DATA ENVELOPMENT ANALYSIS OF TECHNICAL EFFICIENCY IN INDIAN INDUSTRY - A REGIONAL PERSPECTIVE

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Dissertation submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Applied Economics of the Jawaharlal Nehru University

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2002-2004

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June 2004

I hereby affirm that the work for this dissertation, ***Data Envelopment Analysis of Technical Efficiency in Indian Industry: A Regional Perspective****, being submitted as a part of the requirements of the M.Phil. Programme in Applied Economics of the Jawaharlal Nehru University, was carried out entirely by myself. I also affirm that it was not part of any other programme of study and has not been submitted to any other University for the award of any Degree.*

June 29, 2004

Aathira Prasad

Certified that this study is the bona fide work of Aathira Prasad, carried out under my supervision at the Centre for Development Studies.

K. Pushpangadan
Fellow

K.P.Kannan
Director
Centre for Development Studies

To my parents

ACKNOWLEDGEMENT

"Silent gratitude isn't much use to anyone", quoted Stern. As I endeavour to thank the many involved in the smooth completion of my thesis, I pre-warn that the list is pretty long and that I may not be able to thank many as much as is their input into this venture.

First and foremost I would like to thank my supervisor, Dr. K. Pushpangadan, for keeping me on my toes, to finish the work on time. He deserves special mention for guiding me through the methodology of Data Envelopment Analysis, entirely new to me, and taking time out to explain some seemingly baffling estimations. Another who deserves to be mentioned in this context is Dr. M. Suresh Babu, whose valuable suggestions at the start of my thesis work helped me focus on pertinent issues. The faculty in CDS have always patiently listened to raw ideas forming in our minds and helped polish it to be presented as outcomes. The rigorous course-work that we completed under their able guidance helped me visualise development and its issues from a researcher's point of view. Many ideas in this thesis have come from such direction; some initiated as sparking debates on and off our seminar sessions. I thank Dr. P. L. Beena, Dr. Achin Chakraborty, Dr. K.P. Kannan, Dr. K. N. Harilal and others for stimulating my mind during the seminar discussions. A very special thanks to Dr. Chandan Mukherjee for making his sessions on Stata so interesting and informative that I had no qualms using the software for my thesis work. I thank Dr. K. K. Subrahmanian who helped immensely in provoking thought on new researchable issues. Dr. Kabir's consistent "you are always welcome home" certainly added new flavour to my stay in the hostel. Dr. Achin Chakraborty, the M.Phil Coordinator of our batch, Dr. Vijayamohanan Pillai, the present M. Phil Coordinator and Dr. K. P. Kannan, Director of the CDS need special acknowledgement for enabling a smooth flow of the course work and the dissertation. I also thank Dr. Arup Mitra for his comments during a conference and directions for additional research.

Books from the CDS library have to be given their due credit, without which I would have been a lost soul in the sea of Industrial Economics. Along with them I have to thank the library staff, always willing to lend a helping hand in finding 'lost' or misplaced books and journals. Ameer (Ikka), Molly aunty and Gopakumar have always been a great help at the counter; many a time Shobha chechi has had to bear with my accusations of 'books can never be found in this library' and proved me wrong (thank god for that!); Shankar has been a boon finding out old journals not kept in their original racks; Surabhi, who helped not only in finding books in the library, but also allowed us into the PhD theses section for cursory glances at those works; above all, a person who just needs to be thanked- for providing help at the most appropriate times - Anilkumar, who has been the best in enabling timely availability of data. Kudos to all the staff in the library for organising it well to cater to the needs of us young researchers. As helpful as the library staff are Sreekumari chechi and Geetha chechi from the Administration. They made sure we finished assignments on time, gave back evaluation sheets and helped us remain organised and on time for any submission. Phil Roy deserves many thanks, not only because he kept us aware of upcoming deadlines but also instilled into us lessons of questionnaire and thesis formatting; always ready to *answer any doubt we had with his unique "my dear child". I would also like to thank Soman Nair who has been instrumental in sending for the DEA software from the University of Warwick so that I could proceed with my work. I also thank the staff at the Computer Centre, who patiently listened to all our complaints about the PCs. At this point, I thank the security guards who were willing to extend the opening hours of the CC towards the finishing stages of our work, so that we could submit on time.*

Seniors are a 'must thank' in any thesis acknowledgement and my experience has been no different. At this stage I need to specially mention a few: Sunny for his ever-pleasant attitude and his offers of help and guidance; Parameswaran for his ready help on the topic of technical efficiency and vital inputs in terms of his class lecture; Hari for his help in many-a-seminar and otherwise; Prabhakaran for his always ready to help nature and especially for all those printer ink-filling times especially during the final stages of thesis work; Rajesh P. for some critical comments and issues which helped me gain clarity in the topic; Ranjan for his happy-go-lucky attitude towards everything; Subrata (dada) for his inspiring approach towards work and for all the help on Stata commands; Rathikant (ji) for his constant questions of "So, your thesis is over?" which made me even more determined to get it finished on time, not to forget his 'treats' for all of us burning the midnight oil in the Students' Bay during the very last stages of the thesis; Shyjan for explaining the convergence estimation in a 'capsule' form and also for making me prepared for the number of 'rewrite's I got for my thesis chapters; Anil for being around in the CC and keep our spirits high. I have to mention a special thanks to Rajesh Puliyara who helped me with the DEA software during the initial stages of its use. I sincerely thank George for helping me out by formatting this thesis.

I also wish to thank my friends in the hostel for a wonderful two years spent in CDS. Rakhe for the staircase meets and conversation, Sajitha for her gentle and meek nature, Indu for all the help she did, especially with the canteen, Lekshmi, always undecided, but in her own special way bringing a cheer to our minds; at this point I would also like to thank Sindhu and Bindu, the former for her small doubts which gave me some pointers for estimation possibilities and the latter for being the neighbour with a cheerful disposition. At this point, I remember the good times we had with our immediate senior batch, especially Varman, Vaithegi, Sandeep, Aparajita, Rakhee and Lakshmi Priya. Raji, Ashitha, Tina, Poornima, and Nija were very good company on campus.

The juniors who have been a great support to us- be it Alice with her helpful nature and dedication, Sejuti for her ever-so-concerned approach, Remya with her silent and elegant stance, Aravindan, with his melodious voice and perfect imitations, Ashish, with his fun talk and arguments, Joseph, for his collection of old sad Hindi film songs, Nadhanael for his 'jokes' and talk in Students' Bay most of the time, not to forget Shyam's one liners which sent many a person rolling with laughter.

The journey from seniors to the junior batch over, how can I not thank my classmates and Dhanya (an essential part of our class). The times we shared, fun and frolic, not to mention the fury part, would remain etched in my mind forever. All said and done, I think we were just the right mixture! Dhanya, the 'Ph.D. student' but so much an integral part of our very own mph02- the one who got the opportunity of going through many of our theses and 'approving' acknowledgements; Nandana, my 'deskmate' from the classroom- how can anyone forget her ever smiling face and the few selective words she managed to pick up in Malayalam, Tamil and Telegu; Ashutosh, the 'nice boy' whose smile always got him food before any of us did, not to forget the favourite song of his, which used to wake up the entire CDS in the morning; Francis, for his inevitable mix of Malayalam and Tamil, with hearing in Malayalam and thinking in Tamil; Hari, the 'innocent' guy in our class who has tolerated quite a bit of leg-pulling from us; Siddiqui, the one with whom we could embark on a discussion about any topic on the earth, ranging from religion to economics and yet see no end of discussion; last but definitely not the least I remember Gowri, with her ever caring attitude and pampering nature towards many. The most striking thing is that though from different parts of India, we had so much in common which made the two years I spend here seem like two weeks. I cannot forget all those treats, on the spur of the moment dinners and outing...I could possibly write pages and pages about it all, but given the page constraint I better end it so- without them, I am sure that my stay in CDS wouldn't have been as memorable as I consider it now.

Some friends outside the CDS community do deserve an equal share of acknowledgement for helping out in ways that they themselves might not have realised. Alfy, her presence and support helped in a very big way during the times of my thesis. My friends, Amaya and Smita whose phone calls and Surya, whose mails were of immense help during the rigorous coursework and dissertation time; Purnima who was always concerned about the work hours I put into the thesis; Seetha for her once in a while mails which made a lot of difference; Nipun, Venu and Monica for keeping alive my forwarding spirit; Sohini for her instant mail replies, be it on the academic front or otherwise; Nilanjana for her blue moon mails of delight; Anand for his constant pestering for joining the groups which brought a world of difference to my life; Jayadev for innumerous discussions on the economy of Kerala and current issues of concern; and finally, Reghu, for always being there for me - extending the support I needed, especially towards the final stages of my thesis work.

No work can ever be completed without the extended support given by one's family. My family have been the pillars of strength and support throughout this program and always backed me in whatever I have done. I thank Amma and Achan for providing me this wonderful opportunity of pursuing my M.Phil from CDS. Not to forget Vava, whose mails would come flying in during my course work trying to remind me about replying to her and also about the place called home: "Home is after all where the heart is". Above all, I thank God who has not only enabled me to finish the course successfully but also for keeping my path smooth through it.

~ Aathira.

(Disclaimer: To go about acknowledging people who have helped in the very many stages of the thesis is indeed a very taxing job (as I got to know while writing this) because you really do not want to leave anybody out. So if anyone of you finds that they have not been mentioned, please do not take it to heart, as it is just a small error on my part... blame it on last minute jitters of thesis submission!)

ABSTRACT OF THE DISSERTATION

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The study aims at analysing the technical efficiency, one of the major determinants of productivity, in Indian manufacturing using the methodology of Data Envelopment Analysis. This deviates from the already existing studies on a few grounds particularly in the context of economic reforms. Firstly, it examines most comprehensively the technical efficiency at the regional as well as industry-level (two-digit industrial classification) for the period, 1976/77-1997/98, using data from Annual Survey of Industries. Secondly it brings out the regional distribution of efficiency by decomposing it into pure technical and scale using input orientation model of DEA under constant returns to scale (CRS) and variable returns to scale (VRS). Thirdly, it provides a methodology for ranking the states according to relative performance of each industry. The major findings are summarised below.

Index of pure technical efficiency, estimated from DEA under VRS, indicate decline in five industries, an increase in nine and the remaining constant out of sixteen industries. The statistical validity of the results show that the most significant changes have occurred in Karnataka and in the manufacture of paper and paper products from among all the states and industry. Under reform analysis, Maharashtra and Kerala represent the two extremes of mean value of pure technical efficiency with the former showing the highest value. Comparing the three period mean values, a once for all change is seen to have taken place. Scale efficiency, calculated as a ratio of technical efficiency under CRS to the technical efficiency under VRS, shows decreasing returns to scale operating in most of the regions especially in Maharashtra and Orissa. The manufacture of wool, silk and man-made fibre textiles in the industry category also indicates decreasing returns to scale across all regions. The dummy variable analysis undertaken exhibits variations in the results of industry and states significantly affected by reforms. The sigma convergence indicates low levels of duplicability in the case of pure technical efficiency estimated. Scale efficiency, however shows statistically significant results of convergence in two industries, the manufacture of wool, silk and man-made fibre textiles and in the manufacture of paper and paper products.

To check the sensitivity of the DEA results, we use the benchmarking approach as modified by Thanassoulis (2001). While estimating this, we find widespread regional variations in efficiency ranking over the reform periods with the exception of Kerala, maintaining its most efficient position in the manufacture of food products. To examine the relationship between productivity and technical efficiency, we use the case study method by taking one of the best (Karnataka) and least (Uttar Pradesh) performing states. While estimating the Malmquist Index of Productivity change, we find a declining trend for the two states; the result remains robust if the nominal values are replaced by real values.

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ABBREVIATIONS

DEA	Data Envelopment Analysis
TE	Technical Efficiency
PTE	Pure Technical Efficiency
SE	Scale Efficiency
AP	Andhra Pradesh
ASSM	Assam
BH	Bihar
GUJ	Gujarat
HAR	Haryana
KAR	Karnataka
KER	Kerala
MP	Madhya Pradesh
MH	Maharashtra
ORI	Orissa
PUN	Punjab
RAJ	Rajasthan
TN	Tamilnadu
UP	Uttar Pradesh
WB	West Bengal

Chapter 1

INTRODUCTION

"The three fundamental requirements of India, if she is to develop industrially and otherwise, are: a heavy engineering and machine-making industry, scientific research institutes, and electric power. These must be the foundations of planning."[1]

The road to growth of a developed Indian economy was considered to be through planning since independence. In planning, the importance given to the secondary sector has been substantial and can be linked to Kaldor's first law which states that the growth rate of an economy is closely related to the growth rate of its manufacturing sector. Also considering the fact that this is the only sector which could face increasing returns to scale, an additional emphasis was laid on its faster growth. So on the grounds of building up a stable industrial base, the industrial policies were begun - starting with the first industrial policy resolution of 1948. Over the years drastic changes have been brought about in industrial policies, mainly in two years, once in 1985 and the other in 1991, the latter coinciding with the first generation of economic reforms. These changes would be discussed in detail in a later section in this chapter. We would like to analyse if these policies, initiated with the intention of restructuring, have left any impact on variables like technical and scale efficiency.

I.1. Motivation of the Study

As Nayyar[2] put it "Success at industrialisation is not only about resource allocation. It is as much, if not more, about resource utilisation and resource creation. The mode of utilisation of resources is a crucial determinant of economic efficiency". From the above statement we find that the efficiency concept, which is the optimum utilisation of resources, is a very crucial variable in assessing the industrialisation factor. Hence not only should we dwell on analysing the output growth, but also check for the efficiency in terms of optimal utilisation of inputs or outputs. More often than not, studies on the Indian manufacturing sector deal with the issue of productivity.

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[1] Nehru (1946) in the Discovery of India.
[2] See Nayyar (1994).

Slight variance in the concepts of productivity and efficiency need to be clarified to justify the attempt made in this study. The difference between the two notions is brought out through the variations in definitions and its calculation. By productivity of a production unit, what is generally meant is a ratio of its output to its input. But this being the most simplistic case, its calculation would be simple. If several units of different inputs are used to produce several outputs, then the outputs in the numerator should be aggregated in some economically sensible fashion, as must inputs in the denominator so that the overall productivity remains the ratio of two scalars. Productivity varies due to differences in production technology, differences in the efficiency of the production process and difference in the environment in which production occurs. In other words, efficiency is only one of the components while estimating the productivity of a particular unit.

Efficiency of a production unit is the comparison between the optimal and observed values of the units of input and output. The comparison can be done in two forms: as the ratio of the observed output to maximum potential output obtainable from the given input; or as the ratio of the minimum potential input to observed input required to produce the given output or some combination of the two. The optimum can also be defined by comparing the observed and optimum cost, revenue, profit or else subject to the appropriate constraints on quantities and prices. Hence, we find that the two concepts, productivity and efficiency, are quite different from each other, though at first look they may appear the same. The minor difference in concept can be elucidated by saying that a change in efficiency inevitably leads to a change in productivity but a change in productivity may not necessarily be due to change in efficiency. In other words, efficiency is a sufficient but not necessary condition for productivity change.

