TRADE LIBERALISATION AND TECHNICAL EFFICIENCY: A FIRM LEVEL STUDY INVOLVING SOME SELECTED INDIAN MANUFACTURING SECTORS

Dissertation submitted to the Jawaharlal Nehru University
in partial fulfilment of the requirements
for the award of the degree of

MASTER OF PHILOSOPHY

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2002

Dedicated

to

my Baba & Maa

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21 July 2002

CERTIFICATE

This is to certify that the dissertation entitled, "**TRADE LIBERALISATION AND TECHNICAL EFFICIENCY : A FIRM LEVEL STUDY INVOLVING SOME SELECTED INDIAN MANUFACTURING SECTORS**" submitted by **DIBYENDU MUKHOPADHYAY** in partial fulfillment of the requirements for the award of the degree of **MASTER OF PHILOSOPHY(M.Phil)** of the University is his own work and has not been previously submitted for any degree of this or any other University.

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ACKNOWLEDGEMENT

Let me begin by making an unequivocal categorical statement. This thesis would never have taken shape had I not received the help and assistance that I have from ICRIER (Indian Council for Research on International Economic Relations). This very idea of exploring the openness technical efficiency link struck me while working on a World Bank project pertaining to trade liberalization and total factor productivity growth with Dr. Isher Judge Ahluwalia the then Director and Chief Executive of ICRIER. I am also indebted to ICRIER for providing me unhindered access to The Centre for Monitoring Indian Economy's corporate database Prowess.

Dr. Archana Aggarwal my dissertation supervisor not only gave me wonderful insights into the research area and helped me correct a number of misconceptions that I had but also painstakingly went through each and every line that I wrote and helped me correct the countably infinite typographical errors that I committed. Once again this thesis would have remained thoroughly unrefined and grossly crude had she not guided me through this entire process. At ICRIER Dr. K.L.Krishna and Mr. Debkusum Das helped me in every conceivable way from providing me invaluable articles to reviewing my regression results and drafts. I am also grateful to Dr. Isher Judge Ahluwalia and Dr. Aradhana Aggarwal both eminent members of the Delhi academic community for their insightful comments and suggestions. Within the JNU academic community I would like to express my gratitude to professor Abhijit Sen for his extremely important suggestions.

It does not need to be mentioned that no research work succeeds without an efficient support system and hence I would like to thank the entire staff of the JNU Exim Bank library, the ICRIER library and the RIS library who helped me in the course of my

dissertation work. On this occasion I would like to say that I am fortunate to have friends like Rajeev, Soma, Sasank, Ruchika, Vineet, Partha, Subrat, Siddharth, Surajit, Jyotirmoy, Sumana, Abhishikta, Radhika, Mili and Debashish who helped me in innumerable number of ways in the course of my dissertation. I would also like to have a special word of thanks for Mr. C.S.C Sekhar, Subhajit Roy, Abhijeet Sengupta and Arindam Banerjee for their help at the crucial penultimate stage of my dissertation process. To Dr. Arpita Mukherjee and Mrs. Subhobrota Ray I would like to say thanks a lot for being perennial sources of support and encouragement throughout this process. Let me also express my sincere gratitude and indebtedness to Dr. Rakesh Mohan (Director and Chief Executive ICRIER) Mr. P.N.Bhattacharya (Secretary ICRIER) and the entire ICRIER family for their help, support and co-operation.

Finally I would like to say that though my parents are 1500 kilometers away in Kolkata it is their continuous support, encouragement and good wishes that helped this dissertation see the light of day. All shortcomings and inadequacies are entirely mine.

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Introduction

1.1The Context

Trade policy reform has been a central feature of the economic adjustment programs introduced in many developing countries in the recent years. Despite the authority with which such reforms are recommended to developing countries, evidence on the link between trade reform and improvement in economic performance is relatively scarce and is often ambiguous. However, there is a widespread belief that competition will usher in efficiency and imports serve as an excellent disciplining device. Leibenstein (1966) was the first to state explicitly that "proper motivations" should discipline firms forcing them to become more efficient or perish. Development economists routinely argue that in markets characterized by entry barriers the absence of foreign competition allows domestic producers to enjoy monopoly rents consequently these firms may fail to achieve scale efficiency and/or get the maximum possible output from their input bundles (achieve technical efficiency). Balassa quite succinctly puts it that it has been observed "monopolies and oligopolies prefer a quiet life to innovative activity which entails risk and uncertainty. In turn the carrot and stick of competition gives inducement for technological change. Imports by creating competition for domestic products in home markets provide firms with incentives to improve their operations; and another thing in response to competition in foreign markets exporting firms try to keep up with modern technology in order to maintain or improve their position."

Moreover, in markets characterized by Chamberlinean competition trade protection may attract inefficiently small producers causing similar increases in average production costs. It is sometimes claimed that these two intra-industry effects of protectionism are more important sources of welfare loss than the traditional comparative advantage effects.

Now whether there is really a cause and effect relationship between protection and poor technological performance is something that needs to be tested empirically. There is a wide array of empirical evidence that deserves mention and they can be

broadly categorized under two heads namely firm level case studies of technological change and cross industry studies of technical efficiency and productivity change.

1.2 Significance of the Investigation in the Indian Context

The gulf war of 1991and the associated oil price hike tipped India's fragile external finances into a full-blown balance of payments crisis. Spurred by this crisis the Govt. introduced a wide-ranging programme of stabilization and structural reform. It is thus a matter of great interest to find out the impact of these reforms on the performance of Indian industry. In fact the reforms initiated in 1991 were expected to improve the performance and competitiveness of the Indian industry by making it more productive and efficient. This along with better resource allocation resulting from international prices and competition was expected to improve the growth performance of the Indian industry and economy. In the years following the initiation of reforms in 1991 the stabilization measures did bring results. Though initially imports along with trade deficit and current account deficit witnessed a sharp reduction, imports picked up and surged in the mid nineties. However trade deficit and current account deficit remained well below 2% of GDP partly boosted by strong exports and strong recovery of net invisible earnings. Merchandise exports grew at about 20 percent a year in dollar terms for three successive years between 1993-94 and 1995-96 before decelerating to a negative growth in 1998-99 and then reached a record high of 20% in 2000-01. Though there was a poor performance on the export front the current account deficit remained low primarily on account of slow growth in non-oil imports. This deceleration in non-oil imports reflects the industrial recession that has been building up over the last few years. Though industry is showing some signs of recovery whether that recovery is sustainable or not depends crucially on the news on the efficiency and productivity front. That is why this investigation is very crucial. At this stage it is absolutely necessary to provide a brief overview of the package of reforms introduced since 1991.

1.3 Reform measures in the nineties

The industrial statement issued by the Government of India on 24th July 1991 stated, " The attainment of technological dynamism and international competitiveness requires that enterprises must be enabled to swiftly respond to fast changing external conditions that have become characteristic of today's industrial world. Government policies and procedures must be geared to assisting entrepreneurs in their efforts. This can be done only if the role played by the Government were to be changed from that of only exercising control to one of providing help and guidance by making essential procedures fully transparent and by eliminating delays."

So spurred by the crisis of 1991 a massive set of changes took place in the policy framework in the spheres of industrial licensing, public sector, small scale sector, foreign direct investment, portfolio investment, external borrowing, international trade and commerce, finance, taxation, banking sector, development finance institutions and non-banking finance companies.

Trade and Commercial Policy

Since this study intends to explore the impact of trade liberalization on technical efficiency the area that is being specially focussed upon is the trade and commercial policy area. The area of trade and commercial policy broadly encompasses the areas of import licensing, tariffs, export subsidies and exchange rate policies.

Import Licensing

Prior to 1990 India's trade policy regime was quite complex with various categories of importers, import licenses and ways of importing. The import and export policy (1990-93) was replaced by the Exim policy (1992-97) and then the Exim policy (1997-2001). The former contained a negative list on imports subject to licensing, infact almost all consumer goods were subject to licensing. In the latter, the list of restricted

consumer goods and the list of canalized items were also pruned. Permitting their imports through freely transferable special import licenses has liberalized import of some restricted items. India's unrestrained use of quantitative restrictions was strongly challenged in the WTO balance of payments committee in December 1995. Citing comfortable balance of payments position the committee gave a ruling that India has to abolish all quantitative restrictions and in April 2001 India abolished all quantitative restrictions.

Tariffs

Prior to 1991 India's import tariffs were among the highest in the world. Following the Chelliah committee (1992) recommendations India lowered it's average tariff rate from 125% in 1990-91 to 35% in 1997-98. The corresponding reduction in import-weighted average has gone down from 87% to 20%. The peak rate of duty declined from 335% in 1990-91 to 45% in 1997-98 and to 40% in 1999-00.Following the principle of systemic escalation according to the degree of processing, the committee suggested the use of multiple tariff structure with lowest rate of 5% applicable to fertilizer and news print inputs and highest rate of 50% applicable in case of inessential consumer goods. The peak rate of import duty has been brought down from 50% to 40% advalorem and to 30% for raw materials. Import of capital goods for general projects has a uniform tariff of 20%. Import duty on raw materials and components viz. coking coal and ferro alloys used in the steel and power sector has been reduced to 10% and 20% respectively to keep the duty on raw materials less than that on finished products. The overall dispersal of customs duty rates on chemicals has been reduced with a reduction of peak duty from 40% to 30%. Tariffs have been rationalized with full exemption to computer software and equipment and chemicals used in petroleum operations and setting up of crude petroleum refinery.

Exchange rate policies

The macroeconomic stabilization and structural adjustment program initiated in mid 1991,adjusted the external value of the rupee, which was overvalued for most of the preceding period. This had adversely affected exports. An explicit dual exchange rate system was introduced in March 1992 on a temporary basis to facilitate transfer to a more liberalized exchange rate regime. The newly introduced liberalized exchange rate system (LERMS) consisted of a free market rate along with an official rate set by the Reserve Bank of India (RBI) in U.S. Dollars. Forty percent of current account receipts from export of goods and services were to be surrendered at the official exchange rate while the remaining 60% could be converted at the market exchange rate. Import transactions undertaken at the official rate include crude and diesel oil, kerosene, certain fertilizers and raw materials for fertilizers, life saving drugs and government department imports. All other imports were to be undertaken at the free market rate, as were capital account transactions (barring IMF transactions). RBI could intervene at its discretion to level excessive and erratic movements and to offset seasonal fluctuations in the exchange rate. From 1993 onwards what we find on the exchange rate front is known as dirty float.

1.4 Objective of Study

Empirical studies tend to suggest that there is a lot of ambiguity regarding the nature of the relationship between trade liberalization and technical efficiency contrary to theoretical claims made in this regard. This makes it a fit case for further investigation. This particular study intends to carry out both time invariant as well as time variant technical efficiency analysis for certain manufacturing sectors of the Indian economy over the time span 1988-89 to 1997-98.Observing the broad trends in the foreign trade indicators namely exports and imports, I have identified a set of two manufacturing sectors, which have witnessed a lot of opening up and in that sense, have been subjected to international prices and competition. In this particular study we are trifurcating the time span 1988-89 to 1997-98 into a pre-liberalization span from 1988-89 to 1990-91 and a post liberalization span from 1992-93 to 1997-98 with the adjustment year 1991-92

coming in between. Of the three industries being studied textiles and transport equipment have witnessed a surge in imports in the post liberalization era in a relative sense. In order to prove by negation I have also selected another industry, which has hardly faced any imports and that is pharmaceuticals. The study not only presents relative technical efficiency estimates at the firm level for all the industries under consideration it also tries to capture whether the variation in technical efficiency is taking place at a significant rate or not. The next exercise that the study carries out is an identification procedure of the crucial driving forces behind technical efficiency. By carrying out a random effects feasible generalized least squares regression involving time variant technical efficiency as the regressand and outward orientation factors like ratio of exports to sales, raw material import intensity and import of technology as regressors. The other regressors included in the regression are firm specific factors like age and square of age of the firm and research and development expenditure carried out by the firm. The underlying objective is to see whether the outward orientation factors are really crucial in influencing technical efficiency or do firm specific characteristics overshadow them.

1.5 The plan of Study

There are six chapters in this study including the present one. Chapter 2 presents a literature review covering the methodologies of technical efficiency measurement, including both parametric as well as non-parametric approaches. The second chapter also provides an account of the manufacturing sector studies exploring the dynamic link between trade liberalization and technical efficiency. Chapter 3 describes the database, the primary variables and the derived variables that have been used for calculating time invariant as well as time variant technical efficiency for this study. Chapter 4 provides a detailed picture of the relative position of the various firms on the technical efficiency scale for each of the industries under consideration. The chapter also shows whether the variation in technical efficiency and its rate over the time span under consideration is significant or not. Chapter 5 carries out an identification exercise trying to identify the crucial driving forces behind technical efficiency. It carries out a random effect feasible generalized least squares regression involving time variant technical efficiency as the

regressand and ratio of exports to sales, age of the firm, square of age, raw material import intensity and import of technology as regressors. Chapter 6 summarizes the study and presents its conclusions.

Chapter-2

Review of Literature: Openness and Technical Efficiency

Chapter 2

Review of Literature: Openness and Technical Efficiency

2.1 Introduction

The present chapter makes an attempt at encapsulating the literature on trade liberalization and technical efficiency. The survey has been broadly divided into two sections. The first pertains to a review of the various methodologies of measuring technical efficiency and openness and the second section makes an attempt at listing the findings of various empirical studies exploring the dynamic link between trade liberalization and technical efficiency in the context of various countries.

The lay out of the chapter is as follows; Section 2.2 provides a brief review of openness indicators. Section 2.3 pertains to frontier functions and technical efficiency estimation. Section 2.3.1 deals with frontier production frameworks whereas Section 2.3.2 deals with technical efficiency estimation. Sections 2.3.2.1 and 2.3.2.2 deal with deterministic and stochastic frontier production frameworks respectively. Section 2.4 is devoted to panel data models. Section 2.4.1 deals with time invariant panel data models while Section 2.4.2 is devoted to time variant panel data models. Stochastic Coefficients Frontier Approach (SCFA) has been discussed at length in Section 2.5.Section 2.6 pertains to a comparative analysis between Data Envelopment Analysis (DEA), Stochastic Coefficients Frontier Approach (SCFA) and Stochastic Frontier Approach (SFA). Section2.7 onwards the paper moves on to the empirical findings.

The focus in this section is on two studies carried out in the context of two different countries Peru and Chile. Alam and Morrison (2000), which has studied the impact of trade liberalization on technical efficiency in the Peruvian context, has come up with a conclusion supporting the contention that protectionism and technical efficiency are inversely related. On the other hand Tybout De Mello and Corbo (1991) concludes that in Mexico a dramatic spell of trade liberalization led to an overall decline in productivity and efficiency in the manufacturing sector. These two studies have been

reviewed at length to highlight the ambiguity that prevails regarding the relationship between trade liberalization or openness and technical efficiency.

Last of all Section 2.8 caters to the summary and conclusions of this literature review on openness and technical efficiency.

2.2 Indicators of Openness

The large literature on trade policy reform includes several different concepts of liberalisation. In general liberalisation has been equated with becoming more "outward oriented". However this term tends to be interpreted in three broad ways. Countries may be considered more outward oriented if their trade reforms imply a move toward neutrality, liberality or openness. A move toward neutrality involves equalizing incentives on average between the exporting and imports competing sectors. A more liberal regime is one where the level of intervention has been reduced. Finally an increase in openness is equated with an increase in the importance of trade in the economy (as a percent of GDP). Thus we find there is no consensual definition on trade liberalisation and hence it becomes difficult to assess the extent to which it has occurred. This study defines openness in the following way. An industry or economy is said to be more open the smaller is the extent of barriers to the free movement of goods, services and ideas.

A common method of measuring the degree of trade control is by calculating tariff barriers either it is a simple average or it is a weighted mean.

2.2.1Measures calculating tariff barriers

Mean tariff is a simple arithmetic mean of all tariff lines defined at four digit level obtained from aggregating over six digit trade commodity classification as followed in the nomenclature of Indian Trade Classification Harmonized System (ITCHS). In order to measure the extent of protection prevailing in an economy we have to introduce weights. The weights may be calculated on the basis of value added or value of imports of the commodity in question.

2.2.2Measures calculating non-tariff barriers

Among the various ways of measuring non-tariff barriers a commonly used indicator is the coverage ratio (frequency). The coverage ratio measures the percentage of commodities within a four-digit ITCHS category that are affected by non-tariff barriers. Henceforth we will refer to non-tariff barriers as NTBs. The coverage ratio shows the extent of NTBs envisaged by trade policy however it does not capture the effect of those NTBs. This brings us to the price gap based measures because they can be used to capture the effect of those non-tariff barriers. Price gap based measures however capture the effect of both tariff as well as non-tariff barriers.

Coverage ratios are defined as the percentage of products within a category that is affected by an NTB. If we define $w_i = m_i/\Sigma m_i$ as the import weight, where m_i=imports of the i^{th} commodity affected by an NTB.If a dummy n_i is used to capture the presence or absence of NTB's such that n_i=1 if there are NTB's and $n_i = 0$ if there are no NTB's Then, the NTB coverage ratio is defined as $\Sigma n_i w_i$. An alternative is to calculate simple average of the coverage ratios. Another variant assigns different weights to the different types of NTB's, and uses that to derive a more sophisticated measure.

2.2.3 Price-gap based measures

The two price gap based measures are nominal and effective rates of protection. The nominal rate of protection is defined as the percentage excess of domestic price over world market price resulting from protective measures. The nominal rate of protection denoted here by NRP is expressed as follows.

$$NRP^0 = [(P_d/P_w) - 1]*100$$

Where

P_d = domestic price of the product measured as the ex-factory price net of excise duty.

P_w = world price of the product taken as the f.o.b. export price if the product is exported/exportable and the c.i.f. world price if it is imported/importable.

If tariffs are the only source of protection then the NRP is the tariff rate itself. However domestic prices may be distorted due to non-tariff barriers as well. While a

tariff on the commodity provides protection to the domestic producer, tariffs on intermediate inputs reduce the extent of protection by raising the price of inputs. A measure of protection that takes into account tariffs on both the inputs and the output is the effective rate of protection.

The effective rate of protection (ERP) is defined as the percentage excess of domestic value added introduced because of tariff and other trade barriers. This measures the distortions introduced due to both tariff and non-tariff barriers on the input prices as well as the final output prices and therefore measures the true level of protection as compared to world prices.

Methods to measure ERPs are classified into two broad categories. Tariff based and Price based .In the first approach the ERP is rewritten in terms of tariff rates and input output coefficients as

$$ERP_j = (t_j - \sum_i a_{ij} t_i)/(1 - \sum_i a_{ij})$$

Where a_{ij} is the free trade input coefficient per unit of output t_j denotes the tariff rate on the finished product whereas t_i denotes the tariff rate on the i^{th} input entering into the production of one unit of the j^{th} product. Effective rates of protection are thus an increasing function of output tariffs and a decreasing function of input tariffs. The tariff rates itself can be measured in three different ways. The first is the nominal or the published tariff rate. The second is the realized tariff rate that is the amount of import duty actually collected divided by the value of imports. The third measure is the implicit tariff rate defined as the ratio of domestic price minus the border price to the border price.

In the tariff based approach we measure both NRP and ERP using published tariff rates. The price-based measure of ERPs involves the calculation of value addition using price levels of outputs and inputs. Whereas the tariff based ERP is restricted to sectors for which input output coefficients are available the price based ERP can be calculated at a more disaggregated level.

Following this method

$$ERP^0 = (VA_d / VA_w) - 1$$

$$= [(p_d - TI_d)/(P_w - TI_w)] - 1$$

$= [(p_d - TI_d)/(P_w - TI_w)] - 1$

here VA_d denotes value addition estimated using prices prevailing in the domestic economy whereas VA_w denotes the value added estimate calculated using international prices. TI denotes the value of tradable inputs and P the price of output.

Apart from these there are a number of other indicators of openness like David Dollar's indices of Distortion and variability, The Sachs-Warner indicator etc.

2.3 Technical efficiency and Frontier Functions

The basic concept of measuring technical efficiency is concerned with describing production technology. Generally production technology can be represented using isoquants, production functions, cost functions or profit functions. This study focuses on frontier production functions.

2.3.1 Production Functions

Firm i in period t is constrained by a production technology represented by

$$Q_{it} = Ae^{h(i,t)} f_t(K_{it}, L_{it}, M_{it})$$

Where Q_{it} represents output, and K_{it} , L_{it} and M_{it} represent the capital labor and materials inputs for firm i in period t. The Hicks neutral productivity factor, $Ae^{h(i,t)}$ is allowed to be different across firms. It is further assumed that h(.) can be parameterized as

$h(i,t) = u(i) + \lambda(t) + v_{it}$

Where $u(i) = u_i$ depends on unobservable firm level differences such as differences in managerial efficiency and quality of inputs $\lambda(t)$ represents productivity and policy shocks common to all firms during any time period and v_{it} represents all other omitted variables and is assumed to be a mean zero error term. Thus u_i is an individual effect as first proposed by Mundlak (1961) and Hoch (1962).

Now

$\lambda(t) = \lambda_t$

Taking logs the above equation can be re-written as

$$\log(Q_{it}) = \ln(A) + u(i) + \lambda(t) + v_{it} + \ln f_t(.)$$

The estimation of this equation requires the form of $f_t(.)$ to be specified. Three alternative specifications are estimated. In the first $f_t(.)$ is assumed to be a Cobb-Douglas function of the three inputs. In the second $f_t(.)$ is assumed to be a translog function of the three inputs. We are assuming that $f_t(.) = f(.)$ for all t.

Specifications:

Cobb-Douglas

$$f_t(.) = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it}$$

Where l,k and m respectively refer to the natural logs of the three inputs L,K and M.

Translog1

$$f_t(.) = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + (1/2)\beta_{ll} l_{it}^2 + (1/2)\beta_{kk} k_{it}^2 + (1/2)\beta_{mm} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it}$$

Translog2

$$f_t(.) = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + (1/2)\beta_{ll} l_{it}^2 + (1/2)\beta_{kk} k_{it}^2 + (1/2)\beta_{mm} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it}$$
$$+ \beta_{km} k_{it} m_{it} + \beta_t t + (1/2)\beta_{tt} t^2 + (1/2)\beta_{lt} l + (1/2)\beta_{kt} k + (1/2)\beta_{mt} m$$

2.3.2 Methodology for estimating Technical Efficiency

The basic assumption underlying the measurement of technical efficiency is that a gap normally exists between a firm's actual and potential levels of performance. Let us consider the production function for the single output y using input vector x. Then an output based Debreu-Farell style measure of technical efficiency is.

$$TE(y,x) = y / f(x)$$

The econometric framework for our study embodies the Debreu-Farell interpretation as well as the textbook definition for a production function. Thus we begin with a model such as.

$$y_i = f(x_i, \beta) TE_i$$

Where

$$0 \leq TE(y_i, x_i) \leq 1$$

β is the vector of parameters of the production function to be estimated and i indexes the n firms in the sample. The production model will usually be linear in the logs of variables, so the empirical counterpart will be of the form

$$\ln\ y = \ln\ f(x_i, \beta) + \ln TE_i$$

Where $u_i > 0$ is a measure of technical efficiency since

Farrell suggested that technical efficiency can be analyzed in terms of realized deviations from an idealized frontier isoquant. This approach falls naturally into an econometric approach in which the inefficiency is identified with disturbances in a regression model.

If we assume that the production model $f(x_i,\beta)$ is linear in the logs of the inputs or functions of them, and the log of the output variable appears on the left hand side of the estimating equation. It is convenient to maintain that formulation and write

$$\ln y_i = \alpha + \beta' x_i + \varepsilon_i$$

Where $\varepsilon_i = -u_i$ and x_i is the set of whatever functions of inputs enter the empirical model. We assume that ε_i is randomly distributed across firms. An important assumption to be dropped later is that the distribution of ε_i is independent of all variables in the model. ε_i is a nonzero mean constant variance and otherwise ordinary regression disturbance. So $E(\varepsilon_i) < 0$. The model can thus be written.

$$\therefore \ln y_i = (\alpha + E(\varepsilon_i)) + \beta' x_i + (\varepsilon_i - E(\varepsilon_i))$$

$$\ln y_i = (\alpha + E(\varepsilon_i)) + \beta' x_i + (\varepsilon_i - E(\varepsilon_i))$$

$$\ln y_i = \alpha^* + \beta' x_i + \varepsilon'_i$$

This produces a classical linear regression model. Since the only deficiency in the OLS estimates is a displacement of the constant term one. Two approaches can be adopted to

get rid of these 1) Corrected Ordinary Least Squares method and 2) Modified Ordinary Least Squares method.

In the Corrected Ordinary Least Squares Method we create a series of residuals and then find out the maximum of the residuals is max e_i

$$a_{COLS} = a^* + \max e_i$$

$$e_{i,COLS} = e_i - \max e_i$$

The technical efficiency is then estimated as follows

$$TE = \exp(e_{i,COLS})$$

The firm for which TE = 1 is regarded as the most efficient firm. We next rank other firms relative to that firm. In the first all firms in the sample (irrespective of the sector to which they belong) are rated relative to the most efficient firm in the sample. This exercise is carried out for looking at inter sector differences in efficiency. In the second case each firm in a sector is rated relative to the best firm in that sector. The sector level exercise is carried out for analyzing the performance of sectors in terms of the variation of efficiency across firms in that sector.

An alternative approach that requires a parametric model of the distribution of u_i is Modified Ordinary Least Squares method (MOLS). The OLS residuals, save for the constant displacement are point wise consistent estimators i.e. $\varepsilon_i = -u_i$ .The mean of the OLS residuals is useless because it is zero by construction. However, since the displacement is constant the variance and any higher order central moment of the negative of the OLS residuals will be a consistent estimator of the counterpart of u_i. Thus if the parameters of E (u_i) are identified through the variance or perhaps, higher moments or other statistics, then consistent estimation of the deeper model parameters may be completed using the method of moments. Once an estimate of E(u_i) is obtained in this manner the estimated frontier function can now be displaced upward by this estimate of

$E(u_i)$.This MOLS method is a bit less orthodox than the COLS approach since it is unlikely to result in a full set of negative residuals.

2.3.2.1Deterministic Frontier Framework

Frontier functions in which the deviation of an observation from the theoretical maximum are attributed solely to the inefficiency of the firm are labeled deterministic frontier functions.

Aigner and Chu (1968) suggested a log linear Cobb-Douglas production function

$$y_i = AX_{1i}^{\alpha} X_{2i}^{\beta} U_i$$

In which U(which corresponds to Technical efficiency) is a random disturbance between 0 and 1.

Taking logs produces

$$\ln y_i = \alpha + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i$$

$$\ln y_i = \alpha + \sum_{k=1}^{K} \beta_k x_{ki} - u_i$$

Where $\alpha = \ln A$, $x_{ki} = \ln X_{ki}$ and $\varepsilon_i = \ln U_i$

The non-stochastic part of the right hand side is viewed as the frontier. It is labeled as "deterministic" because the stochastic component of the model is entirely contained in the inefficiency term. Aigner and Chu's approach was non-parametric involving linear programming and quadriatic programming methods of estimating residuals.

