diversification is a strategy suitable for firms with large capacity that can sustain an initial fall in overall productivity.

Therefore, we conclude that diversification is a profitable strategy when implemented wisely. A firm must consider the amount of excess returns available to dispose of while making the decision of whether to diversify into a related field or an unrelated field. The approach used in this study is one of considering the across industry classifications as opposed to the composite index approach that takes all three classifications of diversification (industry classification, technology classification and multinational classification) into consideration and relates to profitability, establishing a relationship between diversification and firm performance.

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