Though there have been numerous studies on productivity (some would be listed in a later section of this chapter), the effect of efficiency, the leading component of productivity changes, has not been probed in depth. In this study, our main aim is to estimate the efficiency - technical and scale – of the Indian states across the industry groups over some time period. The specific aim is to check the impact of reforms on the major components of technical and scale efficiency. But before listing out the main objectives of study, the concept of efficiency needs to be explained more. Also, special emphasis on the method of its estimation is required for finalising the methodology to be used in this study.

I.2. Framework of the Study

In this section, we attempt to define the concept of efficiency and the methods of its measurement with specific emphasis on the non-parametric method of Data Envelopment Analysis (DEA). This section deals with the definition and measurement of the concept of efficiency; the estimation of technical efficiency is then discussed in detail in the following sub-section.

I.2.1. Definitions and Measures of Productive Efficiency

"If the theoretical arguments as to the relative efficiency of different economic systems are to be subjected to empirical testing, it is essential to be able to make some actual measurements of efficiency".

- Farrell (1957).

Koopmans (1951) provided a formal definition of technical efficiency: a producer is technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output. Here we can make out the distinction between the output and input oriented framework of technical efficiency estimation respectively. Debreu (1951) and Farrell (1957) introduced a measure of technical efficiency addressing the question of resource utilisation at the aggregate level. Their measure is defined as one minus the maximum equiproportionate reduction in all inputs that still allows continued production of given outputs. A score of unity indicates technical efficiency because no equiproportionate input reduction is feasible; a score less than one indicates the severity of technical inefficiency. Shephard (1953) introduced the distance function as an alternative characterisation of the technology.

Farrell[3] (1957) put forward the concept of technical and allocative efficiency as essential components of overall/productive efficiency. He defined efficiency with the assumption that the efficient production function was known and that the concepts of technical and allocative efficiency were methods of comparing the observed performance of a firm with some

[3] Some of Farrell's terminology differs from that used nowadays. He used the term price efficiency instead of allocative efficiency and the term overall efficiency instead of economic efficiency.

"postulated standard of perfect efficiency"[4]. He proposed two scalar measures of efficiency for the input-oriented problem:

(a) Technical efficiency (TE) which is just the proportional reduction in inputs possible for a given level of output in order to obtain the efficient input use[5] and

(b) Allocative efficiency (AE) which reflects the ability of the firm to use the inputs in optimal proportions, given their respective prices.

The contribution of Farrell was path breaking in three aspects:

(i) Efficiency measures were based on radial uniform contractions or expansions from inefficient observations to the frontier,

(ii) The production frontier was specified as the most pessimistic piecewise linear envelopment of the data,

(iii) The frontier was calculated through solving systems of linear equations, obeying the two conditions on the unit isoquant:

  (i) that its slope is not positive;

  (ii) that no observed point lies between it and the origin.

The inter-linkages and relationships of the various measures of efficiency can be illustrated with the help of a diagram taken from Farrell (1957). He has examined the simplest case of a two-input one-output production possibility taken up under the constant returns to scale framework for his paper. Consider a case where two inputs x_1 and x_2 are used in the production of an output 'y'. In figure I.1, the two inputs are represented on the horizontal and vertical axes and SS' is the isoquant representing the various combinations of inputs used to produce the certain quantity of output 'y'. All the points on this isoquant reflect technically efficient production.

At that particular point P in the figure the firm is not operating at technically efficient levels of production. To define technical efficiency, a line is drawn connecting the origin and the point P, which crosses the isoquant at point Q. In the case of a technically efficient firm, the same amount of output 'y' is produced using the inputs defined by point Q. Since the point P is technically inefficient when compared to Q, the technical efficiency of that point can be

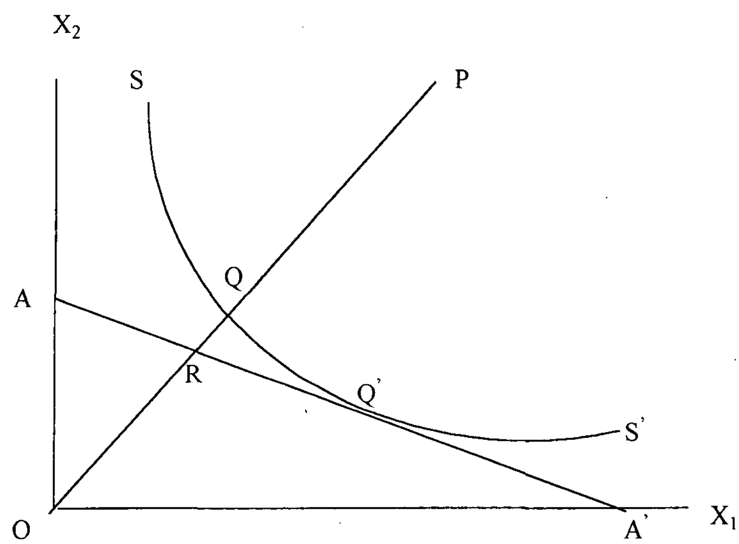
[4] See Farrell, 1957.

[5] TE measures only that portion of inefficiency that could be eliminated by proportional reduction of inputs. It is the proximity of the data point (yr, xi) to the facet of the piecewise linear envelopment surface. Even after reducing input use by (1 - TE), however, some inputs may still exhibit slack (i.e., be used inefficiently).

defined as the ratio of the distance from the point Q to the origin, over the distance of point P from the origin. So, Technical efficiency = (OQ/ OP).

The allocative efficiency could be defined given the values of input prices. The isocost line AA' is drawn tangential to the isoquant SS' at point Q' where the required output quantity is produced at minimum cost. So the point Q is not an optimal point as the distance RQ could be reduced without any reduction in output. Allocative efficiency is hence defined as the ratio of the distance of the point R to the origin over the distance of the point Q from the origin: That is, Allocative efficiency = OR/OQ.

Figure I.1: Technical and Allocative Efficiency.



Source: Farrell (1957).

Another concept equally important while considering productive efficiency is that of scale efficiency. While Farrell did not refer to this concept in his seminal paper[6], several others, taking into consideration the significance of this component, have incorporated it in the estimation of productive efficiency. Overall technical efficiency is a product of pure technical efficiency and scale efficiency. In the constant returns to scale paradigm, scale efficiency would be equal to one. But on moving from a constant to variable returns to scale scenario, we find that the value of scale efficiency has an impact on technical efficiency and hence on the productive efficiency value. This concept is dealt with in details in the third chapter of this thesis.

[6] The assumption of constant returns to scale parameter would imply overall technical efficiency is equal to pure technical efficiency since scale efficiency would be one in such a scenario. He does however mention the case of returns to scale being not equal to one, though he does not specifically mention the term scale efficiency nor its calculation.

It is the product of these three components – pure technical efficiency, scale efficiency and allocative efficiency that constitute productive/overall efficiency. Most of the studies in the Indian context are concerned with technical efficiency, though its components, the pure technical efficiency and scale efficiency are not constructed for extended analysis. So, in this study we take up an in depth analysis of the two, spatially and temporally.

I.2.2. Estimation of Technical Efficiency

In the analysis designed to measure technical efficiency in particular, there are two commonly used approaches - the econometric approach and the data envelopment analysis approach. The econometric methodology has taken two routes: one has been to estimate the flexible functional forms without giving much importance to the needed economic properties of the cost or production functions and the equilibrium arising from optimisation. The other has been to impose the properties and the equilibrium conditions and estimate the efficiency. The use of this methodology would give rise to a stochastic trend.

Relatively few studies have used the non-parametric method of Data Envelopment Analysis (DEA). This implies that certain properties of a production function assume importance for the estimation procedure without, however, creating the need to specify a functional form and to estimate its parameters. DEA is based on the estimation of efficiency variations with reference to a (world) technology frontier.

Farrell suggested that the function should be estimated from the sample data using a non-parametric piece-wise-linear technology or a parametric function. Charnes, Cooper and others developed the former idea, whereas Aigner and others pursued the latter. In the deterministic frontier approach[7] attempted by Aigner and Chu (1968) and others, the log of a production function is taken and the Farrell measure of technical inefficiency is found. This is labeled "deterministic" because the stochastic component of the model is entirely contained in the (in)efficiency term. The stochastic production frontier was motivated by the idea that deviations from the frontier were not often under the control of the agent, who is being examined, as also the shortcomings of the other approach.

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[7] Econometricians have largely abandoned the deterministic frontier as a useful model for efficiency measurement. The inherent problem with the stochastic specification and the implications of measurement error are technical problems pointed out by Schmidt (1976) and Greene (1980).

The parametric approach, which is more common, has the major disadvantage that it requires an explicit functional form for the technology as also for the distribution of the inefficiency terms. The non-parametric method introduced as DEA by **Charnes, Cooper and Rhodes** (1978,1981) builds on the individual firm framework of Farrell. They extend the engineering ratio approach to efficiency measures from a single-input single-output efficiency analysis to multi-input, multi-output situations. Drawing on the work of Debreu (1951) and Koopmans (1951), Farrell (1957) argued that it is practical to measure productive efficiency based on a production possibility set consisting of the conical hull of input-output vectors. This framework was generalized to multiple outputs and reformulated as a mathematical programming problem by Charnes, Cooper, and Rhodes (1978).

"Farrell's contribution was itself ignored for more than two decades. It was rediscovered by Charnes, Cooper, and Rhodes (1978), who referred to the mathematical-programming method of measuring technical efficiency as Data Envelopment Analysis (DEA), an appellation that seems to have stuck." (Russell, 1998)[8].

Estimation of a production function in the conventional approach is to first specify a parametric form for the function and then to fit it to observed data by minimising some measure of their distance from observed data. The weakness of this approach is that it is a difficult task to theoretically substantiate or statistically test the maintained hypotheses about the parametric form for the production function and the postulated distribution for the disturbance term. Since the most commonly used methods are the parametric and non-parametric approaches of estimation, a choice has to be made between the two.

Table I.1: A comparison of the three methods under different case scenarios

Problem	Regression	Frontier Analysis	
		SFA	**DEA**
Multiple input output models	Complex and rarely done	Complex; rarely taken up	Simple solution
Specification of functional form	Done but may be incorrect	Done but may be incorrect	Not required
Outliers	Not as sensitive	Not as sensitive	Inaccurate efficiency assessment
Sample size	Medium sample size is needed	Large samples required	Small sample size is adequate
Explanatory factors highly collinear	Possible misleading interpretation of relationships	Possible misleading interpretation of relationships	Better discrimination
Testing	Straightforward statistical testing	Straightforward statistical testing	Sensitivity analysis is possible but complex

Note: SFA= Stochastic Frontier Analysis; DEA= Data Envelopment Analysis.

[8] An overview of the developments in the literature after Farrell's seminal publication is discussed in detail in Forsund and Sarafoglou (2000).

In the stochastic frontier analysis (SFA) the main drawback is the use of an explicit functional form when compared to the non-parametric methodology. The regression framework seems to be taking a backseat in comparison. When compared to other methodologies, it can be seen that in most cases, it would be better to analyse data in terms of DEA rather than the methods of stochastic frontier analysis or even the regression framework. In table I.1 above, we have examined the different cases and clarified which methodology would better suit our purpose.

The advantage DEA has over the former econometric approach is that this method does not require any assumptions about the functional form, as mathematical programming techniques are inherently bounding techniques. The econometric approach is stochastic and hence attempts to distinguish the effects of noise from that of inefficiency. The programming method clubs the two and calls the combination inefficiency. DEA allows for the use of nominal and physical values at the same time as inputs and outputs, since the objective is not to estimate the functional parameters but a relative measure of performance (Majumdar, 1996).

However, Lovell (1993), while discussing the pros and cons of the parametric and non-parametric methods concludes "...in my judgement neither approach strictly dominates the other, although not everyone agrees with this opinion; there still remain some true believers out there". In this study, we derive the results of the objectives using the non-parametric methodology of Data Envelopment Analysis. The following section would make clear the concept of Data Envelopment Analysis, the non-parametric method of estimation. DEA is nothing but the use of programming techniques to solve the optimisation problem, to obtain the engineering ratios generated in a normal paradigm. The method of DEA, how it follows from the ratio forms, where does it score over the parametric approach- these are explained in the next subsection, specifically on the method of DEA.

I.2.3. Non- parametric Approach: What is DEA?

Defined by Charnes, Cooper and Rhodes (1978), DEA is "A mathematical programming model applied to observational data [that] provides a new way of obtaining empirical estimates of extremal relations – such as the production functions and/or efficient production possibility surfaces that are a cornerstone of modern economics".

DEA involves identification of units, which in the relative sense, use the inputs for the given outputs in most optimal manner, which is then used to construct the efficiency frontier over the data of available organisation units [called Decision Making Units (DMU) in DEA terminology]. DEA is non-stochastic, which suggests that random variation in the data can potentially impact the efficiency measure.

DEA uses this efficient frontier to calculate the efficiencies of the other organisation units that do not fall on efficient frontier and provide information on which units are not using inputs efficiently. Hence the efficiency of a DMU is measured relative to all other DMUs with the simple restriction that all DMUs lie on or 'below' the efficient frontier. That is, efficiency in a given time period is measured relative to all other time periods with the simple restriction that production of each output in each time period lie on or below the efficient frontier. The measure of efficiency of a DMU can change when the set of DMUs used to construct the frontier changes. Further, a DMU may well be inefficient in absolute terms even when it is efficient in DEA terms. All that the DEA efficiency measure tells us is whether or not a DMU can improve its performance relative to the set of DMUs to which it is being compared.

The computational problem when converted to the programming technique is to maximise the output of any producer *i* subject to the constraint that their input usage be no less than the "best" possible linear combination of all the observed producers in this sample. If expansion is possible then the variable of technical efficiency will be greater than one for that producer. So, in principle, the DEA procedure constructs a piecewise linear, quasi-convex hull around the data points in input space (for this one-output problem). Instead of trying to fit a regression plane through the centre of the data, DEA floats a piecewise linear surface to rest on top of the observations. This is empirically driven by the data, rather than by assumptions about the functional form, which makes it superior to its counterparts.

There are two methods used for determination of technical efficiency: it can be estimated either as the minimum level of input combination needed to produce an optimal level of output or as the maximum output level which can be obtained using a certain proportion of inputs. This is done in DEA using the input or output orientation - the output orientation is appropriate when outputs are controllable and the input orientation is appropriate when inputs are controllable. Coelli (1995) argues, in many studies the researchers have to select input oriented models because Decision Making Units (DMUs) have particular orders to fill (e.g. electricity generation) and hence the input quantities appear to be the primary decision variables. Generally, one should select an orientation according to which quantities (inputs or outputs) the managers have most control over. The results under either of the two orientations would be the same, under constant returns to scale framework. However it is suggested that in cases where inputs are controllable, the estimation of technical efficiency under input orientation is superior for practical reasons.

