

Effect of Product Market Diversification on Firm Performance: A study of the Indian Corporate Sector

Vardhana Pawaskar*

Indira Gandhi Institute Of Development Research
Gen. A. K. Vaidya Marg
Goregaon (East), Mumbai - 400 065, India
e-mail : vardhana@igidr.ac.in
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Abstract

In this paper an attempt is made to test the hypothesis that diversification leads to an improvement in firm performance. A sample of 524 Indian private sector manufacturing firms is analysed for the post-liberalisation period from 1992 to 1995. The measure of performance is the excess profitability of the firm as compared to the industry average or benchmark profitability. Using the threshold regression model, it is seen that the directions of diversification leading to improved performance depends largely on how efficiently the assets are utilised in the present operations. If the asset utilisation was around the industry average then related diversification improves the overall performance. However, when the firm is not able to best utilise the assets in present operations, performance was significantly improved with diversification into unrelated industries.

* This paper is a part of my doctoral dissertation submitted at the Indira Gandhi Institute of Development Research, Mumbai in September 1999. Address for correspondence: Ms.Vardhana Pawaskar(nee Saple), 601, Nilanjana, Marve Road, Malad (west), Mumbai – 400 064, INDIA. E-mail: vardhanas@hotmail.com

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Diversification by the firm, either through internal capacity expansion or through external expansion by merger, is essentially a means of growth for the firm. There is an interesting implication for the relation between the desire to grow and the desire to make profits. If profits are a pre-condition of successful growth, but profits are sought primarily to grow, that is, to reinvest in the firm rather than to reimburse owners for the use of their capital or their 'risk bearing', then, from the point of view of investment policy, *growth and profits become equivalent as the criteria for the selection of investment programs* (Penrose, 1980). Firms will never invest in expansion for the sake of growth if the expected return on the investment is lower than the cost of capital, for that would be self-defeating. Firms will invest outside if and only if the managers expect that it eventually lead to a further increase the funds available for investment. To increase total long-run profits of the enterprise in some sense is therefore equivalent to increasing the long-run rate of growth. Hence, it does not matter whether 'growth' or 'profits' is considered as the goal of a firm's investment activities.

A diversified firm can be considered as one having operations in more than a single industry. The consequences of such diversification can be examined for the individual firm with respect to the long-run growth/profit, which becomes less dependent on the trend in demand for products within its primary industry. In addition diversification increases the range of a firm's investment opportunities, since it permits a company to take advantage of the more profitable opportunities in sectors of the economy in which it previously had no activities.

In this paper the short to medium term effect of diversification are studied and the hypotheses that increase in diversification is associated with improved performance of the firm is tested for. The measure of performance is the excess profitability of the firm as compared to the industry average or benchmark profitability. The previous studies on diversification in Indian firms used a static framework, making a point to point comparison of the change in diversification and

the effect on performance. Shanker (1988) defines the optimal level of diversification as the measure, which corresponds to the class interval where the variability of returns is lowest. This study has been the only detailed study for diversification pattern of 1694 firms covering the two points of time 1975-76 and 1980-81. The variability of returns has been computed for returns over the entire sample period.

Results presented later in this paper indicate that the effect of an increase in diversification depends on the level of asset utilisation by the firm as compared to the average of the industry. It is seen that in the range of asset utilisation by the firm being less than that of industry by 54 percent to 62 percent, a further increase in diversification either by starting new operations or increasing the spread of operations in related industries had a significant positive impact on performance. On the other hand, in firms having asset utilisation less than 34 percent of industry average, diversification into unrelated industries had a significant positive impact on firm performance.

The paper is organised as follows: Section 1, gives the details of the sample of firms¹. Section 2, describes the model used to determine the relation between diversification and performance of the firm, after controlling for certain other factors. In Section 3, the fixed effects model used to analyse the effect of diversification on performance. In Section 4, the threshold regression model is used to test for the effect of diversification on performance given the level of asset utilisation by the firm. And finally Section 5 concludes.

1 Characteristics of the Sample of 524 firms

To measure the extent of diversification by the firms detailed information is required about each of the business activity of the firm. From the annual reports of the firms, the information about the sales of a product both in quantity and value terms is available. This information being at the product level, was grouped into an industry, whereby identical products are clubbed together.

The data on the annual reports of the firms, was taken from the Corporate Information on Magnetic Medium (CIMM), a database compiled by the Centre for Monitoring Indian Economy (CMIE). All private corporate firms, belonging to the manufacturing sector and listed on Mumbai Stock Exchange (MSE) were selected. The database begins at the year 1989. Since diversification of the firms is studied over

the whole time period, only those firms having information on product wise sales over all the years from 1989 to 1995 were selected. Secondly, a check is done whether the difference between the total sales of the firms as reported in the profit and loss account of the annual report and the sum of the product-wise sales for each firm is less than 1 percent. As a result of these two criteria the final sample consists of 524 firms. The sample of 524 firms from manufacturing sector have total assets of Rs.39777.91 crores in the year 1989. Of the total 1315 firms from the manufacturing sector covered by the CIMM, having total assets of Rs.132979.34 crores, this sample represents 39.84 percent of firms and 29.91 percent of total population in terms of size.

The National Industrial Classification scheme of 1987 given in the Annual Survey of Industries, India (ASI-NIC-1987) is used to classify the products into industries. The grouping is done at the 2-digit and 4-digit level of classification. The 2-digit classification is in relatively unrelated industries as compared to 4-digit classification which can be said to be of related industries. The total sales product-wise are clubbed with respect to the industry, so that the final data has the industry-wise sales for each firm.

1.1 Entry by the Firm

The entry of an established firm is said to take place in time t when it starts operations in a new industry in which it had no operations in period $(t-1)$. The frequency distribution of entry at the 2-digit industry aggregate level is given in the table 1. The table shows that in the year 1990, 40 firms had started new operations in one more industry over their operations in 1989. About 5 firms had started new operations in 2 new industries, over their previous operations. Overall, 45 firms had gone in for new entry in 1990. Similarly, we compute this marginal entry over all the time periods. It is seen that the number of firms that diversified into new industries increased in the post-liberalisation period.