Limitations of Deterministic Frontier Model

It assumes that all factors are under the control of the firm. So it does not allow for random shocks that are beyond the control of the individual firm. Further it ignores the existence of "statistical noise" for example measurement error, specification error etc.

The deterministic frontier production model was estimated using ML method [Afriat (1972), Schmidt (1976), Greene (1980a, 1980b). It was also estimated using

corrected ordinary least squares technique (Richmond (1974), Page (1978) and Goldar (1985)].

2.3.2.2The Stochastic Frontier Model

If we go by the interpretation of the deterministic frontier model then deviations from the production frontier on account of an unusually high number of random equipment failures or even bad weather might appear to the analyst as inefficiency. So as an improvement over the deterministic frontier model the stochastic frontier model was suggested by Aigner, Lovell and Schmidt and Meusen and Van Den Broeck (1977). This entire model is motivated by the idea that deviations from the production frontier are not entirely under the control of the firm being studied. So as a matter of fact a firm faces it's own production frontier and that frontier is randomly placed by the whole collection of stochastic elements, which might enter the model outside the control of the firm. The frontier is formulated as follows.

$$y_i = f(x_i)TE_i e^{v_i}$$

Where all terms are as defined earlier and v_i is unrestricted. The latter term embodies measurement errors, any other statistical noise and random variation of the frontier across

$$\ln y_i = \alpha + \beta' x_i + v_i - u_i$$

firms. The reformulated model is

$$\ln y_i = \alpha + \beta' x_i + \varepsilon_i$$

As before $u_i > 0$ but v_i may take any value. A symmetric distribution such as the normal distribution is usually assumed for v_i . Both components of the compound disturbance are generally assumed to be independent and identically distributed (iid) across observations. The average inefficiency present in the distribution is reflected in the asymmetry of the distribution measured with the third moment of the residuals.

$$m_3 = 1/N(\sum_{i=1}^{N} (\hat{\varepsilon}_i - E(\varepsilon_i))^3$$

By expanding

$$\mu_3 = E[v_i - (u_i - E(u_i)]^3$$

We see that in fact the skewness of the distribution of the estimable disturbance ε_i is simply the negative of that of the latent inefficiency component, u_i. Regardless of the assumed underlying distribution the negative of the third moment of the OLS residuals provides a consistent estimator of the skewness of the distribution of u_i. Since this statistic has units of measurement equal to the cube of those of the log of output, which is a bit ambiguous, one might as a useful first step in any analysis examine the conventional normalized measure

$$\sqrt{b_3} = -m_3 / s^3$$

Values between 0 and say 4 are to be expected. Now we want to test whether there is any systematic inefficiency in the distribution we can then carry out a Wald test of the hypothesis based on the familiar chi-squared test.

$$\chi_1^2 = 1/6[-m_3 / s^3]^2$$

The skewness coefficient in any finite sample could have the wrong sign positive in this case. This might cast doubt on the specification of the stochastic frontier model and suggest that the Wald test is meaningless.

Specification and Maximum Likelihood estimation

The compound disturbance in the stochastic frontier model, while asymmetrically distributed is for most choices of the disturbance distributions otherwise well behaved. Maximum likelihood estimation is generally straightforward. The distribution of v_I is usually assumed to be normal, which we denote by

$$h(v_i) \cap N[0, \sigma^2]$$

The inefficiency part of the compound disturbance has a half normal distribution. With the assumption of a half normal distribution we obtain

$$E[u_i] = [\sqrt{2/\pi}]\sigma_u$$

$$Var[u] = [(\pi - 2)/\pi]\sigma^2{}_u$$

For a half normally distributed inefficiency term the log likelihood function for the stochastic frontier model is

$$\log l(\alpha, \beta, \sigma, \delta) = -N \ln \sigma - cons\tan t + \sum_{i=1}^{N} \{\ln \phi[-\varepsilon\lambda/\sigma_i] - 1/2[\varepsilon_i/\sigma]^2\}$$

Where

$$\varepsilon_i = \alpha + \beta' x_i - \ln y_i$$

$$\lambda = \sigma_u / \sigma_v$$

$$\sigma^2 = \sigma^2{}_v + \sigma^2{}_u$$

And ϕ is the standard normal CDF. The factor $\lambda = \sigma_u / \sigma_v$ is the ratio of standard deviations from the frontier due to error or inefficiency. If σ^2_v tends to zero then the one sided error becomes the dominant source of variation and the model collapses to a deterministic one.

Estimation by Corrected Ordinary Least Squares

The parameters of the stochastic frontier model can be estimated using the second and third central moments of the OLS residuals m_2 and m_3. For the half normal model the moment equations are

$$m_2 = [(\pi - 2)/\pi]\sigma_u^{\ 2} + \sigma_v^{\ 2}$$

$$m_3 = (\sqrt{2/\pi})[1 - (4/\pi)]\sigma_u^{\ 3}$$

It is to be noted that m_3 is negative since the offset in ε_i by u_i is negative. Thus σ_u and σ_v are easily estimable.

Since

$E[u_i] = (2/\pi)^{1/2}\sigma_u$

The adjustment of the OLS constant term is

$\hat{\alpha} = a + \hat{\sigma}_u\sqrt{2/\pi}$

These COLS estimators are consistent but the MLEs are more efficient in comparison to these. The degrees to which they are inefficient remains to be determined .The deeper parameters are all estimable by the method of moments. Waldman (1982) has pointed out an "intriguing quirk" in the half normal model. Normally there are two roots of the log likelihood function, one at the OLS estimates and another at the MLE. In theory the distribution of the compound disturbance is skewed to the left. But if the model is badly specified it can occur that the OLS residuals are skewed in the opposite direction. In this instance the OLS residuals are the MLEs and consequently one must estimate the one sided terms as terms as 0.0. This might be viewed as a built in diagnostic, since the phenomenon is likely to arise in a badly specified model or in an inappropriate application.

Coelli's formulation may be more convenient in this regard. He suggested the moment estimators.

$\hat{\sigma}^2 = m_2 + (2/\pi)[(\sqrt{\pi/2})(\pi/(\pi-4)m_3]^{2/3}$

$\hat{\gamma} = (1/\hat{\sigma}^2)[(\sqrt{\pi/2})(\pi/(\pi-4))m_3]^{2/3}$

$\hat{\alpha} = a + \sqrt{(2\gamma\hat{\sigma}^2)}/2$

As before the "wrong sign" on m_3 can derail estimation of γ,but in this instance a convenient place to begin is with some small value. Coelli suggests some small value 0.05.

Limitations of Stochastic Frontier model

There are mainly three problems that may arise with using stochastic frontier models. Firstly, the separation of random error and technical efficiency hinges on particular assumed statistical distribution. Schmidt and Sickles (1984) showed that with the use of panel data stochastic frontier could be estimated without distributional assumptions. Secondly it may be incorrect to assume that inefficiency is independent of the regressors. Thirdly technical efficiency of a particular firm in a stochastic frontier model can be estimated but not consistently.

Most of the drawbacks of the stochastic frontier production frontiers are avoidable if one refers to panel data models.

2.4 Panel Data models

Now let us delve into panel data models for technical efficiency estimation. Depending on the assumption regarding the variation of technical efficiency in a dynamic frame panel data models can be broadly categorized into time invariant panel data models and time variant panel data models. In the case of time invariant panel data models the assumption that the technical efficiency is "Time invariant" is very strong and depending on the data may prove inappropriate.

2.4.1Time-invariant panel data models

Prominent among the panel data studies estimating time invariant technical efficiency are Pitt and Lee (1981), Schmidt and Sickles (1984), Battesse and Coelli (1988), Battesse et al.(1989), Kalirajan and Shand (1989), Kumbhakar (1987), Kumbhakar and Suma (1989) ,Seale Jr.

A brief description of these models will follow Pitt and Lee (1981) attempted to measure the time invariant technical efficiency by estimating a stochastic frontier function associated with n firms over T time periods. The model is defined by,

$$Y_{it} = f(X_{it}, \beta)e^{(v_{it}-u_{it})}$$

Where Y_{it} represents the possible production for the i^{th} firm at time period t. Pitt and Lee (1981) considered three basic models defined in terms of assumptions made about the non-negative u_{it} s.The first model assumed that the u_{it} s were time invariant effects, that is $u_{it} = u_I$,t=1,2,....T. The second model specified that u_{it} s were uncorrelated and the third model permitted the u_{it} s to be correlated for given firms.

Schmidt and Sickles (1984) a special case of Cornwell Sickles and Schmidt (1990) formulated a model for technical efficiency estimation from Panel data. Henceforth we will refer to Cornwell Sickles and Schmidt as CSS. The single equation stochastic frontier production is of the following form.

$$Y_{it} = a + X_{it}'\beta + v_{it} - u_{it} ----(1)$$

i stands for firms and t stands for different time periods. Y_{it} is the output of firm i at time t and X_{it} is the vector of inputs.

Assumptions

Technical efficiency of a firm is constant over time i.e. there is no time effect. More over it is assumed that v_{it} are uncorrelated with the regressors X_{it}. The u_i represents technical efficiency of a firm and $u_i >= 0$ for all i and treated as firm effects and it is identically and independently distributed as a normal distribution with mean μ and variance σ^2 and independent of v_{it}.

Defining

$$a^* = a - \mu$$

And

$$u_i^* = u_i - \mu$$

Where

$\mu = E(u_i)$

And u_i^* are iid with mean zero. Therefore the model becomes.

$Y_{it} = a^* + X'_{it}\beta + v_{it} - u^*$

Again defining

$a_i = a - \mu_i = a^* - u^*$

The model becomes

$Y_{it} = a_i + X'_{it}\beta + v_{it}$

In this model only the intercept varies over firms. Differences in intercept can be interpreted as the differences in the level in inefficiencies over firms. The level of inefficiency remains unchanged through out the year a_i is the intercept of the i^{th} firm. It can be estimated as the coefficient of the dummy variable for the i^{th} firm. Differences in a_i across firms reflect differences in technical efficiency.

$\hat{a}_{\max} = \max(\hat{a}_1, \hat{a}_2, \hat{a}_3, ... \hat{a}_n)$

Let

Then the technical efficiency of the i^{th} firm with respect to the beat practice firm in the industry is measured as

$TE = \exp(\hat{a}_i - a_{\max})$

The best practice firm has technical efficiency equal to 100.Some advantages of the model are no particular assumption is required about the probability distribution of technical efficiency or random noise, the parameter estimates and efficiency levels obtainable without assuming that inefficiency is correlated with the explanatory variables, the model can be estimated by a number of techniques, depending on the number of assumptions that one is willing to make on the model. An important drawback is that given the time period studied the assumption of technical inefficiency is time invariant is a strong one and it may not have been realistic.

2.4.2 Time variant panel data models

CSS (1990) relaxed the assumption that the firm effects are time invariant in such a way that the advantages of panel data are preserved, that is CSS used panel data and allowed for intertemporal as well as cross-sectional variations in technical efficiency. The procedure used by CSS significantly improves upon the earlier work of Hausman and Taylor (1981). CSS's analysis is an improvement over earlier studies wherein only the intercept of the estimated equation varies across firms. Furthermore although cross-sectional and temporal variations in efficiency have been allowed in the random coefficient literature, typically this has involved the use of restrictive assumption that variations in the coefficients are independent of the regressors. The empirical model of CSS allows some or all of the regressors to be correlated with the cross-sectional variation in the coefficients. Thus the model also generalizes the earlier econometric results of Hausman and Taylor (1981) to develop an econometric technique that allows to choose how many explanatory variables we wish to assume to be uncorrelated with the firm's temporal pattern of economic growth. In the estimation of technical efficiency CSS used a general functional form for the transcendental logarithmic function. They included in the production function a flexible function of time that differs across firms.

In CSS (1990) model, the firm effects a_i of Schmidt and Sickles(1984) is replaced by flexibly parameterized function of time, with parameters that vary over firms. The firm effects at different time periods are a quadratic function of time, which is

$$a_{it} = \theta_{i1} + \theta_{i2}t + \theta_{i3}t^2$$

We can re write the model as

$$Y_{it} = X_{it}^{/}\beta + W_{it}^{/}\delta_i + v_{it}$$

With

$$W_{it}^{/} = [1, t, t^2] and \delta_i^{/} = [\theta_{i1}, \theta_{i2}, \theta_{i3}]$$

The model can be estimated by "Within", GLS, Efficient Instrumental Variable estimation procedure and for each case we get the residuals.

$$e_{it} = Y_{it} - X_{it}' \hat{\beta}$$

"Within" estimation procedure transforms data into deviation from individual means and performs least squares on the transformed data. In other words using a residual maker matrix we calculate deviations from individual specific means and then carry out regression on the transformed data.

As before the estimated firm-specific efficiency scores are computed relative to a base firm.

$$\hat{u}_{it} = \max(\theta_{1j} + \theta_{2j}t + \theta_{3j}t^2) - (\theta_{1i} + \theta_{2i}t + \theta_{3i}t^2)$$

Note that the maximum (or minimum for a cost frontier) is period specific and need not apply to the same firm in every period. This will interrupt the quadratic relationship between time and inefficiencies.

Random Effects Models

If the assumption of independence of inefficiencies and input levels can be maintained then a random effects approach might be preferable. One advantage of the random effects model is that it allows time invariant firm specific attributes such as the capital stock of a firm, which is not growing to enter the model. The familiar random effects regression model is easily adapted to the stochastic frontier model.

Two estimators are available, Generalized Least Squares (GLS) and ML (Maximum Likelihood). This estimation procedure can be carried out for both balanced as well as unbalanced panels. For GLS estimation we have to rewrite the model as.

$$\ln y_{it} = (\alpha - E(u_i)) + \beta' x_{it} + v_{it} - (u_i - E(u_i))$$

$$\ln y_{it} = \alpha^{*} + \beta' x_{it} + \nu_{it} - u_i^{*}$$

Now α^{*} does not depend on I because $E(u_i)$ is a positive constant. The displacement of the constant term notwithstanding it is amenable to the usual two step GLS treatment. At the first step OLS estimates of all parameters are estimated. The variance components $var[v_{it}]$ and $var[u_{it}]$ must be computed. Then estimates of $[\alpha^{*},\beta]$ are computed by feasible GLS (FGLS).

In order to derive an estimate of the inefficiency component $E(u_i)$ subsequent calculations are required. The simplest approach is to compute

$$\hat{w}_i = 1/T_i \sum_{t=1}^{T_i} (y_{it} - a^{*} - b' x_{it})$$

$$\hat{w}_i = -(\hat{u}_i - \hat{E}(u_i))$$

This estimator is consistent in w_i and requires b to be a consistent estimator of β. However the fact remains that neither of these actually estimates u_i. In order to do so it is necessary to obtain an estimate of $E(u_i)$, which in turn necessitates a fuller specification of the distribution of u_i. Stevenson produced results for a truncated normal distribution. The one-sided error term u_i was obtained by truncating at zero the distribution of a variable with nonzero mean.

$$U_i \sim N[\mu, \sigma_u^2], u_i = |U_i|$$

Then

$$E(u_i) = \mu + \sigma_u [\phi(-\mu/\sigma_u) / \Phi(-\mu/\sigma_u)]$$

This is not identified in terms of $\overline{w}$, which equals zero by construction. The parameters are then identified in terms of second and third moments of w, or the second moment of w and any sample cumulative frequency assuming that N is large enough. Alternatively one might define efficiency in a relative sense as was done in the fixed effects model and use

$$\hat{u}_i = max_i(\hat{w}_i) - \hat{w}_i$$

2.5 The Stochastic Coefficients Frontier Approach

An alternative approach of modeling firm specific production behaviour and of measuring firm-specific technical efficiency measures is proposed and defined here as the Stochastic Coefficients Frontier approach (SCFA).

The literature indicates that a firm obtains its frontier potential output by following the best practice techniques, given the technology. In other words, frontier output is determined by the method of application of inputs, regardless of the level of inputs. Empirical evidence suggests that with the same level of inputs different levels of actual output are obtained by following different methods of applications. This implies that the different methods of applying various inputs will produce different outputs. This means that diversity of individual decision-making behaviour leads to variations in production response coefficients, which include not only the intercept but also the slope coefficients, across units and over time for the same unit. The value of this approach was appreciated earlier by Nerlove (1965), who found it appropriate to treat the elasticities of output with respect to inputs as random variables differing from firm to firm. This random coefficients approach was later popularized by Swamy (1970) and provides an important alternative new methodology to the existing methods of measuring technical efficiency.

A general formulation in terms of panel data is as follows.

$$y_{it} = \sum_j \beta_{ijt} x_{ijt} + \varepsilon_{it}$$

i = 1,2,3,.....,n and t = 1,2,3,.....T

Where y_{it} is the logarithm of output of the ith firm in the tth period x_{ijt} is the logarithm of the j^{th} input used by the i^{th} firm in the t^{th} period and ε is the disturbance term. The above equation implies that production response coefficients are specific to each individual decision making unit and to each time period for the same decision making unit.

Unfortunately the above equation cannot be estimated as the number of parameters to be estimated exceeds the number of observations. This necessitates imposing certain restrictions on the structure of the equations. One method to reduce the number of parameters in the above equation is to follow the Analysis of Variance(ANOVA) approach. This means imposing the following restrictions.

$$\beta_{ijt} = \bar{\beta}_j + u_{ij} + v_{jt}$$

Where j = 1,2,....., m

$$\sum_{i=1}^{n} u_{ij} = 0$$

$$\sum_{i=1}^{T} v_{jt} = 0$$

Where u_{ijt} and v_{jt} respectively denote cross-sectional and temporal variation of the production coefficients β_{ijt}. The above specification is a more general case of the specification discussed by Cornwell Sickles and Schmidt (1990) and so is not parsimonious. Following the estimation procedures suggested by Hsiao(1986) and Griffiths(1972) the individual response coefficients can be estimated. From the results, the coefficients of the frontier production function can be estimated as follows.

$$\beta_{jt}^{*} = max\{\beta_{ijt}\}$$

$$i = 1,2,.....,n; j = 1,2,.....m; and t = 1,2,.....T$$

Where β^{*}_{jt} is the frontier coefficient of the j^{th} input in the t^{th} period and β_{ijt} is the coefficient of the j^{th} input of the i^{th} firm in the t^{th} period. The underlying assumption is that the appropriate production coefficients will be the maximum from among those achieved by individual decision-makers who follow the best practice techniques. It should be understood that in this approach it is not assumed that each and every maximum coefficient will be from a single decision-maker. Now technical efficiency of the i^{th} decision-making unit can be calculated as:

$$(TE)_{it} = (y_{it})/exp(y_{it}^{*})$$

Where y_{it} is the observed output of the i^{th} decision making in the t^{th} time period and y_{it}^{*} is the estimated frontier output of he i^{th} unit in the t^{th} time period using the frontier coefficients from the above equation. A major advantage of the above methodology is that the analysis can be carried out even with cross-sectional data though panel data would be preferable. The limitations of the stochastic frontier production function including considering technical efficiency as lumpsum assigning a distribution to the efficiency related variable, and the potential output as a neutral shift from the actual output are eliminated.

2.9 Data Envelopment Analysis (DEA), Stochastic Frontier Approach (SFA)and the Stochastic Coefficients Frontier Approach:A Comparison

The Data Envelopment Analysis (DEA),the Stochastic Frontier Approach(SFA) and the Stochastic Coefficients Frontier Approach(SCFA) use the concept of frontier to define technical efficiency. In both DEA and SCFA, the level of technical efficiency is determined in relation to the most dominant observations in the sample. In stochastic frontier approach on the other hand the level of technical efficiency is measured in relation to its own potential, which is not observed in the sample. While DEA and SCFA can facilitate identification of a benchmark of excellence in a given sample of observations, the SFA can provide a signal to indicate whether a firm's performance is adequate in realizing its own potential.

A major advantage of DEA is that it places no restrictions on the functional form of the relationships between inputs and outputs. Another disadvantage is that DEA does not require imposition of any distributional assumptions on form specific effects u_i. But one of the principal disadvantages is that DEA can be extremely sensitive to the selection of variables and data errors. Another limitation, which is often mentioned in the literature, is that DEA efficiency measures in small samples are sensitive to the difference between the number of firms and the sum of inputs and outputs. Due to this limitation many firms may seem to be efficient even though they are not.

An advantage of SFA is that various hypotheses concerning modeling of the technology and characteristics of firm specific efficiency measures can be statistically tested. Modeling production functions following SFA is in conformity with production theory. Stochastic production functions offer flexibility in modeling various specific aspects of production such as production and marketing risks. Further it facilitates decomposition of economic efficiency into technical and allocative efficiencies. However a major criticism of this approach is that it requires the imposition of certain specific distributional assumption on firm specific technical efficiency related variables.

SCFA possesses some of the advantages of using both DEA and SFA, because SCFA may be viewed as a stochastic counterpart of DEA. SCFA does not require the imposition of any distribution assumption on firm specific effects. The modeling of production technology following SCFA is in conformity with production theory. SCFA facilitates calculation of overall technical efficiency as in SFA and also provides measures of input specific efficiencies without involving any significant any additional calculations. A major criticism which can be levelled against SCFA under special cases of the production process in which constant returns to scale are imposed on the individual response coefficients is that estimation of frontier coefficients B_Js would be complicated and intractable and the frontier would not remain feasible.

Stevenson (1980) has pointed out different assumptions about firm specific effects make comparisons from different studies less meaningful. Nevertheless several researchers have attempted to compare results from the applications of different estimation methods on the same data sets. Gong and Sickles (1992) used their Monte Carlo results to indicate the relative performance of the stochastic frontier models vis-à-vis DEA is determined by the choice of the functional forms. If the employed functional; form is close to the underlying technology then SFA outperforms DEA using a number4 of metrics. As the misspecification of the chosen functional form becomes more serious and as the degree of correlated ness of inefficiency with the regressors increases DEA becomes more appealing than SFA.

Kalaitzandonakes et al. (1992) in their study found that the technical efficiency of each individual observation in the sample varied widely when DEA and SFA were used as estimation procedures. They also found that the degree of measured efficiency was

very sensitive to the assumptions above the appropriate the method of analysis. They showed that in many cases, SFA and DEA not only yielded different estimates of technical efficiencies but also provided different distributions of efficiencies among observations for the same data set.

Thus from the above comparisons of DEA and SFA the following points emerge. First the efficiency measurement is determined by the choice of functional forms considered to represent the production technology and second DEA appears to be more appropriate when the knowledge about underlying technologies is weak. On the other hand information about scale and substitution possibilities is best handled with either SFA or SCFA.

2.10 Manufacturing sector studies exploring the dynamic link between Trade Liberalisation and Technical Efficiency

This section makes an attempt to list the findings of various studies exploring the dynamic link between trade liberalization and technical efficiency in the context of various countries. Development economists routinely argue that the loosening of trade restrictions is a macroeconomic policy shift that should have a microeconomic impact on technical efficiency. In the process of covering various studies this section would make an attempt at segregating studies supporting the hypothesis that trade liberalization has a favorable impact on technical efficiency from those opposing it. The fact remains that it is impossible to state unequivocally that trade liberalization leads to an enhancement in technical efficiency. In order to bring out this ambiguity clearly the focus in this section will be on two studies Alam and Morrison (2000) which explores the impact of the 1990 Peruvian reform on plant level technical efficiency and Tybout, DeMello and Corbo (1990) which explores the impact of the dramatic trade liberalization of the 1970s on industrial sector performance in the Chilean context. The section also reviews another study by Nina Pavcnik using the same Chilean firm level data investigating the trade liberalization productivity link.

Peru was one of the last Latin American countries to abandon import substitution industrialization as a development strategy. Under the stewardship of the Fujimori

government the country experienced a far-reaching neo-liberal reform package from July 1990 onwards. The country witnessed not only tariff reforms but also removal of wage and price controls, increases in the price and elimination of subsidies to public services, reduction in public sector employment, unification of a multiple exchange rate system and other wide ranging reform measures. Alam and Morrison (2000) carried out a firm level analysis involving manufacturing plants with an employee strength exceeding 20 over the time span 1988-92 two years before and two years after the reforms of 1990.They estimated technical efficiency using a linear programming method of data envelopment analysis and then regressing it on rates of effective protection, Herfindahl index of industrial concentration and the square root of the number of plants in each sector. In the absence of the third regressor the regression results do not support the hypothesis that trade liberalization has a favorable impact on technical efficiency. Although the coefficient on trade protection is negative (indicating that industries that with higher levels of protection have lower mean efficiency scores) it is not statistically significant. The coefficient on industrial concentration as measured by the Herfindahl index is statistically significant but its sign is quite contrary to expectations. The coefficient suggests that more efficient industries have higher efficiency scores. However including the square root of the number of firms as the third regressor the results do support the hypothesis and the coefficients of all the regressors are significant at the ten percent level of significance.

The second study that this section reviews is based on the Chilean experience. Tybout, Demello and Corbo (1990) explores the changes in industrial sector performance that accompanied the dramatic trade liberalization of the 1970s.Like most developing countries Chile pursued an import substituting industrialization strategy in the 1950s and 1960s.By 1967 quantitative restrictions were widespread the cross sectoral dispersion in tariff rates was extremely high and the average effective protection rate for manufacturing was over 100%. In addition, market entry and exit were limited by extensive controls on the domestic credit market and by labor laws that made worker dismissal difficult. Finally price controls on domestic credit markets were all pervasive. All these changed in the 1970s by 1974 all quantitative restrictions were dismantled, and between 1975 and 1979 the average effective protection rate for manufacturing was

brought down below 15%, while cross-sectoral dispersion in tariff rates was virtually eliminated. By 1979 Chile had achieved one of the lowest and most uniform protection structures in the world. Tybout, Demello and Corbo (1990) reports that between 1967 and 1979 there was an unequivocal fall in total factor productivity, value added per plant, workers per plant and labor efficiency per plant. Finally the paper concludes that over the census years understudy there was an overall decline in industrial efficiency.

Pavcnik (1988) once again is a study devoted to the Chilean context. The paper empirically investigates the effects of trade liberalization on firm productivity. The production function is estimated semi parametrically to correct for the presence of selection and simultaneity biases in the estimates of the input coefficients required to construct a productivity measure. Firm exit is also introduced in the estimation process to correct for the selection problem induced by liquidated plants. The paper finds evidence of within firm productivity improvements that can be attributed to a liberalized trade policy especially for firms in the import competing sectors. The paper also reports that in many cases aggregate productivity improvements stem from the reshuffling of resources and output from less to more efficient producers. This brief review reinforces the ambiguity that prevails regarding the trade liberalization, technical efficiency link in general.

Since this study explores the causal link between trade liberalization and technical efficiency in the context of some selected Indian manufacturing sectors, it becomes thoroughly important to cite some studies exploring the impact of trade liberalization on industrial performance in the Indian context. However, the fact remains that most of the India specific studies explore the link between trade liberalization and total factor productivity growth. Fujita (1994) is an industry level study involving firms at three digit level of disaggregation it intended to explore whether TFP growth is a function of trade liberalization. The methodology that is used in that study is an inter industry cross-section regression. It concluded that trade liberalization has a positive impact on TFP growth. However the major limitation of the study was that there was an explicit lack of trade policy indicators.

