7.1. **Introduction**

The previous three chapters have shown that the firms’ choice of capital is driven by the internal as well as the external macroeconomic factors, but the question as to how much debt a firm should take remains unanswered. As it is known that, the debt being the cheaper source of finance reduces the overall cost of capital, however, at the same time care must be taken while using debt because, it increases the financial risk of the firm e.g. the costs of financial distress (Gilson, 1997; Kapil, 2013). In addition to this, it is also seen that unless a firm gains in excess of its cost of capital, it will not add to the value of the firm. Therefore, in order to maximize the value of the firm, the management must choose that level of debt, which minimizes the overall cost of capital and maximizes earnings.

Over the past few decades, the researchers have been trying to find out the value of this optimal level of debt. Knowing this optimal level would help the financial managers in preventing a debt overhang or worse a bankruptcy situation for the firm (Halim Ahmad & Adiana Hiau Abdullah, 2013). Amongst the three theories of capital structure (i.e., the trade-off, pecking order and the market timing theories), only the trade off theory supports the existence of an optimal capital structure. From the literature review (from section 3.2.5), it is seen that no work has been done on studying the optimal capital structure in context to India. In addition to this, as it is seen that the capital structure of the firms varies according to the three sectors of the economy, so their level of optimal debt should also be different. Again, it is evident, from the literature, that there is hardly any work done on the “target” debt when the firms are classified into the three sectors of the economy.
economy. Therefore, the study would be pivotal if the analysis is extended to the sectoral classification of the firms.

So, the present analysis has two objectives– first, to test whether an asymmetric non-linear relationship of debt ratio exists with the value of the firm or not; and if it exists, then to determine the optimal (or the threshold) level of debt. The second objective is to study the same effect when the firms are categorized into the three sectors of the economy– primary, secondary and tertiary. For the first objective, the full data set is used and for the second objective, the firms are first categorized into the different sectors of the economy and then the effect is analyzed for the respective sector.

This chapter is divided into the following sections. The second section concentrates on the methodology– providing the definitions of the variables used, discussing the model used and the hypothesis formulated. The third and fourth section presents the data analysis & results and the discussion respectively. The last section concludes the main findings of the analysis.

7.2. Methodology

In order to analyze the effect of capital structure dynamics on the value of firms, panel threshold regression model is used. Panel threshold regression model is selected because in the ordinary least square regression, the model is identical across all the observations in a sample whereas in the panel threshold regression model, the individual observations can be divided into different classes based on the value of an observed variable which is continuous in nature (i.e., debt in this case). Further, this model is employed when the value at which the sample is to be split is unknown (Hansen, 1999; 2000). So, this model quantifies the threshold level rather than assuming it.


7.2.1. Sample

The present study is a balanced panel data study of Indian firms listed on Bombay Stock Exchange. The raw data of the firms are taken from the database CMIE PROWESS. The analysis is done on the annual, audited data of the firms from the year 1993-2013.

For the analysis, all the firms with missing information on firm variables like total assets, net equity etc. were dropped. Here, the data is collected from the year 1993 because for the year 1992 there were firms with a lot of missing information. Further, all those firms which have their book leverage value greater than or equal to one were dropped, again for the same reason as discussed in section 4.2.1. Thus, the analysis was done on a sample of 805 firms over the period of 21 years (from 1993-2013). A total 16,905 observations were adopted for each variable considered. Further, these firms were categorized into their respective sectors. The Table 7.1 below shows the number of firms used in the study.

<table>
<thead>
<tr>
<th>All Firms Data</th>
<th>Primary Sector</th>
<th>Secondary Sector</th>
<th>Tertiary Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Firms</td>
<td>805</td>
<td>188</td>
<td>468</td>
</tr>
</tbody>
</table>

Source: Authors’ compilation (The number of firms here is after dropping the firms with missing values and applying the outliers).

7.2.2. Variables Used

In the analysis, three sets of variables are used– the dependent variable, the threshold variable, and the control variable.

The dependent variable is the firm value for which Return on Assets (ROA) is used as a proxy for it (as discussed in detail in section 2.5).