2 Diversification and Effect on Performance of the Firm

In India, prior to 1991, most diversification by firms as regulated under various restrictive government policies. This was done to prevent dominance through the pre-emption of capacity. But with the New Industrial Policy introduced in 1991,

there was simplification in these procedural rules and regulations. The opening up of the industrial sector and the consequent increase in competition meant that a business group had to reassess its portfolio of activities. It is seen (from Table 1) that over the post-liberalisation period there was an increase in diversification.

The starting point for any assessment of economic profitability is the internal rate of return (IRR) on the project or investment. The IRR is that rate of return, which equates to zero the present value of the net cash flows, positive or negative, over the life of an investment. The accounting rate of profit (ARP) of a firm, on the other hand, is computed as the ratio of profits to book value of the assets in any accounting period. When a firm undertakes many activities, commenced at different times, each may have a different internal rate of return. The outcome will be an accounting rate of profit varying over time. There is, on the one hand, the dispersion of rates of return over projects and on other the dispersion of profits over time. The IRR relates to a single project, and is calculated over the whole life of the project. The ARP relates to a firm as a collection of assets and projects and is measured at a single point in time. The ERR or the economic rate of return is the internal rate of return which discounts to zero the stream of returns which would be obtained if the firm began the period by purchasing its assets for their economic value and ended it by selling on the same basis.

Fisher and McGowan (1983) showed that taking a collection of projects all with the same IRR, a firm so created, only in special case did report an ARP equal to that IRR. Later, however, Kay (1987) considers a more realistic example of a firm being a collection of projects with different IRRs. He shows that the average of these rates of return is equal to the average of the accounting rate of profit over the whole life of the firm. Also, for a firm in steady state growth for a segment of its life, if the ARP exceed the cost of capital so does its ERR. Two points come up through this discussion. First, in case of the study of firms for the effect of its investments into new projects the ARP does reflect the performance of the firm. Second, ARP and ERR lie on the same side with respect to the cost of capital and gives the same assessment of firm performance.

In the analysis to follow, we attempt to explain firm performance in terms of the level of investment (diversification) it has in various operations, after controlling for certain other factors.

2.1 Measure of Performance

Under the profit maximisation hypothesis, it can be assumed that a firm undertakes diversification into new industry with the expectation that it will lead to improved performance. The performance of the firm is measured in terms of profits taken gross of interest, depreciation and taxes. Since the firms in the sample belong to different industries, which have different depreciation and tax schedules, the gross measure of profitability is taken. They are scaled by the total assets to give the profitability measure of return on total assets. This is then adjusted for the benchmark value of industry profitability. The benchmark value of return computes the returns over the assets had the firm operated in the respective industries as single segment firms². Thus, this measure represents the excess returns over total assets available with the firm. The difference in the level of excess profitability between different firms can be attributed to the type of industries in which the firm is operating.

2.2 Factors that may influence the Performance of the Firm

This section, describes some of the factors that may influence the adjusted profitability of the firms. Most of these factors represent the fact that the excess profit of being diversified depends on the portfolio of industries in which the firm operates.

Profitability and risk

Certain industry and firm characteristics are related to observed profit differentials across companies. Should the activities of companies differ significantly in their risk properties, the capital market will demand higher returns from the riskier companies. The risk of the firm depends on the industry characteristics and can be reduced by having operation's in industries with uncorrelated earnings stream. In these cases the firms may have operations in industries whose demands are uncorrelated or which are not perfect substitutes.

Two types of risk measures are most frequently used in the empirical literature: are the beta measure computed from the capital asset pricing model and the standard deviation measure of risk for a portfolio of assets. Some empirical work

exists in which the current profitability of a firm (profits over total assets or equity) is used to explain its beta estimated from monthly stock market returns (Ben-Zion and Shalit, 1975). This work has found that firm profitability is negatively related to the firm's systematic risk.

In the present study, the firm has been considered to hold a portfolio of industries in the product market. Hence to measure the risk of operations, it is required to measure the portfolio risk as a whole. In the finance literature, the most commonly used measure is the standard deviation measure of risk³. To compute this measure, the variance-covariance of the rates of return of the individual securities that form the portfolio are estimated. In the product market, the individual securities are considered to be the industries in which the firm is operating. The index of industrial production (IIP) at the 2-digit level of ASI classification of industries for each year is taken as a measure of the output from the industry.

The IIP index (1980-81=100) series is a simple weighted arithmetic mean of production relatives, the weights being proportional to gross value of output as available from Annual Survey of Industries Reports⁴. At the industry indicator levels, the weights were allocated in proportion to their gross value of output.

The variance-covariance matrix of the index of industrial production from 1981 to the year t of entry was computed. The variance of the portfolio composed of N industries is given by summing all the weighted variances as well as the weighted covariance's (of all pairs of industries), where the weights are the corresponding investment proportions (θ_i). The computation of the risk measure can be explained using Table 2.

On the diagonal are the variance terms, $\theta_i^2 \sigma_i^2$ for $i = 1..n$ and in the off-diagonal element we have the covariance terms, $\theta_i \theta_j \sigma_{ij}$, where i denotes the i^{th} row of the square and j denotes the j^{th} column. For example, in Row 3 and Column 2, the term $\theta_3 \theta_2 \sigma_{32}$ is the covariance between industries 3 and 2, σ_{32} , multiplied by their respective investment weights, θ_3 and θ_2 . Note that the table is symmetrical. The element in Row 2 and Column 3, $\theta_2 \theta_3 \sigma_{23}$ is equal to $\theta_3 \theta_2 \sigma_{32}$ because $\sigma_{23} = \sigma_{32}$. The covariance between industries 2 and 3, σ_{23} is the same as the covariance between industries 3 and 2, σ_{32} . Thus, the boxes contain all variance components as well as covariances multiplied by the respective portfolio weights. Summing all terms in all

boxes yields the portfolio variance. Substituting ρ_{ij} , σ_i , σ_j , where ρ_{ij} = correlation coefficient, for σ_{ij} the portfolio variance is given by the formula,

$$\sigma_p^2 = \sum_{i=1 \text{ to } n} \theta_i^2 \sigma_i^2 + 2 \sum_{i=1 \text{ to } n} \sum_{j=1, j>1 \text{ to } n} \theta_i \theta_j \rho_{ij} \sigma_i \sigma_j \quad \dots(1)$$

Each variance is multiplied by its squared investment weight θ_i^2 , and the contribution $\theta_i \theta_j \rho_{ij} \sigma_i \sigma_j$ is counted twice. The square root of this variance, σ_p is the standard deviation measure of risk for the portfolio. It is hypothesised that a firm facing high variability of the IIP (risk) in current operations would tend to diversify to reduce its risk.

