Chapter-4

Research Methodology
CHAPTER-4
RESEARCH METHODOLOGY

4.0. INTRODUCTION

In the previous chapter we have discussed the conceptual framework for our study. The research methodology is divided into five parts as under:

1. Framing the real variables as per the requirement of the final model
2. Framing the financial variables as per the requirement of the final model
3. Treatment of both financial and real variables to convert the data of 20 years (1991-2010) into a new form, so that the variables can be used for cross sectional analysis
4. Framing the final model as per the objectives of the thesis it will establish the relationship between financial structure and productivity
5. Conclusion

4.1. REAL VARIABLES

After the detailed conceptual framework of chapter 3, we believe that financial structure depends on the real variables as well apart from the financial variables. We have developed various real variables as per the requirement of our final model. The variables are as under:

i. TFP (Total Factor Productivity)
ii. NFA (Net Fixed Assets)
iii. K (Capital)
iv. K/L (Technology)
v. SAL (Sales)
vi. R&D (Research & Development)
vii. ROY (Royalties, technical know-how fees, etc)
viii. TFE (Total Forex Earnings)
ix. IMP (Total Imports)
The real variables are discussed in details as under:

A. TFP (Total Factor Productivity)

‘Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production’ Comin (2006).

In our study we are using a four factor production function, i.e. Labour, Capital, Material and Energy are used as four factor inputs. The function will be represented as shown in Equation 1.

\[ Y_t = A L^\alpha K^\beta E^\gamma M^\delta \]  

...(1)

where

- \( Y \) = total output
- \( L \) = labour input
- \( K \) = capital input
- \( E \) = Energy input
- \( M \) = Material input
- \( A \) = total factor productivity
- \( t \) = Time

\( \alpha, \beta, \gamma \) and \( \delta \) are the output elasticities of labour, capital, energy and material respectively. These values are constants determined by available technology.

We will calculate various variables for computation of total factor productivity. The variables which will be needed for computation are as under:

i. Output
ii. Wages and Salaries
iii. Energy
iv. Material
v. Capital, which is a residual after making all the factor payments from the output.

Data has been collected from prowess for the computation of total factor productivity. Now we will discuss the definitions of each of the five variables which are needed for computation of TFP as under:
i. Output: It is an amount produced or manufactured during a certain time. As per National income accounting, Choudhury (1995) and Miron and Zeldes (1987) output is defined as:

\[
\text{Output} = \text{Sales} + \text{Change in stock} \tag{2}
\]

where,

\[
\text{Change in stock} = \text{Closing stock} - \text{Opening stock} \tag{3}
\]

OR

\[
\text{Output} = \text{Sales} + (\text{Closing stock} - \text{Opening stock}) \tag{4}
\]

ii. Wages and salaries: It is the factor payment (remuneration) made to labour for his services.

iii. Energy: It means the sources of energy like power, fuel, water etc used by the manufacturers for the production of goods and services.

iv. Material: It is basically the raw material used for the production of finished goods. It is used for the primary production or manufacturing of a good.

v. Capital: It is a measure of the flow of capital services available for production from the stock of capital goods.

‘Prowess’ Database gives information on these five components of TFP as shown in Table 4.1.

**Table 4.1: Heads of the Five Variables of TFP under Prowess**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variable Name</th>
<th>Heads under Prowess***</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sales</td>
<td>Sales</td>
</tr>
<tr>
<td>2</td>
<td>Change in Stock</td>
<td>Change in stock of finished and semi-finished goods</td>
</tr>
<tr>
<td>3</td>
<td>Wages</td>
<td>Salaries &amp; Wages</td>
</tr>
<tr>
<td>4</td>
<td>Energy</td>
<td>Power, fuel (including wheeling charges paid by electricity companies) &amp; water charges</td>
</tr>
<tr>
<td>5</td>
<td>Material</td>
<td>Raw material expenses</td>
</tr>
</tbody>
</table>

***All the above variables are denoted in ‘Rs. Million’.

TFP will be calculated for a period of 20 years i.e. from 1991 to 2010. We will be doing time series analysis for TFP.
Steps for calculating TFP are as under:

i. From the variables discussed above will calculate total output, total wages, total amount of material input used and total amount of power input used. So we will get the final values of output, wages, material and energy.

ii. As productivity is a real variable so we will convert output, wages, energy and material into real output, real wages, real energy and real material by deflating the variables by their deflators.

iii. For finding out deflators we have used ‘Handbook of Statistics’ from RBI website. The Consumer Price Index is used for the finding the deflator of wages and Wholesale Price Index is used for finding the deflators of output, energy and material. The deflators are given in Table 4.2.