Further explanations of how each variable can be estimated using this programming technique will be dealt with in the respective chapters. So, before moving onto the existing literature in India and the chapter outline of the thesis, we need to understand the working of the Indian industrial sector which witnessed immense change on the policy front. Hence in the next section we take a look at the policy changes which took place over a few decades in Indian manufacturing.

I.3. Industrial Policies in India

With an aim to establish a developed industrial sector, steps were taken to adhere to the Mahalanobis model in the Second Five Year plan. The development model so planned emphasised the development of heavy industries, import substitution across the board and also spearheaded the vast expansion of the public sector. Moving along the lines of Lenin regarding the 'commanding heights' of an industrial battlefield, the infrastructure and key raw materials supplying industries were left under the purview of the public sector with the private sector being required to function along the lines of the industrial policies set by the state.

In 1948, immediately after Independence, Government introduced the Industrial Policy Resolution that had the objective of increasing production and of equitable distribution. The Industrial Policy Resolution of 1948 was followed by the Industrial Policy Resolution of 1956, which had as its objective, the acceleration of the rate of economic growth and the speeding up of industrialisation as a means of achieving a socialist pattern of society. In 1956, capital was scarce and the base of entrepreneurship not strong enough. Hence, the 1956 Industrial Policy Resolution gave primacy to the role of the State to assume a predominant and direct responsibility for industrial development.

To achieve this, an industrial licensing framework was established controlling not only the entry into the industry but also the expansion of capacity, technology, output mix, capacity location and the import content. Major policy changes were brought about with the implementation of the Industries Development and Regulation Act of 1951, the Monopolies and Restrictive Trade Practices Act of 1969, the Foreign Exchange Regulation Act of 1973 and also the Control of Capital Issues along with the export and import controls as well as the commodity controls.

Hence in the decades of the Nehru-Gandhi rule, the policies were of indiscriminate import substitution and foreign exchange regulation with a highly regulated industrial policy framework. Since there was protection against competition from abroad due to the import regulations and also capacity licensing for protection from the new indigenous firms, the incumbent firms had little incentive to enhance productivity and efficiency. This also resulted in reduction of competitiveness of India's exports through the firms' lack of incentive for reduction in costs as also the complex policy network coupled by the inherent red-tapism involved in the administration.

While identifying high-priority industries and emphasis on small-scale industries were the objective of the Industrial Policy Statements in 1973 and 1977, the Industrial Policy Statement of 1980 focussed attention on the need for promoting competition in the domestic market, technological upgradation and modernisation. The policy laid the foundation for an increasingly competitive export base and for encouraging foreign investment in high-technology areas. These objectives were continued through various programmes in the Five-Year plans but the outlining of the New Industrial Policy (NIP) 1991 made the process of reforms pace further. The areas where the thrust was given were: (a) industrial licensing (b) foreign investment (c) foreign technology agreements (d) public sector policy and (e) MRTP Act.

The various measures taken to ensure the ushering in of rapid industrialisation through the reform process were: Industrial licensing being abolished; large business houses no longer requiring to take separate permission for investment and expansion; the list of industries reserved for the public sector being reduced; equity in public enterprises being divested; access to foreign capital and technology being made freer; quantitative restrictions on imports being virtually abolished; import duties also being significantly reduced.

The above said policy reforms along with the stabilisation policy can also be categorised into two - with respect to internal and international economic activity; they have sought to be deregulated and liberalized. Internal liberalization included the dismantling of a complex industrial licensing system, opening up of a number of sectors previously reserved for the public sector to private investment, some divestment of stock in the state sector, and decontrol of administered prices. External liberalization measures included removal of non-tariff barriers to imports, reduction in import tariffs, removal of restrictions on - and active encouragement of - foreign investment, some freeing up of technology imports, and attempts to increase portfolio inflows.

The importance of openness and globalization in India's economic reforms is obvious. The official case for the reforms relies on both positive and negative arguments. The key positive arguments are:

(1) That trade liberalization will improve allocative efficiency by shifting resources from capital-intensive to labor-intensive sectors;

(2) That reduced protection will raise technical efficiency by exposing Indian firms to foreign competition;

(3) That lowered barriers to foreign capital inflows will speed up capital accumulation and raise productivity levels through technology upgradation and spillovers.

Bhagwati and Desai (1970), Bhagwati and Srinivasan (1975), Ahluwalia (1985) and Bhagwati (1993), among others, consider controls and regulations as a fundamental constraint on economic growth in general, and industrial growth in particular. Their basic argument is that the weak growth performance reflected a poor productivity performance, which in turn is primarily due to India's policy framework consisting of extensive controls over production, investment and trade and a substantial private sector.

I.4. Existing Literature in the Indian Context

Many studies have been done on the Indian industry with respect to its productivity, mainly Total Factor Productivity Growth (TFPG), without actually reaching any consensus. Famous on this count is the still unresolved question of TFPG in the 80s. The debate was initiated by the response of Balakrishnan-Pushpangadan (1994) to Ahluwalia's (1991) findings of a 'turnaround' in TFPG during the 80s, the debate being centered on pure methodology grounds. The debate was then later on extended by others like Goldar (1997,2000,2002), Dholakia and Dholakia (1994), Pradhan and Barik (1998), Trivedi, Prakash and Sinate (2000) and so on. Of these studies on the Indian manufacturing sector, productivity has been given the maximum importance in research. One of the important factors, which determine productivity changes, is efficiency. This is where our focus would be - by observing the efficiency patterns, an analysis of their variations across time, specifically through the reform period needs to be reviewed.

For a given time period, efficiency is defined as the ratio of the actual production of the firm given its inputs to the firm's potential production in the absence of inefficiency. In short, it is the ratio of what the firm does produce, to what it could produce if it was completely efficient. Relatively fewer studies have been done on efficiency in the Indian context. Some of the studies, Majumdar (1996), Mitra (1999), Krishna and Mitra (1998) and Ray (1997, 2002) are the ones on the basis of which we have formulated the objectives of study. Of these, Majumdar and Ray have used the method of DEA whereas Krishna and Mitra have used a regression framework and Mitra, a stochastic frontier analysis.

So in most of these studies, a partial attempt has been made to understand efficiency and/or the changes in efficiency. We plan to apply the non-parametric method and fill the gap by examining the changes over time of the industries across the states in India.

I.5. Objectives, Database and Relevance of the Study

In this section, we have three main subparts: the objectives of the study, the data base and variables used, justification of the period of study. The essential deviation of this proposed study from the existing ones and hence the objectives are:

(a) Estimation of technical and scale efficiency using DEA.
(b) Analyse the impact of reforms on technical and scale efficiency.
(c) The trends in regional variations in technical efficiency.

Such a study would bring to light the changes in efficiency over the time period of the reforms using the relatively new methodology of non-parametric analysis. Since the study would be attempted across the states by industry, conclusions can be drawn into variations across industry, state and time.

Data Set and Variables Used

The study uses the Annual Survey of Industry database, for the period 1976 to 1998. In the present study, we have limited to just a few inputs like - fixed capital, fuel consumed, materials consumed, total employees and the value of output has been taken for the output. The choice of these variables has been made on the basis of earlier studies on technical efficiency by Mitra (1999) and Ray (2002).

The variables taken have not been deflated to get their real values. This is because in the method of DEA, we are doing only a relative comparison analysis. So, taking the real values for the analysis or the nominal values would not make a difference in the results got (Majumdar, 1996). Only the registered segment of India's manufacturing sector has been taken up for the analysis. This implies the exclusion of unregistered manufacturing activity along with generation of electricity, the provision of water supply and repair services, all of which count as industry. The data only up to 1997-98 has been taken for the time being as adjustments have to be done for the NIC changes made afterward.

Now moving on to the industries taken in the study, based on the industrial classification the industries from 20 to 38 have been taken. However due to changes in the NIC from 1989-90 the NIC- 1970 classifications had to be adjusted for comparison of figures. The major adjustments done were the following:

1. The industry classifications 30 and 31 were switched.
2. The industry division 39, repair of capital goods, was added. But due to unavailability of such classification pre 1989 the analysis could not be done for that division.
3. After 1991-92 values for the industry divisions 35-36 (manufacture of machinery and machine tools including electrical machinery) are not available.
4. The industry divisions 20 and 21 have been taken as a single industry, which is manufacture of food products.

The data being unavailable for some years, industry 25, manufacture of jute textiles, has not been considered in the analysis. This was because continuous comparison across states was becoming a problem with so many missing values.

In this particular study, the DMUs taken are the states in India. The states taken for the analysis are Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu, Uttar Pradesh and West Bengal. Because of the special features of the northeastern and other special category states, and also some gaps in the data for some of these states, they have been excluded from the analysis. The smaller states such as Goa and also Delhi, the latter having the additional special feature of being the capital, with a large concentration of the central government's bureaucracy have also been excluded from the analysis. The analysis therefore will be confined to the 15 major states, which together account for 95 per cent of the total population.

The study focuses on the movements in technical efficiency pre and post reform. Since the time period of study is taken as 1976-77 to 1997-98, the classification of periods has been in the following manner with 1976-77 to 1984-85 as the pre reform period, the years 1985-86 to 1990-91 representing a quasi reform period and the later period of 1991-92 to 1997-98. The reforms, though 'initiated' in 1991, were started off in a small way through industrial reforms from 1985 onwards. Srivastava (1996) took 1985 as period of initiation of reforms in his study and hence provides justification for taking the period 1985 as start of the quasi-reform era. He justified this by giving some prominent features that marked 1985 to be the start of some genuine reforms. He says that

1. The scope of reform was considerably wider than anything that had been attempted before, covering almost the entire sector.
2. There was recognition of the need for industrial policy reform, to complement liberalisation in the foreign trade regime.
3. There was a move away from discretionary and quantitative controls towards the use of fiscal instruments.
4. There was an attempt at introducing some stability into the policy environment by spelling out a long-term fiscal policy and medium-term (three-year) import-export policy.

It is for these reasons that we suggest that 1985 marks a watershed in the process of economic reforms in India". Hence, on this basis, we take up 1985 as the initial year of quasi-reform.

The significance of the year 1991 taken as another time point for change in policies is justified due to the wide implementation of economic reforms (not only industrial reforms) during that year. With the start of the decade of the 90s, the main reform initiatives were undertaken after a fiscal and foreign exchange crisis, which brought India to the verge of default on its foreign loans. This generation of reforms, after the severe financial crunch, were to be beneficial especially to the industry as it was aimed at improving the efficiency of the sector by bringing in more competition and hence ensuring better growth. This was to be possible through the reduction in size of the public sector and also reducing the level of controls and regulation imposed upon them so that further trade and investment would ensure better competitive spirit among the players in the market. This impact, whether it has been achieved or not, is what we aim at analysing in this study.

I.6. Chapter Scheme

These objectives are explored in three core chapters of the thesis. In chapter two, "Pure Technical Efficiency: An Inter-industry Inter-state Analysis", we analyse the estimates of technical efficiency from DEA. The changes are examined through the index number method. The dummy variable technique will be used to estimate the reform impact. Finally we would also check for convergence in their efficiency levels through time.

Chapter three, "Scale Efficiency: An Inter-state Inter-industry Analysis", aims to ascertain if there is an increasing returns to scale operating in the manufacturing sector. In this chapter, the method of estimating scale efficiency will be explained using both the constant and variable returns to scale models under the DEA framework. To examine for changes in scale efficiency using the method of DEA, technical efficiency under the Constant Returns to Scale (CRS) model and Variable Returns to Scale (VRS) model need to be computed. This is because the scale efficiency is the ratio of technical efficiency under the CRS model to the technical efficiency under the VRS model. The empirical evidence for Kaldor-Verdoon's law, of increasing returns to scale operating in the manufacturing sector, can also be examined. The results, hence obtained, can be compared with existing literature, especially with that of Srivastava (1996).

"Pareto-efficiency: A Sensitivity Analysis"; the fourth chapter tries to overcome a limitation of DEA, that the method is very sensitive to small measurement errors[9], by testing the sensitivity of the DEA results. The different methods of ranking for sensitivity analysis are benchmarking, super-efficiency, cross-efficiency matrix, statistics based models ranking of inefficient units and the multiple-criteria decision making (Adler *et al.*, 2002) of which the first two are the most widely used. So a sensitivity analysis, in this case a peer state analysis has been attempted. Using this method, the states acting as peer state for the other inefficient ones can be determined and the leading states in terms of efficiency can be got. The additional advantage with the use of this method is that not only can the leading players be identified, but also, it can be examined by how much the other states have to reduce their inputs to reach the required target levels. The relationship between productivity and efficiency is also brought out in this chapter by checking the productivity and efficiency of two selected states.

In the concluding chapter, the summary and conclusions of the study are reported. The limitations of the study as well as further areas of research would also be suggested.

[9] Since DEA is an extreme point technique and the efficiency frontier is made up of only the best performing DMUs, errors in measurement can affect results significantly.

Chapter 2

PURE TECHNICAL EFFICIENCY: AN INTER-STATE AND INTER-INDUSTRY ANALYSIS

The pure technical efficiency of the manufacturing sector has not been extensively studied in the Indian context, unlike productivity. Of the studies so attempted, the non-parametric method of Data Envelopment Analysis has not been frequently used. Such a study with a comprehensive coverage at the two-digit industry at state level is attempted here to bring out the regional dimensions of pure technical efficiency.

In most of the studies on technical efficiency, only the overall technical efficiency (obtained under constant returns to scale framework) has been examined. Srivastava (1996), in a significant study, finds that the Indian manufacturing sector is characterised by a low degree of competition, plants of less-than-minimum efficient scale and chronic underutilisation of capacity. Under such a condition, the efficiency estimate calculated under Constant Returns to Scale (CRS) would be biased, since it would also include the values of scale efficiency, as demonstrated below. Hence an attempt will be made here to analyse only pure technical efficiency in this chapter.

The aim of this chapter is to analyse the pure technical efficiency in the Indian manufacturing sector applying the non-parametric method of Data Envelopment Analysis (DEA). Pure technical efficiency is derived under a Variable Returns to Scale (VRS) framework in the DEA model, which excludes the scale efficiency factor. The scale efficiency factor will be further explored in the subsequent chapter. The meaning and definition of pure technical efficiency (PTE), its measurement using DEA, the literature on technical efficiency in the Indian context, its levels and variations and convergence across states form the essence of this chapter.

The main objectives to be examined in this chapter are:

1. Analyse the pure technical efficiency.
2. Evaluate the impact of reforms on PTE.
3. Check the convergence of PTE across states.

The first section of the chapter deals with the theory and measurement of pure technical efficiency. The second section provides the literature review. The third section presents the empirical results and its discussion. The last section sums up the findings and concludes the chapter.

II.1. Pure Technical Efficiency- Definitions and Concepts

In this section we will define pure technical efficiency using DEA in particular and bring out its difference from the technical and overall/productive efficiency. We will also discuss the programming model used in the estimation procedure.