Growth in primary industry and profitability

The necessity of including the growth rate of the primary industry arises from the fact that most of the firms in this sample though operating in different industries have operations concentrated in a single industry⁵. In case of rapidly growing industries demand growth often outstrips supply growth and thus allow incumbents to earn short-run above normal profits. Also, considering that the firms operate in multiple industries, over time the firm may shift the operations to a different industry, which may have a high rate of growth. It is therefore hypothesised that the growth rate of the primary industry affects' the performance positively.

Diversification and profitability

Several hypotheses in the literature⁶ predict a positive association between diversification and firm profits. These have two implications (i) those predicting greater market power for diversified firms, and (ii) those hypothesising greater efficiency. Market power advantages might arise through the exploitation of an advantage of one market in some other market. Efficiency advantages can be claimed for diversified firms because they are able to avoid some of the imperfections of the capital market. Promising investment opportunities in one market can be funded by drawing capital away from other markets, without jeopardising the profitability of the investment by having to reveal its characteristics to raise capital. The study by Mueller (1986) has found a positive association between diversification and profits.

The two measures of diversification used are (1) the simple count of industries in which the firm operates (N) and (2) the Berry Index (*BH*). The Berry Index (Berry, 1971) is defined as,

$$BH = 1 - \sum \theta_i^2 \quad \dots(2)$$

where θ_i is the ratio of the firm's output in the i^{th} industry to the firm's total output. This index is a variant of the Herfindhal Summary Index of Industrial Concentration applied to the distribution of a firm's industrial activity rather than to the distribution of an industry's sales among firms. This index takes value *zero* when a firm is active in a single industry, and approaches *unity* when the firm in question has its output distributed equally in a large number of different industries. If the firm is equally active in each of the several industries, the index of diversification becomes $BH = (1 - 1/N)$ where N is the number of industries in which the firm is active. If the benefits of diversification are achieved properly, then one can expect a positive association between diversification and performance.

Asset Utilisation and profitability

Studies [Srinivasan, 1992; Goldar and Renganathan 1991] in the Indian context have shown the existence of this excess capacity in many industries. These were mainly due to the government policies existing at the time. The firm could not expand in its core activity and hence would invest into a new industry. With the changes in the policy the firms were now restructuring themselves. The new flexibility of investment decisions allowed the firm to efficiently employ its existing excess capacity and to earn increased marginal revenue. Hence the asset utilisation ratio, as measured by sales to total assets, would give how well the assets are utilised in the present activity. The benchmark value of asset utilisation ratio is also computed similar to the profitability benchmark using industry average values. Thus the excess asset utilisation is given by:

$$EAUR = AUR_c - AUR_B \quad \dots(3)$$

Where AUR_c = sales to assets ratio from the company reports and AUR_b is the benchmark value of the asset utilisation ratio. Thus the excess asset utilisation ratio gives the extent of inefficiency existing in the firms' activities as compared to the average. Thus we expect a positive relation between the excess asset utilisation ratio and performance.

Table 3 gives the descriptive statistics for all the above mentioned variables for the single-segment and multi-segment firms and also gives the test of difference.

3 Econometric Methodology: Fixed Effects Model

The previous section described certain proxies for the performance of the firm and also the factors that could influence it. Using those proxies the hypothesis is tested whether diversification leads to an improved performance, after controlling for the other factors. The performance of the firm is measured by the excess value of profitability as given by the return over total assets. The excess value is the value of the firm profitability adjusted for the benchmark profitability (EROA). The profit performance is related to the factors like:

- i) AGE : defined as the number of years since incorporation,
- ii) BH and N : Measures of diversification computed at both the 2-digit level (BHN2) and at the 4-digit level (BHN4). A cross-product is taken to account for both the extent and spread of diversification,
- iii) GPC : Growth rate of the IIP for the primary industry,
- iv) RISK: Standard deviation measure of risk of operating in a portfolio of industries, and,
- v) EAUR: Excess value of the asset utilisation ratio.

The data set is a panel of 524 firms for the period from 1992 to 1995. All the independent variables have been taken with a lag of two periods. This would ensure that the present day returns are a function of past decisions. It is assumed that diversification decision taken in period 1, are implemented in period 2 and the output affects performance in period 3. The fixed effect model is used to estimate the following equation:

$$EROA_{it} = \alpha_i + \beta_1 AGE_{(i, t-2)} + \beta_2 (BH*N)_{(i, t-2)} + \beta_3 GPC_{(i, t-2)} + \beta_4 RISK_{(i, t-2)} + \beta_5 EAUR_{(i, t-2)} + \beta_6 EAUR^2_{(i, t-2)} + \varepsilon_{it} \quad \dots(4)$$

Separating the time effects using dummy variables for the years 1993, 1994 and 1995, the equation (5) is estimated.

$$EROA_{it} = \alpha_i + \beta_2 (BH*N)_{(i, t-2)} + \beta_3 GPC_{(i, t-2)} + \beta_4 RISK_{(i, t-2)} + \beta_5 EAUR_{(i, t-2)} + \beta_6 EAUR^2_{(i, t-2)} + \theta_1 D93 + \theta_2 D94 + \theta_3 D95 + \varepsilon_{it} \quad \dots(5)$$

3.1 Model Results and Interpretation

The results of the fixed effect model reported in table 4 are for the diversification index computed at the 4-digit level. The results in terms of significance of coefficients remain the same even when diversification is measured at the 2-digit level.