Krishna and Mitra (1998) is a firm level study done in a production function framework involving the Hall's methodology. The methodology is inter-firm panel

regression involving a random effect model. The observation that the study came up with was essentially that trade liberalization has a positive impact on total factor productivity growth.

Balakrishnan, Pushpangadan and Babu (2000) is also a firm level study involving the Hall's methodology that carried out an inter-firm panel regression using a fixed effects model. It concluded that trade liberalization has a negative impact on growth. The most vivid limitation that both these studies encountered was that there was an explicit lack of trade policy indicators. Das (2001) is once again an industry level study. The panel data used for the study is composed of a set of three digit industries. The methodology is once again a panel regression assuming a fixed effects model framework. The study once again gave a verdict supporting the hypothesis that trade liberalization leads to an enhancement of TFPG.

So the fact that there is an ambiguity in the nature of the relationship between trade liberalization and total factor productivity gets established in this brief review on India specific studies.

2.8 Summary and Conclusions

The review begins with indicators of openness, starting off with the ones used to measure tariff and non-tariff barriers then slowly moving on to price gap based measures like nominal rate of protection and effective rate of protection. The review then moves on to frontier functions and the various methodologies involved in the measurement of technical efficiency. Explaining the fundamental drawback underlying the deterministic frontier framework of technical efficiency measurement the paper next reviews the stochastic frontier framework. Panel data models both time invariant and time variant are reviewed next they are of special significance because this study is a firm level study involving unbalanced panels of firm level data. The last of the parametric methodologies of technical efficiency measurement that this review covers is the stochastic coefficients frontier approach. The review next presents a comparative analysis between the parametric and non-parametric methodologies of technical efficiency measurement. Had it not covered the manufacturing sector studies exploring the trade liberalization technical

efficiency link in the context of various countries this literature review would have been thoroughly inadequate and that is what section 2.10 of this review is exactly devoted to.

Chapter-3

Data and Measurement of Variables

Chapter 3

Data and Measurement of Variables

3.1 Introduction

This chapter discusses the data source and construction of variables used for the estimation of both time invariant and time variant technical efficiency. The data has been principally extracted from CMIE Prowess, a database of over six thousand companies incorporating their profit and loss statement, balance sheet, cash flows, products manufactured, raw materials consumed, changes in capital structure, share price movements, returns, news, investment plans etc. The lay out of the chapter is as follows. Section 3.2 describes the sample industries and the unbalanced panel of firms chosen for the study. Section 3.3 presents the background data fields that have been used to identify the various firms considered in the study. Section 3.4 deals with the financial performance data fields from which information has been compiled followed by a brief description of the variables constructed for efficiency estimation. The last section 3.5 devoted is to the data sources.

3.2 Sample industries and time periods of the study.

Three industries have been chosen for the study namely textiles, transport equipment and pharmaceuticals. The industry category textiles is broadly composed of silk and silk textiles, wool and woolen products, cotton and cotton textiles, jute and other vegetable fibres, man made filaments and fibres, apparels, carpets etc. and other textile articles. The second industry category that the study explores is transport equipment it is composed of aircrafts, ships, boats, automobiles, automobile ancillaries and cycle rickshaws etc. The last but by no means the least industry that the study considers is pharmaceuticals i.e. drugs, medicines and allied products. The period under consideration is from 1988-89 to 1997-98.This entire time span has been trifurcated into a pre-liberalization era stretching from 1988-89 to 1990-91 and a post liberalization span from 1992-93 to 1997-98 with the adjustment year 1992-93 coming in between.

3.3 Basic Background Datafields

The basic background datafields that have been used for identifying a company are company name and year of incorporation. Company name is the complete name of the company. In Prowess, the name of a company is kept as close to its official registered name as possible .The year of incorporation pertains to the most recent incarnation of the company. In the case of companies that were reorganized the year of incorporation may not reflect the true age of the company.

3.4 Financial Performance Data fields

Sales

Gross sales/operating income denotes the revenue generated by an enterprise during a given period. The revenue is measured by the charges made to consumers or clients for goods supplied and services rendered to them. Sales/operating income includes revenue generated by a firm from its main business activities. It excludes other income and income from non-recurring transactions, income of extra ordinary nature and prior period income.

Wages and salaries

This includes total expenses incurred by an enterprise on all employees, including the management. Besides salaries and wages, items such as payment of bonus, contribution to employee's provident fund and staff welfare expenses are also included under wages. Certain companies particularly in tea and sugar industry pay wages in kind, the value of such items are included here. Salaries and wages also include commissions given to employees. While remuneration paid to directors is treated as part of wages, sitting fees, commission paid to directors is treated as other expenses. Recently many

companies have announced VRS (Voluntary Retirement Scheme) packages to its employees. However there is no standard accounting treatment related to this expenditure. While some companies charge the full amount of VRS to their revenue account during a year others treat these as deferred revenue expenditures and charge part of it over the years to the revenue account. Prowess treats VRS amount as non-recurring extra ordinary item if the company has charged the full amount to the revenue account in a single year. If the company has followed deferred accounting policy the amount charged is treated as part salaries and wages of the current year.

Total Cost

This broad expenditure category is composed principally of the two sub categories cost of sales and administration and other costs. The cost of sales subcategory is composed principally of cost of production, selling cost and cost of change in finished goods stocks. Selling cost on the other hand is composed off advertising expenditure, marketing expenditure, distribution expenditure and the cost incurred on account of bad debts.

R & D expenditure on capital account

These are the capital expenses incurred by a company on research and development. The information provided by Prowess under this head has been sourced from the particulars required under the Companies (Disclosure of particulars in the report of the board of Directors) Rules, 1988 and not from the profit and loss statement of companies. On many occasions companies do not disclose revenue expenditure on research and development separately. However as a mandatory requirement they are required to disclose this information as part of the report of the board of directors. That is the reason why Prowess has sourced the information not from the profit and loss account statement of companies but from the board of director's report.

Value of Output

Value of output is actually the sum total of sales (net of indirect taxes) and change in stocks. The change in stocks data is usually reported in the income and expenditure statement of companies and it is from there that Prowess sources the data.

Gross Value Added

The gross value added entity broadly captures the difference between value of output and the value of inputs entering into the production process. It also includes capital consumption allowance or depreciation.

Gross Fixed assets

These are the fixed assets that are used for producing goods and services and are shown gross of depreciated value. These include movable and immovable assets as well as capital work-in-progress i.e. assets which are in the process of being installed. Fixed assets comprise a significant part of the total assets of an enterprise and therefore are important in the presentation of financial position of an enterprise. Stand-by equipment and servicing equipment are normally capitalized. Machinery spares are usually charged to the profit and loss statement as and when consumed. However if such spares can be used only in connection with an item of fixed assets and their use is expected to be irregular, it may be appropriate to allocate the total cost on a systematic basis over a period not exceeding the useful life of the principal item. The cost of an item of fixed asset comprises its purchase price, including import duties and other non-refundable taxes or levies and any directly attributable cost of bringing the asset to its working condition for its intended use. Any trade discounts and rebates are deducted in arriving at the purchase price of the fixed asset.

Financing costs relating to deferred credits or to borrowed funds attributable to construction or acquisition of fixed assets are also some times included in the gross book value of the asset to which they relate. The cost of fixed assets may undergo changes subsequent to its acquisition or construction on account of exchange fluctuations, price adjustments, changes in duties or similar factors.

Total Exports

This is the total revenue earned from exports of goods and services. Income earned in foreign currency by way of interest, dividend, royalties and consultancy fees area also included here. Exports of goods are usually in freight on board value. Deemed exports are also included in total exports.

Import of Raw material

This is the cost of imported raw material stores and spares at c.i.f value. It does not include other imports like capital goods, technical know-how fees paid etc.

Imported Capital goods

This is the value of imported capital goods like plant and machinery. Import of capital goods is a proxy for embodied technological imports.

Derived Variables

From the financial data fields extracted from Prowess three variables have been constructed for the technical efficiency estimation exercise they are namely gross value added at constant prices, labor and capital Stock. Gross value added at constant prices is obtained by deflating the figures obtained from the gross value added financial datafield extracted from Prowess for the three industries under consideration by their respective

wholesale price indices. All value figures in Prowess are reported in Rupees crores. The labor variable is constructed in the following way. Figures obtained from the financial data field wages and salaries are divided by the industry specific annual wage rates for the time span under consideration. The assumption that is being made here is that the wage rate that holds for the industry as a whole is the same across firms.

Measurement of Capital Stock

Capital is a crucial input in the production process and the most complex of all input measurements. The most widely used procedure for capital stock creation is the perpetual inventory method. This method enables us to construct the time series of capital stock from the time series of the rupee values of investment and the prices of capital goods. Figures from the financial datafield gross fixed asset extracted from the Prowess database have been used to construct the time series on investment for different firms corresponding to the years 1988-89 to 1997-98. In order to get them in real terms we have simply deflated them with WPI for capital goods. We have next taken the difference between deflated GFA figures to obtain investment in real terms. We have taken 1988-89 as the starting year simply because of the reason that the earliest year for which prowess reports firm level data is the above-mentioned year. Now going by the perpetual inventory method we have created the capital stock series by first multiplying the gross fixed asset for the starting year i.e. 1989 by a factor of 2 in order to get capital stock at replacement cost for that year. Next for the subsequent years we have simply added the investment in real terms to the initial capital stock. It is in this manner that we have created the capital stock series for the period in question that is 1989 to 1998.The base year for all deflators is 1981-82.

3.5 Sources of Data

The firm level data pertaining to the financial data fields mentioned above have been extracted from Prowess the corporate database developed by The Center for Monitoring Indian Economy Pvt. Ltd. Prowess is an interactive and user-friendly system

of accessing and manipulating a large database on companies. It contains a database of over six thousand companies incorporating their profit and loss statement, balance sheet, cash flows, products manufactured, raw materials consumed, changes in capital structure, share price movements, returns, news investment plans etc. Industry level data pertaining to gross value added, employment and capital stock have been extracted from Annual Survey of Industries, Summary Results (Factory Sector). The Annual Survey of Industries is published by Central Statistical Organization, Ministry of Planning and Programme Implementation, Govt. of India. The figures pertaining to the foreign trade indicators namely exports and imports have been obtained from Monthly Statistics of Foreign Trade of India (DGCIS). The figures for the deflators have been constructed from Index Numbers Of Wholesale Prices In India, published by Office of Economic Adviser, Ministry of Industry, Government of India.

Chapter- 4

Relative Technical efficiency estimates A firm level study

Chapter 4

Relative Technical efficiency estimates A firm level study

4.1 Introduction

This chapter describes the relative technical efficiency estimates of the various firms in the industries being studied, namely textiles, transport equipment and pharmaceuticals. The entire technical efficiency estimation has been done in a stochastic frontier framework. One of the basic assumptions on which this entire exercise rests is that the production function is of Cobb-Douglas nature and incorporates Hicks neutral technological change.

The basic model underlying the study is as follows

$$Y_{it} = AL_{it}^{\alpha} K_{it}^{\beta} e^{v_{it}-u_{it}}$$

Taking natural logarithms we get

$$\ln Y_{it} = a + \alpha \ln L_{it} + \beta \ln K_{it} + v_{it} - u_i$$

Where a $= \ln A$

Defining

$$a_i = a - u_i$$

The model becomes

$$\ln Y_{it} = a_i + \alpha \ln L_{it} + \beta \ln K_{it} + v_{it}$$

Here Y_{it} denotes gross value addition at constant prices, L_{it} denotes the number of persons engaged and K_{it} denotes capital stock at constant prices. The capital stock has been calculated by the perpetual inventory method taking the capital stock of the starting year of the study as twice the value of the book value of capital for that year. When a time invariant technical efficiency computation is being carried out the measure of technical efficiency (TE) is as follows.

$$TE = e^{a_i - \max(a_i)}$$

When time variant technical efficiency computation is being carried out instead of the individual specific error component the entire composite error is used.

This chapter reports both time invariant and time variant technical efficiency estimates of the various firms that constitute the industry panels. The lay out of the chapter is as follows. The entire chapter has been trifurcated into three sections each pertaining to a particular industry. Sections 4.2 to 4.5 pertain to three industries textiles, transport equipment and pharmaceuticals respectively. Section 4.6 pertains to the summary of the results. Each section broadly caters to three aspects first of all a random effects generalized least squares estimation of the Cobb-Douglas production function for the industry as a whole. The second aspect that is focussed upon is the relative position of various firms on the efficiency scale in comparison to the frontier firm. The third aspect that each section caters to is the variation and the rate of variation of technical efficiency of the various firms under study.

4.2 Textile Industry

4.2 .1 Introduction

The textile industry occupies a unique position in the Indian economy. Its predominant presence in the Indian economy is manifested in terms of its significant contribution to the industrial production, employment generation and foreign exchange earnings. Currently it adds about 14% to the industrial production and about 4% to the GDP. It has immense potential for employment generation, particularly in the rural and remote areas of the country on account of its backward linkage with agriculture. It provides direct employment to about 35 million ranking second in terms of employment generating potential after agriculture. The contribution of this industry to the gross export earnings of the country is about 37% while it adds only 1% to 1.5% to the gross import bill of the country.

Indian textile is extremely complex and varied with hand-spun and hand-woven sector on one end of the spectrum and the capital-intensive sophisticated mill sector at the other, with the decentralized powerloom and knitting sectors coming in between. This industry uses a wide range of fibres from natural fibres like cotton, jute, silk and wool to

synthetic manmade fibres like polyester, viscose, nylon, acrylic and the multiple blends of such fibres and filament yarns.

The Indian textile industry has also significant presence in the world textile economy by virtue of its contribution to world textile capacity and production of textile fibres and yarns. This industry contributes about 20% to the world spindleage in the world after China. With almost 5.7 million looms (including handlooms) this industry has also the highest loomage in the world and contributes about 64% to the 8.9 million-world loomage. Even excluding handlooms this industry contributes 42% to the world loomage of 4.38 million. The contribution of this industry to the world production of textile fibres and yarns including jute at about 6 million tonnes is about 12%. In the world textile scenario it is the third largest producer of jute, second largest producer of silk, third largest producer of cotton and cellulosic fibre/yarn and fifth largest producer of synthetic fibre yarn. It has been observed that despite the textile industry's strong presence in the world economy in terms of production of fibre/yarn and fabrics its share in world trade is a meagre 3.11% as against a share of 6.13% and 8.3% of even small countries like Germany and Italy respectively, which don't even have any worthwhile fibre/yarn production base. China, which has a comparable raw material base, enjoys a textile trade share of 13.75%. The primary reason for our low share in international trade is the predominance of low value items in our export basket and our insignificant presence in man-made textiles, which predominate world textile trade with a 70% share.

The setting up of the WTO has accelerated the process of gradual phasing out of the tariff barriers and the lowering of the quantitative restrictions on imports aimed at integration of the world textile trade by the end of the year 2004. As a consequence, competition in domestic and international markets has intensified and is expected to intensify more. In the next three to four years a scenario may well emerge when only the fittest will survive. It is a well-known hard reality that a free market scenario offers not only unlimited opportunities but also a substantial amount of threat, particularly from export led economies to destabilise our local economy. The objective of this study is to see over the time span 1989 to 1998 what has been the response on the technical efficiency front of Indian industries.

4.2 .2 Growth trends of Gross Value addition, Employment and Capital Stock

Table 1: Growth trends of Gross Value Addition, Employment and Capital Stock (1988-89 to 1997-98)-Textile Industry

Year	Gross Value Addition	Employment	Capital Stock
1988-89	1.1	-4.7	5.1
1989-90	27.9	6.3	6.5
1990-91	8.7	-2.5	6.5
1991-92	-14.2	-3.8	5.3
1992-93	6.1	3.4	7.4
1993-94	22.6	2.0	8.2
1994-95	4.7	-0.5	9.3
1995-96	-14.0	12.3	11.4
1996-97	14.0	-4.6	7.7
1997-98	4.9	0.6	8.1

Source: Annual Survey of Industries (Summary Results-Factory Sector)

The period under study can be broadly divided into two broad segments the pre-reform span and the post reform span with the year 1991-92 coming in between. Hence 1988-89 to 1990-91 is our pre-reform span 1991-92 is the adjustment year and naturally 1992-93 to 1997-98 is the post reform span. Gross value addition records a sharp drop in the post reform span recording an average of 6.4% relative to the pre-reform figure of 12.6%. The adjustment year of 1991-92 witnessed a negative growth of 14.2% in gross value addition at constant prices. The employment story is a bit different from a negative growth rate of -0.3% in the 89-91 span there is an improvement to 2 .2% in the 93-98 span. Capital stock also shows a marked improvement in the growth trend from 6% in our pre-reform span to 8.7% in the 93-98 span.

4.2 .3 Production Function-Textile Industry

A total of 674 firms have been used to construct an unbalanced panel of 3769 observations. Some firms report values for the entire time span of the study that is from 1989 to 1998 however there are also firms that report figures for only one year. On an average firms report values for around 5 years.

Table 2: Random Effects GLS Estimate of the Cobb-Douglas Production function (Textile Industry)

Dependent Variable: Log GVA				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Log L	0.756	0.013	58.726	0.000
Log K	0.157	0.023	6.813	0.000
Constant	-4.823	0.086	-55.888	0.000

R-square Overall 0.6831

As expected both the regressors the log values of labor (Total persons engaged) and capital are highly significant with positive coefficients. The coefficient for the labor input is around 5 times that of capital proving the fact that the industry is predominantly labor intensive.

4.2 .4 Relative time invariant technical efficiency estimates of a sample of firms

This subsection attempts to present a brief picture of how a sample of firms are faring in terms of time invariant technical efficiency relative to the most efficient firm in the panel.

Table 3: Estimates of Technical Efficiency of the Firms in the Textiles Sector (Time invariant)

Firm	a_i	$U_i = a_i - \max(a_i)$	TE = exp (U_i)*100
Eskay K'N'It (India) Ltd.	-1.763	0.00	100.00
KrishnaLifestyle Technologies Ltd.	-2 .009	-0.25	78.20
Mahadev Industries Ltd.	-2 .18	-0.42	65.91
Delight Handicrafts Ltd.	-2.401	-0.64	52.81
K S L Inds. Ltd.	-2 .58	-0.82	44.16
Bala Techno synthetics Ltd.	-2.932	-1.17	31.06
Emtex Industries Ltd.	-3.19	-1.43	23.99
Enkay Texofood Inds. Ltd.	-3.24	-1.48	22.72
Jagruti Synthetics Ltd.	-3.50	-1.74	17.64
Akhileshwar Exports Ltd.	-3.60	-1.84	16.04
Alok Industries Ltd.	-3.65	-1.89	15.22
Jaybharat Fabrics Mills Ltd.	-3.97	-2.21	14.96
DCL Polyesters Ltd.	-3.71	-1.95	14.29
Filatex India Ltd.	-3.75	-1.99	13.64
Ashima Ltd.	-3.83	-2.01	12.64
Acknit Knitting Ltd.	-4.01	-2.25	10.54
AV Cottex Ltd.	-4.03	-2.27	10.34
Ambika Cotton Mills	-4.10	-2.34	9.62
Amarjyothi Spinning mills	-4.23	-2.47	8.51
Addi Industries Ltd.	-4.24	-2.48	8.34
Aarvee Denims & Exports Ltd.	-4.28	-2.52	8.11
Abhishek Industries Ltd.	-4.29	-2.53	7.97
Adhunik Synthetics Ltd.	-4.41	-2.65	7.11
Everlon Synthetics Ltd.	-4.45	-2.69	6.81

Table 3 Contd.

Firm	a_i	$U_i = a_i - \max(a_i)$	$TE = \exp(U_i)*100$
Eastern Enterprises Ltd.	-4.74	-2.97	5.09
AKC Synthetics Ltd.	-4.78	-3.02	4.96
APM Industries Ltd.	-4.91	-3.15	4.27
Madura Coats Ltd.	-4.92	-3.16	4.26
Mafatlal Industries Ltd.	-4.93	-3.17	4.21
Hitkari Fibres Ltd.	-5.20	-3.44	3.22
Howrah Mills. Co. Ltd.	-5.55	-3.79	2.28
Kitex Garments Ltd.	-6.33	-4.57	1.04
N T C Ltd. (Maharashtra N)	-6.45	-4.69	0.92
Matulya Mills Ltd.	-6.56	-4.80	0.82

Source: CMIE Prowess

The frontier firm in the Textile industry panel is Eskay K'N'It (India) Ltd. all other firms have been ranked relative to that firm. As Table 2 depicts there are firms reporting technical efficiency as high as 78.2% to as low as 0.82%. The second best firm in the sample is 21.8% inefficient relative to the frontier firm whilst the lowest placed firm on the efficiency scale is more than 99% inefficient relative to the frontier firm a very diverse picture indeed.

4.2 .5 Variation in Technical efficiency: 1988-89 to 1997-98

This section attempts to put together a picture of how technical efficiency is varying on a firm-to-firm basis. It tries to answer the following questions. Firstly is Technical efficiency increasing or decreasing and if so at what rate. It also explores whether the variation is significant or not.

Table 4: Variation of Technical Efficiency of the Firms in the Textiles Sector (Captured as coefficients of time and square of time)

Firm	Time	Square of time
Eskay K'N'It (India) Ltd.	4.67(0.49)	0.55(0.36)
KrishnaLifestyle Technologies Ltd.	55.39(0.06)	-2.97(0.13)
Mahadev Industries Ltd.*		
Delight Handicrafts Ltd.	68.33(0.20)	-4.18(0.20)
K S L Inds. Ltd.	77.27(0.62)	-4.28(0.64)
Bala Techno synthetics Ltd.	4.44(0.64)	-0.04(0.94)
Emtex Industries Ltd.	6.11(0.12)	-0.22(0.26)
Enkay Texofood Inds. Ltd.	7.35(0.21)	-0.50(0.26)
Jagruti Synthetics Ltd.	2.78(0.07)	-1.55(0.08)
Akhileshwar Exports Ltd.*		
Alok Industries Ltd.	0.33(0.79)	0.03(0.74)
Jaybharat Fabrics Mills Ltd.	0.48(0.70)	0.04(0.70)
DCL Polyesters Ltd.	3.04(0.01)	-0.29(0.00)
Filatex India Ltd.	-2.74(0.42)	0.17(0.43)
Ashima Ltd.	0.29(0.64)	-0.03(0.5)
Acknit Knitting Ltd.	-2.69(0.41)	0.15(0.43)
AV Cottex Ltd.*		
Ambika Cotton Mills	1.01(0.74)	-0.08(0.67)
Amarjyothi Spinning mills	0.79(0.62)	-0.06(0.55)
Addi Industries Ltd.	-1.47(0.07)	0.13(0.07)
AarveeDenims & Exports Ltd.	0.10(0.87)	0.01(0.74)
Abhishek Industries Ltd.	0.13(0.95)	-0.03(0.84)
Adhunik Synthetics Ltd.	1.24(0.00)	-0.11(0.00)
Everlon Synthetics Ltd.	0.65(0.64)	-0.05(0.61)
Eastern Enterprises Ltd.	0.45(0.31)	-0.01(0.63)
AKC Synthetics Ltd.	0.97(0.01)	-0.10(0.01)

Contd. Table 4

Firm	Time	Square of time
APM Industries Ltd.	0.01(0.83)	0.01(0.20)
Madura Coats Ltd.	0.18(0.00)	-0.01(0.00)
Mafatlal Industries Ltd.	0.45(0.00)	-0.04(0.00)
Hitkari Fibres Ltd.	0.27(0.26)	0.00(0.87)
Howrah Mills. Co. Ltd.	-0.01(0.29)	0.00(0.03)
Kitex Garments Ltd.*		
N T C Ltd. (Maharashtra N)	0.07(0.40)	-0.12(0.16)
Matulya Mills Ltd.	0.12(0.55)	-0.02(0.50)

Note: Figures in parentheses denote p-values

* Insufficient number of observations

The broad trend that emerges from the preceding table is that technical efficiency is increasing at a decreasing rate. This is because the coefficients of time for most of the firms in the sample are positive and the coefficients for square of time are negative. Next moving on to the question regarding whether the variation is significant or not. Firms like DCL Polyesters Ltd. show a significant improvement in technical efficiency over time but the improvement is at a declining rate. Both Madura Coats and Mafatlal Industries have a similar story to tell. AKC Synthetics and Adhunik Synthetics are other firms reporting similar variation in technical efficiency. There are however firms like Krishna Lifestyle Technologies Ltd. placed very high in the technical efficiency scale reporting time invariant technical efficiency as high as 78.2% which report insignificant improvement over time. Infact the top five firms in the time invariant technical efficiency scale all report insignificant variation in technical efficiency over time.

4.3 Transport Equipment

4.3.1 Introduction

The transport equipment sector can be broadly categorized into the sub categories of shipping, aviation, automobile (Two wheelers), automobile (Cars), automobile (LCV & HCV) and auto ancillary industries.

Shipping

The shipping industry encompasses overseas shipping, coastal shipping and offshore shipping. In general, when the term "shipping" is used, it refers to overseas shipping. Of the total shipping tonnage in India, almost 90% is engaged in overseas shipping, while 7% is coastal shipping and the remaining is offshore shipping. Major shipping companies in India are either totally into international shipping or have limited coastal shipping activities.

The industry is global in nature. On both demand and supply side, global scenario has to be taken into account rather than the availability/ demand of ships in a particular country. Shipping fleet can be classified into dry bulk carriers and tankers. Dry bulk carriers are used to transport bulk goods such as grain, iron ore and coal, while tankers are used to carry crude oil, petroleum products, chemicals etc. Tankers can further be classified into crude oil tankers and product tankers depending upon their usage, i.e. whether they transport crude oil or petroleum products. Internationally, container shipping also plays an important role. Of the total world merchant fleet, around 10% of the fleet is engaged in container shipping, while in India this proportion stands at a negligible 1%.

The average age of the Indian fleet is 15 years as against the world average of 18 years the proportion of India's sea-borne trade carried by the domestic shipping industry has been steadily decreasing and now stands at 30%. This implies that foreign shipping companies conduct 70% of India's sea-borne trade.

South East Asian crisis has affected both dry bulk and tanker segments due to reduced movement of goods. Dry bulk segment is passing through one of the worst phases with freight rates nose-diving to unprofitable levels with no apparent sign of recovery. The tanker segment enjoyed profitable times in the last four years. Increased tonnage and reduced activity has now affected the freight rates in this segment also. The freight rates are not expected to rise in the near future.