Table 4.2: Deflators Selection for each Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Index</th>
<th>Deflator Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages</td>
<td>Consumer Price Index</td>
<td>IW (Industrial Worker)</td>
</tr>
<tr>
<td>Output</td>
<td>Wholesale Price Index</td>
<td>MP (Manufactured Products)</td>
</tr>
<tr>
<td>Energy</td>
<td>Wholesale Price Index</td>
<td>F&amp;P (Fuel and Power)</td>
</tr>
<tr>
<td>Material</td>
<td>Wholesale Price Index</td>
<td>NF (Non-Food articles)</td>
</tr>
</tbody>
</table>

We are using 1993-94 as the base year for all the deflators in the 20 years. For formulating the same base we have also used ‘Splicing method’ because the WPI and CPI indexes are based on different base years. The Table 4.3 is the final table of deflators.

iv. We will get real output, real wages, real energy and real material by dividing variables from their deflators shown as under:

Real Output = Total Output / Output Deflator  
Real Wages = Total Wages / Wage Deflator  
Real Energy = Total Energy / Energy Deflator  
Real Material = Total material / Material deflator.
Table 4.3: Final Deflators

<table>
<thead>
<tr>
<th>Year</th>
<th>Wage Deflator</th>
<th>Material Deflator</th>
<th>Energy Deflator</th>
<th>Output Deflator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92</td>
<td>0.85</td>
<td>0.92</td>
<td>0.76</td>
<td>0.84</td>
</tr>
<tr>
<td>1992-93</td>
<td>0.93</td>
<td>0.91</td>
<td>0.87</td>
<td>0.93</td>
</tr>
<tr>
<td>1993-94</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1994-95</td>
<td>1.1</td>
<td>1.24</td>
<td>1.08</td>
<td>1.12</td>
</tr>
<tr>
<td>1995-96</td>
<td>1.21</td>
<td>1.35</td>
<td>1.14</td>
<td>1.21</td>
</tr>
<tr>
<td>1996-97</td>
<td>1.82</td>
<td>1.34</td>
<td>1.26</td>
<td>1.24</td>
</tr>
<tr>
<td>1997-98</td>
<td>1.95</td>
<td>1.37</td>
<td>1.43</td>
<td>1.28</td>
</tr>
<tr>
<td>1998-99</td>
<td>2.2</td>
<td>1.51</td>
<td>1.48</td>
<td>1.33</td>
</tr>
<tr>
<td>1999-00</td>
<td>2.28</td>
<td>1.43</td>
<td>1.62</td>
<td>1.37</td>
</tr>
<tr>
<td>2000-01</td>
<td>2.36</td>
<td>1.46</td>
<td>2.08</td>
<td>1.41</td>
</tr>
<tr>
<td>2001-02</td>
<td>2.46</td>
<td>1.52</td>
<td>2.26</td>
<td>1.44</td>
</tr>
<tr>
<td>2002-03</td>
<td>2.56</td>
<td>1.65</td>
<td>2.39</td>
<td>1.48</td>
</tr>
<tr>
<td>2003-04</td>
<td>2.66</td>
<td>1.86</td>
<td>2.54</td>
<td>1.56</td>
</tr>
<tr>
<td>2004-05</td>
<td>2.77</td>
<td>1.87</td>
<td>2.8</td>
<td>1.66</td>
</tr>
<tr>
<td>2005-06</td>
<td>2.88</td>
<td>1.81</td>
<td>3.18</td>
<td>1.7</td>
</tr>
<tr>
<td>2006-07</td>
<td>3.08</td>
<td>1.91</td>
<td>3.39</td>
<td>1.8</td>
</tr>
<tr>
<td>2007-08</td>
<td>3.28</td>
<td>2.14</td>
<td>3.39</td>
<td>1.89</td>
</tr>
<tr>
<td>2008-09</td>
<td>3.57</td>
<td>2.42</td>
<td>3.78</td>
<td>2</td>
</tr>
<tr>
<td>2009-10</td>
<td>4.02</td>
<td>2.55</td>
<td>3.7</td>
<td>2.05</td>
</tr>
<tr>
<td>2010-11</td>
<td>4.43</td>
<td>3.12</td>
<td>4.16</td>
<td>2.16</td>
</tr>
</tbody>
</table>