The fixed effect model shows that there exists a non-linear relationship between the excess asset utilisation ratio and performance. Non-linearities in the other variables had also been checked for but were not found to be significant. It also rejects the hypotheses that there exists any association between the diversification by the firm and its performance. The growth in the primary industry has a significant negative association with returns. This result which seems slightly counter-intuitive, implies that the growth of the primary industry negatively influences the performance. The table 5 giving the specialisation ratio indicates that most of the firms were diversified yet concentrated in the primary industry. The specialisation ratio measures the share of output from the firms' primary industry. It indicates the extent of skewness in the spread of operations over various activities. If the primary industry share is very high the firm may not be considered well diversified. The maximum value the specialisation ratio can take is unity, when it is a single segment firm. The table 5, shows that the minimum value taken by the specialisation ratio has reduced from 0.377 in 1989 to 0.32 in 1995. On the average the extent of operations in the primary industry also reduced from 0.9057 to 0.8919.

The positive growth in the primary industry could be the reason why the firm can sustain their operations in other industries. There could an element of cross-subsidisation that could adversely affect the profitability.

The only other factor that significantly affects performance is the extent to which the assets of the firm are efficiently utilised as compared to the average in the industry. There exists an inverted 'U' type relationship between the imputed value of the asset utilisation ratio and performance. The estimated relation indicates that some optimal level of asset utilisation exists. However, in the econometric framework used above the breakpoint cannot be estimated.

Hence in the further analysis the effect of diversification on performance is tested for depending on the level of asset utilisation by the firm. The threshold (the

maximum point in the inverted ‘U’ relationship for the excess asset utilisation ratio) can be estimated and its statistical significance tested using the Threshold Regression Model for which standard asymptotics have been developed by Hansen (1999).

4 Effect of Diversification on Performance Given the Level of Asset Utilisation by the Firm

Caves and Porter (1977) in their seminal paper have stated that under-utilised asset base of the established firms if employed efficiently could improve the performance of the firm. The analysis in the previous section shows that diversification had no effect on performance. Considering this the hypothesis that can be checked for is whether diversification leads to improved return on total assets (over the industry benchmark) depending on the level of asset utilisation of the firm, with respect to the industry. From equation 1, the relation between diversification and performance can now be specified as:

$$\begin{aligned} \text{ROA} &= \alpha_1 + \beta_1 (\text{BH}^* \text{N}) + \varepsilon_1 & \forall \text{ EAUR} \leq \gamma \\ \text{ROA} &= \alpha_2 + \beta_2 (\text{BH}^* \text{N}) + \varepsilon_2 & \forall \text{ EAUR} \geq \gamma \end{aligned} \quad \dots(6)$$

where γ is the threshold.

This gives a piece-wise linear regression, also called spline regression. Here the ‘ γ ’ is fixed exogenously and the function is estimated. This method has two drawbacks. Firstly, since the threshold is fixed exogenously it depends completely on the discretion of the individual user. Secondly, such a method could estimate the threshold, however accurately, for a cross-sectional data set only. To overcome both these problems we use the threshold estimation technique developed by Hansen (1999) for non-dynamic balanced panels with individual specific fixed effects. This is a multi-regime model with endogenous estimation of ‘ γ ’.

4.1 Econometric Methodology: Threshold Regression Model

The regression functions in which the observations in a sample fall into discrete classes are addressed using threshold regression techniques. Threshold regression models specify that individual observations can be divided into classes based on the value of an observed variable. Hansen (1999) has developed the econometric technique appropriate for threshold regression with panel data. Least square estimation methods are used and an asymptotic distribution theory is derived

which is used to construct confidence intervals for the parameters. A bootstrap method is used to assess the statistical significance of the threshold effect. The details about the Threshold Regression model are given in Appendix 2.

The dependent variable is the excess value of return over total assets, $EROA_{it}$, a scalar. The threshold variable is the excess asset utilisation ratio ($EAUR_{it}$) is also a scalar. The regressor X_{it} is a k-vector of the other control variables. The equation of interest is:

$$EROA_{it} = \mu + \beta_1 X_{it} I(EAUR_{it} \leq \gamma) + \beta_2 X_{it} I(EAUR_{it} > \gamma) + \varepsilon_{it} \quad \dots(7)$$

where $I(\cdot)$ is the indicator function.

The model specification (3) is modified here to find the threshold. As in the fixed effects model taking a two period lag of all the dependent variables ensures that present day returns are a function of past decisions. This also ensures the exogeneity of the indicator variable. In principle, existence of multiple thresholds can be tested for. In the present case, the model specified for two thresholds is as:

$$\begin{aligned} EROA_{it} = & \alpha_i + \beta_1 AGE_{(i,t-2)} + \beta_2 GPC_{(i,t-2)} + \beta_3 RISK_{(i,t-2)} + \beta_4 EAUR_{(i,t-2)} \\ & + \theta_1 (BH*N)_{(i,t-2)} I(EAUR_{(i,t-2)} \leq \gamma_1) + \theta_2 (BH * N)_{(i,t-2)} I(\gamma_1 < EAUR_{(i,t-2)} \leq \gamma_2) \\ & + \theta_3 (BH* N)_{(i,t-2)} I(EAUR_{(i,t-2)} > \gamma_2) + \varepsilon_{it} \quad \dots(8) \end{aligned}$$