II.1.1. Definitions of Pure Technical Efficiency

As mentioned earlier,

"Productive efficiency has two components. The purely technical, or physical component refers to the ability to avoid waste by producing as much output as input usage allows, or by using as little input as output production allows. Thus the analysis of technical efficiency can have an output augmenting orientation or an input-conserving orientation".

(Lovell, 1993).

Technical efficiency is the capacity and willingness of an economic unit to produce the maximum possible output from a given bundle of inputs and technology. The diagrammatic representation of this has already been dealt with in the earlier chapter. In this study we will be focusing on the 'input-conserving orientation'[1] as defined by Koopmans (1951). He defined a producer as technically efficient if, to produce a given output, a reduction in any input requires an increase in the use of at least one other input. The Debreu and Farrell measure is defined as "one minus the maximum equiproportionate reduction in all inputs that still allows continued production of given outputs" (Lovell 1993).

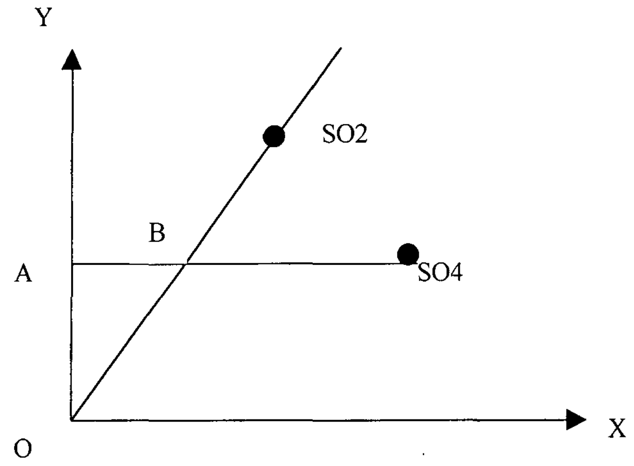
It may be noted that the technical efficiency[2] (TE), can be decomposed into pure technical efficiency (PTE) and scale efficiency. This decomposition is taken up under the non-parametric method of DEA, using the diagram below.

[1] The use of an input orientation is justified in the introduction chapter.
[2] From now on, technical efficiency would be referred to as TE and pure technical efficiency would be labeled PTE.

II.1.2. Diagrammatic Analysis of Technical Efficiency and its Components

Following Thanassoulis (2001), we consider the simplest case of a one-input one-output case for the DMUs. We have two scenarios to be considered- one where the DMUs are under CRS and one under VRS. The axes represent the input X on the x-axis and output Y on the vertical y-axis.

Figure II.1: Technical efficiency under CRS (one input one output).



Source: Thanassoulis (2001).

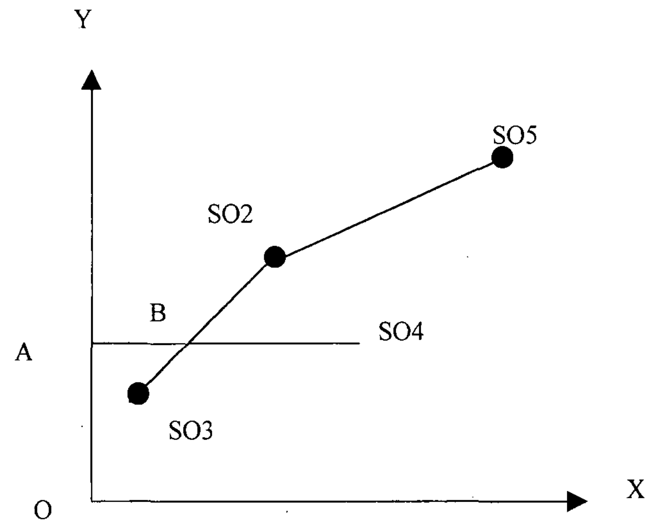
In the above figure, we find that CRS holds and there are two DMUs SO2 and SO4, the former an efficient one and the latter, inefficient; we can construct a linear production possibility set (PPS) enclosed by OSO2, the efficient boundary being denoted by OSO2 and its extension. Under the case of CRS and input minimisation here, we find that the inefficient point SO4 can be brought to level B, found to be technically efficient. But if the DMUs are not operating under CRS, then the efficiency obtained for SO4 earlier would be misleading. For correcting this flaw, we need to incorporate the assumption of VRS into the analysis.

We now consider the four DMUs- SO2, SO3, SO4, SO5 and their efficiency. Under this VRS scheme, the piecewise linear curve SO3SO2SO5 becomes the PPS. The piecewise linear hull is representative of the production possibilities; but the curve is not shown smooth because while estimating using DEA, a production function is not needed. Using the inefficient production assumption, we construct the vertical segment[3] down from SO3. The input

[3] Points along this segment are feasible but are dominated by SO3. By virtue of the same assumption of inefficient production, the same applies to the horizontal segment, right of SO5.

efficiency of SO4 is obtained by keeping the output constant and contracting its input as far as possible.

Figure II.2: Technical Efficiency under VRS (one input one output).



Source: Thanassoulis (2001).

So, from the figure II.2, we need to identify the feasible point of lowest input level along ASO4. That point, from the figure, is seen to be B. Expressing the input level AB as a proportion of the observed input level ASO4, we obtain the input efficiency of SO4 under VRS as (AB/ASO4). This establishes the relation that TE is a product of PTE and SE, where SE is nothing but TE under CRS divided by TE under a VRS scheme. Now, we formulate the linear programming model for the estimation of pure technical efficiency.

II.1.3. The Model

Consider a case of N DMUs with m inputs, 's' outputs; let x and y denote the vector of inputs used and outputs produced respectively. Charnes *et al.* (1978) developed the generalised multi-input multi-output framework from where the optimal value of technical efficiency, k_0 could be obtained under a Constant Returns to Scale framework. The optimal values hence derived from solving for technical efficiency can be denoted with a '*' superscript. The model hence identifies a point within the Production Possibility Set (PPS) such that the lowest proportion k_0^* of the input levels of DMU j_0 is used, while offering output levels which are at least as high as that of the DMU j_0. In other words we can say that this is the technical input efficiency of the particular DMU.

But in order to explain the same under a situation of Variable Returns to Scale (VRS), the CRS model was modified and introduced by Banker et al. (1984). It was Banker, Charnes and Cooper (1984) who suggested the use of VRS specification to attend to a limitation of the CRS framework. The limitation was that the value of technical efficiency estimated under the CRS specification might include scale efficiency values also, if the firms are not operating on optimal scale. The model differs from the CRS model with the inclusion of the convexity constraint.

Model A

$$\text{Min } k_0 - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} = k_0 x_{ij_0} - S_i^- \qquad i = 1\ldots\ldots m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} = S_r^+ + y_{rj_0} \qquad r = 1\ldots\ldots s$$

$$\lambda_j \geq 0, j = 1\ldots\ldots N, S_i^-, S_r^+ \geq 0 \forall i \text{ and } r, k_0 \text{ free.}$$

$$\sum_{j=1}^{N} \lambda_j = 1$$

ε is non-Archimedean infinitesimal.

The convexity constraint is not needed when the CRS model is used. This constraint prevents any interpolation point constructed from being scaled up and down to form a reference point for efficiency measurement since such scaling is not permissible under VRS. The introduction of this constraint ensures that firms operating at different scales are recognised as efficient. Therefore the multiple convex linear combinations of the best practice (incorporating VRS) form the 'envelope'.

In this model, once the technical efficiency obtained has been minimised, the next step is to maximise the sum of its slack values S_i^- and S_r^+. The existence of these slack values denote the possibility of further improvements to the input or output of the DMU, after its input levels have been contracted to the proportion of k_0^*. When the value of the slacks are zero and the value of technical efficiency k_0^* is equal to one, the DMU is said to be Pareto-efficient.

The results of the above model A are used to estimate pure technical efficiency. In this chapter, we limit our focus to only the pure technical efficiency, leaving the trends in scale efficiency to be covered separately in the next chapter. Before analysing the estimates derived under such a framework, it would help to review the existing Indian literature in this field.

II.2. Technical Efficiency: A Literature Review

The efficiency dispersion in Indian industry was initially attempted using a frontier production technology. These studies, done at different levels of aggregation, using different methodologies, are not quite comparable. Reviewing this literature, Tybout (2000) reports that the mean technical efficiency levels are around 60 to 70 per cent of the best practice frontier in the less developed countries. Trade protection is often suggested as one of the explanations for inefficiency in the economy as this leads to monopolist domestic producers with no competition from the rest of the world (Rodrick, 1992). Literature on the effect of competition on technical efficiency has been summarised in Nickell (1996). Tybout (2000) reviews the trade liberalisation-efficiency link[4] only to find that efficiency could improve due to intra-plant improvements and not quite owing to internal and external scale economies.

Writings on the Indian manufacturing sector never concentrated on efficiency as opposed to the studies on productivity, especially total factor productivity. The studies on efficiency[5] can be sub-divided under the following heads: firm level studies, aggregate manufacturing sector studies and disaggregate sector level studies. Some of the firm level studies which have dealt with technical efficiency are Driffield and Kambhampati (2003), Parameswaran (2002), Aggarwal (2001), Balakrishnan *et. al.* (2000), Mamgain (2000), Krishna and Mitra (1998) among others, whereas Ray (2002, 1997), Mitra *et al.*(2002), Singh (2001) and Majumdar (1996), among others, look at the issue from an aggregate industry viewpoint. The method used by these studies is mainly the stochastic production frontier methods with a few

[4] The link between trade liberalisation and efficiency is generally expected to show a positive trend. Havrylyshyn (1990) reviews the literature showing the link between trade liberalisation and efficiency, later correlating it with the degree of protection. While some studies like Nishimizu and Page (1982) and Page (1984) (for India) find evidence of a positive effect, a negative link is estimated by Moran (1987) and Tybout et.al. (1991). Market concentration tends to reduce technical efficiency is a result coming out quite evidently in Caves (1992).

[5] Studies attempted in India on technical efficiency have very often referred to the overall technical efficiency as opposed to the pure technical efficiency tried in this study. So the results which have been quoted are the results of an overall technical efficiency which hence includes the scale efficiency component too.

exceptions of Ray and Majumdar who used the non-parametric method of DEA. The only disaggregate study of technical efficiency at the state and industry level is that of Mitra (1999).

Estimating PTE using DEA approach has certain additional advantages of identifying a regional leader for each industry group; technical efficiency without the impact of scale efficiency can be estimated using a VRS model. A summary table of the major studies in the Indian industry is given below.

Table II.1: Technical efficiency in the Indian manufacturing sector: A summary

Author (Year)	Method Used	Results/Remarks
Ray S. (2004)	DEA	Average TE declined in the period 1991-96 but thereafter an increase was observed (Macro level study).
Pattnayak and Thangavelu (2003)	Translog cost function	There is a capital-using biased technological change (Micro level study).
Driffield and Kambhampati (2003)	Translog production function	Technical efficiency has increased in four out of six sectors taken in the post reform period.
Ray S. C (2002)	DEA	Malmquist and Tornqvist indices (based on TE) show a productivity increase during the period 1985-97 (Macro level study).
Parameswaran (2002)	SFA	Technical efficiency enhancement is a direct result of access to technology imports (Micro level study).
Aggarwal (2001)	SFA	No impact of reforms in increasing the efficiency of public sector enterprises in India.
Balakrishnan et. al. (2000)	Parametric estimation	They find a productivity decline in the 90s and also that there is no significant change after the initiation of the 1991-92 reforms.
Mamgain (2000)	SFA	Her conclusion is the lack of efficiency (technical) changes as only fourteen industries show increasing efficiency of eighty-two.
Mitra (1999)	SFA	Declining levels of technical efficiency for the period 1979-80 to 1992-93 (Macro level study).
Ray (1997)	DEA	Estimated TFPG declined through 1964-84 with considerable regional variation; regressive technical change cited as cause (Macro level study).
Majumdar (1996)	DEA	Analysis of the period from the 1950s showed high industrial efficiency in 50s that came down in 60s and 70s; pattern reversed in the 80s (Macro level study).
Jha et al. (1993)	Translog cost function	Biased technical change in favour of labour and materials as against the use of capital (Micro level study).

Note: DEA- Data envelopment Analysis; SFA- Stochastic Frontier analysis; TFPG- Total Factor Productivity Growth.

Majumdar (1996), one of the earlier exponents of DEA in the Indian context, studied technical efficiency in the manufacturing sector from the 50s to the year of 1993. He came to the conclusion that a significant decline in efficiency existed in the 60s and early 70s; following a very highly efficient performance in the 50s. From 1980 onwards, an upward rising trend was seen for the efficiency patterns culminating only in 1988-89 being a frontier defining efficient year.

Jha et al. (1993), however, find that in the four industries which they have taken, there exists biased technical change which in turn affects the factor income distributions. The change has been toward the use of labour and materials and against the use of capital and energy in the gas and electricity sectors, with opposite biases in cotton textiles. But the period of study being till 1983, it gives us an indication of what the situation was in the pre reform period (before 1985).

According to the estimates of some studies like Basant and Fikkert (1998) and Fikkert (1996), the reforms are supposed to bring rapid improvements in technical efficiency by allowing firms greater access to embodied and disembodied foreign technology. Using a cost function approach, Pattnayak and Thangavelu (2003) show a biased technological change in the capital using industries, suggesting that the New Industrial Policy (NIP) has led to greater capacity utilisation and investment in capital goods.

Driffield and Kambhampati (2003) consider firm level efficiency in six manufacturing sectors with results of overall efficiency in the post reform period and the factor of liberalisation leading to increase in efficiency in four of these sectors. Mitra (1999), using stochastic frontier analysis, found low levels of technical efficiency in most of the industry groups across states. Also during the sub periods he divided his data set into, there was a mixed picture with some industries facing a decline in technical efficiency with some others showing a rise. Mamgain (2000) finds that out of the eighty-two industries studied, only fourteen show increasing efficiency, majority showing no changes and twenty-two showing a decline. She goes on to conclude, "the striking result here is the lack of efficiency changes".

Parameswaran (2002) finds, using frontier analysis, that changes in the policies have a favourable impact on technical efficiency and this efficiency enhancement could be ~~as~~ a direct result of the access to technology imports. In the case of electrical machinery and electronics in the study, there is a significant impact of policy change on technical efficiency (on the basis of the dummy variable for 1991). Aggarwal (2001) checks the performance of public sector enterprises in India using parametric methods and finds that the technical efficiency levels have been quite low in these units and that the reforms have not brought about major changes in their performance.

Ray (2004) checks not only the trends in technical efficiency of selected industries but also the factors affecting efficiency. It is found that factors affecting the technological capabilities are quite significant in improving efficiency. However, import intensity (a factor which should have a positive influence on efficiency after reforms) shows an opposite trend indicating that "these reforms are only partially successful." Srivastava (2001) has estimated the technical efficiency of Indian manufacturing firms for the period 1980-81 to 1996- 97. He finds that mean technical efficiency has gone down in the 1990s (the period of liberalisation) compared to the 1980s.