Aviation

The Indian aviation industry can be broadly classified into two main segments - civil and cargo. In fact, the birth of civil aviation is attributed to air cargo and mail. In the beginning, mail and air cargo were the important elements of air carrier services than passengers. The major players in the Indian context are Air India in the international segment and Indian Airlines, Jet Airways and Sahara in the domestic segment. Over the years, the aviation sector in India has evolved and today it is on the threshold of a major shake out with the divestment of the Indian government's stake in Air India and Indian Airlines on the cards. A number of domestic and foreign parties have evinced interest in the divestment process. Recently, foreign airlines like Virgin Atlantic of Britain and Singapore Airlines have also entered the Indian skies.

Automobile Cars

The Indian passenger car industry as we see today is relatively recent in origin. Except the ubiquitous Ambassador and the Premier Padmini's there was not much moving around with an Indian tag. The restrictive policies of the Indian government did not allow foreign players to set shop in India and in the absence of adequate technology and purchasing power it resulted in the slow growth of the industry even after a long time since independence. The demand for cars increased from 15,714 in financial year 1960 to 30,989 in financial year 1980 at a compound annual growth rate of only 3.5%. The entry of Maruti Udyog Ltd, a govt.of India joint venture with Suzuki of Japan, in 1983 with a

so-called "peoples" car and a more favorable policy framework resulted in a compound annual growth rate of 18.6% in car sales from financial year 1981to 1990.

After witnessing a downturn from financial year 90 to 93, car sales bounced back to register 17% growth rate till financial year 97. Since then, the economy slumped into recession and this affected the growth of the automobile industry as a whole. As a result car sales remained almost stagnant in the period between financial year 97 and 99. However, with the revival in the economy, financial year 2000 turned out to be a significant year for the industry in which it recorded volume sales of 638,815 units as against 409,951 units in the previous year. Thus, the compound annual growth rate for the period 1996 - 2000 stands at 16.6%.

On the basis of price, the Indian car industry can be classified into economy or the 'small' car (upto Rs0.3mn), mid-size (Rs0.3-0.5mn), luxury car (Rs0.5-1mn) and super luxury car segments (above Rs1mn). Economy segment dominates with a market share of about 80% of total car sales in financial year 2000.

Taking into consideration the rise in expendable income levels and necessity of personal transportation as a result of inefficient or deficient public transportation means, the demand for cars is expected to increase. Financial year (FY) 2000 was an indicator of the growth phase to follow, registering a 20-year high growth rate of 56% year over year. The second highest growth was recorded in 1985 at 42% year over year (yoy) when Maruti had entered the market. Riding on the popularity of the small car segment, coupled with the boost in sales of the mid-size segment, total sales grew by 56%yoy. However, such high levels of growth are highly unsustainable in the long run given the fact that there are as yet unutilized capacities in the industry. This would make the question of survival important and carmakers would have to play their cards well to remain in contention. Moreover, sales growth in 2000 was calculated on a lower base of FY99. Keeping in mind these factors, one could predict a demand growth of 15-20%yoy in the years to follow. Going by this trend, the demand for cars during FY2001 would be around 670,755 units.

The flood of new entrants into the car industry as a result of liberalization has led to a complete transformation of the sector. The car segment is flooded with new models

from new and existing players, a visible shift from a constrained supply situation to a surplus. In the last decade or so, as many as 30 models have invaded the market.

In general it can be said that the transport equipment is one sector, which has witnessed a lot of competition. The question that naturally arises is has competition succeeded in ushering in technical efficiency.

4.3.2 Growth trends of Gross Value addition, Employment and Capital Stock

Table 5: Growth trends of Gross Value Addition, Employment and Capital Stock (1988-89 to 1997-98)-Transport Equipment

Year	Gross Value Addition	Employment	Capital Stock
1988-89	7.33	5.16	7.29
1989-90	6.46	-18.59	4.66
1990-91	10.77	-2.03	3.81
1991-92	-6.24	2.82	6.03
1992-93	4.58	0.66	7.21
1993-94	10.78	0.57	5.53
1994-95	21.29	5.97	6.27
1995-96	55.40	14.36	12.24
1996-97	5.85	-1.75	13.17
1997-98	-12.46	-6.96	0.96

Source: Annual Survey of Industries (Summary Results Factory Sector)

Following a convention absolutely similar to other industries we have segmented the period under study into two segments the pre-reform phase from 1988-89 to 1990-91 and the period from 1992-93 to 1997-98 is our post reform phase with 1991-92 the adjustment year coming in between. There is a significant improvement on all three fronts with the period averages for GVA rising from 8.19% in the pre-reform phase to a high of 14.24% in the post reform phase. Negative employment growth rates of –5.15% registered a significant improvement to reach a significantly positive growth rate of

2.14%. A similar story emerges on the capital stock front also with growth rates climbing from 5.26% to 7.56%.

4.3.3 Production Function-Transport Equipment

A total of 199 firms have been used to construct an unbalanced panel of 1372 observations. Some firms report values for the entire time span of the study that is from 1989 to 1998 however there are also firms that report figures for only one year. On an average firms report values for around 7 years.

Table 6: Random Effects GLS Estimate of the Cobb-Douglas Production function (Transport Equipment)

Dependent Variable: Log GVA				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Log L	0.587	0.03	21.28	0.00
Log K	0.521	0.03	19.92	0.00
Constant	-3.61	0.13	-27.76	0.00

R-square Overall: 0.8583

Confirming expectations both the regressors report positive and highly significant coefficients. The coefficients of log L and log K are more or less similar indicating that the sector is quite capital intensive in nature. By all means the sector is more capital intensive than both textiles and pharmaceuticals.

4.3.4 Relative time invariant technical efficiency estimates of a sample of firms

This sector attempts to present a brief picture of how different firms in the sample are faring in terms of time invariant technical efficiency in comparison to the most efficient firm in the sample.

Table 7: Estimates of Technical Efficiency of the Firms in the Transport Equipment Sector (Time Invariant)

Firm	a_i	$U_i = a_i - \max(a_i)$	TE = exp. $(U_i)*100$
TebmaEngineering Ltd.	-2.02	0.00	100.00
Maharashtra Scooters Ltd.	-2.63	-0.61	54.16
A N G Exports Ltd.	-2.66	-0.64	52.92
IndiaNippon Electricals Ltd.	-2.79	-0.69	50.33
I P Rings Ltd.	-2.77	-0.76	46.90
Design Auto Systems Ltd.	-2.84	-0.82	44.21
SchraederDuncan Ltd.	-2.89	-0.87	41.97
AutoPins (India) Ltd.	-2.91	-0.89	41.21
MothersonPudenz fuses Ltd.	-3.01	-0.99	37.19
Autolite (India) Ltd.	-3.17	-1.15	31.66
Aamcol Tools Ltd.	-3.22	-1.20	30.14
AutopalIndustries Ltd.	-3.23	-1.21	29.76
DelcoRemy Electricals India Ltd.	-3.25	-1.23	29.28
Yuken India Ltd.	-3.26	-1.25	28.74
TractorEngineers Ltd.	-3.29	-1.27	27.99
Goa Shipyard Ltd.	-3.32	-1.30	27.26
CanaraWorkshops Ltd.	-3.32	-1.30	27.18

Table 7 Contd.

Firm	a_i	$U_i = a_i - \max(a_i)$	TE = exp. $(U_i)*100$
BancoProducts (India) Ltd.	-3.33	-1.31	26.95
Bharat Seats Ltd.	-3.38	-1.36	25.72
Apex Intertech Ltd.	-3.42	-1.40	24.75
BimetalBearings Ltd.	-3.43	-1.41	24.32
Aamtek Auto Ltd.	-3.45	-1.43	24.02
AutolecIndustries Ltd.	-3.45	-1.43	23.97
Ceekay Daikin Ltd.	-3.45	-1.43	23.88
Z F Steering Gear (India) Ltd.	-3.49	-1.47	23.04
TVS Motor Co. Ltd.	-3.59	-1.57	20.83
Hi-Tech Gears Ltd.	-3.60	-1.58	20.50
HeroHondaMotors Ltd.	-3.61	-1.59	20.48
Bajaj Auto Ltd.	-3.76	-1.74	17.60
Bharat Gears Ltd.	-3.82	-1.80	16.45
AutocompsIndia Ltd.	-3.85	-1.83	16.03
Braithwite & Co.Ltd.	-4.02	-1.99	13.57
Ashok Leyland Ltd.	-4.02	-2.00	13.47
Daewoo Motors India Ltd.	-4.04	-2.02	13.27
TELCO Ltd.	-4.08	-2.06	12.75
HindustanMotors Ltd.	-4.27	-2.25	10.55
Hindustan Aeronautics Ltd.	-4.27	-2.25	10.49

Source: CMIE Prowess

From the above table it is evident that Tebma Engineering is the most efficient firm in the sample we term it as our frontier firm. The second best firm in the sample under consideration Maharashtra Scooters Limited reports a technical efficiency of 54.16% that is the second best firm is almost half as efficient as the frontier firm. There are a big chunk of firms in the 20s group firms like Banco Products (India) Ltd., Bharat Seats Ltd., Canara Workshops Ltd. all report technical efficiencies in the range of the mid 20s.Firms like Hero Honda motors and Bajaj Auto are at the lower end of the spectrum reporting technical efficiencies of 20.48% and 17.60% respectively. However a strange sight that strikes one is that a firm like Telco lies almost at the lowest end of the spectrum under consideration. Hindustan Aeronautics reporting a technical efficiency of 10.49% is the lowest in the spectrum.

4.3.6 Variation in Technical efficiency (Transport Equipment): 1988-89 to 1997-98

The previous section gave us a brief idea regarding how transport equipment firms are placed relative to the frontier firm in terms of time invariant technical efficiency. However that is not all, the question that next looms large are how is technical efficiency behaving in a dynamic sense. This section makes an attempt at answering all these. It tries to put together a picture of how technical efficiency is varying on a firm-to-firm basis. It also explores whether the variation is significant or not.

Table 8: Variation of Technical Efficiency of the Firms in the Transport Equipment Sector (captured as coefficients of Time and Square of Time)

Firm	Time	Square of time
Tebma Engineering Co. Ltd.	60.37(0.34)	-4.83(0.27)
Maharashtra Scooters Ltd.*	5.13(0.00)	-0.44(0.00)
A N G Exports Ltd.*	-132.31(0.07)	8.47(0.07)
IndiaNippon Electricals Ltd.	-0.02(0.99)	0.13(0.73)
I P Rings Ltd.*	18.32(0.03)	-1.32(0.03)
Design Auto Systems Ltd.	22.91(0.50)	-1.56(0.46)
Schraeder Duncan Ltd.	2.83(0.08)	-0.16(0.24)
Auto Pins (India) Ltd.	-16.53(0.80)	0.47(0.90)
MothersonPudenz fuses Ltd.	75.80(0.11)	-5.03(0.11)
Autolite (India) Ltd.*	6.49(0.04)	-0.55(0.03)
Aamcol Tools Ltd.	1.67(0.58)	-0.04(0.86)
Autopal Industries Ltd.	55.35(0.11)	-4.14(0.09)
DelcoRemyElectricals India Ltd.*	4.69(0.03)	-0.34(0.04)
Yuken India Ltd.	0.36(0.72)	0.01(0.97)
Tractor Engineers Ltd.*	2.42(0.05)	-0.19(0.12)
Goa Shipyard Ltd.*	4.69(0.02)	-0.27(0.09)
Canara Workshops Ltd.*	3.73(0.00)	-0.03(0.00)
Banco Products (India) Ltd.	0.55(0.55)	0.04(0.62)
Bharat Seats Ltd.	-2.33(0.25)	0.23(0.18)
Apex Intertech Ltd.	-1.38(0.50)	0.14(0.39)
Bimetal Bearings Ltd.*	1.69(0.01)	-0.14(0.02)
Aamtek Auto Ltd.	1.52(0.20)	-0.05(0.60)
Autolec Industries Ltd.	0.02(0.98)	0.024(0.72)
Ceekay Daikin Ltd.*	1.18(0.00)	-0.08(0.02)

Table 8 Contd.

Firm	Time	Square of time
Z F Steering Gear (India) Ltd.	-1.24(0.17)	0.09(0.25)
TVS Motor Co. Ltd.	0.19(0.77)	0.10(0.11)
Hi-Tech Gears Ltd.	-2 .73(0.26)	0.23(0.17)
Hero Honda Motors Ltd.	-0.25(0.77)	0.10(0.22)
Bajaj Auto Ltd.	0.70(0.32)	0.03(0.59)
Bharat Gears Ltd.	0.27(0.62)	0.04(0.47)
Autocomps India Ltd.	4.04(0.53)	0.01(0.85)
Braithwite & Co.Ltd.	-0.25(0.83)	0.04(0.67)
Ashok Leyland Ltd.	-0.07(0.91)	0.03(0.58)
Daewoo Motors India Ltd.	2 .97(0.20)	-0.35(0.10)
TELCO Ltd.	0.43(0.44)	-0.01(0.89)
Hindustan Motors Ltd.	0.05(0.90)	0.04(0.24)
HindustanAeronautics Ltd.*	0.53(0.01)	-0.01(0.46)

Source: CMIE Prowess

The above table representing a subset of the firms in the transport equipment sector also shows that technical efficiency is increasing at a decreasing rate. This is because the coefficients of time for most of the firms in the sample are positive and the coefficients for square of time are negative. Next moving on to the question regarding whether the variation is significant or not. Out of a total of 37 firms depicted by this table only 11 firms report significant variation in technical efficiency. Big firms like Telco, Hindustan Motors, Ashok Leyland report insignificant variation over time on the other hand firms like Maharashtra Scooters limited, ANG Exports limited and Hindustan Aeronautics Ltd. report statistically significant variation over time.

4.4 Pharmaceuticals

4.4.1 Introduction

At present India has a thriving pharmaceutical industry with an impressive growth rate. From 1970 to 2000, the Indian pharmaceutical industry grew from a value of 738 million U.S. dollars to 2.62 billion US dollars and to a substantial extent this growth was export led. The value of pharmaceutical exports from India rose from approximately 73 million dollars in 1970 to about 1.14 billion dollars in 2000. Possibly the causal factors behind this export led growth were:

1. The ability of Indian manufacturers to produce at substantially low costs
2. Indian industrial policy
3. Lack of product patent protection and a pretty weak intellectual property regime.

4.4.2 Regulatory Framework

On 15th April 1994 India signed the WTO agreement in Marrakech, Morocco. As a result of being a signatory to the TRIPS agreement, India has to patent both processes and products and it also has to pay patent fee even if the product is manufactured by a different method. There are likely to be major consequences of this agreement on the Indian pharmaceutical sector, which are yet unresolved. Proponents claim that this change will help Indian firms develop their own R&D infrastructure. Opponents, on the other hand, claim that the new patent regime will destroy a thriving local industry and will help multinationals or large Indian firms who are capable of doing R&D.

After India signed the final text of the GATT agreement the following changes to the Indian patent Act became inevitable.

1. Grant of patents for food, drugs and pharmaceuticals, per se - and possibly, for microorganisms, non-biological and microbiological processes as well.

2 Reversal of burden of proof - shifting it on to defendant - where the product manufactured by a patented process is new or there is a substantial likelihood that the product manufactured by the defendant's process is identical to that of the plaintiff's process and the patentee has - despite reasonable efforts - been unable to determine the process by which the product was manufactured by the defendant;

3. Reconciliation of provisions relating to compulsory license with those of the Paris Convention;

4. Introduction of a certain degree of pipeline protection in the case of applications for patents made after a date to be fixed.

5. Provision of sui generis protection for plant varieties produced otherwise than by natural methods.

6. Extension of exclusive rights of a patentee to importation - and treat importation as working of a patent;

7. Extension of term of patent to 20 years;

8. Widening of concept of "invention" - to cover processes resulting in new and industrially useful results. (Under the present law, a process has to result in a tangible end product).

Eventually On 26th March 1999 the Indian Cabinet approved a bill to amend Patents Act of 1970 to incorporate measures to protect bio-diversity, traditional knowledge and national security. The amendment is to comply with time-bound WTO regulations contained in Trade Related Intellectual Property rights (TRIPs).

Though the above-mentioned major changes took place on the intellectual property rights front the fact remains that this sector has not faced the onslaught of the imports. Shielded from cutthroat foreign competition a question naturally arises how is the sector performing on the technical efficiency front. This finding juxtaposed against the findings pertaining to the other two sectors can give an effective verdict on the efficacy of imports as a disciplining device. In other words it can give a conclusive verdict regarding whether trade liberalization is crucial for shoring up technical efficiency.

4.4 .3 Growth trends of Gross Value addition, Employment and Capital Stock

Table 9: Growth trends of Gross Value addition, Employment and Capital Stock (1988-89 to 1997-98)-Pharmaceuticals

Year	Gross Value Addition	Employment	Capital Stock
1988-89	8.78	0.45	13.18
1989-90	15.20	3.04	8.98
1990-91	3.47	-3.57	11.69
1991-92	26.96	10.32	12.01
1992-93	15.31	12.76	12.01
1993-94	23.88	4.87	12.29
1994-95	-4.32	4.13	16.26
1995-96	9.39	12.83	14.05
1996-97	28.53	5.26	18.26
1997-98	8.18	-14.55	-3.92

Source: Annual Survey of Industries (Summary Results Factory Sector)

For this study we have broadly divided the period under study into two subsections namely the pre-reform period stretching from 1988-89 to 1990-91 and the post reform span stretching from 1992-93 to 1997-98 with the year 1991-92 coming in between. The year 1991-92 being the adjustment year has been singled out.

4.4 .4 Production Function-Pharmaceuticals

A total of 262 firms have been used to construct an unbalanced panel of 1391 observations. Some firms report values for the entire time span 1989-98 whereas there are others, which report values only for one year. On an average firms report values for around five years.

Table 10: Random Effects GLS Estimate of the Cobb-Douglas Production function (Pharmaceuticals)

Dependent Variable: Log GVA				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Log L	0.580	0.024	24.188	0.000
Log K	0.205	0.026	8.025	0.000
Constant	5.204	0.120	43.488	0.000

R-square Overall: 0.8102

Both the regressors log values of labor and capital report positive and significant coefficients. Though the coefficient of log L is more than three times that of log K signaling that the industry is labor intensive the fact remains that the pharmaceutical industry is more capital intensive than that of textiles

4.4 .5 Relative time invariant technical efficiency estimates of a sample of firms

Table 11: Estimates of Technical Efficiency of the Firms in the Pharmaceuticals Sector (Time Invariant)

Firm	a_i	$U_i = a_i - \max(a_i)$	$TE = \exp(U_i)*100$
Southern Herbals Ltd.	8.062	0.00	100.00
Paam Pharmaceuticals Ltd.	6.461	-1.60	20.18
VitaraChemicals Ltd.	6.361	-1.70	18.26
Torrent Pharmaceuticals Ltd	6.337	-1.73	17.82
Ranbaxy Laboratories Ltd.	6.298	-1.76	17.14
Kopran Ltd.	6.258	-1.80	16.46
AurobindoPharma Ltd.	6.239	-1.82	16.16
CheminorDrugs Ltd.	6.190	-1.87	15.38
Morepen Laboratories Ltd.	6.174	-1.89	15.14
Orchid Chemicals & Pharmaceuticals	6.034	-2.03	13.16
ACELaboratories Ltd.	5.903	-2.16	11.54
Anuh Pharma Ltd.	5.883	-2.18	11.31
Aarti Drugs Ltd.	5.832	-2.23	10.76
ArmourPolymers Ltd.	5.496	-2.57	7.68

Table 11 Contd.

Firm	a_i	$U_i = a_i - \max(a_i)$	$TE = \exp(U_i)*100$
Zora Pharma Ltd.	5.540	-2.52	8.03
Alps Laboratories Ltd.	5.257	-2.81	6.05
American Remedies Ltd.	5.502	-2.56	7.73
Alembic Ltd.	5.753	-2.31	9.94
Albert David Ltd.	5.434	-2.63	7.22
Abbott Laboratories (I) Ltd.	5.440	-2.62	7.27
AddLifePharma Ltd.	4.566	-3.50	3.03
Ambalal Sarabhai E Ltd.	5.455	-2.61	7.37
Ahlcon Parenterals(I) Ltd.	4.119	-3.94	1.94

Source: CMIE Prowess

The relative time invariant technical efficiency estimates for pharmaceuticals present a picture substantially different from that, which holds for textiles. Southern Herbals Limited is the firm operating on the frontier reporting technical efficiency of 100%. The second best firm in the sample reports a technical efficiency of 29.66%. Gufic Biosciences is more than 70% inefficient in comparison to the firm operating on the frontier. Other firms report technical efficiency covering the entire range between 28% and 1%. Ahlcon parenterals (I) Ltd. is the lowest ranked firm in the sample reporting a technical efficiency of 1.29%.

3.5 .4 Variation in Technical efficiency: 1988-89 to 1997-98

This subsection tries to capture the nature of variation in technical efficiency in the pharmaceuticals sector. Is technical efficiency improving over time or is it declining and

what is the rate of variation? This is the principal question that this section tries to address. Moreover the section also tries to make a statement regarding whether the variation is significant or not.

Table 12: Variation of Technical Efficiency of the Firms in the Pharmaceuticals Sector (Captured as coefficients of time and square of time)

Firm	Time	Square of time
Southern Herbals Ltd.	51.88(0.62)	-2.24(0.76)
Paam Pharmaceuticals Ltd.	4.09(0.01)	-0.38(0.01)
Vitara Chemicals Ltd.	0.80(0.70)	-0.01(0.93)
TorrentPharmaceuticals Ltd	-1.39(0.36)	0.06(0.55)
Ranbaxy Laboratories Ltd.	1.30(0.01)	-0.11(0.01)
Kopran Ltd.	1.82(0.01)	-0.15(0.02)
Aurobindo Pharma Ltd.	-12.54(0.01)	0.76(0.01)
Cheminor Drugs Ltd.	-0.73(0.25)	-0.01(0.76)
Morepen Laboratories Ltd.	0.94(0.05)	-0.06(0.07)
OrchidChemicals& Pharmaceuticals	5.69(0.35)	-0.29(0.43)
ACE Laboratories Ltd.	0.81(0.64)	-0.01(0.91)
Anuh Pharma Ltd.	1.87(0.51)	-0.15(0.46)
Aarti Drugs Ltd.	-1.99(0.06)	0.13(0.09)
Armour Polymers Ltd.	-2.86(0.74)	0.13(0.83)
Zora Pharma Ltd.	-0.93(0.65)	0.06(0.64)
Alps Laboratories Ltd.	5.12(0.05)	-0.44(0.06)
American Remedies Ltd.	0.27(0.15)	-0.03(0.05)
Alembic Ltd.	-0.02(0.91)	-0.01(0.77)
Albert David Ltd.	-0.24(0.05)	0.00(0.94)

Table 12 Contd.

Firm	Time	Square of time
Abbott Laboratories (I) Ltd.	0.08(0.68)	-0.02(0.19)
Add Life Pharma Ltd.*		
Ambalal Sarabhai E Ltd.	0.04(0.87)	-0.02(0.50)
Ahlcon Parenterals(I) Ltd.	2.11(0.82)	-0.13(0.81)

Note: Figures in parentheses denote p-values

*Insufficient observations

Source: CMIE Prowess

The broad picture once again is that firms are reporting improvement in technical efficiency but at a declining rate. The second best firm in the sample reporting time invariant technical efficiency of 29.66% shows an almost significant decline over the time span under consideration. Firms like Morepen Laboratories, Kopran Ltd. and Paam Pharmaceuticals Ltd. report significant improvement in technical efficiency at a significantly declining rate. However there are other firms like Vitara Chemicals, Orchid Chemicals and Anuh Pharma, which report insignificant variation over time. Aurobindo Pharma Ltd. however stands as the odd-man out by reporting a significantly declining technical efficiency, moreover the decline is taking place at a significantly rising rate.

Chapter- 5

Trade Reform Dynamics and Technical Efficiency: The Indian Manufacturing Sector Experience

Chapter 5

Trade Reform Dynamics and Technical Efficiency: The Indian Manufacturing Sector Experience

5.1 Introduction

This chapter makes an attempt at exploring the trade liberalisation technical efficiency link in a dynamic frame. In other words the chapter makes an attempt at finding out how crucial is trade liberalization as a causal factor behind ushering in technical efficiency. The underlying question is are there other factors, which are more vital as driving forces behind technical efficiency namely say age, which is a proxy for the accumulated experience of the firm. The study has been carried out in the context of some selected Indian manufacturing sectors namely textiles, transport equipment and pharmaceuticals. Though all three sectors have witnessed major changes in the regulatory framework their experience as far as competition is concerned is not that similar. While textiles and some transport equipment sectors like automobile (cars) are facing the onslaught of the alien the pharmaceutical sector has not till now in true terms experienced the impact of imports as a disciplining device. The layout of the chapter is as follows Section 4.2 gives a brief review of the rationale behind trade reform and their contradictions. Section 4.3 gives a revisionist account of The East Asian experience. Section 4.4 gives the empirical model which tries to regress technical efficiency on outward orientation factors like ratio of exports to sales, embodied technology import variables like ratio of import of capital goods to total cost and learning by doing factors like age. Section 4.5 gives the data and the construction of variables and last but by no means the least Section 4.6 captures the empirical findings and conclusions.

5.2 The Rationale for Trade Reform

Development economists routinely argue that the chilly winds of competition should have favorable effects on industrial efficiency. Leibenstein (1966) was the first to state explicitly that "proper motivations" should discipline firms forcing them to become more efficient or perish. In fact if one takes classical microeconomics at face value then

analysis of efficiency is a fruitless exercise. Functioning markets and the survivor principle simply don't tolerate inefficiency. However in the real world inefficiency in production and allocation is a reality. . While the increase in both foreign and domestic competition puts pressure on firms to improve their performance it is argued that liberalization also provides firms the opportunities to make these possible.

There are at least three important channels to make this possible. Firstly openness enables cheaper and easier access to foreign technologies, global capital, imported inputs and makes possible greater international exchange of information. Technology imports take both embodied and disembodied forms. Import of capital goods represents embodied technological imports whereas royalty payments can serve as a very good proxy for disembodied technology imports. Secondly, increase in competition puts a downward pressure on prices and profits forcing firms to respond by increasing their technical efficiency. This can be achieved through greater organizational competence, improved managerial efficiency, and higher productivity of labor, better capacity utilization and more innovations and these are invariably accompanied by a reduction in the inventory stockpile. Third possible channel is through the potential increase in exports made possible by the more realistic exchange rate policies associated through liberalization. The resultant access to larger markets allows firms to exploit economies of scale. Scale gains lead to an increase in technical efficiency and productivity and these in turn allow firms to compete more effectively in the international market.