Base year 1993-94

v. After deducting real wages, real energy and real material from real output, we will get the value of real capital. So, real capital is a residual value, i.e. the leftover after making the all the other factor payments from real output. It can be represented as:

\[ \text{Real Capital} = \text{Real Output} - (\text{Real Wages} + \text{Real Material} + \text{Real Energy}) \]   ...(5)

vi. After step five we will take LOG of all the five real variables, i.e. Real Output (LRO), Real Wages (LRW), Real Energy (LRE), Real Material (LRM) and Real Capital (LRK), for all the 20 years (1991-2010). From this we will get a semi log equation as under:

\[ Y_t = e^{a+bt} L^\alpha K^\beta E^\gamma M^\delta \]   ...(6)
\[ \log Y_t = A + bT + \alpha \log L_t + \beta \log K_t + \gamma \log E_t + \delta \log M_t + \epsilon_t \]  \( \ldots(7) \)

where:
Log Q = Log of Real Value Added
Log L = Log of Real Wages
Log K = Log of Real Capital input
Log E = Log of Real Energy input
Log M = Log of Real Material input
T= Total factor productivity
\( t = \) Time
\( \epsilon_t = \) Error term

vii. We will run regression on the above semi-log equation taking LRO as dependent variable and the four inputs, i.e. LRW, LRK, LRE, LRM and Time (1991-2010) as independent variables.

viii. From the output sheet of regression of each company, we will get TFP coefficient and then we can check whether the coefficient is significant or not. So for 20 years we will get 1 value of TFP because TFP effect comes over a period of time.

So, from this we can conclude that, total factor productivity (TFP) is a variable which accounts for the effects in total output that is not caused by traditionally measured inputs. TFP is a real variable and also independent in nature. Residual profit increases due to TFP growth. Profit is based on the ordinary economic calculation of cost and revenue but TFP growth is not anticipated so any gain and loss in terms of TFP growth is a return over and above the expected potential profit in the long run. Therefore, it is not likely to influence the long term pattern of financing and hence the long term pattern of financial structure.

B. NFA (Net Fixed Assets)

Fixed assets are as known as non-current assets, such as machinery, property, plant, and equipment etc. These assets cannot easily be converted into cash.
Net fixed assets are the total of all the fixed assets after considering depreciation. It is also the value of fixed assets after depreciation as shown on a balance sheet. NFA are also real and independent variables as it is directly related to production.

Depreciation is calculated on notional basis so we will take NFA. If NFA are more that means that its production is capital intensive and long term finance will be needed Also NFA are “Capital Assets” so they positively influence equity so we would have a lower debt by equity ratio.

C. K (Capital)

Capital is a real and independent variable. Capital is a measure of the flow of services available for production from the use of capital goods. It is residual in nature. Capital is a stock in nature and not flow. Capital is calculated after deducting the sum of real wages, real material and real energy from real output as given in Equation 8:-

\[
\text{Real Capital} = (\text{Real Output} - \text{Real Wages} - \text{Real Energy} - \text{Real Material}) \quad \ldots (8)
\]

**Four input model

D. K/L (Technology)

Capital by labour ratio is basically technology. Here we are using real wages and real capital to derive technology using Equation 9:

\[
\text{Technology} = \frac{\text{Real Capital}}{\text{Real Wages}} \quad \ldots (9)
\]

From the above formula it is clear that technology is also a real variable because it is derived from real variables only. It is also an independent variable.

E. SAL (Sales)

Sales are the actual sales revenue. Total sales revenue, sometimes called gross sales, is the total amount of sales in a given period. Total sales revenue is represented in several ways, but it is formulated as total number of units sold multiplied by price per unit. Sales are also an independent and real variable as it is the result of the production process.
F. R&D (Research & Development)

Research and development is normally scientific and toward the development of particular technologies. R&D is also the discovery of new knowledge about processes, products, and services, and applying that knowledge to develop new and improved products, processes, and services as per the demand of the market. R&D is also a real and independent variable as it directly affects production process.