Ray (1997) uses the non-parametric method of DEA to measure the Malmquist Productivity indices for manufacturing for the period 1969-84. Though an average decline at the rate of 2.89 per cent is shown, there is considerable regional variation. He has identified the factor leading to this decline in TFPG as 'regressive technical change'. Ray (2002) tries to examine the effect of economic reforms on efficiency and productivity. While measuring the productivity growth for the years 1985-86 through 1995-96, using the Tornqvist and Malmquist indices, he finds that the annual rate of productivity growth has been higher in the post-reform period than in the pre-reform period. He also finds that the average technical efficiency is declining for seven states; no improvements in TE for six states and an increase in TE for the remaining. The all India average showed improvements in technical efficiency.

Perhaps the only study, which deals with pure technical efficiency in the Indian context, is that of Coelli *et al.* (2000). They find a decline in pure technical efficiency (in the VRS model) in the cooperative diary plants over the time period till 1996-97, concluding that the deregulation and liberalisation are not the only answer to increases in technical efficiency. Since we find that not all studies are leading to the same conclusions, may be owing to difference in firm and industry level data or due to differences in methodology or else due to the time period differences, it would be worthwhile to see which direction the results of this study takes, using the relatively new non-parametric approach of DEA.

From the existing Indian literature on the country's manufacturing sector, we find that not many studies focus on the efficiency question as such. Moreover, no study analyses the impact of reforms on all industries across all states, for which secondary data exists. Though many studies have attempted to look at the reforms, it has often been done with selected industries and/or with firm level data. In order to examine an overview of the entire industry during the reform period and the reforms' impact, it is better to analyse a disaggregate view of the manufacturing sector rather than an aggregate level. Only Mitra has attempted an analysis at the disaggregate level (using stochastic frontier analysis). We take up this task of a most comprehensive analysis in Indian manufacturing, using the non-parametric method, the results of which are discussed in the following segment.

II.3. Estimation of PTE

The estimation of the model A given in this chapter and major findings on PTE are examined below. The pure technical efficiency values are obtained using the software DEAWIN and the results are based on the variable returns to scale model under an input minimisation framework (Table in Appendix II.1).

II.3.1. Overall Summary

To arrive at a conclusion about the variations in pure technical efficiency of 16 industries over the period 1976-77 to 1997-98, is cumbersome. So, an initial attempt is made to observe the variations across time through the industries and state-wise using the index number method. Due to the large set of values obtained, we cannot come to any striking conclusion; hence we select a few strategic time points to compress our estimates. Taking the starting point, year 1976-77 as the base year, we calculate the index numbers for each of the years 1985-86, 1991-92 and also the final year 1997-98. This is chosen on the basis of the initiation of reforms partially in 1985, and fully in 1991.

Given in Appendix[6] table AII.2 are the index numbers of pure technical efficiency (relative to the year 1976-77 as base year) for the two-digit industry at the disaggregate state level. The most summarised version of results at an aggregate level is that, for nine of the sixteen industries, the index numbers show an increase over time; five indicate declining behaviour

[6] Table AII.2 in the Appendix: Index numbers of the region and industry wise changes in pure technical efficiency through the time period 1976-77 to 1997-98.

whereas the rest show no changes. Since further extensive analysis is required, we check the statistical validity of these variations using trend analysis.

II.3.2. Trend Analysis

The objective is to analyse the trends in pure technical efficiency for which the results are obtained from 1979 onwards[7]. The framework for trend analysis is the simple regression model:

$$PTE_i = \alpha + \beta t + u_i$$

Where i: 1,2,.... 16 (industry at two digit classification.)

t: 1979-80 to 1997-98.

PTE: pure technical efficiency.

In the model specified, the value of beta (β) can take values positive, negative or zero. While positive values signify an increasing trend and negative, a declining trend, the value of beta equal to zero implies a case of no change. u_i is an unobservable variable known as the stochastic disturbance or the stochastic error term.

The trend equations are estimated for the sixteen industry classifications over the fifteen states considered in the analysis. The main findings are shown in table AII.3 in the Appendix[8]. It has been noted that there is a declining trend in the pure technical efficiency over time, spread over different industries and states. Only 32 of the entire 207 values[9] turn out to be significant, which forms around 15 percent. Hence one can assert that there has not been widespread changes in the pure technical efficiencies in Indian manufacturing over the period of analysis.

We summarise the industries and states that have witnessed significant changes in PTE in the table II.2 below. We find that about sixty percent of the significant change has occurred in the positive direction. Even when taking into account the real values[10] of the inputs and output, we find that the results do not vary much as sixty percent of the significant values still remain

[7] Though data is available from 1976 onwards only those values from 1979 is taken as data is missing for some years between 1976-79. Since regression analysis requires continuous set of data, the earlier years have been ignored.

[8] Table AII.3 in the Appendix: Trends in pure technical efficiency by state at the two-digit industry classification 1979-80 to 1997-98.

[9] There should have been 16*15= 240 trend values but due to missing data and unavailable data, only 207 values are eventually estimated.

[10] For the calculation of real values of the variables in question refer the appendix section 2.

in the positive direction. The significant trend values and the analysis of the pure technical efficiency are given below.

Table II.2: Significant Trend of pure technical efficiency by states and industry

STATES	NIC	
	Positive trends	Negative trends
Andhra Pradesh	27,30	
Assam		
Bihar	22,28,30	
Gujarat	28	
Haryana	24	32,34
Karnataka	26,28,35-36	
Kerala	28,35-36	34
Madhya Pradesh	29	22,26,38
Maharashtra		
Orissa	24	26,28,30
Punjab	31	37
Rajasthan		
Tamilnadu	26	37
Uttar Pradesh	38	
West Bengal	2,23	24,33

Source: See Appendix AII.3
Note: NIC: National Industrial Classification.

From the above table, we find that states like Assam, Maharashtra and Rajasthan have shown no trend in PTE. We also find that the manufacture of paper and paper products have witnessed more significant change than any other manufacturing industry, with four states showing positive trend and one negative trend. The other industries showing significant variation over time are the textile industry and the manufacture of beverages, tobacco and related products. Karnataka, Madhya Pradesh, Orissa and Bihar are the states witnessing significant changes with respect to different industries. These dispersed findings are in vogue with the parametric study of Mitra[11] (1998). But since some studies have reported changes in the positive direction with respect to firm level data (on overall technical efficiency), we have to check within each industry and by the reform periods.

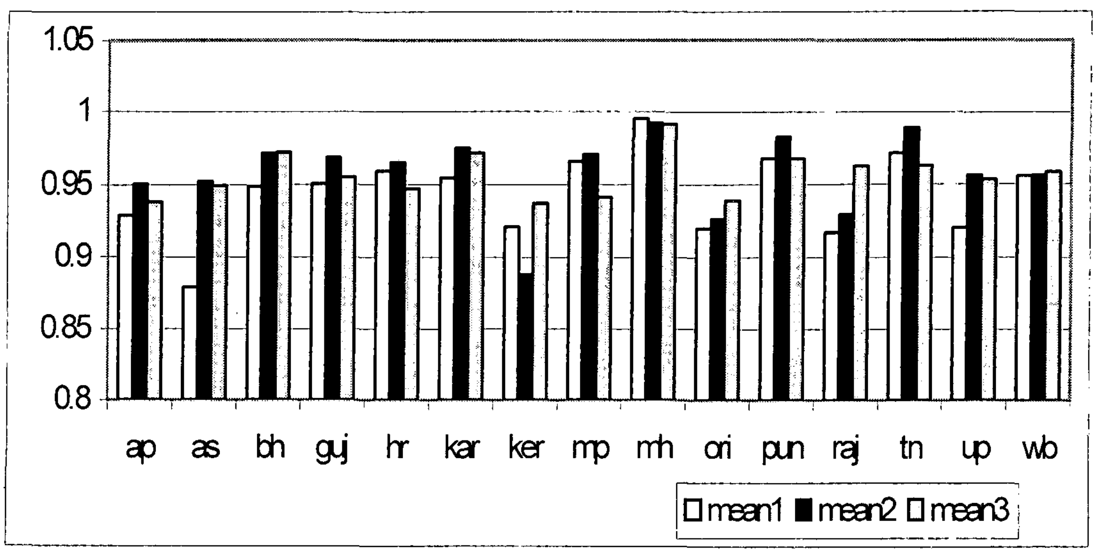
[11] Quoting Mitra's finding: "The difference between the average efficiency in the first and second sub-periods is not uniform across industries or across states. Corresponding to a particular industry while some of the states witnessed a decline in the level of technical efficiency some others recorded an increase. Similarly, for a given state, while some of the industries recorded a decline in the efficiency levels some others registered a decline".

II.3.3. Reforms and Pure Technical Efficiency

It is considered that with the reforms initiation, due to opening up of the economy, there would be increased competition and this would lead to technology diffusion and hence growth of the sector. But the review of literature shows no consensus among studies as shown in an earlier section. In this section, we attempt to evaluate the impact of reforms on the pure technical efficiency, at the state and industry level. For this, we take up the average performance of the PTE in different periods[12]. The period one is denoted as the pre reform period, from 1976-77 to 1985-86; the second period includes the years from 1986-87 to 1991-92, referred to as the quasi reform period[13]; the period 1992 onwards is referred to as post reform. This is the periodisation to be used in the following analysis.

When looking at the means of PTE across industries (figure II.3), we find that the state of Maharashtra is way above the rest in terms of the value of the mean. Though its mean is declining over time, the value still remains the highest. Many of the states, as can be seen from the graph, have an increasing trend in PTE, like for example, Orissa, Bihar and Rajasthan.

Figure II.3: Means of PTE of all industries by state and reform period



Source: DEA estimates in Appendix table AII.1.

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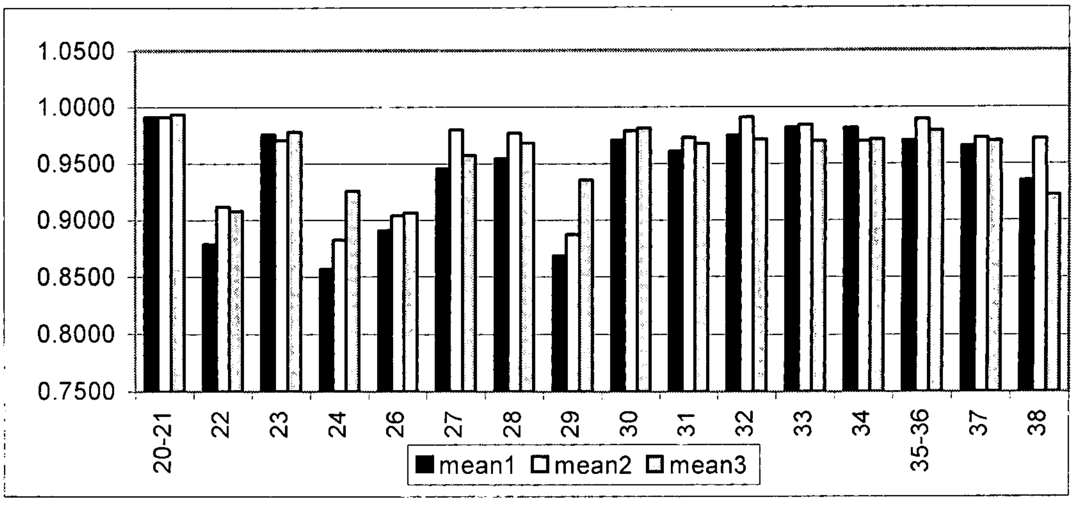
[12] Mean1 estimates the mean of the period from 1979-80 to 1985-86; mean2 refers to the mean between 1986-87 to 1991-92; mean3 values the mean from 1992 onwards.

[13] Since 1985 was considered the initial phase of industrial reforms and 1991 to be the start of first generation reforms, the period in between is classified as a 'quasi-reform' period.

An interesting insight can be made with respect to Kerala. Showing quite the lowest level of pure technical efficiency in the first period, it falls further in the second to increase in the third period. But even this increase takes it to a very low level of mean PTE when compared with the rest of the states. While Assam is the state with lowest PTE in the first period, Kerala usurps this position in the second and third period.

Figure II.4: Mean of PTE by industry and by the reform period, All India



Source: DEA estimates in Appendix table AII.1.

Estimating the means of PTE of industries at the all India level (figure II.4), we find that the manufacture of food products is showing a high and stable level of PTE during the reform period.. Manufacture of beverages, tobacco and related products (NIC 22), manufacture of wool, silk and man-made fibre textiles (NIC 24), manufacture of leather and leather products (NIC 29) and manufacture of textile products (NIC 26) show low levels of average PTE, steadily increasing over time, among the rest of the industries.

The statistical validity of the reforms is examined next. The test is to determine if the means of the periods (as defined earlier in this chapter) are significantly different or not. The null hypothesis is that there is no significant difference in the means of the two periods. The alternative hypothesis states otherwise that the difference is not equal to zero. The t values are reported in the following table II.3. Twelve of the seventeen industries show a decline in the mean values between the first and second period, of which two are statistically significant. In the case of the second and third period, meaning with respect to the quasi and full reform period, there are seven industries showing decline, while the rest 10 are showing improvements of which the statistically significant ones are showing improvements.

Table II.3: Significance of the mean, by industry and by reform periods

NIC	Mean 1&2	Mean 2&3	Mean 1&3
20-21 (Manufacture of food products)	0.092	-0.661	-0.569
22 (Manufacture of beverages, tobacco and related products)	-0.973	0.098	-0.670
23 (Manufacture of cotton textiles)	0.409	-0.605	-0.198
24 (Manufacture of wool, silk and man-made fibre textiles)	-0.253	-0.590	-0.856
26 (Manufacture of textile products)	-0.256	-0.058	-0.343
27 (Manufacture of wood and wood products)	**-2.821***	**2.050***	-0.812
28 (Manufacture of paper and paper products)	-1.770	0.641	-0.848
29 (Manufacture of leather and products of leather)	-0.257	-0.787	-1.241
30 (Manufacture of basic chemicals and chemical products)	-0.598	-0.196	-0.784
31 (Manufacture of rubber, plastic, petroleum and coal products)	-0.989	0.486	-0.495
32 (Manufacture of non-metallic mineral products)	-1.502	1.695	0.222
33 (Manufacture of basic metal and alloys industry)	-0.306	1.073	0.901
34 (Manufacture of metal and metal products)	1.356	-0.127	0.836
35-36 (Manufacture of machinery and equipment)	**-2.274***	1.256	-0.600
37 (Manufacture of transport equipment and parts)	-0.404	0.193	-0.240
38(Other manufacturing industries)	-1.804	**2.206***	0.449

Source: DEA estimates in Appendix Table AII.1.
Note: The t values are shown in the table with * indicating significance at the 5 percent level.