However economic theory does not provide us with unambiguous answers regarding the possible net effect of these factors. While the theoretical and empirical arguments for the resource mis-allocation costs of protectionism or import substituting industrialization are strong it is difficult to make a compelling case regarding the magnitude of these costs (Rodrik 1995). A question that naturally arises is how can such small numbers be reconciled with the large and growing performance gap between import substituting countries and the outward oriented countries of East Asia? So there must be something other than the static, allocative efficiency factor, which explains this performance gap. Are the dynamic benefits of liberalization, in the form of technological change and learning the causal factors? Rodrik once again succinctly puts it forward that the analytical foundations of such arguments regarding the dynamic benefits of

liberalisation are not very clear and moreover there are many studies that suggest that there is a considerable amount of technological tinkering that goes on even when firms are cut of from foreign markets. Balassa's work gave a big boost to policy reform by coming out with the finding that export oriented countries are better positioned to deal with external shocks than inward oriented countries. Focussing on the early 1980s Sach's (1985) comparative analysis of East Asian and Latin American experiences reinforced Balassa's conclusions. Sachs argued that one of the primary reasons most East Asian countries were successful in avoiding protracted debt crisis was the higher share of exports in their GNPs. Though at first sight it is paradoxical that more open economies should perform better in the face of external shocks. However here it is very important to distinguish between the impact effect of a shock and the transition out of it. With regard to the impact effect of a shock it has to be stated that a country with a high export to GNP ratio gets affected more than a country with a low one. Similarly a reduction in external capital flows affects a country that has actively participated in international capital markets more than one has not. There is solid empirical evidence to back this theoretical conclusion. South Korea in 1980 and Chile in the year span 1982-83 were the countries that were affected most by the external negative shocks whereas relatively closed economies like India remained more or less unaffected. So the underlying logic of Balassa and Sach's argument is not that outward oriented economies are immune to external shocks instead it is that they have an easier time out of the crisis. If outward orientation is viewed as the absence of microeconomic distortions that bias incentives away from exports it is difficult to see how such distortions could be causally related to the balance of payments crisis that have followed external shocks (Rodrik 1995). In fact trade restrictions lower exports and imports and have no implications for the balance between the two. Macroeconomic policies and exchange rate policies in fact determine trade balance. The correct response to an adverse balance of payments shock is a combination of expenditure reducing and expenditure switching (i.e. exchange rate policies.

The final set of arguments in favor of policy reform has to do with governance issues. The institutional setting under which import substitution policies have typically operated has given rise to a wide variety of incentive distortions and resource

misallocations that collectively go under the name of rent seeking. There are lots of economists who argue that the resource costs of the prevailing distortions are multiplied several folds by the existence of such activities. Examples of the waste generated include employment of lobbyists and other intermediaries in pursuit of licenses and incentives to be obtained from govt. officials. Generation of excess capacity when import licenses are allocated in proportion to installed capacity. Competition for scarcity rents in black markets when commodities and foreign exchange are rationed and apart from these there are smuggling, under invoicing and over invoicing. Whilst the fact remains that the costs of rent seeking may be genuinely immense it does not follow that a correction of price distortions and a move to outward orientation necessarily eliminates them. Thus examining all the rationale for trade reform and their contradictions it needs to be stated that trade reform is not the only key to growth and efficiency. In the next section the study gives a revisionist account of the East Asian experience to see whether the success stories of the miracle economies of East Asia in the form of stupendous growth and fast rising efficiency are an outcome of trade liberalization only or not.

5.3 Revisionist Account of The East Asian Experience

Development economists who prescribe openness and price liberalisation to developing countries often typically cite the East Asian experience. It is often stated that these countries achieved their miracles by minimizing price distortions giving markets free rein and emphasizing exports. In the case of Korea and Taiwan in particular emphasis is placed on reforms during the 1960s that greatly reduced the restrictiveness of the trade regime, eliminated financial repression and established a free trade regime for exporters. However there are many analysts who quite categorically state that there is another side of that picture and they stress that it would be wrong to interpret liberalisation as non-intervention. They credit the East Asian governments for making the miracles happen not by getting out of the way of private entrepreneurs but by actively nurturing and protecting infant industries. These situations lead one to conclude that liberalization is not the panacea for all ills. More over it bears repeating what is one of the most striking aspect of the revisionist accounts of The East Asian experience: The policy

instruments used to such benefit in that context are no different from those that have apparently failed so miserably in Latin America, Africa and the rest of Asia. The policies in question being import quotas and licenses credit subsidies tax exemptions, public ownership and so on.

There are sets of conclusions regarding the East Asian experience on which the revisionists and liberalisers can agree and they are the following. Firstly there has been a lot of government intervention and an active trade and industrial policy however the intervention has taken place in the context of stable macroeconomic policies in the form of small budget deficits and realistic exchange rate management. Secondly above all the governments emphasis on and unmitigated commitment to exports has helped minimize the resource costs and incentive problems that would otherwise have arisen from heavy intervention. Thirdly the intervention has taken place in an institutional setting characterized by a hard state and strong government discipline over the private sector.

Analyzing the rationale for trade reform and their contradictions, the revisionist account of the often portrayed successful outcomes of trade liberalization the stories of the miracle economies of East Asia it becomes all the more difficult to state that trade liberalization will inevitably lead to efficiency and growth making it once again a fit area for further research.

5.4 The Empirical Model

In order to examine the cruciality of trade liberalization as a causal factor behind technical efficiency we model technical efficiency as a function of firm specific explanatory variables and a single stage estimation process estimates all parameters.

The model is as follows.

$$TE_{it} = \delta_0 + \delta_1 Age_{it} + \delta_2 (Age_{it})^2 + \delta_3 IMRC_{it} + \delta_4 (RTOXS)_{it} + \delta_5 (IMTECH)_{it} + \delta_6 (TLD)_{it} + \delta_7 (R\,\&\,D) + \varepsilon$$

Where

$\varepsilon_{it} = v_{it} + u_i$

The variables included in the efficiency model are

TE_{it}: Time Variant Technical Efficiency

Age: Age of the firm

$(Age)^2$: Square of age of the firm

IMRC: Import of raw materials as a proportion of total cost.

RTOXS: Ratio of Total Exports to Sales

IMTECH: Technology import of the firm

TLD: Trade Liberalisation Dummy

R&D: Research and Development expenditure of the firm.

5.5 Data and Construction of Variables

This study makes use of firm level panel data on some selected Indian Manufacturing Sectors namely textiles, transport equipment and pharmaceuticals over the period 1988-89 to 1997-98. The firm level data were obtained from the Centre for Monitoring Indian Economy's corporate database Prowess. The panel for textiles is unbalanced and contains 3854 observations on 689 firms. Similar unbalanced panels have been constructed for pharmaceuticals and transport equipment also. The panel for pharmaceuticals contains 1402 observations on 264 firms and the panel for transport Equipment contains 1372 observations on 199 firms. The construction of variables used

in the technical efficiency equation and their possible relationship has been explained below.

Regressand

TE: Technical efficiency can be analyzed in terms of realized deviations from an idealized frontier isoquant. This approach falls naturally into an econometric approach in which the inefficiency is identified with disturbances in a regression model.

If we assume that the production model f (x_i,β) is linear in the logs of the inputs or functions of them, and the log of the output variable appears on the left hand side of the estimating equation. It is convenient to maintain that formulation and write

$$\ln y_i = \alpha + \beta' x_i + \varepsilon_i$$

Where $\varepsilon_i = -u_i$ and x_i is the set of whatever functions of inputs enter the empirical model. We assume that $\varepsilon_i = -u_i$ and x_i is the set of whatever functions of inputs enters the empirical model. We assume that ε_i is randomly distributed across firms. An important assumption to be dropped later is that the distribution of ε_i is independent of all variables in the model. ε_i is a nonzero mean constant variance and otherwise ordinary regression disturbance. So $E(\varepsilon_i) < 0$. The model can thus be written.

$$\therefore \ln y_i = (\alpha + E(\varepsilon_i)) + \beta' x_i + (\varepsilon_i - E(\varepsilon_i))$$

$$\ln y_i = (\alpha + E(\varepsilon_i)) + \beta' x_i + (\varepsilon_i - E(\varepsilon_i))$$

$$\ln y_i = \alpha^* + \beta' x_i + \varepsilon'_i$$

This produces a classical linear regression model. Since the only deficiency in the OLS estimates is a displacement of the constant term one. Two approaches can be adopted to get rid of these. 1) Corrected Ordinary Least Squares method 2) Modified Ordinary Least Squares method

In the Corrected Ordinary Least Squares Method we create a series of residuals we then find out the maximum of the residuals is max e_i

$$a_{COLS} = a^* + \max e_i$$

$$e_{i,COLS} = e_i - \max e_i$$

The technical efficiency is then estimated as follows

$$TE = \exp(e_{i,COLS})$$

Regressors

Age: The Age of the firm is used as a proxy for the accumulated experience of the firm and is expected to have a positive effect on technical efficiency. It is calculated from the year of incorporation of the firm. The older a firm is the more is its ability to enhance its technical efficiency in the course of learning by doing.

Square of Age: This is included to allow for a U shaped relationship with technical efficiency. Hence the square of the age variable is expected to have a negative sign in the efficiency equation.

A positive coefficient for Age and a negative coefficient for square of age suggests that the more is the age of the firm more is its experience and more is its ability to enhance its technical efficiency in the course of learning by doing. However that capacity is bound to decline over time

IMRC: Imports of raw materials as a proportion of total cost. The relationship between this variable and the measured technical efficiency once again depends on its distribution among firms in the industry. If a few firms access to the better raw materials increases the productivity disparity among the firms, raw material import has a negative effect on technical efficiency. On the other hand if raw materials import activity enables the domestic firms to reduce the productivity disparity it will have a positive sign on technical efficiency. Trade liberalisation by its very nature increases the access of domestic firms in general to imported raw materials. As a result a positive coefficient of IMRC is expected.

Research and Development: Research and development is an important source of knowledge for the firms. R & D not only generates knowledge but also enhances the firm's ability to learn the new technologies at a faster rate.

Trade Liberalisation Dummy (TD): A trade liberalisation dummy has been included in the technical efficiency equation to see the impact of trade reform dynamics on technical efficiency. The dummy takes a value zero upto 1991-92 and one after that. One of the principal objectives of this exercise is to see the cruciality of the trade liberalization dummy in explaining technical efficiency.

The phenomenon of trade liberalization not only heralds competition from imports it also provides the opportunity to export. The following section provides a tabular representation of the growth trends of the foreign trade indicators namely exports and imports

Textiles

Table 1:Growth Trends Foreign Trade Indicators (Textiles)

Years	Exports	Imports
1988-89	-21.36	165.12
1989-90	113.61	-34.85
1990-91	46.78	5.22
1991-92	23.96	7.03
1992-93	25.82	204.35
1993-94	23.74	-32.59
1994-95	26.76	406.29
1995-96	13.20	-34.99
1996-97	32.90	-45.46
1997-98	2.38	10.04

Source: Monthly Statistics of Foreign Trade of India (DGCIS)

Following the same convention as in this study's previous chapters the period under study is being trifurcated into the pre-liberalization period from 1988-89 to 1990-91 the adjustment year 1991-92 and the post liberalization period from 1992-93 to 1997-98.Though for textiles we find that the growth rate of exports have gone down from a period average of 46.34% in the pre-liberalization period to 20.80% in the post liberalization period with the adjustment year reporting a growth rate of 23.96%. The scenario on the imports front is quite different. The imports in the post liberalisation period reached a stunning high of 84.61% close to double that of the pre-liberalisation period average of 45.16%. The adjustment year witnessed an import growth rate of 7.03% fairly modest. Thus these figures leave us with no doubt regarding the fact that textiles have experienced the onslaught of the alien. This makes the sector a fit case for investigating whether technical efficiency has increased or not.

5.6 Empirical Results

Table2 Cross Sectional Time series FGLS regression (Textiles)

Dependent Variable: TE2 (Time Variant Technical Efficiency)				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Rtoxs	1.95*	0.0446732	43.72	0.00
Age	-0.01*	0.0006716	-17.86	0.00
Sqage	6.04e-06*	6.28e-07	9.63	0.00
Imprs	0.08	0.1076687	0.73	0.47
Imptech	-0.08*	0.0191278	-4.08	0.00
R & D	0.03*	0.0128586	2.22	0.03
TLD	-1.07*	0.0475229	-22.55	0.00
Const	4.50*	0.0486845	92.34	0.00

*** Significant at 5% level of significance**

The estimation was carried out using feasible generalized least squares method on heteroskedastic panels with no serial correlation.

The most striking revelation that unfolds before us from this empirical result is that technical efficiency went down in the post liberalization era. This is aptly captured by the highly significant negative coefficient of the trade liberalization dummy. Age, which is a proxy for accumulated experience and captures the learning by doing factor, also turns out to be significantly negative. This once again shows that in the textile industry the effect of one additional year of experience is much more on younger firms than on older firms however the positive sign of the square of the age variable reflects that after a point diminishing returns sets in.

Research and development expenditure(R&D) going by expectations turns out to be positively significant signaling that R&D expenditure in the textiles sector is reducing the efficiency disparity among firms in the textiles sector. This in turn suggests that diffusion of the effects of R&D to other firms in the textiles sector is taking place.

Transport Equipment

Table3: Growth Trends Foreign Trade Indicators (Transport Equipment)

Years	Exports	Imports
1988-89	41.22	-3.45
1989-90	47.98	103.74
1990-91	37.87	12.67
1991-92	65.13	-48.98
1992-93	25.96	69.52
1993-94	20.63	187.18
1994-95	27.60	-16.60
1995-96	28.82	6.14
1996-97	11.05	42.54
1997-98	1.40	-25.85

Source: Monthly Statistics of Foreign Trade of India (DGCIS)

Once again the growth trends in exports reveals that in comparison to the pre-liberalization period average of 42.35% the post liberalization period average is way down at 19.25% signaling a worsening performance on the export front in the post liberalization era. Though the adjustment year reported a fairly good export performance of 65.13%. The import scenario is once again a bit different. In comparison to the pre-liberalization era the post lib era witnessed a definite surge though not a very substantial one. The period average imports growth rate for the pre-liberalization era was 37.65% on the other hand the post liberalization period average was 43.82%.

Table 4: Cross Sectional Time series FGLS regression (Transport Equipment)

Dependent Variable: TE2 (Time Variant Technical Efficiency)				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Rtoxs	0.26	1.00973	0.25	0.799
Age	-0.09*	0.0047349	-18.14	0.000
Sqage	0.00*	2.34e-06	18.51	0.000
Imprtc	0.02	0.0244611	0.66	0.506
Imptech	-0.04	0.0363721	-1.05	0.295
R & D	-0.20*	0.0626399	-3.13	0.000
TD	3.10*	0.1522073	20.34	0.000
Const	10.96*	0.1840345	59.54	0.000

* Significant at 5% level of significance

The estimation was carried out using feasible generalized least squares method on heteroskedastic panels with no serial correlation.

The efficiency model has been estimated using a cross sectional time Series feasible generalized least squares regression. The objective of the exercise is to identify the cruciality of the various causal factors behind technical efficiency. The picture that unfolds categorically shows that trade liberalization is a very strong positively significant causal factor behind technical efficiency. The trade liberalization dummy, which is an intercept dummy in nature, takes a value zero for the years 1988-89 to 1991-92 and one from 1992-93 to 1997-98.The age variable has significant negative sign and its square has a significant positive sign. This shows that the effect of an additional year of experience for young firms is more than that for old firms however the positive sign of the square of the age variable shows that beyond a point diminishing returns creeps in. The regressor Research and development expenditure on capital account(R&D) has a statistically significant negative coefficient this suggests that a lot of efficiency disparity is being created in the transport equipment sector by investing in R&D. This suggests that diffusion of research and development effects among other firms is not taking place.

Export intensity (rtoxs) has an insignificant positive relationship on technical efficiency in the transport equipment sector. This suggests that firms in this sector are more or less catering to the domestic sector and export orientation of firms in this sector are not of a substantial magnitude. We know that trade liberalization not only exposes firms to foreign competition it also provides firms the access to better imported inputs and advanced technology and thereby enables firms to rise the efficiency ladder. However the results that we find tend to suggest that raw material import intensity and the technology import variable have an insignificant negative relationship on technical efficiency.

Thus we can conclude that the transport equipment sector supports the hypothesis that trade liberalization plays a crucial role in ushering in technical efficiency and the variable age which is a proxy for accumulated experience signals that learning by doing exhibits diminishing returns. Another factor that emerges overwhelmingly is that imports serve as an excellent disciplining device and competition helps firms to sharpen up.

Pharmaceuticals

The solitary objective of including this sector in this particular study is to see what happens when a sector doesn't face the onslaught of the imports. It is a reality that from 1970 to 2000, the Indian pharmaceutical industry grew from a value of 738 million U.S. dollars to 2.62 billion US dollars and to a substantial extent this growth was export led. The value of pharmaceutical exports from India rose from approximately 73 million dollars in 1970 to about 1.14 billion dollars in 2000. So imports as a disciplining device has not operated in the pharmaceutical sector. Now if our empirical exercise yields a result suggesting that trade liberalization led to an increase in technical efficiency we can say for certain then that competition hardly had any role to play there. From 2005 onwards when the patent regime becomes operational we expect to see a definite surge in imports.

Table5: Cross Sectional Time series FGLS regression (Pharmaceuticals)

Dependent Variable: TE2 (Time Variant Technical Efficiency)				
Variable	**Coefficient**	**Standard Error**	**T ratio**	**P value**
Rtoxs	5.51*	0.289823	19.02	0.00
Age	0.02*	0.0013767	11.08	0.00
Sqage	-7.39e-06*	6.86e-07	-10.78	0.00
Imprtc	-1.61*	0.1617963	-9.94	0.00
Imptech	-0.22*	0.006383	-34.78	0.00
R & D	0.21*	0.0320089	6.50	0.00
TD	-0.75*	0.0691012	-10.89	0.00
Const	3.24*	0.0845271	38.28	0.00

*** Significant at 5% level of significance**

The estimation was carried out using feasible generalized least squares method on heteroskedastic panels with no serial correlation.

The most striking revelation of this empirical exercise is that the trade liberalization dummy which takes a value zero for the years 1988-89 to 1990-91 and the value one for the years 1992-93 to 1997-98 turns out to be significantly negative signaling that over the post liberalization era technical efficiency went down. The regressor ratio of exports to sales confirming expectations reports a statistically significant positive coefficient aptly depicted by the T-value of rtoxs to be as high as 19.015.

This signals that firms in the pharmaceutical sector placed high in the efficiency ladder have been mostly export driven or outward oriented. The age variable, which is a proxy for accumulated experience confirming expectations, reports a positive substantially significant coefficient. This shows that learning by doing is a very important causal factor behind technical efficiency. Let us traverse the history of the Indian pharmaceutical sector. The Patents and Designs Act of 1911 was passed while India was under the British rule. This law protected process and product patents for 16 years and was in effect till the Patents act of 1970 was passed. The Patents Act of 1970 were a

turnaround. This Act abolished product patents in food, chemicals and drugs and reduced the life of process patents from 16 to 7 years. Local pharmaceutical entrepreneurs could now reverse engineer any existing drug or new drug and sell them in the domestic market. As reverse engineering gained momentum the learning by doing factor gained significance. The more a firm gained experience the more it could fine-tune its production process.

Research and development expenditure also reports a positive significant coefficient signaling that in the pharmaceutical sector investment in R&D has led to a reduction in the efficiency disparity between firms. This once again signals that the effects of R&D are getting diffused to other firms.

Chapter - 6

Summary and Conclusions

Chapter 6

Summary and Conclusions

The summary of the results and conclusions of the study are presented in this chapter. The study had a two-fold objective the first being to present a picture of the relative position of various firms on the technical efficiency scale in the industries under consideration and also to analyze the variation and the rate of variation in technical efficiency over the period under consideration. The second objective of the study was to see how crucial was outward orientation as a determinant of technical efficiency. In fact the solitary motive behind the selection of the three industries textiles, transport equipment and pharmaceuticals was to see how strong is competition as a driving force behind technical efficiency. It needs to be mentioned here once again that textiles and transport equipment have faced a lot of competition whereas pharmaceuticals have not. So if competition is the important driving force behind technical efficiency then there should be an increase in technical efficiency in both textiles and transport equipment and there should be a decline in efficiency in pharmaceuticals.

The regression results for the textiles sector seem to suggest quite unequivocally that technical efficiency went down significantly in the period 1992-93 to 1997-98. This is aptly captured by the significant negative coefficient of the trade liberalization dummy. However the reason might also be due to the fact that the textiles sector did not undergo substantial amount of liberalization when the rest of the economy did. This makes us conclude that competition was not the solitary driving force behind technical efficiency in the context of the textiles sector. In fact the regressor research and development expenditure going by expectations reports a significant positive coefficient. The implication being that the effects of research and development activity is getting diffused to other firms in the industry. This diffusion tends to promote technical efficiency of the industry as a whole. Very few firms report significant variation in technical efficiency over the time period under consideration. Infact the top five firms on the technical efficiency scale all report insignificant variation in technical efficiency over time. Firms having high export intensities are the ones reporting high technical efficiencies this is aptly captured by the highly significant positive coefficient of the regressor ratio of total

exports to sales. The learning by doing factor is captured by the regressor age, this is because age is a proxy for accumulated experience of the firm. However the regressor age also reports a significant negative coefficient. This suggests that young firms report a greater augmentation in technical efficiency for every additional year of experience than old firms.

The results of the empirical exercise carried out for transport equipment yields overwhelming evidence to support the claim that trade liberalization leads to technical efficiency. This is aptly captured by the highly significant positive coefficient of the trade liberalization dummy. Those firms that are technically efficient in this industry are not necessarily highly export oriented. Once again this gets reflected in the insignificant positive coefficient of the regressor ratio of exports to sales. Therefore this leads us to the conclusion that firms that are technically efficient cater principally to the domestic market. Once again the regressor age reports a significant negative coefficient proving that young firms benefit more in terms of technical efficiency for every additional year of experience than old firms. The raw material import intensity and the embodied technology import variable both turn out to be insignificant determinants of technical efficiency. Sales are once again an important determinant of technical efficiency. Firms that report high sales are those that are placed high on the technical efficiency scale. So as far as transport equipment is concerned competition is a very important driving force behind technical efficiency. Driven by competition firms that shapen up experience an enhancement in technical efficiency on the other hand firms that don't simply perish and resources get transferred from inefficient firms to more efficient ones and the industry as a whole becomes more efficient.

The Patents and Designs Act of 1911 was passed while India was under British rule this law protected process and product patents for 16 years and was in effect till the Patents Act of 1970 was passed. The patents act of 1970 marked a turning point for the local pharmaceutical firms because this enabled them to reverse engineer any existing or new product and sell it in the domestic market. In addition this law also enabled Indian manufacturers of generic drugs to become competitive in the international market. They were able to enter the market for off patent drugs as soon as the drugs patent expired. The absence of product patents in India allowed Indian firms to experiment and fine-tune their

production processes with any drug that was in an on-patent state in U.S and Europe. The moment the patent for that particular product expired Indian firms could compete very effectively in international markets. Thus we find that the learning by doing factor was a very important factor in The Indian pharmaceutical Industry. The more a firm gained in terms of experience the more it was able to fine-tune its production process and hence more it gained in terms of technical efficiency. The year 2005 will experience a lot of changes in this scenario when the intellectual property regime becomes stronger in this country and product patents come into operation. The fact however remains that pharmaceuticals have not faced any significant surge in imports. So if imports are really effective as a disciplining device they will have their absence felt. Now let us see what the empirical results have to say.

Regression results indicate that learning by doing is a very important determinant of technical efficiency. This is aptly captured by the significant positive coefficient of the regressor age. This makes us conclude that the older is a firm in the Indian pharmaceutical industry the more is it able to fine-tune its production process and hence the higher is its technical efficiency. Raw material import intensity and the embodied technology import variable both have significant negative coefficients indicating that firms that are higher up in the technical efficiency ladder source their raw materials and capital goods from the domestic sector predominantly. Research and development expenditure plays a crucial role behind technical efficiency augmentation in the pharmaceutical Industry. The more there is expenditure on research and development the greater is the augmentation of technical efficiency in the industry as a whole. This also signals that the effects of research and development are getting diffused to other firms in the industry. Regression results also provide overwhelming evidence supporting the contention that competition is a crucial factor in driving technical efficiency. The trade liberalization dummy, which takes a value zero for the years 1988-89 to 1991-92 and one from 1992-93 to 1997-98 report a significant negative coefficient suggesting that Technical efficiency did go down in the era of trade liberalization. This suggests that probably absence of imports made firms operate in a non-competitive environment and probably that was the reason why technical efficiency went down in the post liberalization era.

Viewing firm level performance across the industries leads us to the conclusion that competition is important in ushering in efficiency. However it needs to be mentioned that no clear cut results are obtained. The textile industry shows a statistically significant negative coefficient for the trade liberalization dummy in the period 1993-98.As pointed out earlier the opening up of this industry was incomplete in 1991-92.Therefore this result while not supporting the case for liberalization cannot be said to reject it. The transport equipment sector however witnessed a tremendous surge in technical efficiency in the post liberalization era aptly captured by the statistically significant positive coefficient of the trade liberalization dummy. It can be said that firms in this sector did respond positively to international competition. The pharmaceutical industry also reports a statistically significant negative coefficient for the trade liberalization dummy. This is a finding that needs to be analyzed further. The pharmaceutical industry given the nature of the intellectual property right regime in India faced no price competition from imports. Therefore despite liberalization, imports were limited. In this context it becomes difficult to determine reasons for the negative sign of the coefficient of the trade liberalization dummy.

At this stage it is difficult to make a categoric statement regarding whether trade liberalization has a positive or negative impact on technical efficiency. This thesis focuses only on three industries perhaps to come to a conclusive statement a much more detailed analysis involving more industries is required.