The alternative intuitive way of writing (8) is,

$$\begin{aligned} EROA_{it} = & \alpha_i + \beta_1 AGE_{(i,t-2)} + \beta_2 GPC_{(i,t-2)} + \beta_3 RISK_{(i,t-2)} + \beta_4 EAUR_{(i,t-2)} \\ & + \theta_1 (BH*N)_{(i,t-2)} I(EAUR_{(i,t-2)} \leq \gamma_1) + \varepsilon_{it} \quad \forall (EAUR_{(i,t-2)} \leq \gamma_1) \\ EROA_{it} = & \alpha_i + \beta_1 AGE_{(i,t-2)} + \beta_2 GPC_{(i,t-2)} + \beta_3 RISK_{(i,t-2)} + \beta_4 EAUR_{(i,t-2)} \\ & + \theta_2 (BH * N)_{(i,t-2)} I(\gamma_1 < EAUR_{(i,t-2)} \leq \gamma_2) + \varepsilon_{it} \quad \forall (\gamma_1 < EAUR_{(i,t-2)} \leq \gamma_2) \\ EROA_{it} = & \alpha_i + \beta_1 AGE_{i(t-2)} + \beta_2 GPC_{i(t-2)} + \beta_3 RISK_{i(t-2)} + \beta_4 EAUR_{i(t-2)} \\ & + \theta_3 (BH* N)_{(i,t-2)} I(EAUR_{(i,t-2)} > \gamma_2) + \varepsilon_{it} \quad \forall (EAUR_{(i,t-2)} > \gamma_2) \quad \dots(9) \end{aligned}$$

The observations are divided into groups depending on whether the firms asset utilisation as compared to the industry is smaller or larger than threshold γ . The groups are distinguished by differing regression slopes θ_1 , θ_2 , and θ_3 . The error ε_{it} is assumed to be independent and identically distributed (iid) with mean zero and finite

variance σ^2 . To determine the number of thresholds the model is estimated by least squares, allowing for sequentially zero, one, two and three thresholds⁷.

4.2 Model Results and Interpretation

The econometric model used here can test for the presence of a maximum of three thresholds in the sample based on the threshold variable. The result of the regression shows the existence of only two thresholds in the sample. Table 6 reports the estimated coefficients, the two threshold values and their significance. The regime dependent variable is the measure of diversification at the 4-digit level of classification.

The estimated coefficients on the risk, asset utilisation ratio and growth of the primary industry are all insignificant. The coefficient of the age of the firm is highly significant and negatively related with firm performance. The estimated thresholds divide the firms into three groups. The first group, has a very low asset utilisation around 62 percent and below the industry average. In this group further increase in diversification has significant negative effect on performance. In the second group, the asset utilisation is below the industry average and in a range between 54 percent to 62 percent. In this case further diversification has a small but significant positive impact on firm performance. And finally, in the third group is of asset utilisation around the industry average and below upto 54 percent. Here diversification does not effect the performance.

The p-values, which are computed using bootstrap simulation, indicate that both the thresholds are significant at 10 percent level. This shows that diversification, measured as the cross-product of the number of industries in which the firm operates and the extent of operations, has a differential impact on firm performance, depending on the level of the asset utilisation ratio with respect to the industry benchmark.

The decision of the established firm to enter into a new line of business (industry) differs from the new entrants by virtue of its asset holdings. The intangible assets or the excess capacity in tangible assets can reduce the opportunity cost of entry and raise its returns. Intangible assets provide the extreme form of excess capacity – goodwill, knowledge and organisation. They can be used in new markets without resulting in any less service in their former uses.

But even as a firm diversifies into new industries it can exploit positive returns provided its operations in the industry are at the minimum efficient scale. The total asset base does reflect the total capacity available with the firm. The firm is said to efficiently utilise its assets if it has returns from assets atleast of the expected level of the industry mean. In cases when this condition is not satisfied a firm can be said to have under-utilised asset utilisation or an excess capacity. It is seen from the results of the threshold regression model that the improvement in performance of the firm with diversification depends largely on the asset utilisation of the firm with respect to the industry. The age effect of firms is negative on the performance with respect to the industry average. This inefficiency could be attributed to various factors like policy influenced diversification decisions, lack of improved technology, etc. which would be more pronounced in case of the older firms. It is more interesting to compare the results using the diversification measure at 4-digit classification level with those using 2-digit classification level (Table 7). Most of the result is similar to that of Table 6. The most important difference is the effect of diversification on performance. It is seen that in firms with asset utilisation less than 34 percent of the industry, diversification into a new 2-digit industry, which can be considered to be relatively unrelated with the firm's present activity has a positive impact on firm performance.

On the other hand, in firms which have efficient operations further diversification into unrelated industries has a significant negative impact on firm performance. For all other firms however, effect of diversification on firm performance is insignificant.

5 Conclusion

In this paper a sample of 524 firms was analysed over the post-liberalisation period from 1992 to 1995 to find their diversification pattern and effect on performance. There was an increase in the number of multi-segment firms over the years. This increase in diversification was also reflected in a lower proportion of operation in the primary industry over the years. There was a persistent difference in the performance of the single segment firms as compared to the multi-segment firms.

The further analysis on the performance of the firm indicates a differential impact of diversification. The extent of increase in diversification resulting in improved profitability depends significantly on, the asset utilisation by the firm as

compared to the other single segment firms and also on the type of industries, whether related or unrelated with the present activities.

It was seen that overall there were three types of groups of firms. One with the asset utilisation ration far below the average of the industry. Second, a group that was somewhere around the average and the third group that was better than the average. It was seen that in the weak firms, where one could say that the assets were not properly put to use in a particular industry, diversifying into a related industry would further deteriorate the profitability. However, in the same case, if the firms used the asset in a unrelated industry, the performance of the firm improved. In case of firms falling in the middle category, related diversification could be better utilised to exploit economies as compared to unrelated diversification. Finally, for firm's performing better than the industry average, actually perform worse if they start operations in unrelated industry and could do well holding the present portfolio of operations. The results supports the concept of strategic core competence, where the firm is a collection of business that are either, market related or integrity related or functionally related.

In India, most expansion decisions taken prior to 1991 had lead to the existence of excess capacities with most firms. In these situations the directions of restructuring to improve performance depends largely on how efficiently the assets are put to use in the present operations. If it was successful then related diversification improves the overall performance. However, when the firm is not able to best utilise the assets in present operations, the unrelated diversification can be seen to be a better alternative.

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APPENDIX 1

Computation of the Benchmark

The computation of the ratios of costs and profitability of the diversified firms should reflect how do diversified firms perform vis-à-vis specialised firms. Berger and Ofek (1995) computed what they called the imputed value and the excess value of the firm. Here they take the firms imputed value as the sum of segment-imputed values, which are obtained by multiplying an industry median multiplier of total capital to an accounting item (sales, assets or profits) by the segments level of the accounting item. The firm's excess value measure is the natural logarithm of the ratio of the firm's actual value to its imputed value. The firm's imputed value is the sum of segment-imputed values, which are obtained by multiplying an industry mean multiplier of total costs or profits to the accounting item by the segment's level of the accounting item.