On the whole when we compare the pre-reform period to the 'fully reform initiated' period, we find that there are four industries which show the means to be different in the positive direction. They are the metal and metallic products and the other manufacturing industries, that is industries 32, 33, 34 and 38. From the table, we can see that of all the times, only four values have turned out to be significant out of 48 values in total which forms a mere 8 percent. This just means that there is not much difference in the means in different periods indicating that whatever change has taken place might have been a once for all change rather than a continuous one. The fact that the difference is insignificant in almost all cases leads one to argue that there has not been much impact on PTE on a continuous basis since the reforms.

From the table, we come across certain interesting insights. In the case of difference in means, in the second and third column of the table II.3 (mean 1&2 and mean 2&3), we find that the value turned positive in the case of many industries, though not statistically significant. But when we consider the difference in means between the first and third period, we find no result to be statistically significant. One important caveat to mention at this point is that since this is a measure at the aggregate levels, results could be different due to the method of aggregation. Also, since the non-parametric methodology is used, results could be sensitive to the use of this methodology too. So, an explanation as to why such a scenario occurs needs to be further researched. At this point, let us examine if there has been any systematic replicability of technology across states (diffusion of PTE).

II.3.4. PTE Diffusion - σ convergence

The next issue is to determine whether there is a convergence within each industry across the states and over time. For this, the method proposed by Barro and Sala-i-Martin (1995) is used. While the idea of unconditional convergence is examined in terms of both an alpha and beta convergence, only the former will be checked in this chapter. The method has been applied in the Indian context by Sachs *et. al.* (2000). The standard deviation across the regions of the logarithm of technical efficiency would give an indication of alpha convergence. There is said to be a σ-convergence if the standard deviation across states tends to decline over time. The second measure is β-convergence. Here we would have to regress the proportionate growth in technical efficiency on the logarithm of initial technical efficiency. There is a β-convergence if the coefficient on initial efficiency, denoted β, is negative and statistically significant.

The idea of σ-convergence within each industry through the time period shall be explored in the following paragraphs. The methodology used extensively in the growth literature is modified here with the use of PTE as the dependant variable. In this study, we are regressing the standard deviation of the technical efficiency on the independent variable of time. The resultant slope coefficient will determine the σ-convergence and hence some perception into how within an industry convergence has been taking place can be reported. The t ratios and the R- square values will give the fit of the model and hence its significance.

In theory, trade when liberalised would result in an increased effective market size or else "protection may facilitate collusion among domestic producers and induce them to collectively stick with backward technologies" (Rodrick, 1992). The question of protection reducing or inducing productivity growth varies with the kind of assumptions one invokes. So, the exact direction of movement of the variable in concern is quite country specific. It was seen in Ray (2002) that some states experienced a slowdown in productivity growth (Bihar, Chandigarh, Orissa and the Andaman and Nicobar) but overall a tendency towards convergence in productivity growth existed across the states. In his regression analysis for factors influencing levels of productivity, he finds that the levels of urbanisation and capital labour ratio have increased productivity growth.

So, when thinking along the lines of theory, to what extent the PTE, a component of technical efficiency, diffuses across the states is of concern here. There should logically be a convergence in technology with respect to the states, as the markets become more competitive with initiation of reforms. However, in the case of India, we do not exactly see such a trend. It can be seen from the table below that most of the results (13 out of 16 industries) turn out to be insignificant except for the three industries 24 (wool silk textile), 33 (basic metal) and 34 (metal products). This states that there is not much change in standard deviations, that is, there is almost constant movement in technical efficiency. The levels of technical efficiency have not been affected by policy changes to bring about any change in the movements among states.

Table II.4: Convergence of PTE by industry

Industry	Slope Coeffi	T-Value
20-21 (Manufacture of food products)	-0.0001	-0.18
22 (Manufacture of beverages, tobacco and related products)	0.0021	0.68
23 (Manufacture of cotton textiles)	0.0001	0.13
24 (Manufacture of wool, silk and man-made fibre textiles)	-0.0121	-3.72*
26 (Manufacture of textile products)	-0.0031	-1
27 (Manufacture of wood and wood products)	-0.0003	-0.16
28 (Manufacture of paper and paper products)	-0.0006	-0.79
29 (Manufacture of leather and products of leather)	-0.0056	-1.15
30 (Manufacture of basic chemicals and chemical products)	-0.0016	-1.84
31 (Manufacture of rubber, plastic, petroleum and coal products)	-0.0002	-0.12
32 (Manufacture of non-metallic mineral products)	0.0003	0.43
33 (Manufacture of basic metal and alloys industry	0.0023	3.74*
34 (Manufacture of metal and metal products)	0.0016	2.19*
35-36 (Manufacture of machinery and equipment)	-0.0010	-1.4
37 (Manufacture of transport equipment and parts)	-0.0013	-1.67
38(Other manufacturing industries)	0.0003	0.11

Source: DEA estimates in Appendix AII.1.
Note: * implies significant at 5% level of significance.

Hence, we can say that the more efficient states are still so, whereas the less efficient states have not made much effort in improving their position. In most of the cases, we find that the standard deviations among the states are declining; ten declining and six increasing. Though suggesting a declining difference between states with respect to pure technical efficiency, the results are not significant except for three industries, one for which it is declining and the other two with showing an increase.

Thus, it can be concluded that though there is a general converging trend among more industries, policy changes have not made much impact on the state-wise differences in technical efficiency as these changes are not statistically significant in most cases. This shows almost no diffusion of technology across the states with respect to a particular industry.

II.4. Summary and Conclusion

This chapter provides estimates of pure technical efficiency, using the linear programming version of the non-parametric approach of DEA. The results so obtained have been examined for its trends, impact on reforms and convergence patterns across regions and two-digit level industries for the period 1976-1998.

The major findings can be broadly classified as index number findings, trend analysis results, the impact of reforms' and the convergence inference. The results show no widespread change in pure technical efficiency at the state and two-digit industry level analysis. However, changes have occurred in some industries and states as stated below. The index numbers of PTE show a very fluctuating scenario with five industries showing a declining pattern, nine showing an increase and two with a constant pattern of change through time. So, trend analysis was resorted to for checking the statistical validity of the results. Of the significant results, we find a positive trend emerging maximum times in the case of Karnataka and in the manufacture of paper and paper products similarly. Madhya Pradesh and Orissa show significant negative trend.

When considering the impact of reforms on the PTE, we find that among the states, Maharashtra has maintained the highest value of mean PTE through all the time periods[14], though its value is coming down. Kerala, in sharp contrast, stands out as the state whose value of mean is the least, although with fluctuations. The manufacture of food products show a the highest mean value of PTE without variations through the time period while the manufacture of beverages, tobacco and related products, wool, silk and man-made fibre textiles, leather and leather products and textile products show relatively low levels of PTE with wide range of fluctuations. Theory postulates efficiency enhancement on moving from a controlled to a liberal regime through not a continuous change but as a once-for-all one. On testing the impact of reforms, we find that the theoretically held conclusion is valid, though selectively, as the result indicates a once-for all change as opposed to a continuous one in some cases.

Sigma convergence should have occurred across the states as a result of the opening up of the economy, enabled by diffusion. However, contrary to any significant σ-convergence after

[14] The periods include pre-reform 1976/77 to 1984/85, quasi-reform 1985/86 to 1990/91 and post reform period 1991/92 to 1997/98.

implementation of reforms, the standard deviation shows a declining trend for most industry groups. To what extend the duplicablity of PTE is possible is examined through sigma convergence. But, only few of the results are statistically significant to make any emphatic statements of low levels of duplicability. In the case of an economy where the market is operating, the cause of technology not being duplicated is thought provoking. Posing an interesting research question as to why there has been no convergence across states even in an open economy scenario, this can be taken up as an interesting option for operation of efficient institutions. Another credible reason could be the spatial and geographical variations across states, which act as a constraint to such diffusion.

Before concluding this chapter and proceeding to analyse the other component of TE (namely scale efficiency), one reservation needs to be accented. Since the non-parametric method has been used for estimation, the sensitivity of the results with respect to other methods of estimation requires verification. This gives scope for further research.

Chapter 3

SCALE EFFICIENCY: AN INTER-STATE AND INTER-INDUSTRY ANALYSIS

A major component of technical efficiency, as introduced in the earlier chapter, is scale efficiency. In this chapter we will be focusing on the measurement and impact of scale efficiency on the Indian manufacturing sector. Scale efficiency would be determined using Data Envelopment Analysis (DEA), as shown below, and it is estimated as the ratio of technical efficiency from Constant Returns to Scale (CRS) to the technical efficiency from Variable Returns to Scale (VRS) input orientation models of DEA.

The Indian government's interventionist policies are said to have created substantial unexhausted returns to scale and widespread technical inefficiencies. This was mainly owing to the policies, which favoured small sized firms, and also which restricted firms' choices of levels of production, product lines, capital stocks and imports of goods and technology (Fikkert and Hassan, 1998). So, due emphasis will be placed on the movements after reforms were undertaken in the economy, because it was expected to "usher in a more competitive environment, improve efficiency and hence growth" (Chaudhuri, 2002). With this increased openness of the economy, there would be increased competitiveness, which in turn could lead to greater market access and increased production possibilities. Hence an improvement in scale efficiency can be expected with the implementation of reforms. This hypothesis is taken up for detailed analysis in this chapter.

The objectives in this chapter can be broadly categorised into the following:

1. To analyse the trends in inter-state and inter-industry scale efficiency;
2. To examine and test the impact of economic reforms on scale efficiency; and
3. Convergence of scale efficiency across states and industries.

The chapter is divided into the following subsections. The first would deal with the theory and measurement of scale efficiency (SE). The second section would focus on the literature on scale efficiency in the Indian manufacturing sector. The next section deals with the empirical findings and links are made to the literature reviewed. The summary and conclusions, also raising some questions towards further research, form the closing part of this chapter.

III.1. Theory and Estimation of Scale Efficiency

The scale factor which is postulated to be a crucial component in the overall efficiency of an industry, is examined below using the DEA model. Two approaches can be used to estimate the scale efficiency values: (i) the neo-classical production (cost) approach followed by Fare et al.(1994) giving quantitative scale measures, and (ii) the axiomatic approach as followed by Shephard[1] (1953), this giving qualitative information on scale economies. The use of DEA as put forth by Charnes et al.[2] (1978) would give qualitative results whereas the method followed by Banker et al. (1994), Forsund (1995) gives both qualitative[3] and quantitative[4] information (Lothgren and Tambour, 1996). The DEA method for estimating scale efficiency is examined here.

III.1.1. Theory of Scale Efficiency

Regarding the theoretical aspect of scale efficiency, we follow the exposition provided by Thanassoulis (2001). A strength of the scale efficiency analysis done using the DEA methodology is that scale efficiencies can be found for both the efficient and inefficient DMUs.

According to Thanassoulis (2001), scale efficiency measures the impact of scale size on efficiency. It can be defined as:

Scale input efficiency of DMU j_0 (SE) = Technical input efficiency of DMU j_0 / Pure technical input efficiency of DMU j_0

Since the technical efficiency of a DMU cannot exceed the pure technical efficiency, the value of scale efficiency should always be less than or equal to one. If SE is equal to one, then the DMU is scale efficient, if less then it would be scale inefficient. Scale efficiency, thus measures the divergence between the efficiency rating of a particular DMU under CRS and

[1] The notion of radial distance from the production frontier was introduced by Shephard and used by him for the determination of the fundamental duality between production and cost functions. Its advantage is that it is measured independent of measurement units. The Shephard input (output) distance function is equal to the inverse of the input (output) oriented technical efficiency measure proposed by Farrell. Therefore they have a close relationship to the CCR DEA models.

[2] This is the non-parametric linear programming method, closely related to the axiomatic approach.

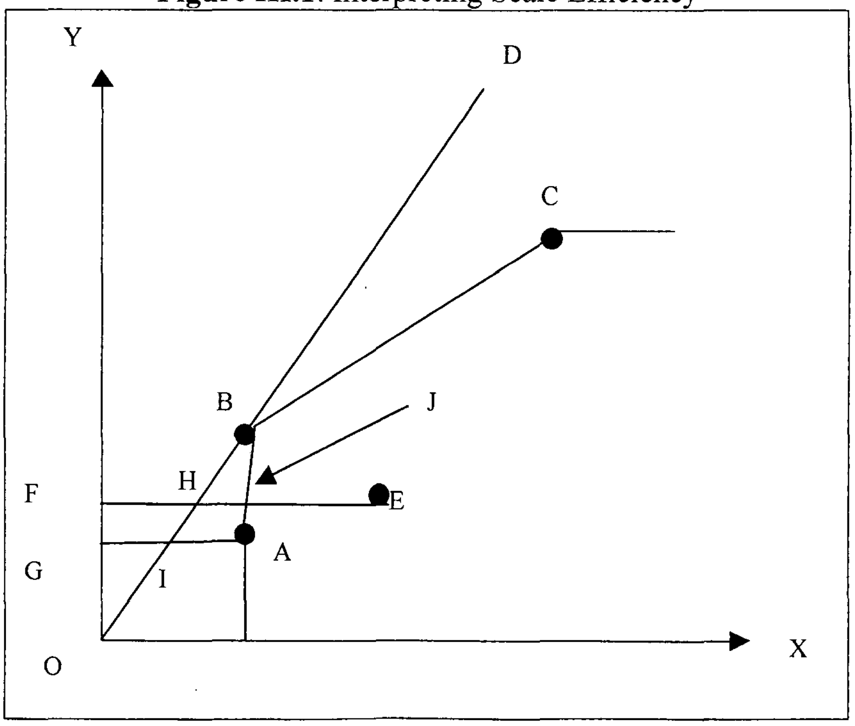
[3] The qualitative information refers to the DMU determined as to be operating in the increasing or decreasing returns to scale region or being scale efficient. The scale efficiency method was highlighted in Fare et al. (1994) whereas Banker (1984) introduced the sum of intensity variables method, further explored in Banker et. al. (1994).

[4] The quantitative scale efficiency measure is the hyperplane approach indicated in Banker et.al. (1984).

VRS respectively. The larger the divergence between VRS and CRS efficiency, the lower will be the value of scale efficiency and more the impact of scale size on productivity.

The figure III.1 below represents the case of using a single input for producing one output. So, the axes are represented by the input X on the x-axis and output Y on the y-axis. The straight line is representative of the constant returns to scale scenario. The variable returns to scale case is shown in the locus of efficient DMUs A, B and C and the PPS lies to the right and below that piece-wise linear boundary. To understand the concept of scale efficiency we need to consider an inefficient DMU say E which lies within the boundaries. The technical efficiency of that particular DMU under CRS would be FH / FE. But under the VRS scheme, the value of pure technical efficiency would be only FJ / FE. The difference between the two, due to the factor of scale efficiency can hence be valued as FH/FE divided by FJ/FE. So the scale efficiency of the DMU E = FH / FJ.