Next, is the threshold variable, it is the key independent variable which is used to investigate the asymmetric threshold effect of the firms’ capital structure on the value of the firm. So, the debt ratio of the firm is treated as the threshold variable.
Further, from the literature (section 2.5.1), it is seen that firm’s profitability also has an impact on the firm value, but here the main interest is in exploring the effect of capital structure dynamics on the value of firms, therefore in order to improve the fitness of the model, profitability is used as the control variable.

Table 7.2 shows the variables used and how they are computed using the definition of variables from COMPSTAT.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Computation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Total Assets</td>
<td>Profit After Tax/Total Assets</td>
</tr>
<tr>
<td>Book Leverage</td>
<td>Total Borrowings/ Total Assets</td>
</tr>
<tr>
<td>Debt Ratio</td>
<td>Total Borrowings /(Total Borrowings + Share Capital + Retained Earnings)</td>
</tr>
<tr>
<td>Profitability</td>
<td>Earnings before Interest, Taxes and Depreciation / Total Assets</td>
</tr>
</tbody>
</table>

Source: Authors’ compilation.

### 7.2.3. Model used

In order to capture the asymmetric response of the value of firm on the capital structure decisions, the advanced Panel Threshold Regression model developed by Hansen (1999) is used:

\[
y_{it} = \mu_i + \gamma_1 D_{it} I_{it}(D_{it} < D^*) + \gamma_2 D_{it} I_{it}(D_{it} > D^*) + \theta X_{it} + e_{it} \tag{7.1}
\]

The above model can also be estimated as is done in the work of Greenidge et al., (2012):

\[
y_{it} = \mu_i + \gamma_1 (1 - I_{it})(D_{it} - D^*) + \gamma_2 I_{it}(D_{it} - D^*) + \theta X_{it} + e_{it} \tag{7.2}
\]

In the above model, the subscript i and t represent the individual firm and time respectively; \(y_{it}\) is the dependent variable– ROA; \(X_{it}\) represents the control variable– profitability; the regressor– \(D_{it}\) is the debt ratio which is also the threshold variable and \(D^*\) represents the threshold level.
Further, the residuals $e_{it}$ are assumed to be independent and identically distributed (i.i.d.), with mean zero and finite variance $\sigma^2$.

$I_{it}$ is a dummy variable that takes the value of one, for debt level greater than $D^*$ and zero otherwise.

$$I_{it}= \begin{cases} 
1 & \text{if } D_{it} > D^* \quad [D_{\text{greater}} = I_{it} (D_{it} - D^*)] \\
0 & \text{if } D_{it} < D^* \quad [D_{\text{less}} = (1 - I_{it}) (D_{it} - D^*)] 
\end{cases} \quad (7.3)$$

Here, depending upon the value of the threshold variable $D_{it}$—whether it is greater or smaller than the threshold level ($D^*$), the observations are divided into “two regimes”. The regression slope $\gamma_1$ is estimated, when the debt is below the threshold level (giving $D_{\text{less}} = (1 - I_{it}) (D_{it} - D^*)$) and $\gamma_2$ is estimated when it is above the threshold level (giving $D_{\text{greater}} = I_{it} (D_{it} - D^*)$).

Next, for determining the value of $D^*$, a search is made in the debt ratio, over the range starting from 0.01 to 99.99 percent, in increments of 0.01 percent, i.e., the debt threshold is among the following values of $D_{it}$ {0.01%, 0.02%, 0.03% ... 99.99%} and is searched for after running a total of 9,999 regressions. The optimal level of debt is chosen based on the minimum sum of squared residuals.

This model is based on the assumption that there is a single threshold effect and to determine whether that threshold effect is statistically significant or not (at a particular value), the following null hypothesis is tested:

$H_0: \gamma_1 = \gamma_2$ (i.e., there is no threshold, $D^* = 0$)
Under the null hypothesis of no threshold, the model (from equation 7.2) becomes:

\[ y_{it} = \mu_i + \gamma_1 D_{it} + \theta X_{it} + e_{it} \]  

(7.4)

Since, this model is developed for non-dynamic panels with individual-specific fixed effects, so after the fixed-effect transformation is made, it becomes:

\[ y'_{it} = \gamma_1 D'_{it} + \theta X'_{it} + e'_{it} \]  

(7.5)

where the regression parameter \( \gamma_1 \) is estimated by ordinary least square, yielding the sum of squared residuals (SSR) \( S_0 = \hat{e}_{it}^2 \hat{e}_{it}^2 \).