Table 1:Time Invariant Technical Efficiency estimates (Textiles)

Company name	Company's main activity	TE
Eskay K'N'It (India) Ltd.	**Cloth (Fabrics)**	**100.00**
Krishna Lifestyle Technologies Ltd.	Cloth processed	79.09
Mahadev Industries Ltd.	Apparels	55.40
Nagreeka Exports Ltd.	Cotton yarn	53.90
National Textile Corpn. Ltd.	Cloth (Fabrics)	48.96
K S L & Inds. Ltd.	Cloth (Fabrics)	48.00
Uniworth Ltd.	Wool yarn	40.54
Delight Handicrafts Palace Ltd.	Coir carpets & floor rugs	39.49
Central India Polyesters Ltd.	Polyester filament yarn (PFY)	33.76
Century Enka Ltd.	Polyester filament yarn (PFY)	31.26
Sanghi Polyesters Ltd.	Polyester filament yarn (PFY)	30.87
Nahar Spinning Mills Ltd.	Cotton & blended yarn	30.50
Jindal Polyester Ltd.	Polyester filament yarn (PFY)	30.42
Bala Techno Synthetics Ltd.	Rubberised textile fabrics	29.84
J B F Industries Ltd.	Partially oriented yarn (POY)	28.17
Enkay Texofood Inds. Ltd.	Textured yarn of synthetic filament yarn	28.02
Emtex Industries (India) Ltd.	Cloth processed	28.02
Haria Exports Ltd.	Apparels	27.42
Arvind Mills Ltd.	Cloth (Fabrics)	27.40
Zenith Exports Ltd.	Silk & silk textiles	25.98
Mahavir Spinning Mills Ltd.	Cotton yarn	25.26
Welspun India Ltd.	Terry towelling & similar woven terry fabrics	25.23
Bombay Dyeing & Mfg. Co. Ltd.	Cloth (Fabrics)	25.12
Garden Silk Mills Ltd.	Woven fabrics of man-made filaments	25.08
S R F Ltd.	Nylon tyre cord fabric	24.81
Recron Synthetics Ltd.	Polyester filament yarn (PFY)	24.46
Prashant India Ltd.	Textured yarn of synthetic filament yarn	24.15
Indo Rama Synthetics (India) Ltd.	Synthetic filament yarn other than sewing threads	23.98
Himatsingka Seide Ltd.	Woven fabrics of silk	23.72
Parasrampuria Synthetics Ltd.	Polyester filament yarn (PFY)	23.25
Vardhman Spinning & General Mills Ltd.	Blended yarn	22.08
E S I Ltd.	Silk & silk textiles	22.05
Ashima Ltd.	Cloth (Fabrics)	21.77
Jindal Worldwide Ltd.	Bed linen, table linen, etc.	21.55
Blue Blends (India) Ltd.	Cotton & blended yarn, texturised	21.43
Leela Scottish Lace Ltd.	Apparels	21.17
Pasupati Acrylon Ltd.	Acrylic fibre	21.01
Indian Acrylics Ltd.	Acrylic fibre	20.88
Uniworth Textiles Ltd.	Wool & woollen textiles	20.32
Nahar Exports Ltd.	Cotton & blended yarn	20.17
Birla V X L Ltd.	Wool & woollen textiles	20.01
Modipon Ltd.	Synthetic filament yarn other than sewing threads	19.93
Modern Denim Ltd.	Cloth (Fabrics)	19.92

Table 1 Contd. Company name	Company's main activity	TE
Alok Industries Ltd.	Cloth (Fabrics)	19.83
Premier Mills Ltd.	Cloth (Fabrics)	19.71
K G Denim Ltd.	Cloth (Fabrics)	19.56
J C T Ltd.	Man-made filaments & fibres	19.52
Vardhman Polytex Ltd.	Cotton yarn	19.01
Malwa Cotton Spg. Mills Ltd.	Cotton yarn	18.96
Jaybharat Fabrics Mills Ltd.	Textured yarn of synthetic filament yarn	18.87
Madura Coats Ltd.	Cotton sewing thread	18.46
Modern Terry Towels Ltd.	Terry towelling & similar woven terry fabrics	18.28
Atlantic Spinning & Wvg. Mills Ltd.	Cotton yarn	18.26
Nahar International Ltd.	Cotton & blended yarn	18.23
D R Softech & Inds. Ltd.	Textured yarn of synthetic filament yarn	18.11
Rajasthan Spinning & Wvg. Mills Ltd.	Blended yarn	18.07
Sonu Synthetics Ltd.	Cotton & blended yarn	17.99
Parasrampuria Industries Ltd.	Textured yarn of synthetic filament yarn	17.97
Maral Overseas Ltd.	Cotton yarn	17.47
Arihant Industries Ltd.	Cloth (Fabrics)	17.45
Niwas Spinning Mills Ltd.	Cotton yarn	17.38
S I V Industries Ltd.	Viscose staple fibre (VSF)	17.37
Filatex India Ltd.	Polyester filament yarn (PFY)	17.18
Filatex India Ltd.	Polyester filament yarn (PFY)	17.18
Krystal Poly-Fab Ltd.	Textured yarn of synthetic filament yarn	16.91
Eurotex Industries & Exports Ltd.	Cotton yarn	16.80
Siyaram Silk Mills Ltd.	Cloth (Fabrics)	16.68
S Kumars Nationwide Ltd.	Cloth (Fabrics)	16.67
Indo Count Inds. Ltd.	Cotton yarn	16.56
Ceenik Exports (India) Ltd.	Apparels	16.50
Patspin India Ltd.	Cotton yarn	16.43
Mafatlal Industries Ltd.	Cloth (Fabrics)	16.38
Shital Fibres Ltd.	Blankets & travelling rugs	16.37
Keswani Synthetics Inds. Ltd.	Cotton & blended yarn, crimped	16.31
Nova Petrochemicals Ltd.	Partially oriented yarn (POY)	16.19
Forbes Gokak Ltd.	Cotton yarn	16.06
Midland Industries Ltd.	Wool yarn	16.04
Ginni Filaments Ltd.	Cotton yarn	16.00
Precot Mills Ltd.	Cotton yarn	15.92
Vijay Textiles Ltd.	Cloth processed	15.85
Sutlej Industries Ltd.	Man-made fibres	15.76
B S L Ltd.	Woven blended fabrics of synthetic staple fibres	15.69
Gangotri Textiles Ltd.	Cotton yarn	15.63
Winsome Yarns Ltd.	Cotton yarn	15.53
Jatta Industries Ltd.	Textured yarn of synthetic filament yarn	15.50
Beekaylon Industries Ltd.	Textured yarn of synthetic filament yarn	15.40
Arihant Cotsyn Ltd.	Cotton & blended yarn	15.11
Shamken Multifab Ltd.	Cloth (Fabrics)	15.10

Table 1 Contd.

Company name	Company's main activity	TE
Morarjee Goculdas Spg. & Wvg. Co. Ltd.	Cloth (Fabrics)	14.86
Porritts & Spencer (Asia) Ltd.	Felt	14.58
Sudhan Spinning Mills Pvt. Ltd.	Cotton yarn	14.52
Loyal Textile Mills Ltd.	Cloth (Fabrics)	14.49
Galaxy Indo-Fab Ltd.	Man-made fabrics	14.45
Cheslind Textiles Ltd.	Cotton yarn	14.43
G S L (India) Ltd.	Synthetic filament yarn other than sewing threads	14.43
Deepak Spinners Ltd.	Cellulose acetate yarn	14.42
Garware-Wall Ropes Ltd.	Twine, cordage, rope & cables	14.28
Baroda Rayon Corpn. Ltd.	Synthetic filament yarn other than sewing threads	14.23
T T Ltd.	Cotton & blended yarn	14.16
Pearl Global Ltd.	Apparels	14.12
Super Spinning Mills Ltd.	Cotton & blended yarn	14.11
Rajasthan Petro Synthetics Ltd.	Polypropylene filament yarn (PPFY)	14.08
Addi Industries Ltd.	Apparels - knitted / crocheted	14.07
Indian Organic Chemicals Ltd.	Polyester staple fibre (PSF)	14.07
Tamilnadu Jai Bharath Mills Ltd.	Cotton yarn	14.05
Dewan Rubber Inds. Ltd.	Cotton & blended yarn	14.05
Priyadarshini Spinning Mills Ltd.	Synthetic filament yarn other than sewing threads	13.94
Pratibha Syntex Ltd.	Textured yarn of synthetic filament yarn	13.92
Welspun Syntex Ltd.	Textured yarn of synthetic filament yarn	13.91
G T N Textiles Ltd.	Cotton yarn	13.80
Thiagarajar Mills Ltd.	Cotton & blended yarn	13.68
Tubeknit Fashions Ltd.	Apparels - knitted / crocheted	13.58
Shri Sarvesh Cotton Mills Ltd.	Cotton yarn	13.48
Ambika Cotton Mills Ltd.	Cotton yarn	13.43
Kadri Mills (Cbe) Ltd.	Cotton yarn	13.42
Kadri Mills (Cbe) Ltd.	Cotton yarn	13.42
Aryan Fine Fab Ltd.	Cloth (Fabrics)	13.40
Arhat Industries Ltd.	Cotton yarn	13.35
Suzlon Fibres Ltd.	Cotton & blended yarn, texturised	13.28
Raghuvir Exim Ltd.	Apparels	13.26
Trent Ltd.	Apparels	13.14
Hind Syntex Ltd.	Synthetic filament yarn other than sewing threads	13.11
Pasupati Spinning & Wvg. Mills Ltd.	Synthetic filament yarn other than sewing threads	13.06
C T Cotton Yarn Ltd.	Cotton yarn	13.03
Arora Fibres Ltd.	Polypropylene fibre	12.95
Rajkamal Synthetics Ltd.	Woven fabrics of man-made filaments	12.95
Sholingur Textiles Ltd.	Cotton & blended yarn	12.91
Lakshmi Mills Co. Ltd.	Cotton & blended yarn	12.85
Shree Rajasthan Syntex Ltd.	Cotton & blended yarn	12.84
Indian Card Clothing Co. Ltd.	Metallised yarn	12.83
Rajapalayam Mills Ltd.	Cotton yarn	12.83
Premier Synthetics Ltd.	Man-made filaments & fibres	12.79
Oswal Spinning & Wvg. Mills Ltd.	Cotton yarn	12.73

Table 1 Contd.

Company name	Company's main activity	TE
V M T Spinning Co. Ltd.	Cotton yarn	12.67
Mehratex (India) Pvt. Ltd.	Textured yarn of synthetic filament yarn	12.61
Shri Dinesh Mills Ltd.	Woven fabrics of wool	12.53
Hindoostan Spinning & Wvg. Mills Ltd.	Cloth (Fabrics)	12.52
Suryavanshi Spinning Mills Ltd.	Cotton & blended yarn	12.43
Monotona Exports Ltd.	Apparels	12.43
Shamken Spinners Ltd.	Cotton & blended yarn	12.39
Virudhunagar Textile Mills Ltd.	Cloth (Fabrics)	12.39
Pacific Cotspin Ltd.	Cotton yarn	12.38
G I S Ltd.	Man-made fibres	12.38
Aarti International Ltd.	Cotton yarn	12.37
Aarvee Denims & Exports Ltd.	Cloth (Fabrics)	12.36
Faze Three Exports Ltd.	Cotton durries	12.35
Santogen Exports Ltd.	Terry towelling & similar woven terry fabrics	12.35
N R C Ltd.	Man-made filaments	12.29
N R C Ltd.	Man-made filaments	12.29
Olympia Industries Ltd.	Yarn of artificial staple fibres, excl. sewing th	12.28
Nufab Industries Ltd.	Textured yarn of synthetic filament yarn	12.28
Adhunik Synthetics Ltd.	Woven fabrics of man-made filaments	12.27
S T I India Ltd.	Cotton yarn	12.25
Sri Kannapiran Mills Ltd.	Cotton & blended yarn	12.24
Amarjothi Spinning Mills Ltd.	Cotton yarn	12.19
Kamadgiri Synthetics Ltd.	Cloth (Fabrics)	12.05
Gujarat Texspin Ltd.	Textured yarn of synthetic filament yarn	11.96
Kayel Syntex Ltd.	Cloth (Fabrics)	11.89
Banswara Syntex Ltd.	Synthetic filament yarn other than sewing threads	11.85
Radhika Polyesters Ltd.	Coated / laminated textile fabrics	11.80
Oswal Woollen Mills Ltd.	Wool & woollen textiles	11.80
Abhishek Industries Ltd.	Cotton yarn	11.72
Salem Textiles Ltd.	Cotton yarn	11.71
Winsome Textile Inds. Ltd.	Cotton yarn	11.68
Shri Renuga Textiles Ltd.	Cotton yarn	11.67
Modern Syntex (India) Ltd.	Polyester filament yarn (PFY)	11.65
Wires & Fabriks (S.A.) Ltd.	Textile products for technical uses	11.61
P B M Polytex Ltd.	Cotton & blended yarn	11.60
Donear Industries Ltd.	Man-made fabrics	11.60
Sumeet Industries Ltd.	Polypropylene filament yarn (PPFY)	11.59
Sarita Software & Inds. Ltd.	Cloth (Fabrics)	11.54
J J Exporters Ltd.	Silk & silk textiles	11.54
Sangeeth Textiles Ltd.	Cotton yarn	11.52
Akhileshwar Texports Ltd.	Woven fabrics of synthetic staple fibres	11.51
Kongarar Integrated Fibres Ltd.	Cotton yarn	11.49
Suditi Industries Ltd.	Cloth processed	11.47
Punjab Fibres Ltd.	Cotton yarn	11.42
Nachmo Knitex Ltd.	Knitted / crocheted fabrics	11.41

Table 1 Contd. Company name	Company's main activity	TE
Sri Ramakrishna Mills (Coimbatore) Ltd.	Cotton yarn	11.37
Nahar Fibres Ltd. [Erstwhile]	Cotton yarn	11.37
Hytone Texstyles Ltd.	Woven fabrics of man-made filaments	11.32
Simco Industries Ltd.	Textured yarn of synthetic filament yarn	11.31
Rajasthan Polyesters Ltd.	Textured yarn of synthetic filament yarn	11.28
Nirlon Ltd.	Nylon tyre yarn	11.23
Paras Petrofils Ltd.	Polyester filament yarn (PFY)	11.18
Vijayakumar Mills Ltd.	Cotton & blended yarn	11.08
Spice Islands Apparels Ltd.	Apparels - not knitted / crocheted	11.07
Ruby Mills Ltd.	Cloth (Fabrics)	11.05
Soma Textiles & Inds. Ltd.	Cotton & blended yarn	11.04
R L F Ltd.	Embroidery in the piece	11.01
Suryalakshmi Cotton Mills Ltd.	Cotton & blended yarn	10.98
Hanil Era Textiles Ltd.	Acrylic filament yarn (AFY)	10.96
Meridian Industries Ltd.	Cotton yarn	10.96
Derby Textiles Ltd.	Cotton & blended yarn	10.95
Kurlon Ltd.	Rubberised coir products & bonded fabrics	10.92
Bholanath International Ltd.	Carpets, etc.	10.91
Super Sales Agencies Ltd.	Cotton yarn	10.88
Bengal Tea & Fabrics Ltd.	Cotton yarn	10.85
Ganesh Polytex Ltd.	Textured yarn of synthetic filament yarn	10.81
Maikaal Fibres Ltd.	Cotton yarn	10.81
Jyoti Overseas Ltd.	Cloth (Fabrics)	10.70
Suryajyoti Spinning Mills Ltd.	Cotton yarn	10.64
Amit Spinning Inds. Ltd.	Cotton yarn	10.64
Bharat Commerce & Inds. Ltd.	Man-made filaments & fibres	10.61
Dhar Textile Mills Ltd.	Cotton yarn	10.60
Supertex Industries Ltd.	Cotton & blended yarn, texturised	10.51
Punjab Woolcombers Ltd.	Wool yarn	10.48
Surat Textile Mills Ltd.	Polyester filament yarn (PFY)	10.47
Hooghly Mills Co. Ltd.	Jute & jute products	10.38
Ventura Textiles Corpn. Ltd.	Cloth (Fabrics)	10.38
Shree Synthetics Ltd.	Nylon filament yarn	10.36
Kandagiri Spinning Mills Ltd.	Cotton yarn	10.36
Champdany Industries Ltd.	Jute yarn	10.36
Mikado Textile Inds. Ltd.	Cotton & blended yarn	10.33
Oxford Industries Ltd.	Cloth (Fabrics)	10.23
Bhilwara Spinners Ltd.	Cotton & blended yarn	10.22
Ritesh Industries Ltd.	Apparels	10.19
India Polyfibres Ltd.	Polyester staple fibre (PSF)	10.16
A V Cottex Ltd.	Cotton yarn	10.13
Omnitex Industries (India) Ltd.	Textured yarn of synthetic filament yarn	10.12
Sri Nachammai Cotton Mills Ltd.	Cotton yarn	10.11
Mid India Inds. Ltd.	Cotton & blended yarn	10.04

Table 1 Contd.

Company name	Company's main activity	TE
Simplex Mills Co. Ltd.	Cloth (Fabrics)	10.02
Sangam (India) Ltd.	Cotton & blended yarn	10.01
Vijayeswari Textiles Ltd.	Cotton yarn	9.97
National Textile Corpn. (T.N. & Pondicherry) Ltd.	Cotton & blended yarn	9.97
Bindu Synthetics Ltd.	Textured yarn of synthetic filament yarn	9.94
Vanasthali Textile Inds. Ltd.	Towels including turkish towels	9.94
Gontermann-Peipers (India) Ltd.	Cotton yarn	9.93
Radhika Spinning Mills Ltd.	Cotton yarn	9.87
Super Syncotex (India) Ltd.	Cotton & blended yarn	9.84
Konark Synthetic Ltd.	Textured yarn of synthetic filament yarn	9.83
Asia Polytex India Ltd.	Textured yarn of synthetic filament yarn	9.81
Asia Polytex India Ltd.	Textured yarn of synthetic filament yarn	9.81
Suryalata Spinning Mills Ltd.	Cotton & blended yarn	9.79
Arunoday Mills Ltd.	Cotton & blended yarn	9.79
Kongarar Textiles Ltd.	Cotton yarn	9.78
Vippy Spinpro Ltd.	Cotton yarn	9.74
Seasons Textiles Ltd.	Cloth (Fabrics)	9.73
Mallur Siddeswara Spg. Mills Ltd.	Cotton yarn	9.72
Acknit Knitting Ltd.	Gloves, mittens, etc. knitted or crocheted	9.72
Rishab Special Yarns Ltd.	Textured yarn of synthetic filament yarn	9.70
Maharaja Shree Umaid Mills Ltd.	Cotton & blended yarn	9.56
Ashnoor Textile Mills Ltd.	Carpets, etc.	9.50
Spentex Industries Ltd.	Cotton yarn	9.44
Sree Ayyanar Spg. & Wvg. Mills Ltd.	Cotton & blended yarn	9.39
Willard India Ltd.	Jute & jute products	9.39
Palani Andavar Cotton & Synthetic Spinners Ltd.	Cotton yarn	9.39
Rahul Merchandising Ltd.	Apparels	9.38
Associated Stone Inds. (Kotah) Ltd.	Cotton & blended yarn	9.38
Kovilpatti Lakshmi Roller Flour Mills Ltd.	Cotton yarn	9.36
Consolidated Fibres & Chemicals Ltd.	Acrylic fibre	9.33
Deora Polytex Ltd.	Cloth (Fabrics)	9.32
Kaytee Cotsynth Inds. Ltd.	Cotton yarn	9.28
Prakash Woollen Mills Ltd.	Blankets & travelling rugs	9.27
Sambandam Spinning Mills Ltd.	Cotton yarn	9.23
Alps Industries Ltd.	Other textile articles	9.20
Libra Filaments Ltd.	Synthetic filament yarn other than sewing threads	9.19
R S L Industries Ltd.	Cloth processed	9.17
Sharad Fibres & Yarn Processors Ltd.	Textured yarn of synthetic filament yarn	9.16
Pranavaditya Spinning Mills Ltd.	Cotton yarn	9.16
A P M Industries Ltd.	Synthetic filament yarn other than sewing threads	9.15
Bhiwani Denim & Apparels Ltd.	Cloth (Fabrics)	9.14
Mukund Syntex Ltd.	Textured yarn of synthetic filament yarn	9.12
Jaipur Polyspin Ltd.	Synthetic filament yarn other than sewing threads	9.11
Jaipur Polyspin Ltd.	Synthetic filament yarn other than sewing threads	9.11
Zodiac Clothing Co. Ltd.	Apparels	9.10

Table 1 Contd.

Company name	Company's main activity	TE
Trimbak Industries Ltd.	Terry towelling & similar woven terry fabrics	9.06
Maya Spinners Ltd.	Cotton yarn	9.02
Hooghly Mills Projects Ltd.	Jute & jute products	9.02
Coimbatore Pioneer Mills Ltd.	Cotton & blended yarn	9.01
Grabal Alok Impex Ltd.	Special woven fabrics	9.01
Zenith Fibres Ltd.	Polypropylene fibre	9.01
Cheviot Co. Ltd.	Jute yarn	8.99
H P Cotton Textile Mills Ltd.	Cotton yarn	8.98
Riba Textiles Ltd.	Towels including turkish towels	8.96
Gold Multifab Ltd.	Curtains, blinds, etc.	8.95
Hanjer Fibres Ltd.	Cotton yarn	8.94
Raymond Apparel Ltd.	Apparels	8.93
Prime Textiles Ltd.	Cotton yarn	8.92
Anjani Synthetics Ltd.	Cloth (Fabrics)	8.89
Jamshri Ranjitsinghji Spg. & Wvg. Mills Co. Ltd.	Cotton & blended yarn	8.85
Valson Industries Ltd.	Textured yarn of synthetic filament yarn	8.84
Raj Rayon Ltd.	Textured yarn of synthetic filament yarn	8.79
Aekta Ltd.	Jute & jute products	8.78
Vijayshree Spinning Mills Ltd.	Cotton & blended yarn	8.69
East India Syntex Ltd.	Yarn of synthetic staple fibres, excluding sewing	8.63
Arvind Polycot Ltd. [Erstwhile]	Cloth (Fabrics)	8.62
Sajjan Textiles Mills Ltd.	Cloth (Fabrics)	8.56
Pioneer Embroideries Ltd.	Embroidery in the piece	8.55
M H Mills & Inds. Ltd.	Cloth (Fabrics)	8.55
Sri Lakshmi Saraswathi Textiles (Arni) Ltd.	Cotton yarn	8.50
Polygenta Technologies Ltd.	Textured yarn of synthetic filament yarn	8.49
Sri Venkatesa Mills Ltd.	Cotton & blended yarn	8.47
Samrat Ashoka Exports Ltd.	Apparels - knitted / crocheted	8.47
Kiran Syntex Ltd.	Textured yarn of synthetic filament yarn	8.46
Shruti Synthetics Ltd.	Cellulose acetate yarn	8.45
Siddhartha Super Spg. Mills Ltd.	Synthetic filament yarn other than sewing threads	8.44
Thambbi Modern Spg. Mills Ltd.	Cotton & blended yarn	8.44
S S M Mills Ltd.	Cloth processed	8.43
Sri Ganapathy Mills Co. Ltd.	Cotton yarn	8.42
Sarla Polyester Ltd.	Textured yarn of synthetic filament yarn	8.42
Sanrhea Technical Textiles Ltd.	Cloth (Fabrics)	8.39
Supreme Woollen Mills Ltd.	Synthetic staple fibres, not carded or combed	8.38
Ramaraju Surgical Cotton Mills Ltd.	Cotton yarn	8.36
Vidyasagar Textiles Ltd.	Cotton yarn	8.34
Khatau Makanji Spg. & Wvg. Co. Ltd.	Cloth (Fabrics)	8.34
Kanco Enterprises Ltd.	Cotton yarn	8.33
Sundaram Textiles Ltd.	Cotton yarn	8.33
Sunflag Filaments Ltd.	Textured yarn of synthetic filament yarn	8.29
Samrat Spinners Ltd.	Synthetic filament yarn other than sewing threads	8.28
Cherry Fashions Ltd.	Apparels - knitted / crocheted	8.28

Table 1 Contd. Company name	Company's main activity	TE
Shamken Cotsyn Ltd.	Apparels	8.26
Bhaval Synthetics (India) Ltd.	Synthetic filament yarn other than sewing threads	8.24
R M Mohite Textiles Ltd.	Cotton yarn	8.24
Tirupur Textiles Pvt. Ltd.	Hosiery yarn	8.23
Sree Uma Parameswari Mills Ltd.	Cotton yarn	8.14
National Textile Corpn. (A.P., Kar., Ker. & Mahe)	Cotton & blended yarn	8.14
Patodia Textile Inds. Ltd.	Textured yarn of synthetic filament yarn	8.13
Vishaldeep Spinning Mills Ltd.	Cotton yarn	8.12
Nitin Spinners Ltd.	Cotton yarn	8.11
M V Infotech Ltd.	Cotton yarn	8.10
Gloster Jute Mills Ltd.	Jute & jute products	8.10
Prakash Cotton Mills Ltd.	Cloth (Fabrics)	8.07
Lohia Polyester Ltd.	Synthetic filament yarn other than sewing threads	8.02
Rai Saheb Rekhchand Mohota Spg. & Wvg. Mills Ltd.	Cotton & blended yarn	8.00
Rajalakshmi Mills Ltd.	Cotton yarn	7.99
Chitradurga Spintex Ltd.	Cotton yarn	7.96
Sarvaraya Textiles Ltd.	Cotton yarn	7.95
Shree Manufacturing Co. Ltd.	Synthetic filament yarn other than sewing threads	7.94
Sri Ramnarayan Mills Ltd.	Cotton yarn	7.94
L D Textile Inds. Ltd.	Textured yarn of synthetic filament yarn	7.89
L S Mills Ltd.	Cotton yarn	7.88
Jasch Industries Ltd.	Coated / laminated textile fabrics	7.86
Sri Vishnu Shankar Mills Ltd.	Cotton yarn	7.85
Raghuvir Synthetics Ltd.	Cloth processed	7.79
Centwin Textile Mills Ltd.	Cotton yarn	7.78
Katare Spinning Mills Ltd.	Cotton yarn	7.78
Piramal Spinning & Wvg. Mills Ltd.	Cloth (Fabrics)	7.77
Kareems Silk International Ltd.	Silk fabrics, processed	7.76
Intercraft Ltd.	Apparels	7.76
S R Industries Ltd.	Terry towelling & similar woven terry fabrics	7.71
Reliance Chemotex Inds. Ltd.	Cotton & blended yarn	7.70
Gem Spinners India Ltd.	Cotton yarn	7.65
Sportking India Ltd.	Acrylic filament yarn (AFY)	7.64
Jain Spinners Ltd.	Yarn of synthetic staple fibres, excluding sewing	7.62
Khator Fibre & Fabrics Ltd.	Cloth processed	7.62
Orbit Exports Ltd.	Cloth (Fabrics)	7.58
Gupta Synthetics Ltd.	Textured yarn of synthetic filament yarn	7.58
Rama Qualitex Ltd.	Cloth (Fabrics)	7.57
Krishna Synthetics Ltd.	Textured yarn of synthetic filament yarn	7.56
Ganges Manufacturing Co. Ltd.	Jute & jute products	7.55
Sri Varadaraja Textiles Ltd.	Cotton yarn	7.54
S P L Industries Ltd.	Apparels	7.53
Filaments India Ltd.	Synthetic filament yarn other than sewing threads	7.49
White House Cotton Inds. Ltd.	Cotton yarn	7.47