Figure III.1: Interpreting Scale Efficiency



Source: Thanassoulis (2001).

This distance between H and J (scale efficiency ratio is a measure of the distance between points H and J) is the saving of the input which the DMU E could have made if it operated at point H, using the same level of input as DMU B. This potential saving of the input is not realised by DMU E because of the scale at which it operates, since even if it had been efficient at its current scale size, it would have operated only at point J. If the value of CRS is less than that of VRS, then the impact of scale on the productivity of the DMU would be more adverse.

One shortcoming of this measure of scale efficiency is that the value does not indicate whether the DMU is operating in an area of increasing or decreasing returns to scale. If a DMU operates under either IRS or DRS, it would become more productive by increasing or decreasing its scale respectively. The scale size sees an increase in productivity till the point where returns to scale becomes constant. Such an increase would happen till an optimal scale size is reached, generally such scale size is addressed as 'most productive scale size' or MPSS. MPSS is defined to be the case where pure technical (VRS framework) and scale efficiency are equal to one. This above drawback is overcome in the next method as suggested in Coelli *et. al.* (1998) as explained in the immediate section below.

III.1.2. Scale Efficiency and Returns to Scale

Returns to scale affects average productivity through scale size and this is dependent on the Pareto-efficient boundary. If IRS holds at a production point, then raising its input levels by a small percentage will lead to an expansion of its output levels by an even larger percentage, assuming the unit remains Pareto-efficient. The percentage rise in output levels will be lower than that of the input levels if DRS holds true while inputs and outputs will change by the same percentage if CRS holds.

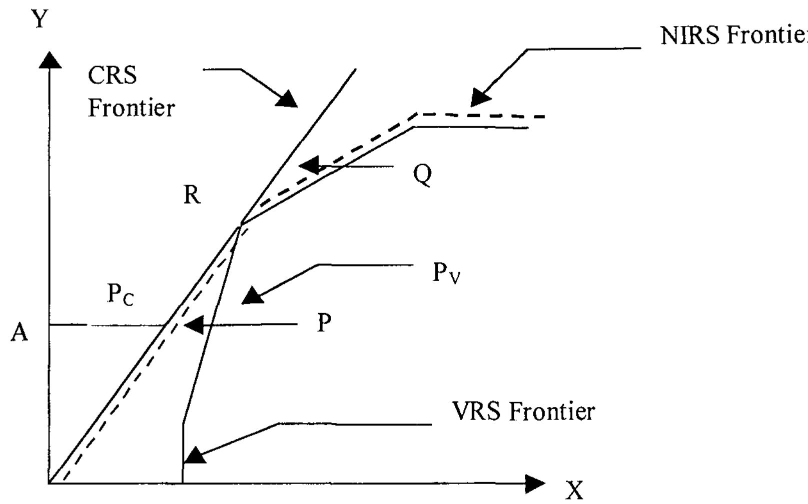
If the scale efficiency is less than one, the input-output mix is not scale efficient, and to determine in what region the DMU is operating, another ratio needs to be computed. This second ratio consists of the non-increasing returns to scale (NIRS) input-based efficiency measure and the equivalent CRS-measure.

Scale efficiency = Technical efficiency under CRS / Technical efficiency under NIRS.

This ratio indicates whether the scale-inefficiency is due to a too small output (IRS) or a too large output (DRS). Following, e.g., Fare *et al.* (1994), we infer increasing returns to scale when the ratio is equal to one and decreasing returns to scale when it is less than one.

Both the methods of estimation are diagrammatically represented in the given figure III.2. Here we again consider the one input one output scenario as earlier, but this time incorporating both the methods in the same diagram. This enables a clearer exposition as the type of returns holding at each part of the efficient boundary can be seen.

Figure III.2: Calculation of scale economies in DEA



Source: Coelli *et. al.* (1998).

Using CRS, the input oriented technical inefficiency of the point P is the distance PP_C. However under VRS, TE would be only PP_V. The difference between the two measures, P_CP_V, is due to scale efficiency. Hence scale efficiency measure can roughly be interpreted as the ratio of the average product of a firm operating at the point P_V to the average product of the point operating at a point of (technically) optimal scale (point R). The NIRS frontier is represented in the same figure as the dotted line. The nature of the scale inefficiencies, whether increasing or decreasing, can be determined by seeing whether the NIRS TE score is equal to the VRS TE score. If unequal (as in the case of point P), then we affirm the existence of increasing returns to scale for that firm. If they are equal, as is the case of point Q, then decreasing returns to scale apply.

This methodology of DEA, which has not been attempted in the Indian context with respect to scale efficiency, is taken up next.

III.1.3 The Model

To analyse scale efficiency, we need to estimate technical efficiency from two models-a CRS and VRS one. First the CRS model is used to find the value of overall technical efficiency. The next step is to estimate the pure technical efficiency under the VRS model. The scale efficiency is derived from the ratio of the former to the latter.

So, the first step is to estimate the technical efficiency under a CRS scheme. The model is as follows [CCR, 1978]:

$$\text{Min } k_0 - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} = k_0 x_{ij_0} - S_i^- \qquad i = 1\ldots\ldots\ldots m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} = S_r^+ + y_{rj_0} \qquad r = 1\ldots\ldots\ldots s$$

$$\lambda_j \geq 0, j = 1\ldots\ldots\ldots N, S_i^-, S_r^+ \geq 0 \forall i \; and \; r, k_0 \text{ free.}$$

ε is non-Archimedean infinitesimal.

Model A

The next step is to find the value of pure technical efficiency from the Variable Returns to Scale model.The VRS specification is used to determine the level of pure technical efficiency, with no impact of the scale efficiency. The model, as put forward by Banker et al. (1984), used to attain the value of pure technical efficiency is not very different from the usual method of finding the value of technical efficiency. An additional constraint of summation λ_j (j ranging from one to N) which equals one, known as the convexity constraint needs to be added on to the already talked of CCR model which is the constant returns to scale version of estimation of technical efficiency.

The formulation of a VRS model according to Banker *et. al.* (1984) is as follows:

$$\text{Min } k_0 - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij} = k_0 x_{ij_0} - S_i^- \qquad i = 1\ldots\ldots\ldots m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} = S_r^+ + y_{rj_0} \qquad r = 1\ldots\ldots\ldots s$$

$$\sum_{j=1}^{N} \lambda_j = 1$$

$$\lambda_j \geq 0, j = 1\ldots\ldots\ldots N, S_i^-, S_r^+ \geq 0 \forall i \; and \; r, k_0 \text{ free.}$$

ε is non-Archimedean infinitesimal.

Model B

The ratio of the values of technical efficiency estimated from the two models A and B gives the scale efficiency. But before embarking on a discussion of the estimates, we review the existing literature on scale efficiency in India.

III.2. Scale Efficiency: A Literature Review

A good summary of pre reform scenario through various micro level and aggregate level studies are given in Fikkert and Hassan (1998). Jha *et. al.* (1993) show significant economies of scale in the iron and steel, electricity and gas industries, with more prominent presence in the latter. However the cotton textile and cement industry show constant returns to scale. The largest firms seem to be working with constant returns to scale, according to Fikkert and Hassan (1998), and so, dismantling of the licensing regime may not have the effect it is supposed to have as the larger firms are already working under CRS.

In a similar panel study using a production function from 1986 to 1993, Krishna and Mitra (1998) show that there are increasing returns to scale in electronics, transport equipment and non-electrical industries; and that there was an "increased exploitation of the scale economies" after the economic liberalization. In a related study using selected industry level data with translog cost function, Jha *et. al.* (1993) shows that there exists biased technological change and economies of scale in two of the four industries analyzed for the initial economic reform periods.

Pattnayak and Thangavelu (2003) support the evidence that there are economies of scale (only moderately) in the Indian manufacturing industries and, that these were exploited after the key economic reforms in 1991. The selected industries in their study have experienced economies of scale (or marginal economies of scale) except in the manufacture of leather and leather products, which has experienced diseconomies of scale. Out of the thirteen industries, six industries have experienced reduction of returns to scale, which suggest the increase in the exploitation of the returns to scale after the key economic reforms of 1991. The rest of the six industries did not experience any decline in the economies of scale.

There was reduction of returns to scale effects after liberalization as reported in Krishna and Mitra (1999) for the selected Indian manufacturing industries- electrical machinery, non-electrical machinery and electronics and transport equipment. They suggest that the "increased exploitation of the returns to scale" might be due to the presence of inflexibility of the industries during the pre-liberalization periods of 1991. Srivastava (1996) finds existence of decreasing returns to scale in the aggregate level at the two-digit industry classification, the lowest value of scale parameter being 0.88 for industry 22 (beverages and tobacco) and the highest value for 23 (cotton textiles) to be 1.07. Mamgain (2000) finds that a null hypothesis of Constant Returns to Scale cannot be rejected for more than half the industries she studied. In the study by Balakrishnan *et al.* (2002) they find that of the six industries which show significant changes only four show improvements and of that only the industry basic metals show an increasing returns to scale. From these we find that the scale efficiency has never been examined in a detailed and comprehensive manner, what we have attempted using the DEA method, as discussed below.

III.3. Empirical Results

The analysis of the empirical results based on the non-parametric method of DEA has been subdivided into sub-sections of overall summary, trend analysis, impact of reforms on scale efficiency, dummy variable analysis and the convergence pattern.

III.3.1. Overall Summary

The index numbers of scale efficiency for the time period are considered and tabulated in Appendix table AIII.2 (Index numbers of scale efficiency by state and industry classification for selected years). The index numbers have been created with 1976-77 as the base year (unless otherwise specified) in order to understand in a broad way the direction and quantum of change with regard to the reforms. The index numbers have been distributed across industries taking into consideration each state.

In case of the industries taken, eight out of the seventeen industry groups show an increase in scale efficiency through the reform periods. But an almost equal number of industries have faced a decline in scale efficiency index numbers in the same time period. A detailed examination of this result is attempted in the following sections where first the trend analysis of scale efficiency will be looked at and second, a dummy variable technique will be used to check the scale efficiency variations across the different reform periods.

III.3.2. Trend Analysis of Scale Efficiency

In this section, we examine the trends, which have taken place in the manufacturing industry across states over the period of time. What we notice from Appendix table AIII.3 (Trends in scale efficiency by states at the two-digit industry classification 1979-80 to 1997-98) is that the scale efficiency values have been showing a declining trend though in the result only forty two out of the two twenty seven observations are statistically significant. This implies that the impact on scale efficiency has not been significant over time. It is seen that of the forty-two trend values, which show statistical significance, twenty-five (roughly sixty percent) show a positive trend. When repeating the same exercise using real values (the labour input uses the number of employees as opposed to the physical concept used earlier), we get a similar result. In this case, out of an observation of forty-five significant trend values, twenty-one turn out showing positive trends (almost fifty percent). This suggests a positive impact on scale efficiency in the particular industry-state combination.

Table III.1: Significant trend values of scale efficiency

STATES	NIC	
	Positive trends	Negative trends
Andhra Pradesh	30	31
Assam	23,24	
Bihar	23,29	27
Gujarat	20,37	22,24,27
Haryana	37	31,35-36
Karnataka	29	
Kerala		
Madhya Pradesh	29,30	33
Maharashtra	27	24,32,33,34
Orissa	24,30,32,34	29
Punjab	28	24,27
Rajasthan	30,37	24,31
Tamilnadu	32	
Uttar Pradesh	31,37	
West Bengal	20,30,37	

Source: Table AIII.3 in Appendix.

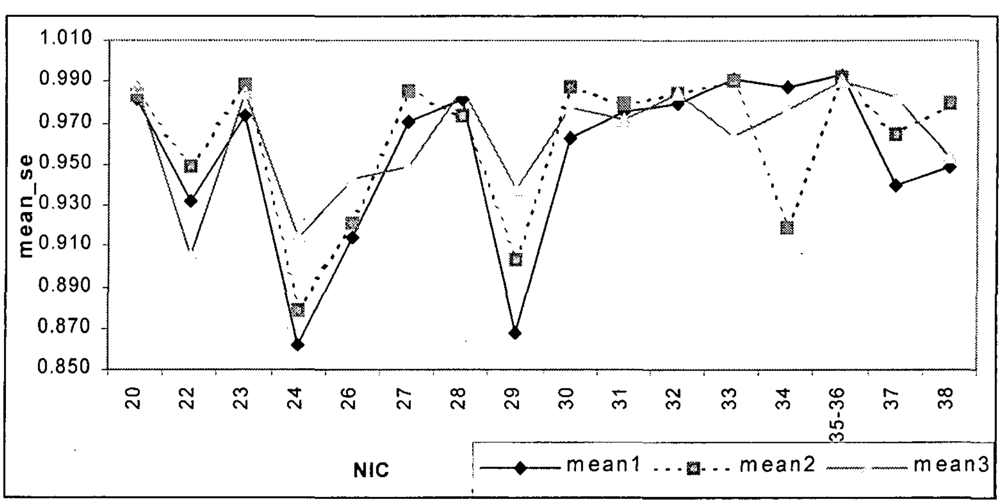
The above table III.1 considers only those cases where the trend values are significant. In all the industries the above are those where at least some impact has been felt in terms of scale efficiency change. We find that the state of Kerala shows no statistically significant change with respect to the scale efficiency implying no change in the entire time period for the state. Maharashtra and Orissa are the two states, which have witnessed maximum change in terms of scale efficiency over time. In the case of industries, the wool, silk and man-made fibre textiles seem to have felt significant changes in scale efficiency along with basic metals and manufacture of transport equipment and parts.

III.3.3. Reforms and Scale Efficiency

A further insight can be made with regard to scale efficiency by checking if the mean values of scale efficiency has undergone some change through the time period concerned. For simplified representation of the results, as also for a periodised classification in terms of reforms, three periods[5] are taken similar to the earlier chapter. The analysis has been clubbed into two major sections: one, the means across regions within a particular industry and two, the means across industry within a particular region.

From the figure III.3 below, we find that most of the industries are showing an increase in mean value after the reforms are being implemented if we consider the first and last period alone. However there are six industries – manufacture of beverages, tobacco and related products (NIC 22), manufacture of cotton textiles (NIC 23), manufacture of wood and wood products (NIC 27), manufacture of basic chemicals and chemical products (NIC 30), manufacture of rubber, plastic, petroleum and coal products (NIC 31) and other manufacturing industries (NIC 38) - which register a decline in scale efficiency in the post 1991 period which have seen an increase in the 1985-1990 period.