In our study, we also compute the benchmark value of the various accounting measures. These benchmark measures would be the value of cost, profits or asset utilisation etc. which the firm would have faced had it operated in each of the industries as stand-alone firms in the size given by proportion of operations in that industry. The industry aggregate measures are taken to account for the industry performance in terms of costs, profits etc. The excess value of the costs, profits or asset utilisation, which is available to the firm for being diversified, is a simple difference between the actual value of the accounting term and the benchmark value. The benchmark value is computed as follows:

$$BVA_j = \sum_i \theta_i A \quad \forall i= 1..N \quad (A1.1)$$

Where BVA = benchmark value of the accounting item j

θ_i = proportion of sales output from industry i in the total sales of the firm

A = industry aggregate value of the accounting j for the industry I

N = total number of industries in which the firm is operating

APPENDIX 2

Threshold Regression Model

3.1 The Model (Hansen, 1999):

The observed data are from a balanced panel $\{y_{it}, q_{it}, x_{it}: 1 \leq i < n, 1 \leq t \leq T\}$. The subscript i indexes the individual and the subscript t indexes time. The dependent variable y_{it} is scalar, the threshold variable q_{it} is scalar and the regressor x_{it} is a k vector. The structural equation of interest is

$$y_{it} = \mathbf{m} + \mathbf{b}_1' x_{it} I(q_{it} \leq \mathbf{g}) + \mathbf{b}_2' x_{it} I(q_{it} > \mathbf{g}) + e_{it} \quad (1)$$

Where $I(\cdot)$ is the indicator function. An alternative intuitive way of writing (1) is

$$y_{it} = \begin{cases} \mathbf{m} + \mathbf{b}_1' x_{it} + e_{it} & q_{it} \leq \mathbf{g} \\ \mathbf{m} + \mathbf{b}_2' x_{it} + e_{it} & q_{it} > \mathbf{g} \end{cases}$$

Another compact representation of (1) is to set

$$x_{it} = \begin{cases} x_{it} I(q_{it} \leq \mathbf{g}) \\ x_{it} I(q_{it} > \mathbf{g}) \end{cases}$$

and $\mathbf{b} = (\mathbf{b}_1' \mathbf{b}_2')$ so that (1) equals

$$y_{it} = \mathbf{m} + \mathbf{b}' x_{it}(\mathbf{g}) + e_{it}$$

The observations are divided into two “regimes” depending on whether the threshold variable q_{it} is smaller or larger than the threshold \mathbf{g} . The regimes are distinguished by different regression slopes, \mathbf{b}_1 and \mathbf{b}_2 . The error e_{it} is assumed to be independent and identically distributed (iid) with mean zero and finite variance σ^2 . The iid assumption excludes lagged dependent variables from x_{it} .

3.2 Estimation: Least Square Estimation

One traditional method to eliminate the individual effect \mathbf{m}_i is to remove individual-specific means. While straightforward in linear models, the non-linear specification (1) calls for a more careful treatment. Note that taking averages of (1) over the time index t produces:

$$Y_i = \mathbf{m}_i + \beta' \bar{x}_i(\gamma) + \bar{E}_i$$

$$x_i(\mathbf{g}) = \frac{1}{T} \sum_{t=1}^T x_{it}(\mathbf{g})$$

$$x_i(\mathbf{g}) = \begin{bmatrix} \frac{1}{T} \sum_{t=1}^T x_{it} I(q_{it} \leq \mathbf{g}) \\ \frac{1}{T} \sum_{t=1}^T x_{it} I(q_{it} > \mathbf{g}) \end{bmatrix}$$

where $Y_i = T^{-1} \sum_{t=1}^T y_{it}$, $\bar{E}_i = T^{-1} \sum_{t=1}^T e_{it}$, and

Taking the difference between (2) and (3) yields

$$y_{it}^* = \mathbf{b}x_{it}^*(\mathbf{g}) + \mathbf{e}_{it}^*$$

Where

$$y_{it}^* = y_{it} - \bar{y}_i,$$

$$x_{it}^* = x_{it}(\mathbf{g}) - \bar{x}_i(\mathbf{g}), \text{ and}$$

$$\mathbf{e}_{it}^* = \mathbf{e}_{it} - \bar{\mathbf{e}}_i$$

In matrix notation

$$Y^* = X^*(\mathbf{g})\mathbf{b} + \mathbf{e}^*$$

Where Y^* , $X^*(\mathbf{g})$ and \mathbf{e}^* are data matrices whose rows correspond to observations, with one time period per individual deleted.

For any given \mathbf{g} , the slope coefficient \mathbf{b} can be estimated by ordinary least squares(OLS). That is,

$$\hat{\mathbf{b}}(\mathbf{g}) = (X^*(\mathbf{g})'X^*(\mathbf{g}))^{-1} X^*(\mathbf{g})'Y^*$$

The vector of regression residuals is

$$\hat{\mathbf{e}}^*(\mathbf{g}) = Y^* - X^*(\mathbf{g})\hat{\mathbf{b}}(\mathbf{g})$$

And the sum of squared errors is

$$\begin{aligned}
S_1(\mathbf{g}) &= \hat{\mathbf{e}}^*(\mathbf{g})' \hat{\mathbf{e}}^*(\mathbf{g}) \\
&= \mathbf{Y}^{*'} (\mathbf{I} - \mathbf{X}^*(\mathbf{g})' (\mathbf{X}^*(\mathbf{g}))^{-1} \mathbf{X}^*(\mathbf{g})') \mathbf{Y}^*
\end{aligned}$$

The recommend estimation method for γ is by least-squares. This is easiest to achieve by minimisation of the concentrated sum of squared errors given above. Hence the least-square estimators of γ is $\gamma^* = \operatorname{argmin}_{\gamma} S_1(\gamma)$

3.3. Computational Issues

The computation of the least squares estimate of the threshold γ involves the minimisation problem (8). Since the sum of squared error function $S_1(\gamma)$ depends on γ only through the indicator functions $I(q_{it} \leq \gamma)$, the sum of squared error function is a step function with at most nT steps, with the steps occurring at distinct values of the observed threshold variable q_{it} . Thus the minimisation problem (8) can be reduced to searching over values of γ equalling the (at most nT) distinct values of q_{it} in the sample.