G. ROY (Royalties, Technical Know-how Fees, etc.)

Royalty, technical know-how fees etc, are the payment made originally to the licensing company for a concession of commercial value. This payment is usually made for using a copyright, patent, trademark or know-how. Royalty, technical know-how fees etc., is an independent and real variable

H. TFE (Total Forex Earnings)

TFE is total amount of foreign earning which a company earns by exporting its goods, services etc. TFE is also a real and independent variable as a company can earn foreign revenue only through specialized production process. That the reason why it is real in nature. For TFE, we have developed TFE variable which is the sum of the following five:

i. Exports of Goods
ii. Exports of Services
iii. Forex Earning Dividend
iv. Forex Earning Interest
v. Other Foreign Earnings

Export of goods and services brings foreign exchange earnings and it enhances funds of the company. Forex Earning by way of Dividend, Interest etc will be only once in a year. So it will not help in “Working Capital” requirements. It is useful for long term financing as it augments funds, so it can be used either as a reserve or for long term finance. Foreign firms most often come with managerial skills, organisational skills and imported technology. Imported technology leads to embodied technological progress,
whereas managerial and organisational skills lead to disembodied technological progress or technological efficiency.

I. IMP (Total Imports)

"Imports" consist of transactions in goods and services (from non-residents residents to residents. It can be sales, barter, gifts or grants. The definition of imports in national accounts includes/excludes specific "borderline" cases. A delimitation of imports in national accounts is given below:

An import of a good takes place when there is a change of ownership from a non-resident to a resident; but this does not necessarily imply that the goods physically cross the frontier. In specific cases national accounts considers changes of ownership even though in legal terms no change of ownership takes place. For example:-

i. Cross border financial leasing
ii. Cross border deliveries between affiliates of the same enterprise,
iii. Goods crossing the border for significant processing to order or repair.
iv. Also, smuggled goods must be included in the import measurement.

Imports of services consist of all type of services rendered by non-residents to residents. In national accounts any direct purchases by residents outside the economic territory of a country are recorded as imports of services; that is why all expenditure by tourists in the economic territory of another country are considered as part of the imports of services. Also international flows of illegal services must be included.

Imports variable is also independent and real in nature because we are considering only manufacturing industries, and manufacturing industries imports raw material for the use of production. It is affecting production directly, so it is a real variable.

We have derived Total imports variable by adding the following four:

i. Import of capital goods
ii. Import of finished goods
iii. Import of raw materials
iv. Import of stores and spares
Imports would also imply foreign exchange requirements and this would have implications for financing. So, in general long term finance would be needed for imports of capital goods whereas working capital requirement would be needed for imports of raw materials and imports of stores and spares.

We have calculated real variables, i.e. K (capital), K/L (technology) and TFP (total factor productivity) and the remaining 6 real variables; the data is collected from prowess as shown in Table 4.4.

**Table 4.4: Heads of the Real Variables under Prowess**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Variable Name</th>
<th>Head under Prowess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NFA</td>
<td>Net fixed assets</td>
</tr>
<tr>
<td>2</td>
<td>SAL</td>
<td>Sales</td>
</tr>
<tr>
<td>3</td>
<td>R&amp;D</td>
<td>Research and development expenses</td>
</tr>
<tr>
<td>4</td>
<td>ROY</td>
<td>Royalties, technical know-how, fees etc.</td>
</tr>
<tr>
<td>5</td>
<td>TFE</td>
<td>Total forex earnings</td>
</tr>
<tr>
<td>6</td>
<td>IMP</td>
<td>Total imports is the sum of: Imports of (capital goods + finished goods + raw materials + stores and repairs</td>
</tr>
</tbody>
</table>

4.2. **FINANCIAL VARIABLES**

For measuring financial structure we have developed various variables as per the need of our thesis to measure the financial structure. The variables are as under:

i. DER (Debt Equity Ratio)

ii. CR (Current Ratio)

iii. FB (Foreign Borrowings)

iv. DIV (Dividend)

v. FE (Foreign Equity)

These data for the above five variables are also collected from prowess. The heads from which these variables are taken is given in Table 4.5.
Table 4.5: Heads of the Financial Variables under Prowess