After that, in order to estimate the threshold level and to test this null hypothesis \( (H_0) \), Hansen (1999) calculates the following likelihood ratio:

\[ F_1 = \frac{S_0 - S_1(D^*)}{\sigma^2} \]  

(7.6)

where \( S_0 \) and \( S_1(D^*) \) are SSRs, under \( H_0: D^* = 0 \) i.e., without a threshold effect (from equation 7.5) and \( H_1: D^* \neq 0 \) i.e., with a threshold effect (from equation 7.2) respectively and \( \sigma^2 \) is finite variance.

As it was noted by Hansen (2000), that \( F_1 \) has a non-standard distribution so, the critical values cannot be tabulated. Therefore, he simulates the empirical distribution of the likelihood ratio test statistic and uses the p-value constructed from a bootstrap technique.

For this technique, first a bootstrap sample is constructed by adding a randomly re-sampled residual \( \hat{e}_{it} \) to the dependent variable \( y'_{it} \) (from equation 7.5). Now, using this bootstrap sample, the model under the null hypothesis (equation 7.5) and the alternate hypothesis (equation 7.2) is estimated and the bootstrap value of the likelihood ratio statistics– \( F_1 \) is calculated (from equation 7.6). The above bootstrap procedure is repeated a large number of times (here 10,000 times) and
the percentage of draws for which the bootstrap value of the likelihood ratio statistics exceeds the actual, is computed. This value is the bootstrap estimate of the asymptotic p-value for $F_1$ under $H_0$. So, here, the null hypothesis of no threshold effect is rejected, if the p-value is smaller than the desired critical value.

For all the tests, 5% is taken as the critical value.

The above model is used for all firms' data and also when they are categorized into the three sectors of the economy.

### 7.2.4. Hypotheses

In order to analyze the asymmetric non-linear relationship of capital structure on the value of firms taking firm's profitability as the control variable; the following hypotheses have been formulated:

In the first hypothesis, a significant asymmetric non-linear relationship of capital structure on the value of firms is expected.

First hypothesis:

$$H_1: \text{Debt ratio and firm value have an asymmetric non-linear relationship.}$$

The above hypothesis is tested for all firms' data as well as when they are categorized into the three sectors of the economy.

In the second hypothesis, an inter-sectoral variation in the effect of capital structure decisions on the value of firms is expected.
Second hypothesis (for sectoral classification):

H2: There is an inter-sectoral variation in the effect of capital structure decisions on the value of firms.

The above two hypotheses have been evaluated against their null hypothesis.

The significance level, for all the hypotheses, has been taken at 5%.

7.3. **Data Analysis and Results**

This section discusses the results of the analysis for all firms’ data, primary, secondary and tertiary sector firms.

To test for the existence of a threshold effect, the asymptotic p-value for $F_1$ is computed for all the values of debt threshold {0.01%, 0.02%, 0.03% … 99.99%}, for each of the four cases (i.e., for all firms data, primary, secondary & tertiary sector firms) respectively. The optimal level of threshold ($D^*$) is chosen at that value where the asymptotic p-value for $F_1$ is smaller than the desired critical value and the sum of squared residual is minimum.

The graphs below show the relationship of the SSR as a function of debt threshold.
The above graphs show that there is no threshold effect in case of all firms’ data and tertiary sector firms (failing to reject the null hypothesis of H1), whereas there is single threshold effect of debt ratio on the firms’ value in case of primary (at 61.48%) and secondary sector (at 48.35%) firms (rejecting the null hypothesis of H1).