To implement the minimisation, the following approach may be taken. Sort the distinct values of the observations on the threshold variable q_{it} . Eliminate the smallest and largest $\eta\%$ for some $\eta > 0$. The remaining N values constitute the values of \mathbf{g} which can be searched for \mathbf{g} . For each of these N values, the regressions (6) are estimated yielding the sum of squared errors (7). The smallest value of the latter yields the estimate \mathbf{g} .

In practice, N may be a very large number, and the optimisation search describe above may be numerically intensive. A simplifying shortcut, which yields nearly identical results, is to restrict the search to a smaller set of values of \mathbf{g} . Instead of searching over all values of q_{it} (between $\eta\%$ and $(1-\eta)\%$ quantile) the search may be limited to specific quantiles, perhaps integer-valued quantiles. This reduces the number of regressions performed in the search to the number of quantiles. The estimates from such an approximation are likely to be sufficiently precise for most applications of interest.

3.4 Inference: Testing for a Threshold

It is important to determine whether the threshold effect is statistically significant. The hypothesis of no threshold effect in (1) can be represented by the linear constraint

$$H_0 : \beta_1 = \beta_2$$

Under H_0 the threshold g is not identified, so classical tests have non-standard distributions. This is typically called the "Davies' Problem". The fixed-effects equation (4) fall in the class of models considered by Hansen (1996) who suggested a bootstrap to simulate the asymptotic distribution of the likelihood ratio test.

Under the null hypothesis of no threshold, the model is

$$y_{it} = \mathbf{m}_i + \mathbf{b}_1' x_{it} + e_{it}$$

After the fixed-effects transformation is made, we have

$$y_{it}^* = \mathbf{m}_i + \mathbf{b}_1' x_{it}^* + e_{it}^*$$

The regression parameter \mathbf{b}_1 is estimated by OLS, yielding estimate $\hat{\mathbf{b}}_1$, residuals and sum of squared errors $S_0 = \mathbf{e}' \mathbf{e}$. The likelihood ratio test of H_0 is based on

$$F_1 = [S_0 - S_1(\hat{g})]/\sigma^2$$

The asymptotic distribution of F_1 is non-standard, and strictly dominates the χ^2 distribution. Unfortunately, it appears to depend in general upon moments of the sample and thus critical values cannot be tabulated. Hansen(1996) shows that a bootstrap procedure attains the first-order asymptotic distribution, so p-values constructed from the bootstrap are asymptotically valid. Given the panel nature of the data we recommend the following implementation of the bootstrap. Treat the regressors X_{it} and threshold variable q_{it} as given, holding their values fixed in repeated bootstrap samples. Take the regression residuals \hat{e}_{it}^* and group them by individual: $\hat{e}_i^* = (\hat{e}_{i1}^*, \hat{e}_{i2}^*, \dots, \hat{e}_{in}^*)$. Treat the sample $\{\hat{e}_1^*, \hat{e}_2^*, \dots, \hat{e}_n^*\}$ as the empirical distribution to be used for bootstrapping. Draw (with replacement) a sample of size n from the empirical distribution and use these errors to create a bootstrap sample under H_0 . Using the bootstrap sample, estimate the model under the null (11) and alternative (4) and calculate the bootstrap value of the likelihood ratio statistic F_1 (12). Repeat this procedure a large number of times and calculate the percentage of draws for

which the simulated statistic exceeds the actual. This is the bootstrap estimate of the asymptotic p-value for F_1 under H_0 . The null of no threshold effect is rejected if the p-value is smaller than the desired critical value.

Table 1: *Number-wise Distribution of Entry at 2-digit level*

<i>Entered industries.</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>
1	40	29	33	28	41	40
2	5	4	3	5	6	8
3			2	2		2
4			1			
Total	45	33	39	35	47	50

Table 2: *The components of Portfolio Variance: the n-industry case*

<i>Industries</i>	<i>1</i>	<i>2</i>	<i>3</i>			<i>n</i>
1	$\theta_1^2 \sigma_1^2$	$\theta_1 \theta_2 \sigma_{12}$	$\theta_1 \theta_3 \sigma_{13}$	.	.	$\theta_1 \theta_n \sigma_{1n}$
2	$\theta_2 \theta_1 \sigma_{21}$	$\theta_2^2 \sigma_2^2$	$\theta_2 \theta_3 \sigma_{23}$	.	.	.
3	$\theta_3 \theta_1 \sigma_{31}$	$\theta_3 \theta_2 \sigma_{32}$	.	.	.	.
.
.
.
n	$\theta_n \theta_1 \sigma_{n1}$	.	.	.	.	$\theta_n^2 \sigma_n^2$

Table 3: *Test of Mean Difference in Characteristics of Single Segment and Multi-Segment Firms*

1992	S.S. Mean	M.S. Mean	S.S. Std-Dev	M.S. Std-Dev	F'	Prob > F'
SALES _c	127.21	120.65	251.54	283.54	1.27	0.0538
TAST _c	111.37	108.64	240.83	304.59	1.60	0.0001
PBIDT _c	18.50	15.93	44.49	39.78	1.25	0.0709
AGE _c	31.53	31.65	21.73	21.81	1.01	0.9520
RISK	42.08	35.04	42.08	32.69	1.66	0.0000
GPC	0.0569	0.0558	0.024	0.024	1.01	0.9135
AURC	1.31	1.33	0.6091	0.6061	1.01	0.9368
OPMC	0.1491	0.1469	0.0930	0.0851	1.20	0.1488
PTAC	0.1764	0.1829	0.0964	0.0994	1.06	0.6233
EAUR	0.2737	0.3373	0.5502	0.6007	1.19	0.1571
EOPM	-0.0907	-0.0841	0.1444	0.0981	2.16	0.0000
EROA	-0.0650	-0.0371	0.1704	0.1183	2.07	0.0000
Observations	258	266				