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Variable Name</th>
<th>Head under Prowess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DER</td>
<td>Debt to equity ratio (times)</td>
</tr>
<tr>
<td>2</td>
<td>CR</td>
<td>Current ratio (times)</td>
</tr>
<tr>
<td>3</td>
<td>FB</td>
<td>Foreign borrowings</td>
</tr>
<tr>
<td>4</td>
<td>DIV</td>
<td>Cash (outflow) due to dividend paid</td>
</tr>
<tr>
<td>5</td>
<td>FE</td>
<td>(Foreign promoters + Foreign non-promoter FII + Foreign non-promoter venture capital fund )%</td>
</tr>
</tbody>
</table>

The financial variables are discussed in detail as under:

A. Debt Equity Ratio

It is a measure of a company's financial leverage. It is calculated by dividing its total liabilities by stockholders' equity. It indicates the proportion of equity and debt the company is using to finance its assets. Debt Equity ratio is a dependent variable. It is basically a financial variable. Debt Equity is raised through public offerings. One of the primary conditions of public offering is that, a company has to show the purpose and this purpose is always long term, i.e., project finance in the prospectus.

It is basically for:

i. New Plant
ii. Expansion
iii. Modernisation

This implies that if a company has long term finance for capita, it is likely that it is through equity. There is a natural limit on debt by equity ratio given the total capital requirements of the company. There are limits to which one can raise equity as equity can’t be raised every year but debt will be required every year. Debt is required for short term finance. In absolute terms, debt is required for short term needs and it cannot be held for indefinite period. There has to be a cycle of holding, repaying etc.

If any company raises new equity for the prospective shareholders than there would be a limit to invest by investors. As debt increases, the fix charges increases and
profitability goes down. At any given point of time, collateral is a limitation. So, the financial institutions are deterred from giving unlimited debt. If debt increases, the leverage increases so trading on equity increases. The interest charge will always be less than profitability. Return on investments is profitability. There are limits to both debt and equity. Financial structure is something which needs optimisation. The objective is to show that optimal financial structure is arriving at optimal capital structure. It also depends upon real factors (productivity).

B. Current Ratio

Current Ratio variable is a financial variable. Current ratio is computed as:

\[
\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \quad \cdots (10)
\]

Current Ratio is an independent variable.

The ratio is used to get an idea of the company's ability to pay back its short-term liabilities (debt and payables) with its short-term assets (cash, inventory, receivables). The higher the current ratio, the more capable the company is of paying its obligations. A ratio under 1 suggests that the company would be unable to pay off its obligations if they came due at that point. While this shows the company is not in good financial health, it does not necessarily mean that it will go bankrupt - as there are many ways to access financing - but it is definitely not a good sign.

The current ratio can give a sense of the efficiency of a company's operating cycle or its ability to turn its product into cash. Companies that have trouble getting paid on their receivables or have long inventory turnover can run into liquidity problems because they are unable to alleviate their obligations. Because business operations differ in each industry, it is always more useful to compare companies within the same industry.

C. Foreign Borrowings

Foreign borrowings are a financial and independent variable. It is the part of borrowings which are taken from the foreign markets by domestic companies.
D. Dividend

It is a distribution of a portion of a company's earnings. Dividend decision is decided by the board of directors, to a class of its shareholders. Dividend is the amount of total cash outflow given as dividend to shareholders. Dividend is also an independent and financial variable.

E. Foreign Equity

FE is the equity issued by a domestic company in the foreign markets. We are assuming that a FDI firm is the one in which foreign equity investment is 10 percent or more. To calculate “foreign equity” three components from the prowess database (Equity ownership pattern in % of shares held) should be added:

i. Foreign promoters (%)
ii. Foreign non-promoter FII (%)
iii. Foreign non-promoter venture capital fund (%)

“Foreign non-promoter FII” will indulge in short term movements. Our data is on annual basis, so it will not reflect the changes on year to year basis. The funds coming from FII’s are unstable so it cannot be used for long term finance. Foreign equity is also a financial as well as independent variable.

4.3. TREATMENT OF BOTH FINANCIAL AND REAL VARIABLES

For our analysis part we will be doing different treatment with the financial and real variables because:

i. TFP (total factor productivity) is just one value for a period of 20 years, i.e. 1991-2010, whereas the other variables are available for 20 years.
ii. There is a problem of discontinued data.
iii. There is also a problem of missing data in prowess.