Further, the tables below show the result of regression that how the firms’ capital structure and profitability (independent variables) affects the value of the firm (dependent variable):
Table 7.3: Regression Estimates of All Firms and Tertiary Sector Firms

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>All Firms' Data</th>
<th>Tertiary Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const.</td>
<td>-0.0843395</td>
<td>-0.0660326</td>
</tr>
<tr>
<td></td>
<td>0.0000***</td>
<td>2.6E-251***</td>
</tr>
<tr>
<td>Debt Ratio</td>
<td>0.00410972</td>
<td>-0.0069122</td>
</tr>
<tr>
<td></td>
<td>7.2E-63***</td>
<td>0.0000***</td>
</tr>
<tr>
<td>Profitability</td>
<td>0.880538</td>
<td>0.827385</td>
</tr>
<tr>
<td></td>
<td>0.0000***</td>
<td>0.0000***</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation (Here *** means the values are significant at 1%).

Table 7.4: Regression Estimates of Primary Sector and Secondary Sector Firms

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Primary Sector @ 61.48</th>
<th>Secondary Sector @ 48.35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const.</td>
<td>-0.0253265</td>
<td>-0.0583549</td>
</tr>
<tr>
<td></td>
<td>9.71E-45***</td>
<td>0.0000***</td>
</tr>
<tr>
<td>Dless</td>
<td>0.00414208</td>
<td>0.0140222</td>
</tr>
<tr>
<td></td>
<td>1.44E-61***</td>
<td>1.1E-218***</td>
</tr>
<tr>
<td>Dgreater</td>
<td>-0.142341</td>
<td>-0.0776133</td>
</tr>
<tr>
<td></td>
<td>4.54E-214***</td>
<td>2.21E-247***</td>
</tr>
<tr>
<td>Profitability</td>
<td>0.665279</td>
<td>0.852904</td>
</tr>
<tr>
<td></td>
<td>0.0000***</td>
<td>0.0000***</td>
</tr>
<tr>
<td>p-value for F_1</td>
<td>0.04**</td>
<td>0.035**</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation (Here **, *** means the values are significant at 5% and 1% respectively).

From Table 7.3, it is seen that debt ratio has a direct relation with firm value for all firms' data and an indirect relation in case of the tertiary sector firms. Here, in both the cases, a symmetric linear relationship is seen. On the other hand, an asymmetric non-linear relation of debt with firm value is seen in the case of primary and secondary sector firms (from Table 7.4). A threshold exists at 61.48% for primary sector firms and at 48.35% for secondary sector firms. Thus, splitting all the observations into two regimes, suggesting that increasing debt ratio beyond the threshold value (61.48% and 48.35%, respectively) would have a negative impact on the firm value and would just add to the existing level of the firm leverage; as a result, the firms may begin to suffer from debt overhang. So, an optimal debt ratio exists for the primary sector firms at 61.48% and for secondary sector firms at 48.35% respectively.

Here, it is also seen that an inter-sectoral variation exists in the effect of capital structure decisions on the value of firms (the null hypothesis of H2 is rejected). The primary sector firms have a high threshold level of debt (at 61.48%) in comparison to the threshold level of the secondary sector firms (at 48.35%) and the tertiary sector firms have no threshold effect at all.
Further, it is visible from the results that, regardless of the sectors to which the firms belong to, profitability has a direct relation with firm value (as expected).

**7.4. Discussion**

The present study intends to determine the optimal level of debt, i.e., “threshold” at which a firm could maximize its value— in case of all firms’ data, primary, secondary and tertiary sector firms. Now, let’s have a look at what the results of the analysis have to say.

In the case of all firms' data (from Table 7.3), it is seen that there exists no threshold effect; instead, a linear direct relation of debt is seen with the firm value. The reason for the nonexistence of threshold effect is that here the firms belonging to different sectors of the economy (i.e., primary, secondary and tertiary) have been clubbed together. Firms of different sectors operate in different environments and face different risks, as a result, their capital structure requirements will be different and so would be the effect on firm value. Therefore, one must study what effect the capital structure decisions have on the firm value when the firms are categorized into the three sectors of the economy.