1995	S.S. Mean	M.S. Mean	S.S. Std-Dev	M.S. Std-Dev	F'	Prob > F'
SALES _C	183.15	210.28	371.07	549.84	2.20	0.0000
TAST _C	179.05	233.47	349.45	782.43	5.01	0.0000
PBIDT _C	28.00	33.74	59.43	100.12	2.84	0.0000
AGE _C	34.49	34.69	21.38	22.12	1.07	0.5831
RISK	47.35	42.55	42.72	37.18	1.32	0.0250
GPC	0.0563	0.0562	0.0239	0.0241	1.01	0.9427
AUR _C	1.19	1.23	0.6226	0.5886	1.12	0.3639
OPM _C	0.1295	0.1357	0.2966	0.4252	2.05	0.0000
PTA _C	0.1693	0.1806	0.1228	0.1008	1.49	0.0014
EAUR	0.3139	0.3795	0.5755	0.5652	1.04	0.7676
EOPM	-0.1337	-0.1226	0.2958	0.4358	2.17	0.0000
EROA	-0.0606	-0.0360	0.1458	0.1205	1.46	0.0000
Observations	253	271				

where:

SS	Single Segment firm
MS	Multi Segment firm
SALES _C	Sales
TAST _C	Total Assets
PBIDT _C	Profits before interest depreciation and tax
AGE _C	Age from the data of incorporation
RISK	Standard deviation measure of risk computed for the var-covar matrix of the Index of Industrial Production (IIP)
GPC	Growth rate of the primary industry IIP
AUR _C	Asset Utilisation Ratio = Sales/Total Assets
OPM _C	Operating Profit Margin = PBIDT/Sales
ROA _C	Return on Assets = PBIDT/Total Assets
EAUR	Excess value of the AUR (deviation from benchmark)
EOPM	Excess value of the OPM
EROA	Excess value of the ROA

Table 4: Estimation results of the fixed effect model

	<i>Coefficient</i>	<i>T-RATIO</i>	<i>Coefficient</i>	<i>T-RATIO</i>
AGE _(t-2)	-0.17E-02	-1.23		
BHN4 _(t-2)	0.28-02	1.21	0.027E-02	1.17
GPC _(t-2)	-0.79	-2.79 ^{**}	-0.79	-2.82 ^{**}
RISK _(t-2)	0.88E-05	0.06	0.26E-04	0.17
EAUR _(t-2)	0.19	21.78 ^{**}	0.19	21.62 ^{**}
EAUR ² _(t-2)	-0.21E-01	-5.04 ^{**}	-0.21E-01	-5.00 ^{**}
D93			0.84E-03	0.19
D94			0.63E-02	1.43
D95			-0.77E-02	-1.73 ^{**}
F-TEST	12.27		12.29	

Table 5: *Specialisation ratio for the sample of 524 firms*

<i>Year</i>	<i>Minimum</i>	<i>Mean</i>	<i>Standard Deviation</i>
1989	0.377	0.9057	0.1564
1990	0.38	0.9005	0.1589
1991	0.38	0.8995	0.1591
1992	0.38	0.8978	0.1605
1993	0.35	0.8959	0.1631
1994	0.33	0.8964	0.1596
1995	0.32	0.8919	0.1618

Table 6: *Effect of diversification on performance: 4-digit level*

VARIABLE	COEFFICIENT	T-RATIO	
AGE _(t-2)	-0.02082	-7.32**	
GPC _(t-2)	-0.26605	-0.53	
RISK _(t-2)	-2.5E-06	-0.02	
EAUR _(t-2)	-0.01918	-1.42	
EAUR THRESHOLDS	BH4 * N4	T-RATIO	LR-TEST (p-value)
EAUR _(t-2) < -0.6255	-0.03854	-6.36**	
-0.6255 < EAUR _(t-2) < -0.5421	0.07177	1.89**	0.04
-0.5421 < EAUR _(t-2)	-0.00214	-0.79	0.09

Table 7: *Effect of diversification on performance: 2-digit level*

VARIABLE	COEFFICIENT	T-RATIO	
AGE _(t-2)	-0.0196	-6.87**	
GPC _(t-2)	-0.1631	-0.33	
RISK _(t-2)	1.518e-05	0.1	
EAUR _(t-2)	-0.0143	-1.04	

EAUR THRESHOLDS	BH2 * N2	T-RATIO	LR-TEST (p-value)
EAUR _(t-2) < -0.3452	0.0641	3.78**	
-0.3452 < EAUR _(t-2) < 1.29	-0.0027	-0.42	0.09
1.29 < EAUR _(t-2)	-0.1463	-2.53**	0.08

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¹ Unfortunately, with the data used here (or with other publicly available data), it is simply not possible to make the obviously desirable distinction between diversification resulting from merger and that resulting from purely internal corporate expansion. The focus of this paper is therefore diversification and not diversification through merger.

² Computation of the benchmark is explained in Appendix 1

³ of securities in capital market

⁴ The index is calculated by the formula: $IIP = \frac{\sum R_p W_p}{\sum W_p}$, where iip is the index, R_p is the production relative for the item 'p' for the year in question and W_p the weight allotted to it. The index is revised from time to time to reflect adequately the industrial growth by shifting comparison base to a recent period by covering larger number of items and industries and by improving, as far as practicable, the technique of construction (Statistical Abstract, India, 1995-96).

⁵ Primary industry is defined as the industry having the maximum share in the total output of the firm

⁶ The motives like synergy, risk-hedging and growth, which are achieved through the benefits of diversification and can lead to improvement in firm profits

⁷ The gauss code, written by Hansen (1999), sorts the threshold variable in an ascending order and checks for the number of thresholds present between its minimum and maximum value. In principle, the model can check for multiple thresholds. In the present case, a maximum of three thresholds were tested for of which only two were found to be significant.