So to overcome such problem, we will be doing cross sectional analysis in our final model to establish the relationship between financial structure and productivity. We will
use different techniques to find out one value for each variable for each company, and that one value will represent the effect of all the 20 years (1991-2010).

Now the next Table 4.6 represents the treatment, which we will be using for real and financial variables.

**Table 4.6: Treatment of Variables**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Variable Name</th>
<th>Treatment</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total Factor Productivity</td>
<td>Estimated</td>
<td>Real</td>
</tr>
<tr>
<td>2.</td>
<td>Net Fixed Assets</td>
<td>Growth</td>
<td>Real</td>
</tr>
<tr>
<td>3.</td>
<td>Capital (K)</td>
<td>Growth</td>
<td>Real</td>
</tr>
<tr>
<td>4.</td>
<td>Technology (K/L)</td>
<td>Growth</td>
<td>Real</td>
</tr>
<tr>
<td>5.</td>
<td>Sales</td>
<td>Growth</td>
<td>Real</td>
</tr>
<tr>
<td>6.</td>
<td>Research &amp; Development (R&amp;D)</td>
<td>Dummy</td>
<td>Real</td>
</tr>
<tr>
<td>7.</td>
<td>Royalties, technical know-how fees, etc</td>
<td>Dummy</td>
<td>Real</td>
</tr>
<tr>
<td>8.</td>
<td>Total Forex Earnings</td>
<td>Index</td>
<td>Real</td>
</tr>
<tr>
<td>9.</td>
<td>Imports</td>
<td>Dummy</td>
<td>Real</td>
</tr>
<tr>
<td>10.</td>
<td>Debt by Equity</td>
<td>Grouped Mean</td>
<td>Financial</td>
</tr>
<tr>
<td>11.</td>
<td>Current Ratio</td>
<td>Grouped Mean</td>
<td>Financial</td>
</tr>
<tr>
<td>12.</td>
<td>Foreign Borrowings</td>
<td>Dummy</td>
<td>Financial</td>
</tr>
<tr>
<td>13.</td>
<td>Dividend</td>
<td>Dummy</td>
<td>Financial</td>
</tr>
<tr>
<td>14.</td>
<td>Foreign Equity</td>
<td>Dummy</td>
<td>Financial</td>
</tr>
</tbody>
</table>

**a. TFP (Total Factor Productivity)**

The value of TFP will be estimated for each industry by using time series analysis as discussed in 4.1A part of the current chapter.

**b. NFA (Net Fixed Assets)**

For NFA, we will be taking the growth rate for the 20 years time period (1991-2010) from semi log equations as shown in equation 11.

\[
\log NFA = \alpha + \beta T \tag{11}
\]

where

Log NFA = Log of Net Fixed Assets

T = Time
c. K (Capital)
We will be taking growth rate of capital input for 20 years from semi log equation 12 as under:

\[ \log K = \alpha + \beta T \] …(12)

where
Log K = Log of Capital
T = Time

d. K/L (Technology)
For K/L, we will take the growth rate for the 20 years time period (1991-2010) from semi log equation 13 as shown below:

\[ \log \frac{K}{L} = \alpha + \beta T \] …(13)

where
Log K/L = Log of Technology
T = Time

e. SAL (Sales)
For Sales, we will take the growth rate from semi log equations 14, for the 20 years time period (1991-2010) given below:

\[ \log SAL = \alpha + \beta T \] …(14)

where
Log SAL = Log of Sales
T = Time

f. R&D (Research and Development Expenses)
Research and Development is an expense for the company. It is basically deferred revenue expenditure. R&D is discontinuous in nature as it not done on regular basis, i.e. every year. So to avoid the problem the discontinuity of R&D expenditure, we will
prepare an index for 20 years. R&D expenditure is basically done for growth of the company. The older the R&D expenditure is, the more effective it becomes for the growth, learning and efficiency of the company, as a company can take more and more advantage of the older R&D for the future years. Due to this reason, we will allocate weights for the R&D expenditure for every year. So for year 1991 R&D, we will give it a weight of 20, for 1992 the weight will be 19 and so on, which will keep on reducing by one and it will become 2 for 2009 and 1 for 2010. After this, all the R&D expenditures will be multiplied by their respective weights for all the 20 years. Lastly, we will take the sum of the same. This same method will be applied for all the companies.