Table 1 Contd.		
Company name	**Company's main activity**	**TE**
Everlon Synthetics Ltd.	Textured yarn of synthetic filament yarn	7.46
Binny Ltd.	Cloth (Fabrics)	7.44
Bhilwara Processors Ltd.	Cloth processed	7.44
Adinath Textiles Ltd.	Acrylic filament yarn (AFY)	7.42
Svadeshi Mills Co. Ltd.	Cloth (Fabrics)	7.41
Howrah Mills Co. Ltd.	Jute & jute products	7.41
Howrah Mills Co. Ltd.	Jute & jute products	7.41
Shree Rajasthan Texchem Ltd.	Synthetic filament yarn other than sewing threads	7.41
K C Textiles Ltd.	Cotton yarn	7.38
Girnar Fibres Ltd.	Cotton & blended yarn	7.29
Silktex Ltd.	Silk fabrics, processed	7.26
Dalmia Laminators Ltd.	Plastic coated / polyethylene jute bags	7.24
Sri Vignesh Yarns Ltd.	Cotton yarn	7.23
Janakiram Mills Ltd.	Cotton yarn	7.23
Shree Kumaran Mills Ltd.	Cotton yarn	7.23
Apeego Ltd.	Apparels - knitted / crocheted	7.22
Divya Enterprises Ltd.	Cotton & blended yarn, processed	7.18
Chhabra Spinners Ltd.	Cotton yarn	7.13
Travancore Rayons Ltd.	Viscose rayon yarn (VFY)	7.12
Veena Textiles Ltd.	Cloth (Fabrics)	7.06
Mansukh Industries Ltd.	Woven pile fabrics & chenille fabrics	7.05
Essjay Synthetics Ltd.	Textured yarn of synthetic filament yarn	7.03
Bhandari Hosiery Exports Ltd.	Apparels - knitted / crocheted	6.99
Gujarat Filaments Ltd.	Polypropylene filament yarn (PPFY)	6.94
Dawn Mills Co. Ltd.	Cotton & blended yarn	6.89
Arvind Clothing Ltd.	Apparels - not knitted / crocheted	6.88
Kamarhatty Co. Ltd.	Jute & jute products	6.87
Thanjavur Spinning Mill Ltd.	Cotton yarn	6.84
Maris Spinners Ltd.	Cotton yarn	6.83
S & Y Mills Ltd.	Cloth processed	6.81
Phoenix Mills Ltd.	Cotton & blended yarn	6.80
Cuddapah Spinning Mills Ltd.	Cotton yarn	6.80
Lambodhara Textiles Ltd.	Cotton yarn	6.75
Pratap Spinning, Wvg. & Mfg. Co. Ltd.	Cloth (Fabrics)	6.72
Ideal Carpets Ltd.	Carpets, etc.	6.71
Prashanth Textiles Ltd.	Cotton & blended yarn	6.71
Blue Chip Tex Fuel Inds. Ltd.	Textured yarn of synthetic filament yarn	6.70
A K C Synthetics Ltd.	Cloth (Fabrics)	6.67
Erhardt+Leimer (India) Ltd.	Other textile articles	6.67
Narayan Krishna Spinners Ltd.	Cotton yarn	6.67
Ginza Industries Ltd.	Other textile articles	6.65
Mayur Uniquoters Ltd.	Other coated / laminated textile fabrics	6.65
Ahmedabad New Cotton Mills Co. Ltd.	Cloth (Fabrics)	6.65
D P F Textiles Ltd.	Cotton yarn	6.63
Asok Textiles Ltd.	Cotton yarn	6.61

Table 1 Contd. Company name	Company's main activity	TE
Fairdeal Filaments Ltd.	Cotton & blended yarn	6.61
Kerala Spinners Ltd.	Blended yarn	6.59
Indian Polyfins Ltd.	Cotton & blended yarn, texturised	6.59
Manav Yarn Products Ltd.	Textured yarn of synthetic filament yarn	6.58
India Jute & Inds. Ltd.	Synthetic filament yarn other than sewing threads	6.53
Sybly Industries Ltd.	Cotton yarn	6.52
Kakatiya Textiles Ltd.	Cotton yarn	6.52
Futura Industries Ltd.	Polyester staple fibre (PSF)	6.51
Juggilal Kamlapat Cotton Spg. & Wvg. Mills Co. Lt	Cloth (Fabrics)	6.50
Naffar Chandra Jute Mills Ltd.	Jute & jute products	6.49
Trend Designs Ltd.	Apparels	6.48
Maheshwari Mills Ltd.	Cloth (Fabrics)	6.47
Veejay Terry Products Ltd.	Cotton yarn	6.45
Western India Cottons Ltd.	Cloth (Fabrics)	6.44
Chetak Spintex Ltd.	Polypropylene filament yarn (PPFY)	6.43
Sagar Silk Inds. Ltd.	Cloth (Fabrics)	6.43
Selvaraja Mills Ltd.	Cotton yarn	6.43
Tai Chonbang Textile Inds. Ltd.	Cotton & blended yarn	6.42
Mayfair Ltd.	Apparels	6.42
Arex Industries Ltd.	Textile labels, badges, etc.	6.38
Pasupati Haryana Woollens Ltd.	Wool yarn	6.29
Madras Spinners Ltd.	Cotton yarn	6.27
Sri Revati Spg. Mills Ltd.	Cotton yarn	6.26
Damodar Threads Ltd.	Cotton & blended yarn, processed	6.25
Madanapalle Spinning Mills Ltd.	Cotton & blended yarn	6.21
Shri Teyem Processors Ltd.	Cloth processed	6.21
Sree Akkamamba Textiles Ltd.	Cotton yarn	6.20
Raipur Manufacturing Co. Ltd.	Cloth (Fabrics)	6.19
Eastern Enterprises Ltd.	Yarn of synthetic staple fibres, excluding sewing	6.17
Kumar Wire Cloth Mfg. Co. Ltd.	Textile products for technical uses	6.17
Ibiza Industries Ltd.	Cloth (Fabrics)	6.14
Auckland International Ltd.	Plastic coated / polyethylene jute bags	6.12
Kallam Spinning Mills Ltd.	Cotton & blended yarn	6.09
Santosh Fine-Fab Ltd.	Cloth (Fabrics)	6.05
Shaktigarh Textile & Inds. Ltd.	Cotton yarn	6.04
Sonia Textiles Ltd.	Knitted / crocheted fabrics	6.02
Sstella Silks Ltd.	Silk & silk textiles	6.02
Suryavanshi Textiles Ltd.	Cloth processed	6.00
Samtex Fashions Ltd.	Men's suits, trousers, etc. knitted or crocheted	6.00
Alan Scott Inds. Ltd.	Other clothing accessories, knitted or crocheted	5.99
Alan Scott Inds. Ltd.	Other clothing accessories, knitted or crocheted	5.99
Hindon River Mills Ltd.	Cloth (Fabrics)	5.99
Garware Marine Inds. Ltd.	Fishing nets	5.99
Premco Global Ltd.	Laces/Lace fabrics	5.99
New Central Jute Mills Co. Ltd.	Jute & jute products	5.93

Table 1 Contd. Company name	Company's main activity	TE
Pee Jay International Ltd.	Wool yarn	5.92
Jawahar Mills Ltd.	Cotton & blended yarn	5.89
S P B L Ltd.	Cloth processed	5.89
Asian Knitwears Ltd. [Erstwhile]	Apparels - knitted / crocheted	5.83
Asian Knitwears Ltd. [Erstwhile]	Apparels - knitted / crocheted	5.83
Sunlord Apparels Mfg. Co. Ltd.	Apparels	5.83
Preyanshu Industries Ltd.	Other clothing accessories, knitted or crocheted	5.82
Hindustan Fibres Ltd.	Cotton yarn	5.79
Sri Karunambikai Mills Ltd.	Cotton yarn	5.77
Sree Meenakshi Mills Ltd.	Cotton yarn	5.73
United Textiles Ltd.	Cotton yarn	5.71
Lakshmi Apparels & Wovens Ltd.	Cloth (Fabrics)	5.70
Arvind Fashions Ltd.	Apparels - not knitted / crocheted	5.69
Vogue Textiles Ltd.	Special woven fabrics	5.69
Cityman Ltd.	Apparels - knitted / crocheted	5.66
G I V O Ltd.	Men's suits, trousers, etc. knitted or crocheted	5.65
Aditya Spinners Ltd.	Cotton & blended yarn	5.63
Budge Budge Co. Ltd.	Jute & jute products	5.63
L N Polyesters Ltd.	Textured yarn of synthetic filament yarn	5.59
Pondicherry Spinners Ltd.	Cotton yarn	5.58
Pushpsons Industries Ltd.	Cloth (Fabrics)	5.56
National Textile Corpn. (South Maharashtra) Ltd.	Cloth (Fabrics)	5.55
Ahmedabad Kaiser-I-Hind Mills Co. Ltd.	Cotton yarn	5.52
Karnavati Spinners Ltd.	Cotton yarn	5.51
Shree Gouri Shankar Jute Mills Ltd.	Jute & other vegetable fibres	5.51
Pasari Spinning Mills Ltd.	Cotton yarn	5.50
Sri Natesar Spg. & Wvg. Mills Ltd.	Yarn of synthetic staple fibres, excluding sewing	5.49
Krystal Knitwear Ltd.	Textured yarn of synthetic filament yarn	5.49
Coromandel Garments Ltd.	Apparels	5.47
Dhanlaxmi Fabrics Ltd.	Cloth processed	5.38
Asia Pack Ltd.	Tarpaulins	5.37
Oxemberg Apparels Ltd.	Apparels	5.33
Coimbatore Popular Spinning Mills Ltd.	Cotton yarn	5.32
Ahmedabad Advance Mills Ltd.	Cloth (Fabrics)	5.30
Tuni Textile Mills Ltd.	Cloth (Fabrics)	5.29
Janice Textiles Ltd.	Cotton yarn	5.29
Podar Knitex Ltd.	Woven fabrics of artificial staple fibres	5.24
Padam Cotton Yarns Ltd.	Cotton yarn	5.23
Hada Textile Inds. Ltd.	Cotton yarn	5.21
Mahalakshmi Fibres & Inds. Ltd.	Cotton yarn	5.21
Uniroyal Textile Inds. Ltd.	Textile labels, badges, etc.	5.20
Sri Narendraraja Textiles Ltd.	Cotton yarn 1s to 10s	5.14
Hinafil India Ltd.	Synthetic monofilament of more than 66 decitex	5.14
Bonanza Industries Ltd.	Textured yarn of synthetic filament yarn	5.13

Table 1 Contd. Company name	Company's main activity	TE
Navsari Cotton & Silk Mills Ltd.	Cotton & blended yarn	5.06
Arihant Threads Ltd.	Cotton yarn	5.00
Priyadarshini Fabs Ltd.	Cotton yarn	5.00
India Polyspin Ltd.	Textured yarn of synthetic filament yarn	4.99
Uni Socks (India) Ltd.	Knitted / crocheted fabrics	4.99
Supreme Textiles Processing Ltd.	Cotton & blended yarn, processed	4.98
International Clothing Inds. Ltd.	Apparels	4.97
Hitkari Fibres Ltd.	Carpets, etc.	4.93
Pioneer Spinning & Weaving Mills Ltd.	Cotton yarn	4.87
G T M Synthetics Ltd.	Cotton yarn	4.87
Arcot Textile Mill Ltd.	Cotton yarn	4.87
Anglo-India Jute Mills Co. Ltd.	Jute yarn	4.87
Vijay Spinning Mills Ltd.	Cotton yarn	4.83
Aggarsain Spinners Ltd.	Cotton yarn	4.81
N E P C Textiles Ltd.	Cotton yarn	4.80
Hisar Spinning Mills Ltd.	Cotton yarn	4.80
Gujarat Nitrates Ltd.	Textured yarn of synthetic filament yarn	4.80
Cravatex Ltd.	Apparels	4.76
National Textile Corpn. (Delhi, Pun. & Raj.) Ltd.	Cloth (Fabrics)	4.75
Ganga Textiles Ltd.	Cotton yarn	4.74
Mohit Industries Ltd.	Cotton & blended yarn, texturised	4.69
Ankit Yarns Ltd.	Cotton & blended yarn	4.68
Ankit Yarns Ltd.	Cotton & blended yarn	4.68
Arrow Webtex Ltd.	Special woven fabrics	4.66
Chandni Engineering Ltd.	Woven pile fabrics & chenille fabrics	4.65
Octagon Industries Ltd.	Textured yarn of synthetic filament yarn	4.64
Akasha Syncotex Ltd.	Apparels - knitted / crocheted	4.63
Deepak Woollens Ltd.	Woven fabrics of wool	4.61
Devagiri Textile Mills Ltd.	Cloth (Fabrics)	4.60
Delta Polysters Ltd.	Cloth processed	4.57
Dupont Sportswear Ltd.	Apparels	4.54
Hari Govind International Ltd.	Other textile articles	4.50
Sri Jayalakshmi Spg. Mills Ltd.	Cotton yarn	4.49
Aspinwall & Co. (Travancore) Ltd.	Coir mats	4.41
Global Knitfab Ltd.	Knitted / crocheted fabrics	4.37
Ravi Spinning Ltd.	Cotton yarn	4.32
Runeecha Textiles Ltd.	Cotton yarn.	4.31
Sterling Spinners Ltd.	Cotton yarn	4.27
Pearl Clothing Ltd. [Erstwhile]	Apparels	4.25
Haryana Texprints (Overseas) Ltd.	Cloth processed	4.23
Cethar Industries Ltd.	Apparels - knitted / crocheted	4.23
Dumraon Textiles Ltd.	Cotton yarn	4.19
Bhuvaneshwari Textiles Ltd.	Cotton yarn	4.18
Volant Textile Mills Ltd.	Cloth (Fabrics)	4.18
Subhash Silk Mills Ltd.	Cloth processed	4.18

Table 1 Contd. Company name	Company's main activity	TE
Sree Solaiandavar Textile Mills Ltd.	Cotton yarn	4.17
Raymond Calitri Denim Ltd. [Erstwhile]	Denim	4.13
Deepak Cosmo Ltd.	Wool & woollen textiles	4.12
Surbhi Industries Ltd.	Textured yarn of synthetic filament yarn	4.11
Broach Textile Mills Ltd.	Cotton & blended yarn	4.10
Prag Bosimi Synthetics Ltd.	Polyester filament yarn (PFY)	4.07
Shree Janardana Mills Ltd.	Cotton yarn	4.06
Lloyd Rockfibres Ltd.	Wool mats	4.06
Gupta Fibres Ltd.	Wool yarn	4.04
Banswara Textile Mills Ltd.	Cloth (Fabrics)	4.04
Betex India Ltd.	Cloth processed	4.04
Ratangiri Textiles Ltd.	Woven fabrics of man-made filaments	4.03
Priyadarshini Thread Ltd.	Cotton sewing thread	4.03
Banswara Fabrics Ltd.	Cotton & blended yarn, texturised	3.99
Eureka Industries Ltd.	Cotton yarn	3.99
Birla Transasia Carpets Ltd.	Wool carpets	3.93
Kareems Spun Silk Ltd.	Silk yarns	3.92
National Textile Corpn. (Maharashtra North) Ltd.	Cloth (Fabrics)	3.83
Sky Industries Ltd.	Yarn of other polyamides, excluding nylon	3.81
Moonbeam Industries Ltd.	Pneumatic mattresses	3.78
Nylofils India Ltd.	Fishing nets	3.73
Vee Kay Fibres Ltd.	Wool yarn	3.72
Sree Jayalakshmi Autospin Ltd.	Cotton yarn	3.71
Lakshana Cotton Spg. Mills Ltd.	Cotton yarn	3.69
Amit International Ltd.	Knitted / crocheted fabrics	3.68
Raghuvanshi Mills Ltd.	Cotton & blended yarn	3.66
Hemalatha Textiles Ltd.	Cotton yarn	3.65
Campbell Knitwear Ltd.	Other garments, knitted or crocheted	3.65
Hathising Manufacturing Co. Ltd.	Cotton & blended yarn	3.64
Sarvamangalam Synthetics Ltd.	Synthetic filament yarn other than sewing threads	3.64
Shri Ganesh Spinners Ltd.	Cotton yarn	3.63
Niryat Sam Apparels (India) Ltd.	Other garments, knitted or crocheted	3.60
Bholanath Industries Ltd.	Carpets, etc.	3.55
Balaji Modern Spinners Ltd.	Cotton yarn	3.55
Neptune Textile Mills Ltd.	Cloth (Fabrics)	3.54
Stanpacks (India) Ltd.	Plastic coated / polyethylene jute bags	3.52
Virat Industries Ltd.	Apparels - knitted / crocheted	3.50
Dhanalaxmi Roto Spinners Ltd.	Cotton yarn	3.49
S M Textiles Ltd.	Cotton yarn	3.42
Veer Vardhman Textile Mills Ltd.	Cotton yarn	3.40
Silvia Apparels Ltd.	Cloth (Fabrics)	3.37
Salzer Textiles Ltd.	Embroidery in the piece	3.36
Swan Mills Ltd.	Cloth processed	3.34
Gogte Textiles Ltd.	Terry towelling & similar woven terry fabrics	3.26
Siddheswari Garments Ltd.	Other clothing accessories, knitted or crocheted	3.23

Table 1 Contd. Company name	Company's main activity	TE
Suvarna Apparel & Fashion Exports Ltd.	Knitted / crocheted fabrics	3.22
Multiplex Collapsible Tubes Ltd.	Apparels	3.22
Gravity (India) Ltd.	Silk fabrics, processed	3.20
Abhishek Spinfab Corpn. Ltd. [Erstwhile]	Terry towelling & similar woven terry fabrics	3.15
Pressure Sensitive Systems (India) Ltd.	Other textile articles	3.05
Kelvin Jute Co. Ltd.	Jute yarn	3.03
Gujarat Bulk Packs Ltd.	Textile fabrics coated/laminated with plastics	3.00
Jersey India Ltd.	Knitted / crocheted fabrics	3.00
Cawnpore Textiles Ltd.	Cloth (Fabrics)	2.98
New Bombay Prtg. & Dyg. Mills Ltd.	Cloth processed	2.98
Pulgaon Cotton Mills Ltd.	Cloth (Fabrics)	2.94
Duck Tarpaulins Ltd.	Tarpaulins	2.91
Flora Textiles Ltd.	Cloth (Fabrics)	2.89
Shree Ram Mills Ltd.	Cloth processed	2.85
J J Spectrum Silk Ltd.	Silk fabrics, processed	2.81
Tanushree Silks Ltd.	Silk fabrics, processed	2.80
Sree Bharani Spinners (India) Ltd.	High tenacity yarn of viscose rayon	2.72
Nutech Spinning Ltd.	Woven fabrics of man-made filaments	2.68
Gupta Carpets International Ltd.	Carpets, etc.	2.67
Towels India Exports Ltd.	Terry towelling & similar woven terry fabrics	2.67
Superior Sox Ltd.	Knitted / crocheted fabrics	2.64
G S P L (India) Ltd.	Man-made fabrics	2.58
Range Apparels Ltd.	Other clothing accessories, knitted or crocheted	2.54
National Textile Corpn. (Gujarat) Ltd.	Cloth (Fabrics)	2.54
Nav-Jyoti Investment & Dealers Ltd.	Cloth (Fabrics)	2.53
Sunanda Industries Ltd.	Apparels - knitted / crocheted	2.44
Matulya Mills Ltd.	Cloth (Fabrics)	2.44
Interworld.Com Ltd.	Other garments, not knitted / crocheted	2.44
Goldwon Textiles Ltd.	Knitted / crocheted fabrics	2.40
Terryfab (India) Ltd.	Terry towelling & similar woven terry fabrics	2.36
Parakaram Technofab Ltd.	Knitted / crocheted fabrics	2.33
Jaihind Synthetics Ltd.	Cloth (Fabrics)	2.31
Ritesh Polyesters Ltd.	Woven fabrics of man-made filaments	2.28
Lifestyle Fabrics Ltd.	Woven fabrics of man-made filaments	2.23
Minaxi Textiles Ltd.	Millmade fabric	2.22
Spenta International Ltd.	Other clothing accessories, knitted or crocheted	2.22
Hindustan Cotex Exports Ltd.	Knitted / crocheted fabrics	2.21
Anjani Fabrics Ltd.	Cloth (Fabrics)	2.15
Dawn Apparels Ltd.	Apparels	2.14
Kapil Cotex Ltd.	Worn clothing & other worn textile articles	2.05
Perfect Thread Mills Ltd.	Sewing thread of man-made filaments	1.99
Chandra Synthetics Ltd.	Polypropylene filament yarn (PPFY)	1.83
Peeti Securities Ltd.	Cloth (Fabrics)	1.78
Asia Fab Ltd.	Woven fabrics of synthetic staple fibres	1.76
S Kumars Textiles Ltd.	Cloth (Fabrics)	1.75

Table 1 Contd. Company name	Company's main activity	TE
Asahi Fibres Ltd.	Cotton yarn	1.63
Laxmi Vishnu Textile Mills Ltd.	Cloth (Fabrics)	1.62
Laxmi Vishnu Textile Mills Ltd.	Cloth (Fabrics)	1.62
Kitex Garments Ltd.	Apparels - knitted / crocheted	1.58
Leena Textiles Ltd.	Textured yarn of synthetic filament yarn	1.58
Santaram Spinners Ltd.	Cotton yarn	1.53
Haitima Textiles Ltd.	Worn clothing & other worn textile articles	1.45
Pearl Retail Ltd.	Apparels	1.36
British India Corpn. Ltd.	Woven fabrics of wool	1.32
Novotex Industries Ltd.	Woven blended fabrics of synthetic staple fibres	1.27
Karan Woo-Sin Ltd.	Other clothing accessories, knitted or crocheted	1.26
Birds Jute & Exports Ltd.	Jute & jute products	1.25
Birds Jute & Exports Ltd.	Jute & jute products	1.25
Alka Spinners Ltd.	Cotton & blended yarn	1.22
Alka Spinners Ltd.	Cotton & blended yarn	1.22
National Textile Corpn. (Uttar Pradesh) Ltd.	Cotton & blended yarn	1.20
Elgin Mills Co. Ltd.	Cloth (Fabrics)	1.17
National Textile Corpn. (W.B., Ass., Bih. & Ori.)	Cotton & cotton textiles	1.16
Gaekwar Mills Ltd.	Cotton & blended yarn	1.04
Landale & Clark Ltd.	Jute & other vegetable fibres	0.97
Marson'S Textiles Ltd.	Cotton yarn	0.96
Malwa Industries Ltd.	Denim	0.95
Uni Legwears (India) Ltd.	Knitted / crocheted fabrics	0.85
Textile Corpn. Of Marathwada Ltd.	Cloth (Fabrics)	0.36
Source: CMIE Prowess		

Table 2:Time Invariant Technical Efficiency estimates (Transport Equipment)

Company name	Company's main activity	TE
Tebma Engineering Ltd.	Ships, boats, etc.	100.00
Maharashtra Scooters Ltd.	Scooters	54.16
A N G Exports Ltd.	Suspension & braking parts	52.92
J P S L Marketing Ltd.	Leaf springs (Automotive)	50.33
India Nippon Electricals Ltd.	Flywheel magnetos	50.33
Spectra Industries Ltd.	Automobile anicllaries, nec	47.37
I P Rings Ltd.	Piston rings	46.90
Design Auto Systems Ltd.	Ignition coils	44.21
Madras Radiators & Pressings Ltd.	Automobile anicllaries, nec	43.67
Schrader Duncan Ltd.	Automobile engine parts	41.97
Auto Pins (India) Ltd.	Axles & wheels	41.21
Sunku Auto Ltd.	Three wheelers	39.91
United Flashlights Inds. Pvt. Ltd.	Flasher units	38.83
J M T Auto Ltd.	Drive transmission & steering parts	38.48
Motherson Pudenz Fuses Ltd.	Other Automobile ancillaries, nec	37.19
Shanthi Gears Ltd.	Gears including crown wheels	36.65
Ucal Fuel Systems Ltd.	Carburettors	35.64
Motherson Sumi Systems Ltd.	Other Automobile ancillaries, nec	35.44
Motherson Auto Components Engg. Ltd. [Erstwhile]	Electrical automobile parts	34.77
Suprajit Engineering Ltd.	Automobile equipment	33.20
Amtek India Ltd.	Automobile ancillaries	33.08
Micro Forge (India) Ltd.	Automobile engine parts	32.30
I F B Automotive Seating & Systems Ltd.	Other Automobile ancillaries, nec	32.25
Standard Radiators Ltd.	Radiators	32.21
Autolite (India) Ltd.	Automobile equipment	31.66
Fleetguard Filters Ltd.	Filter elements, inserts	30.95
Allied Nippon Ltd.	Brake linings	30.90
Roxy Exports Ltd.	Bicycle parts & accessories	30.66
Alang Marine Ltd.	Ships, boats, etc.	30.65
Harita Grammer Ltd.	Other Automobile ancillaries, nec	30.42
Aamcol Tools Ltd.	Drive transmission & steering parts	30.14
Steel Strips Wheels Ltd.	Wheels for automobiles	29.65
Munjal Showa Ltd.	Shock absorbers	29.61
Sibar Auto Parts Ltd.	Automobile engine parts	29.36
Delco Remy Electricals India Ltd.	Starter motors	29.29
Q H Talbros Ltd.	Steering linkages	28.96
Menon Bearings Ltd.	Other Automobile ancillaries, nec	28.91
Denison Hydraulics India Ltd.	Hydraulic pumps	28.76
Yuken India Ltd.	Fuel pumps	28.74
Triton Valves Ltd.	Engine valves	28.71
Talbros Engineering Ltd.	Axle shafts	28.54
Lakshmi Auto Components Ltd.	Other Automobile ancillaries, nec	27.63
Subros Ltd.	Automobile anicllaries, nec	27.40

Table 2 Contd.		
Company name	**Company's main activity**	**TE**
Punjab Scooters Ltd.	Automobile anicllaries, nec	27.38
Goa Shipyard Ltd.	Ships, boats, etc.	27.26
Canara Workshops Ltd.	Leaf springs (Automotive)	27.18
Atul Auto Ltd.	Three wheelers	27.02
Banco Products (India) Ltd.	Automobile engine parts	26.95
Gujarat Automotive Gears Ltd.	Gears including crown wheels	26.57
Eimco-Kcp Ltd.	Automobile engine parts	26.39
Jai Parabolic Springs Ltd.	Leaf springs (Automotive)	25.92
Rasandik Engineering Inds. India Ltd.	Automobile anicllaries, nec	25.87
Bharat Seats Ltd.	Other Automobile ancillaries, nec	25.71
Srivatsa Electric & Electronic Ltd.	Flywheel magnetos	25.65
K A R Mobiles Ltd.	Engine valves	25.30
P M P Components Ltd.	Automobile equipment	25.27
Precision Camshafts Ltd.	Crankshafts	25.25
C M H Tools Ltd.	Other Automobile ancillaries, nec	25.24
India Radiators Ltd.	Radiators	25.14
G S Auto International Ltd.	Other Automobile ancillaries, nec	24.93
Jay Yuhshin Ltd.	Automobile equipment	24.69
Dynamatic Technologies Ltd.	Hydraulic pumps	24.60
Stone India Ltd.	Railway & tramway equipment	24.36
Clutch Auto Ltd.	Drive transmission & steering parts	24.35
Bimetal Bearings Ltd.	Thickwall, thinwall bearings	24.32
San Engineering & Locomotive Co. Ltd.	Locomotives	24.24
Maruti Udyog Ltd.	Passenger cars	24.14
Amtek Auto Ltd.	Automobile anicllaries, nec	24.02
Samkrg Pistons & Rings Ltd.	Pistons	23.98
Autolec Industries Ltd.	Automobile anicllaries, nec	23.97
Avon Cycles Ltd.	Bicycles	23.95
Ceekay Daikin Ltd.	Drive transmission & steering parts	23.88
Sona Koyo Steering Systems Ltd.	Drive transmission & steering parts	23.74
Rockman Cycle Inds. Ltd.	Bicycles	23.73
Jamna Auto Inds. Ltd.	Leaf springs (Automotive)	23.41
Z F Steering Gear (India) Ltd.	Steering gears	23.04
Minda Huf Ltd.	Automobile anicllaries, nec	22.98
Ring Plus Aqua Ltd.	Thickwall, thinwall bearings	22.79
Simmonds Marshall Ltd.	Other Automobile ancillaries, nec	22.77
Apex Auto Ltd.	Other Automobile ancillaries, nec	22.67
Roto Pumps Ltd.	Rotor pumps	22.52
Indiapistons-Repco Ltd.	Gears including crown wheels	22.51
Sundaram Industries Ltd.	Automobile anicllaries, nec	22.36
Perfect Circle India Ltd.	Automobile engine parts	22.00
Rane Brake Linings Ltd.	Brake linings	21.76
Rico Auto Inds. Ltd.	Wheels for automobiles	21.59
Raunaq Automotive Components Ltd.	Drive transmission & steering parts	21.40
Premier Instruments & Controls Ltd.	Automobile equipment	21.25