The analysis shows that there exists an inter-sectoral variation in the effect of capital structure decisions on the value of firms. The results show that firm value has an asymmetrical relationship with the capital structure of the firms belonging to the primary and secondary sector firms, whereas a symmetrical relationship in case of tertiary sector firms. It is found that the primary and secondary sector firms (from Table 7.4) have a threshold effect at 61.48% and 48.35% respectively (high for primary sector firms). The results indicated that debt contributes positively to firm value when it is below this threshold level, but becomes the main concern beyond that.

This difference is attributed to the difference in financing patterns of the firms across the three sectors— debt to equity ratio is found highest for the primary sector firms, followed by the secondary sector firms and finally by the tertiary sector firms. Now, this difference in the financing pattern of the firms in general is due to the diverse characteristics of the sector. For
instance risk (Scott, 1972) – firms belonging to high risk sectors push their management to use more of equity or retained earnings, which have relatively zero fixed burden (Hardiyanto et al., 2014); debt market accessibility (Bayless & Chaplinsky, 1991) – firms having an easy access to the debt market prefer debt over equity; capital intensive (Williams, 1995) – firms which require large amount of money and other financial resources to produce a good or service generally have high leverage ratios.

Tangible assets of a firm may be used as collateral for raising capital and the firms with high tangible assets faces less risk and in turn have high debt market accessibility (as discussed in section 2.3.1.2). Here, it is seen that the tertiary sector firms are not capital intensive in nature and have low tangible assets (rather high intangible assets) as compared to the firms belonging to other sectors. Therefore, these firms are relatively high-risk firms and have low accessibility to debt market. As a result, these firms cannot borrow easily from banks and other financial institutions. Thus, the only option available with them is either to go for equity or for retained earnings and so accordingly, they opt for their source of finance.

On the contrary, the secondary sector firms are the most capital-intensive firms (as discussed in Section 5.4); and have high tangible assets that back the debt taken by them. Therefore, they are less risky and generally have high leverage ratios (as compared to tertiary sector firms). But on the other hand, it is seen that the debt ratio of the firms belonging to this sector is lower than that of the firms belonging to primary sector firms. It could be due to the reason that the firms belonging to this sector have enough sales to provide sufficient cash inflows which could be retained by them. So, the secondary sector firms have an easy access all the three sources of finance (i.e., debt, equity and retained earnings) in comparison to the firms of other sectors. Therefore, these firms time the market and whichever source is easily available, they opt for that source of finance.

Now coming to the primary sector firms, these firms prefer debt finance to equity finance or retained earnings. These are the firms which neither have an easy access to the equity market nor do they have sufficient retained earnings. These firms have high tangible assets and so have an
easy access to the debt market. The only financing option available for the firms belonging to primary sector is of debt finance.

From the results, it is also seen that regardless of the sector to which the firms belong to, profitability has a direct relation with the firm value. An increase in profitability represents better prospects of the firm and sends a positive signal in the market; thus, increasing the value of the firms.

### 7.5. Conclusion

Firm value is an essential aspect while analyzing a firm’s financial health. So, in pursuit of maximizing the firm value, the managers of the firms have to be cautious regarding their financing strategies. It is important for them to know the level of debt beyond which an increase in debt would not add to the firm value, but would add to the risk level of the firms. The estimations have shown that in the case of all firms’ data, no optimal level of debt exists; it is so because here the firms belonging to different sectors of the economy have been clubbed together. Further, an inter-sectoral variation is seen in the effect of capital structure decisions on the value of firms. From the analysis, it has been found that a single threshold effect exists in the case of primary and secondary sector firms and no threshold effect for the tertiary sector firms. In addition to this, it is also observed that for primary sector firms, the threshold level is higher (i.e., of 61.48%) compared to the secondary sector firms (i.e., of 48.35%). Thus, an optimal debt ratio exists in the case of primary and secondary sector firms, but not for the tertiary sector firms.

The results of the primary and secondary sector firms are more consistent with the trade-off theory that the firms seek a level of debt that balances the benefits of interest tax shield and the incremental cost of debt financing. Whereas, the results of the tertiary sector firms are not as per the trade-off theory, as they do not define an optimal capital structure. Therefore, depending upon the sector to which the firms belong to and knowing the optimal debt ratio, the financial managers will be able to formulate the appropriate financing policy.