We will use dummy for the R&D index. The reason of using dummy is to avoid the zeros of the index for those companies which had not done R&D at all in the 20 years i.e. the period of the study (1991-2010). Hence, if the R&D index for a company is greater than zero then dummy will be 1 else 0.

g. ROY (Royalties, technical know-how fees, etc)

Royalties, technical know-how fees, etc is an expense for the company and not an income. Its nature is similar as the research and development expenditure. Royalty payment is also discontinuous in nature as it not done on regular basis, i.e. every year. So to avoid the problem the discontinuity of royalty expenditure, we will prepare an index of royalty for 20 years. Just like R&D, royalty expenditure is also done for growth of the company. The older the royalty expenditure is, the more effective it becomes for the growth, learning and efficiency of the company, as a company can take more and more advantage of the older techniques, learning, processes, patents etc. for the future years which were bought through royalty, technical fees etc. Due to this reason, we will allocate weights for the royalty expenditure for every year. So for year 1991 royalty, we will give it weight of 20, for 1992 the weight is 19 and so on, which keep on reducing by one and it becomes 2 for 2009 and 1 for 2010. After this, all the royalty expenditures will be multiplied by their respective weights for all the 20 years. Lastly, we will take the sum of the same. This same method is applied for all the companies.
Finally, we will use dummy for the royalty index. The reason of using dummy was to avoid the zeros of the index for those companies which had not paid any royalty, technical know-how fees etc., at all in the 20 years i.e. the period of the study (1991-2010). Hence, if the royalty index value will be greater than zero for a company than dummy is 1 else 0.

**h. TFE (Total Forex Earnings)**

A company’s foreign earnings depend on its exports. The higher the exports, the higher are the forex earnings. But usually very few companies are able to exports their products because only a less number of companies are able apply innovative techniques to make something new and distinct from the foreign markets. The reason for the discontinued forex earnings is also that some companies are not at all making exports or there is no demand of their products in the foreign markets. To overcome the problem of discontinuity, we will prepare an index for 20 years (1991-2010) for forex earnings.

For TFE, we prepared an index for 20 years. Due to this reason we have allocated weights for the TFE for every year. If a company is earning income through forex earnings than even the demand for financing goes down for that company because of the cash inflows generated by the exports. So for TFE of year 1991, we will give it weight of 1, 2 for 1992 which keep on increasing by one and it will be 19 for 2009 and 20 for 2010. After this all the TFE will be multiplied by their respective weights for all the 20 years for all the companies. Lastly, we will be taking the sum of the same for all the companies.

In case if this index value is zero for some companies, i.e. those companies which are not at all earning forex earnings in any of the three industries, in such case we will be using dummy for TFE rather than Index. So for dummy if TFP Index is greater than zero than we are assigning it a value 1, else 0.

**i. IMP (Imports)**

Usually manufacturing companies import raw material from the foreign markets. The material purchased from abroad is basically of good quality to make superior products.
But every company is not able to make imports as the demand for financing goes up if a firm decides to import. For imports as well, we will be using dummy. If a company imports goods, raw materials etc., for 10 years or more, out of 20 years (1991-2010), than the dummy value will be 1, else 0.

j. DER (Debt by Equity)

We will use grouped mean for DER ratio for 20 years (1991-2010). The same method of using mean was also used in Aghion et al. (2010). The formula used for grouped mean is as under:

\[
\text{Grouped mean} = \frac{\sum FX}{\sum F} \quad \ldots(15)
\]

We will ignore the extreme values of DER ratio, i.e., which exceeds 20 and also DER which is zero for finding out the grouped mean.