Table 2 Contd.		
Company name	**Company's main activity**	**TE**
X L O India Ltd.	Steering gears	21.23
Lumax Industries Ltd.	Automobile equipment	21.15
Eicher Motors Ltd.	Light commercial vehicles	21.06
Jonas Woodhead & Sons (India) Ltd.	Leaf springs (Automotive)	21.01
Menon Pistons Ltd.	Pistons	20.96
Wheels India Ltd.	Wheels for automobiles	20.96
Axles India Ltd.	Axle shafts	20.94
G K N Driveshafts (India) Ltd.	Drive transmission & steering parts	20.93
Hindustan Hardy Spicer Ltd.	Propeller shafts	20.90
Omax Autos Ltd.	Other Automobile ancillaries, nec	20.86
T V S Motor Co. Ltd.	Two wheelers	20.83
V D O India Ltd.	Other Automobile ancillaries, nec	20.78
Talbros Automotive Components Ltd.	Gaskets	20.72
Remsons Industries Ltd.	Automobile anicllaries, nec	20.72
Jay Bharat Maruti Ltd.	Other Automobile ancillaries, nec	20.63
Kalyani Brakes Ltd.	Suspension & braking parts	20.57
Hi-Tech Gears Ltd.	Drive transmission & steering parts	20.50
Hero Honda Motors Ltd.	Motorcycles	20.48
Shriram Pistons & Rings Ltd.	Pistons	20.44
Engine Valves Ltd. [Erstwhile]	Engine valves	20.35
Escorts Auto Components Ltd.	Carburettors	20.33
Lucas-Tvs Ltd.	Electrical automobile parts	20.31
Sundaram-Clayton Ltd.	Suspension & braking parts	20.04
Kinetic Motor Co. Ltd.	Scooters	19.91
Chetan Genthe & Co. Ltd.	Other Automobile ancillaries, nec	19.80
Coventry Spring & Engg. Co. Ltd.	Leaf springs (Automotive)	19.64
Rane (Madras) Ltd.	Steering gears	19.50
T I Diamond Chain Ltd.	Timing chains	19.38
Automobile Corpn. Of Goa Ltd.	Other Automobile ancillaries, nec	19.26
Gabriel India Ltd.	Shock absorbers	19.21
C T R Manufacturing Inds. Ltd.	Railway & tramway equipment	19.10
Hindustan Composites Ltd.	Brake linings	18.88
V S T Precision Components Ltd.	Automobile engine parts	18.81
J M A Industries Ltd.	Automobile equipment	18.68
Shardlow India Ltd.	Crankshafts	18.57
Coventry Coil-O-Matic (Haryana) Ltd.	Leaf springs (Automotive)	18.42
Bharat Wagon & Engg. Co. Ltd.	Railway wagons, coaches, etc., nec	18.29
Taneja Aerospace & Aviation Ltd.	Aircrafts	18.08
Spaco Carburettors (India) Ltd.	Carburettors	18.04
Automotive Axles Ltd.	Axle shafts	18.03
Sundaram Brake Linings Ltd.	Brake linings	17.91
Pronto Steerings Ltd.	Steering linkages	17.85
India Pistons Ltd.	Pistons	17.79
Chokhani International Ltd.	Ships, boats, etc.	17.67
Bajaj Auto Ltd.	Scooters	17.60

Table 2 Contd.

Company name	Company's main activity	TE
Saks Ancillaries Ltd.	Automobile anicllaries, nec	17.48
Globe Active Technologies Ltd.	Electrical automobile parts	16.72
Aditya Gears Ltd.	Drive transmission & steering parts	16.65
Garden Reach Shipbuilders & Engineers Ltd.	Ships, boats, etc.	16.61
Automotive Coaches & Components Ltd.	Passenger coaches	16.48
Brakes India Ltd.	Suspension & braking parts	16.48
Bharat Gears Ltd.	Gears including crown wheels	16.45
Atlas Cycles (Haryana) Ltd.	Bicycles	16.25
Kinetic Engineering Ltd.	Mopeds	15.90
Denso India Ltd.	Electrical automobile parts	15.87
Gajra Bevel Gears Ltd.	Gears including crown wheels	15.70
Tube Investments Of India Ltd.	Bicycles	15.69
Renowned Auto Products Mfrs. Ltd.	Shock absorbers	14.96
Bajaj Tempo Ltd.	Light commercial vehicles	14.94
Yamaha Motor Escorts Ltd.	Motorcycles	14.90
Tobu Enterprises Ltd.	Childrens' cycles	14.48
Swaraj Mazda Ltd.	Light commercial vehicles	14.33
Rane Engine Valves Ltd.	Engine valves	14.19
Mahindra & Mahindra Ltd.	Utility Vehicles incl. jeeps	13.80
Bharat Brakes & Valves Ltd.	Brakes & parts thereof	13.60
Braithwaite & Co. Ltd.	Railway wagons, coaches, luggage vans, etc.	13.57
Motor Industries Co. Ltd.	Automobile engine parts	13.54
Ashok Leyland Ltd.	Heavy commercial vehicles	13.47
Goetze (India) Ltd.	Piston rings	13.36
Harig Crankshafts Ltd.	Crankshafts	13.33
Daewoo Motors India Ltd.	Passenger cars	13.27
Mazagon Dock Ltd.	Ships, boats, etc.	12.93
Tata Engineering & Locomotive Co. Ltd.	Heavy commercial vehicles	12.75
Majestic Auto Ltd.	Mopeds	11.99
Hindustan Motors Ltd.	Passenger cars	10.55
Burn Standard Co. Ltd.	Railway & tramway equipment	10.53
Hindustan Aeronautics Ltd.	Aircrafts	10.49
Premier Automobiles Ltd.	Passenger cars	10.39
Cochin Shipyard Ltd.	Ships, boats, etc.	8.95
Scooters India Ltd.	Three wheelers	8.94
Gujarat Setco Clutch Ltd.	Clutch plates/discs	8.20
Hooghly Dock & Port Engineers Ltd.	Ships, boats, etc.	6.96
Hindustan Shipyard Ltd.	Ships, boats, etc.	3.87
Gujarat Cycles Ltd.	Bicycles	3.65
National Bicycle Corpn. Of India Ltd.	Bicycles	1.75

Source: CMIE Prowess

Table 3:Time Invariant Technical Efficiency Estimates (Pharmaceuticals)

Company name	Company's main activity	TE
Southern Herbals Ltd.	**Vegetable alkaloids**	**100.00**
Paam Pharmaceuticals (Delhi) Ltd.	Drug formulations	20.18
Vitara Chemicals Ltd.	Drugs, medicines & allied products	18.26
Torrent Pharmaceuticals Ltd.	Drug formulations	17.82
Ranbaxy Laboratories Ltd.	Drugs, medicines & allied products	17.14
Kopran Ltd.	Drugs, medicines & allied products	16.46
Aurobindo Pharma Ltd.	Drugs, medicines & allied products	16.16
Dr. Reddy'S Laboratories Ltd.	Drugs, medicines & allied products	15.66
Cheminor Drugs Ltd. [Erstwhile]	Drugs, medicines & allied products	15.38
Morepen Laboratories Ltd.	Drugs, medicines & allied products	15.14
Gufic Biosciences Ltd.	Drugs, medicines & allied products	15.11
Smithkline Beecham Pharmaceuticals (India) Ltd. [	Drug formulations	15.04
Lupin Laboratories Ltd. [Erstwhile]	Drug formulations	15.04
Lupin Ltd.	Rifampicin	14.91
Cipla Ltd.	Drug formulations	14.89
Bharat Immunologicals & Biologicals Corpn. Ltd.	Drug formulations	14.54
Wockhardt Ltd.	Drug formulations	14.30
Krebs Biochemicals Ltd.	Drug formulations	14.19
Siris Ltd.	Drugs, medicines & allied products	14.06
Sun Pharmaceutical Inds. Ltd.	Drug formulations	13.99
Novartis India Ltd.	Drug formulations	13.80
Orchid Chemicals & Pharmaceuticals Ltd.	Drugs, medicines & allied products	13.16
Glaxosmithkline Pharmaceuticals Ltd.	Drug formulations	12.99
Universal Capsules Ltd.	Drug formulations	12.71
J B Chemicals & Pharmaceuticals Ltd.	Drug formulations	12.69
Knoll Pharmaceuticals Ltd.	Drug formulations	12.33
Ajanta Pharma Ltd.	Ayurvedic & unani medicaments	12.33
Surya Pharmaceutical Ltd.	Antibiotics	12.01
Wyeth Lederle Ltd.	Drug formulations	11.89
Eupharma Laboratories Ltd.	Drug formulations	11.83
Vera Laboratories Ltd.	Drugs, medicines & allied products	11.73
Natco Pharma Ltd.	Drug formulations	11.69
A C E Laboratories Ltd.	Drug formulations	11.54
Earnest Healthcare Ltd.	Drug formulations	11.37
Core Healthcare Ltd.	Drug formulations	11.36
Anuh Pharma Ltd.	Antibiotics	11.31
Paam Drugs & Pharmaceuticals Ltd.	Drugs, medicines & allied products	11.25
Nicholas Piramal India Ltd.	Drug formulations	11.07
Intercare Ltd.	Drug formulations	11.03
Ipca Laboratories Ltd.	Drug formulations	10.87
Dee-Pharma Ltd.	Drug formulations	10.84
Aarti Drugs Ltd.	Anti dysentery medicaments	10.76
R P G Life Sciences Ltd.	Drug formulations	10.67

Table 3 Contd. Company name	Company's main activity	TE
Burroughs Wellcome (India) Ltd.	Drug formulations	10.48
Merck Ltd.	Drug formulations	10.42
Kaprinas Pharmaceuticals & Chemicals Ltd.	Drugs, medicines & allied products	10.29
Parke-Davis (India) Ltd.	Drug formulations	10.20
Pfizer Ltd.	Drug formulations	10.13
Aventis Pharma Ltd.	Drug formulations	10.02
Aventis Pharma Ltd.	Drug formulations	10.02
Infar (India) Ltd.	Drug formulations	9.99
Torrent Gujarat Biotech Ltd.	Penicillin	9.97
Alembic Ltd.	Drug formulations	9.94
Fulford (India) Ltd.	Drug formulations	9.91
Shasun Chemicals & Drugs Ltd.	Drugs, medicines & allied products	9.85
S O L Pharmaceuticals Ltd.	Drugs, medicines & allied products	9.83
Geoffrey Manners & Co. Ltd.	Drug formulations	9.77
Pfimex Pharmaceuticals Ltd.	Drug formulations	9.64
Biological E. Ltd.	Drug formulations	9.53
U S V Ltd.	Drug formulations	9.50
Suven Pharmaceuticals Ltd.	Drugs, medicines & allied products	9.23
Panacea Biotec Ltd.	Drug formulations	9.21
Gujarat Lyka Organics Ltd. [Erstwhile]	Drugs, medicines & allied products	9.20
Jupiter Bioscience Ltd.	Trimethoprin	9.11
Shilpax Laboratories Ltd.	Chloramphenicol	9.09
German Remedies Ltd.	Drug formulations	9.04
Vorin Laboratories Ltd.	Drugs, medicines & allied products	8.91
Godavari Drugs Ltd.	Sulphamethoxazole	8.88
Blue Cross Laboratories Ltd.	Drug formulations	8.84
Gran Heal Pharma Ltd.	Homeopathic medicaments	8.84
Astrazeneca Pharma India Ltd.	Drug formulations	8.83
Meghdoot Chemicals Ltd.	Drug formulations	8.75
Bal Pharma Ltd.	Drug formulations	8.74
T T K Healthcare Ltd.	Drug formulations	8.69
Omega Laboratories Ltd.	Drug formulations	8.67
Lyka Labs Ltd.	Drug formulations	8.64
Neuland Laboratories Ltd.	Salbutamol	8.63
Merind Ltd.	Drug formulations	8.59
F D C Ltd.	Drug formulations	8.45
Esskay Pharmaceuticals Ltd.	Drug formulations	8.37
Matrix Laboratories Ltd.	Drugs, medicines & allied products	8.33
Mesco Pharmaceuticals Ltd.	Drug formulations	8.28
J K Pharmachem Ltd.	Penicillin	8.27
Unichem Laboratories Ltd.	Drug formulations	8.24
Rhone-Poulenc (India) Ltd. [Erstwhile]	Drug formulations	8.23
Jagsonpal Pharmaceuticals Ltd.	Drug formulations	8.18
Cadila Healthcare Ltd.	Drug formulations	8.18
Gujarat Themis Biosyn Ltd.	Rifampicin	8.13

Table 3 Contd. Company name	Company's main activity	TE
Max India Ltd.	Drugs, medicines & allied products	8.09
M J Pharmaceuticals Ltd.	Drug formulations	8.07
Elegant Pharmaceuticals Ltd.	Drugs, medicines & allied products	8.07
Biddle Sawyer Ltd.	Drug formulations	8.07
Wintac Ltd.	Drug formulations	8.03
Zora Pharma Ltd.	Trimethoprin	8.03
Zandu Pharmaceutical Works Ltd.	Ayurvedic & unani medicaments	7.95
East India Pharmaceutical Works Ltd.	Drug formulations	7.81
Jayant Vitamins Ltd.	Drugs, medicines & allied products	7.78
American Remedies Ltd. [Erstwhile]	Drug formulations	7.73
Armour Polymers Ltd.	Drug formulations	7.68
Karnataka Antibiotics & Pharmaceuticals Ltd.	Drug formulations	7.68
Glenmark Pharmaceuticals Ltd.	Drug formulations	7.67
Parenteral Drugs (India) Ltd.	Drug formulations	7.58
Hindustan Antibiotics Ltd.	Drugs, medicines & allied products	7.57
Bharti Healthcare Ltd.	Other pharmaceutical products, nec	7.57
Richline Pharma Ltd.	Drugs, medicines & allied products	7.51
Yogi Pharmacy Ltd.	Pharmaceutical products, nec	7.48
T A S C Pharmaceuticals Ltd.	Drugs, medicines & allied products	7.44
Ambalal Sarabhai Enterprises Ltd.	Drug formulations	7.37
Pearl Organics Ltd.	Drugs, medicines & allied products	7.29
N G L Fine-Chem Ltd.	Pharmaceutical products, nec	7.28
Abbott Laboratories (India) Ltd.	Drug formulations	7.27
Albert David Ltd.	Drug formulations	7.22
Duphar-Interfran Ltd.	Drug formulations	7.17
Ind-Swift Ltd.	Drug formulations	7.16
Surya Medicare Ltd.	Drugs, medicines & allied products	7.12
Caplin Point Laboratories Ltd.	Drug formulations	7.05
Haffkine Bio-Pharmaceutical Corpn. Ltd.	Drug formulations	7.01
Coral Laboratories Ltd.	Drug formulations	6.95
Plant Organics Ltd.	Drugs, medicines & allied products	6.81
Raptakos, Brett & Co. Ltd.	Drug formulations	6.81
Amrutanjan Ltd.	Ayurvedic & unani medicaments	6.80
Group Pharmaceuticals Ltd.	Drug formulations	6.78
Croydon Chemical Works Ltd.	Drug formulations	6.76
Kilitch Drugs (India) Ltd.	Drug formulations	6.66
Vysali Pharmaceuticals Ltd.	Drug formulations	6.56
Wander Pvt. Ltd.	Drug formulations	6.47
Romeda Chemicals Ltd.	Drugs, medicines & allied products	6.44
Malladi Drugs & Pharmaceuticals Ltd.	Ephedrines	6.41
Medi-Caps Ltd.	Other pharmaceutical products, nec	6.38
Ind-Swift Laboratories Ltd.	Drugs, medicines & allied products	6.36
Anglo-French Drugs & Inds. Ltd.	Drug formulations	6.32
Themis Medicare Ltd.	Drug formulations	6.17
Alps Laboratories Ltd.	Drugs, medicines & allied products	6.05

Table 3 Contd. Company name	Company's main activity	TE
Dey'S Medical Stores Mfg. Ltd.	Drug formulations	6.03
Transmedica (India) Ltd.	Other pharmaceutical products, nec	5.99
Nalin Chemicals Ltd.	Drugs, medicines & allied products	5.99
Alpha Drug India Ltd.	Drugs, medicines & allied products	5.98
Lincoln Pharmaceuticals Ltd.	Drug formulations	5.98
Senbo Industries Ltd.	Drug formulations	5.96
Karnataka Malladi Biotics Ltd.	Drugs, medicines & allied products	5.95
Phaarmasia Ltd.	Drug formulations	5.93
Biowin Pharma (India) Ltd.	Drugs, medicines & allied products	5.90
Li Taka Pharmaceuticals Ltd.	Drug formulations	5.84
Hiran Orgochem Ltd.	Drugs, medicines & allied products	5.84
Granules India Ltd.	Paracetamol	5.82
Sunil Synchem Ltd.	Other pharmaceutical products, nec	5.74
Geno Pharmaceuticals Ltd.	Drug formulations	5.65
Veronica Laboratories Ltd.	Drug formulations	5.64
Desh Rakshak Aushdhalaya Ltd.	Ayurvedic & unani medicaments	5.61
Mercury Laboratories Ltd.	Drug formulations	5.57
Dental Products Of India Ltd.	Dental cements & other bone reconstruction cement	5.39
Solus Pharmaceuticals Ltd.	Pharmaceutical products, nec	5.38
Arvind Remedies Ltd.	Drug formulations	5.37
Smruthi Organics Ltd.	Drugs, medicines & allied products	5.36
Supriya Pharmaceuticals Ltd.	Drugs, medicines & allied products	5.31
Pradeep Drug Co. Ltd. [Erstwhile]	Drugs, medicines & allied products	5.23
Swet-Chem Antibiotics Ltd.	Antibiotics	5.23
Hosur Chemicals Ltd.	Drugs, medicines & allied products	5.21
Dujohn Laboratories Ltd.	Drug formulations	5.19
Elder Health Care Ltd.	Drug formulations	5.17
Dolphin Laboratories Ltd.	Drug formulations	5.07
Tonira Pharma Ltd.	Drug formulations	5.06
Syncom Formulations (India) Ltd.	Drug formulations	5.04
Pan Drugs Ltd.	Formulations of mainly chloramphenicol	5.03
Astron Drugs & Inds. Ltd.	Drug formulations	5.02
Shaba Chemicals Ltd.	Trimethoprin	5.01
Venkat Pharma Ltd.	Drug formulations	5.00
P C I Chemicals & Pharmaceuticals Ltd.	Drug formulations	4.99
Monozyme India Ltd.	First aid boxes & kits	4.94
Venus Remedies Ltd.	Drugs, medicines & allied products	4.91
Dr. Sabharwal'S Manufacturing Labs Ltd.	Adhesive medicinal tape	4.85
Harshita Ltd.	Drugs, medicines & allied products	4.84
Bombay Drugs & Pharmas Ltd. [Erstwhile]	Drugs, medicines & allied products	4.84
Span Diagnostics Ltd.	Drugs, medicines & allied products	4.79
White Way Products (Pharma) Ltd.	Drug formulations	4.74
Bajaj Consumer Care Ltd.	Ayurvedic & unani medicaments	4.73
Rekvina Laboratories Ltd.	Drugs, medicines & allied products	4.69
Chemech Laboratories Ltd.	CNS stimulant formulations	4.63

Table 3 Contd. Company name	Company's main activity	TE
Suprajit Chemical Pvt. Ltd.	Drugs, medicines & allied products	4.63
Nagarjuna Drugs Ltd.	Drugs, medicines & allied products	4.62
Relish Pharmaceuticals Ltd.	Drugs, medicines & allied products	4.61
Sarvodaya Labs Ltd.	Drug formulations	4.57
Makers Laboratories Ltd.	Drug formulations	4.56
Leopard Investments Ltd.	Ayurvedic & unani medicaments	4.45
Rajasthan Drugs & Pharmaceuticals Ltd.	Drug formulations	4.43
Vitara Merven Ltd.	Drugs, medicines & allied products	4.36
Everest Organics Ltd.	Drug formulations	4.23
Everest Organics Ltd.	Drug formulations	4.23
Denis Chem Lab Ltd.	Other pharmaceutical products, nec	4.19
Samrat Pharmachem Ltd.	Drugs, medicines & allied products	4.18
Jenburkt Pharmaceuticals Ltd.	Drug formulations	4.16
Trans Medicare Ltd.	Drug formulations	4.14
Sandu Pharmaceuticals Ltd.	Ayurvedic & unani medicaments	4.10
Alta Laboratories Ltd.	Salicylic acids & their esters	4.10
Taulis Pharma Ltd.	Drug formulations	4.02
Hulta Pharmaceutical Export Ltd.	Drug formulations	4.01
B D H Industries Ltd.	Drug formulations	4.00
Kappac Pharma Ltd.	Drug formulations	3.98
Apte Amalgamations Ltd.	Sulphamethoxazole	3.97
Endolabs Ltd.	Drug formulations	3.89
Triochem Products Ltd.	Drugs, medicines & allied products	3.84
Maharashtra Antibiotics & Pharmaceuticals Ltd.	Drugs, medicines & allied products	3.82
Sanjivani Paranteral Ltd.	Antibiotics	3.76
Bio-Ethicals Pharma Ltd.	Drug formulations	3.69
Auro Laboratories Ltd.	Trimethoprin	3.67
Indian Medicines Pharmaceuticals Corp. Ltd.	Other formulations nec	3.66
Principal Pharmaceuticals & Chemicals Ltd.	Drugs, medicines & allied products	3.65
S S Organics Ltd.	Drugs, medicines & allied products	3.57
Unjha Formulations Ltd.	Drug formulations	3.54
Avinash Drugs Ltd.	Drugs, medicines & allied products	3.51
Amol Drug Pharma Ltd.	Drugs, medicines & allied products	3.49
Biofil Chemicals & Pharmaceuticals Ltd.	Drug formulations	3.44
Shilpa Antibiotics Ltd.	Drugs, medicines & allied products	3.38
Welcure Drugs & Pharmaceuticals Ltd.	Drug formulations	3.32
Konar Organics Ltd.	Drugs, medicines & allied products	3.31
Combat Drugs Ltd.	Drug formulations	3.31
Medicamen Biotech Ltd.	Drug formulations	3.23
Prudential Pharmaceuticals Ltd.	Drugs, medicines & allied products	3.18
Yenkey Drugs & Pharmaceuticals Ltd.	Theophylline & aminophylline	3.14
Zenith Health Care Ltd.	Drugs, medicines & allied products	3.11
Shree Dhootapapeshwar Ltd.	Ayurvedic & unani medicaments	3.11
Kamron Laboratories Ltd.	Drugs, medicines & allied products	3.11
Chiplun Fine Chemicals Ltd.	Ibuprofen	3.10

Table 3 Contd.

Company name	Company's main activity	TE
Add-Life Pharma Ltd.	Ethambutol	3.03
Vikram Thermo (India) Ltd.	Basic pharmaceuticals nec	2.89
Ebers Pharmaceuticals Ltd.	Drug formulations	2.87
Roopa Industries Ltd.	Drugs, medicines & allied products	2.87
Gujarat Terce Laboratories Ltd.	Drug formulations	2.84
Shrishma Fine Chemicals & Pharma. (Kar.) Ltd.	Drugs, medicines & allied products	2.76
Colinz Laboratories Ltd.	Drug formulations	2.71
Pharmaids Pharmaceuticals Ltd.	Drugs, medicines & allied products	2.69
Advik Laboratories Ltd.	Drug formulations	2.66
Kerala Ayurveda Pharmacy Ltd.	Ayurvedic & unani medicaments	2.65
Protochem Ltd.	Drug formulations	2.52
Datt Mediproducts Ltd.	Pharmaceutical products, nec	2.48
Perk Pharmaceuticals Ltd.	Drug formulations	2.48
Synbiotics Ltd.	Drugs, medicines & allied products	2.48
Fine Drugs & Chemicals Ltd.	Drug formulations	2.39
Invinex Laboratories Ltd.	Drug formulations	2.35
Shri Nicosect Ltd.	Nicotine & its salts	2.32
Dr. Wellmans Homeopathic Laboratory Ltd.	Homeopathic medicaments	2.26
U B Pharmaceuticals Ltd.	Drugs, medicines & allied products	2.22
Chemo-Pharma Laboratories Ltd.	Drug formulations	2.20
Vardhaman Laboratories Ltd.	Drugs, medicines & allied products	2.17
Hester Pharmaceuticals Ltd.	Drugs, medicines & allied products	2.14
Beryl Drugs Ltd.	Drugs, medicines & allied products	1.99
Harleystreet Pharmaceuticals Ltd.	Drug formulations	1.96
Ahlcon Parenterals (India) Ltd.	Drug formulations	1.94
Indo-American Advanced Pharmaceuticals Ltd.	Drug formulations	1.91
Ivee Injectaa Ltd.	Drug formulations	1.90
Kabra Drugs Ltd.	Drug formulations	1.85
Indian Drugs & Pharmaceuticals Ltd.	Drugs, medicines & allied products	1.79
Bengal Immunity Ltd.	Drug formulations	1.74
Fredun Pharmaceuticals Ltd.	Drug formulations	1.66
Ishita Drugs & Inds. Ltd.	Drugs, medicines & allied products	1.61
U P Drugs & Pharmaceuticals Co. Ltd.	Drug formulations	1.35
Smith Stanistreet & Pharmaceuticals Ltd.	Drug formulations	1.25
Marck Parenterals (India) Ltd.	Drug formulations	1.22
New World Medical (India) Ltd.	Drugs, medicines & allied products	1.11
Laurel Organics Ltd.	Drugs, medicines & allied products	1.08
Medicorp Technologies India Ltd.	Drugs, medicines & allied products	1.05
Elder Projects Ltd.	Drug formulations	0.95
J K Drugs & Pharmaceuticals Ltd.	Drugs, medicines & allied products	0.81

Source: CMIE Prowess

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