The reason for this is that it is possible that a company has extreme values for DER, not a problem of reportage. But in a regression equation, the parameters always explain the dependent variables to an average. The purpose of regression is to explain the average relation. If we will not exclude the extreme values, it will disturb the β value.

k. CR (Current Ratio)

We will be taking grouped mean, as used by Aghion et al. (2010), of the current ratio for 20 years just like we have discussed for the DER ratio.

l. FB (Foreign Borrowings)

Foreign borrowings are the borrowings made by a domestic company from the foreign markets. Foreign borrowings are not all easily available for any company unless the company’s goodwill is very high or its ability to generate cash flows is exceptionally good since a long period of time. We will consider only the value of FB for year 2010 as it FB is cumulative in nature. We will use dummy for the same. If FB for year 2010 are greater than 0, dummy will be 1, else 0.
m. DIV (Dividend)

Dividend is the cash outflow of a company’s funds given to its shareholders. It is not necessary that a company will pay it every year because dividend outflow depends on profits, which are left after making all the obligations of the company. Also it depends upon the policy of the company, i.e. whether they prefer to pay dividend or to keep excess funds as reserves. This is the reason that dividend is usually not given on continuous basis for all the company. So for dividend outflow, we will be using dummy. If the dividend outflow will be for 5 years or more out of 20 years (1991-2010), than dummy will be 1 else 0.

n. FE (Foreign Equity)

Foreign equity is the equity issued by a domestic company in the foreign markets. To create demand for equity by the foreign participants is a very challenging job for any company. None of the foreign participant will invest unless the equity would be assumed to be profitable and safe. So, mostly very few companies are able to raise equity in the foreign markets. So there are chances of discontinuous foreign equity and also nil foreign equity issued in the 20 years (1991-2010) by many companies. We will use dummy for FE. Is FE is issued at-least once during the period of 20 years than the dummy will be 1 else 0.

4.4. MODEL SPECIFICATION

We will be doing cross sectional analysis for finding out the relationship between financial structure and productivity. DER will be taken as dependent variable to find out whether debt to equity ratio is dependent on the real and financial variables or not. The remaining 13 variables, i.e., CR, FB, Div, FE, TFP, NFA, K, K/L, SAL, R&D, ROY, TFE, and Imp will be taken as independent variable. We will use the following functional equation for estimating the relationship between financial structure and productivity:

\[
\frac{D}{E} = f (\text{List of real variables}; \text{List of financial variables}) \quad \text{...(16)}
\]
\[
\frac{D}{E} = f (\text{TFP}, \text{Roy}, \text{R&D}, \text{K}, \text{Sal}, \text{Tech}, \text{TFE}, \text{NFA}, \text{IMP} ; \text{CR}, \text{FB}, \text{Div}, \text{FE}) \quad \ldots(17)
\]

or

\[
\left( \frac{D}{E} \right)_i = A + \beta_1 \text{TFP}_i + \beta_2 \text{ROY}_i + \beta_3 \text{R&D}_i + \beta_4 \text{K}_i + \beta_5 \text{SAL}_i + \beta_6 \text{Tech}_i + \beta_7 \text{TFE}_i + \\
\beta_8 \text{NFA}_i + \beta_9 \text{IMP}_i + \beta_{10} \text{CR}_i + \beta_{11} \text{FB}_i + \beta_{12} \text{Div}_i + \beta_{13} \text{FE}_i + U_i \\
\ldots(18)
\]

where, the real variables are:

- \(\text{TFP} = \) Total factor productivity
- \(\text{ROY} = \) Royalties, technical know-how fees etc.
- \(\text{R&D} = \) Research and development expenses
- \(\text{K} = \) capital input
- \(\text{SAL} = \) Sales
- \(\text{Tech} = \) Technology
- \(\text{TFE} = \) Total forex earnings
- \(\text{NFA} = \) Net fixed assets
- \(\text{IMP} = \) Imports

And the financial variables are:

- \(\text{DER} = \) Debt to equity ratio
- \(\text{CR} = \) Current ratio
- \(\text{FB} = \) Foreign borrowings
- \(\text{DIV} = \) Dividend
- \(\text{FE} = \) Foreign equity
- \(i = \) Number of Firms

We will run regression by using equation number 18 using ‘SPSS’.

**4.4. CONCLUSION**

From our methodology we have tried to establish a list of financial and real variables. We have also developed a model to find out the relationship between financial structure and productivity as per the requirement of our thesis. Debt by equity will be taken as a
dependent variable and the remaining 13 variables, i.e., CR, FB, Div, FE, TFP, NFA, K, K/L, Sal, R&D, Roy, TFE, and Imp will be taken as independent variable. The same approach will be used in cement, pharmaceutical and steel industries.

In the next chapter we will use the concepts of our methodology for analyzing the cement industry.