Figure III.3: Mean of scale efficiency by two digit industry and reform period

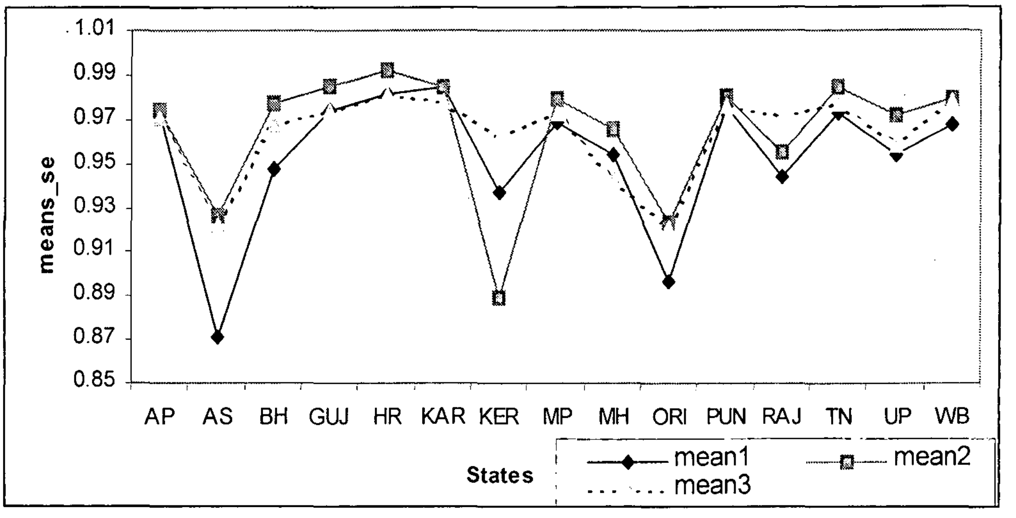


Source: Derived from the DEA estimates in Appendix table AIII.1.

[5] The first period denotes the pre reform era till 1984-85, the second the quasi reform time between 1985 and 1991 and the third after 1991.

The industries 22 (manufacture of beverages, tobacco and related products), 24 (manufacture of wool, silk and man-made fibre textiles) and industry 29 (manufacture of leather and leather products) are ones with relatively large deviations in the mean and standard deviation over the entire time range.

Figure III.4: Means of scale efficiency of all industries by states and reform period



Source: Derived from DEA estimates in Appendix table AIII.1.

From the above graph we find that considering just the tail periods, all the regions except three show an increase in mean value of scale efficiency. Andhra Pradesh, Karnataka and Maharashtra are the three states which show significant decline in scale efficiency when comparing just the pre and post reform period broadly. Of the 16 industries, 10 show a rise in scale efficiency soon after the initial implementation of reforms in the year 1985. But this pattern is not followed in all industries later as 12 of them show fall in scale efficiency after the year 1991.

When we observe the three period scenario, the variations are not much in the first and third period, with the second showing some difference. The variation is large when states like Kerala and Assam are considered; in states like Rajasthan and Orissa also this variation is observed, though not as large as the earlier. Assam and Orissa show low levels of mean scale efficiency values, even after the reforms are initiated. Kerala witnessed a sharp fall in SE in the quasi-reform period to bounce back in the next. Punjab remains on a stable value of mean SE through the entire time period.

III.3.4. Dummy Variable Analysis

Dummies have been taken for the years 1985-86 and also the year 1991-92 when the reforms were implemented, considering the former as the period of quasi reform and the latter as a period of total reforms.

First the scale efficiency values are taken from the ratio of the values of technical efficiency under the CRS and VRS model. Next, regression is done with the two dummy variables taken as the years 1985-86 and 1991-92 respectively for the years of reform against the scale efficiency values.

$$SE_{ij} = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2$$

Where D_1 = 1, years 1985/86-1990/91

= 0, otherwise

Where D_2 = 1, years 1991/92-1997/98

= 0, otherwise

Scale will be $(\alpha_0 + \alpha_1)$ when the time dummy for 1985/86 is taken and it will be denoted by $(\alpha_0 + \alpha_2)$ when the second time dummy is used. The constant term obtained would give us an indication of the returns to scale with the value greater than one implying an increasing returns to scale, equal to one implying constant returns to scale and less than one implying a decreasing returns to scale. The value of the slope coefficient can be used to identify whether the reforms have made an impact on the scale efficiency or not.

In both the tables III.2 and III.3, each dealing with a different dummy year, we find that comparatively fewer values are showing increasing returns to scale behaviour. On the whole we find more evidence of decreasing or even constant returns to scale confirming to some of the studies including Srivastava (1996). But again, as was found in the earlier section, here too the statistically significant values are few in number. So the following tables result only the significant results.

Table III.2: Significant state-industry values with 1985/86 as time dummy

STATES	NIC	
	Positive trends	Negative trends
Andhra Pradesh		32,35-36
Assam	23	
Bihar		
Gujarat	29,35-36,38	
Haryana	22	
Karnataka		
Kerala		
Madhya Pradesh		
Maharashtra		
Orissa	35-36	31
Punjab	29	
Rajasthan	22,26,28	
Tamilnadu	38	22
Uttar Pradesh	31,38	32
West Bengal	21	34,35-36

Source: Table AIII.4 in Appendix.

In table III.2, the dummy year is the first period of reform initiation (dummy year 1984-85). Here, we find that there are only twenty-one statistically significant estimates among the 224 derived estimates of scale efficiency, which is roughly about eight percent. But we find that only in some industries there have been statistically significant changes. They are mainly 22 (beverages and tobacco), 29 (manufacture of leather and products of leather), 31 (manufacture of rubber, plastic, petroleum and coal products), 32 (manufacture of non-metallic mineral products), 35-36 (manufacture of machinery and equipment) and 38 (other manufacturing industries). Among the states, we find Gujarat, Rajasthan, Uttar Pradesh and West Bengal to have witnessed some statistically significant changes in the scale parameter. With respect to the observations regarding returns to scale (of the statistically significant estimates) we find that twenty of them show decreasing returns to scale and only one shows signs of increasing returns to scale.

Similarly in table III.3, we find that nineteen out of the two twenty four estimates (about 8 percent) of scale efficiency with 1991 as dummy year show statistically significant results. Of these, most of the statistically significant results are concentrated in the industry 24 (manufacture of wool, silk and man-made fibre textiles), though mostly negative. Fifteen of the significant results show a decreasing returns to scale behaviour with the rest four showing values very close to one.

Table III.3: Significant trends of state-industry slope coefficients with 1991/92 as time dummy

STATES	NIC	
	Positive trends	Negative trends
Andhra Pradesh	24	35-36
Assam		
Bihar		
Gujarat		24
Haryana		24
Karnataka	21	
Kerala		30
Madhya Pradesh	23	24,35-36
Maharashtra	32	
Orissa	21	
Punjab		24
Rajasthan		24,31
Tamilnadu		24
Uttar Pradesh	21	24
West Bengal	24	29

Source: Table AIII.5. in Appendix.

Though these are the specific findings with respect to the dummy variable regression, to sum up we need to bring down the results to a more compact form. So, we can say that the broad finding with respect to the statistical significance of the results is that there is evidence of decreasing returns to scale in the Indian manufacturing industry as opposed to the increasing returns to scale, as expected under Kaldorian lines of growth[6]. Since the Indian industry is characterised by less-than-efficient scales of production (Srivastava, 1996) it should have been all the more likely that increasing returns to scale existed.

In this context, it is inevitable not to mention Tybout[7] (2000) where he talks of the problem of scale efficiency in a liberalised regime. He gives different scenarios and explains why the results need not necessarily be in the same direction in different countries, especially with respect to the differences owing to policy changes. At this point, it would be an interesting

[6] Kaldor's second law of growth (Kaldor, 1966) states that the manufacturing sector is subject to substantial increasing returns to scale. This law has been widely known as Verdoorn's Law: the growth of productivity in manufacturing is an endogenous result of the growth of output. The importance of this law is that we can confirm the manufacturing sector's use as an engine of growth and its basis for "cumulative causation models of growth" (Leon-Ledesma, 1998, Mamgain, 2000).

[7] In this paper Tybout is checking into the plausible impacts of protection in the less developed countries and finds contrary results to theoretical basis. The firms in these economies are heavily regulated and also are considered to be performing inefficiently as their scale economies go unexploited. Though he finds this to be not holding in the sample countries he took, two main findings were that protection was seen to increase the firms' price-cost margins and reduce average efficiency levels at the margin.

observation to check for any kind of convergence in terms of scale efficiency; this is analysed in the following section.

III.3.5. The Question of Convergence

When considering the movements of scale efficiency, it would be useful to know if there has been some changes in the impact of scale size on efficiency with the reforms, especially if there has been any convergence among the states. The methodology followed is the same as in the earlier chapter, of Barro and Sala-i-Martin (1995).

Here we are checking for sigma convergence which is defined as:

"a group of economies are converging in the sense of σ if the dispersion of their per capita GDP levels tend to decrease over time." [8]

By the above definition, if $\sigma_{t+T} > \sigma_t$, where σ_t is the time *t* standard deviation of log $(y_{i,t})$ across *i*. In this case, instead of taking the country's GDP per capita, we have used the same estimation procedure to check for convergence in scale efficiencies. We find that some regional variation existent during the pre-reform period has continued later on also.

Table III.4: The convergence or divergence of scale efficiency among states

Industry	Slope Coefficient	t- values
20	-0.0001	-0.4
22	0.0043	1.22
23	-0.0007	-1.04
24	-0.0125	**-3.87***
26	-0.0012	-0.29
27	0.0022	1.66
28	-0.0012	**-2.02***
29	-0.0065	-1.16
30	-0.0021	-1.9
31	0.0004	0.4
32	-0.0003	-0.38
33	0.0013	1.19
34	0.0009	1.57
35-36	0.0004	0.88
37	-0.0016	-1.08
38	-0.0016	-0.55

Source: DEA estimates in Appendix AIII.1.
Note: '*' implies statistical significance at 5% level of significance.

[8] Refer Barro and Sala-i-Martin (1995).

From the table III.4, we notice that in most of the cases (10 out of 16), the standard deviations are showing a declining trend; but, of these, only two are significant changes. Hence we cannot conclude that there has been a convergence among the states. At the most we can say that though the changes shown are declining in nature, since they are statistically insignificant, the policy reforms cannot be said to have a major impact on the scale efficiency.

The finding raises an interesting question why there has been no convergence in scale efficiency in spite of the market becoming more competitive and why the rigid markets are not integrating after the reforms. This area clearly requires further intensive research.

III.4. Summary and Conclusion

As in the earlier chapter, the trends in scale efficiency have also been analysed with estimates from the non-parametric method of DEA. The result of lower values of scale efficiency i.e. decreasing returns to scale with time does not support the manufacturing as an engine of growth, resulting from IRS, as hypothesised by Kaldor. Theoretically, increasing returns to scale was expected on the basis of Kaldor's laws.

Since the same number of industries show an increase and decline in scale efficiency over time, further analysis was required to know their pattern of change and statistical validity. For this, a trend analysis and impact of reforms using dummy variable regression was undertaken. Though a declining trend was seen in the economy as a whole over time, when considering only the statistically significant results, we arrive at more valid findings. While the states of Maharashtra and Orissa witnessed significant changes in SE, the same was visible in the manufacture of wool, silk and man-made fibre textiles (NIC 24).

While analysing the impact of reforms on SE, we find low levels of scale efficiency persisting in manufacture of wool, silk and man-made fibre textiles and manufacture of leather and leather products with manufacture of beverages, tobacco and related products showing a decline in the recent times. In the case of states, Punjab maintains a constant level of SE whereas Kerala witnesses sharp fall in level of SE in the second period. Assam and Orissa stay at low levels of SE through the entire period. The dummy variable technique was then undertaken with 1985-86 and 1991-92 as the two years of reform initiation. The states and industries, which show significant changes in SE, are different when considering the two time dummies. In the first case with 1985-86 as the dummy year, we find that industry 22 (beverages and tobacco) and 35-36 (manufacture of machinery and equipment) show significant changes as with Rajasthan and West Bengal. When taking the year 1991-92 as the dummy year, we find that industry 24 (manufacture of wool, silk and man-made fibre textiles) undergoes variations in scale efficiency as also the state of Madhya Pradesh.

A convergence across the states should have been witnessed given that the market was becoming more competitive owing to the opening up of the economy. But the results indicate almost no convergence at the all India level, though the two significant values indicate sigma convergence. The non-occurrence of such an event raises a question on geographical location of industries. From this chapter and the earlier, we see that not much changes have taken place in either the scale or pure technical efficiency figures after the reform implementation. The answer to the question of such impact on efficiency of reforms could lie in the third component of the overall efficiency which is the allocative efficiency.

The main objectives of this chapter are:

1. Analyse the sensitivity of Pareto-efficiency by industry and by regions;
2. Check for the impact of reforms on Pareto efficiency ranking;
3. Test the relationship between productivity and technical efficiency; and
4. Examine the sensitivity of technical efficiency to real and nominal values of the inputs and output using the case study method.

The chapter is broadly categorised according to the objectives stated above. In the next section, we specify the methodology used to find regional variations across industries and time. Initially we find the overall performance of states in the different industries and then explore their performance period-wise to check the impact of reforms. In the latter part of this chapter, the relation between productivity and technical efficiency is taken up by examining the Malmquist Index of Productivity change. The case study method is then used to check the sensitivity of the findings using the nominal and real values of inputs and output. The estimated results are then interpreted and the conclusion is presented with some further research questions.

IV.1. Pareto-Efficiency Ranking

This section will first look at the theory of peer state analysis, the model to be used and then discussion of the estimated results.

IV.1.1. Methodology

The ranking method has two steps as indicated by Thanassoulis (2001): (i) the identification of efficient states from among all the DMUs, after which, from among the efficient units, the best is taken as the peer state; and (ii) to identify the Pareto-inefficient DMUs and choose those DMUs whose practices the former can emulate.

Technical efficiency has been computed using the DEA model under Constant Returns to Scale method. The first step is the identification of DMUs as Pareto-efficient and Pareto-inefficient. From this, the capability of the efficient DMU to help other states in achieving efficiency is considered. This can be done by checking the frequency of the times any particular DMU comes up as a peer, whose performance others can emulate. Sometimes it may happen that more than one state turns out to be efficient for another to follow. In this case, to identify the best state that it can emulate, a method of targeting can be used. This is discussed in detail below.

There are certain input output levels which would ensure that the efficient DMU is on the efficient frontier. This is given by (Thanassoulis, 2001):

$$x_i^t = \sum_{j=1}^{N} \lambda_j^* x_{ij} = k_0^* x_{ij_0} - S_i^{-*} \qquad i = 1, \ldots\ldots\ldots m$$

$$y_r^t = \sum_{j=1}^{N} \lambda_j^* y_{rj} = S_r^{+*} + y_{rj_0} \qquad r = 1, \ldots\ldots\ldots s$$

These above defined levels, also called the targets of that particular DMU j_0, are the co-ordinates of the point on the efficient frontier which is used as a benchmark for evaluating DMU j_0. When the inefficient and efficient DMUs are hence got, using targeting the peer state analysis can be continued and the peer state is where the efficiency rating k_0^* of the DMU j_0 is the maximum of the ratios $\frac{x_i^t}{x_{ij_0}}$, $i = 1 \ldots\ldots\ldots m$..

An efficient DMU is highly ranked if chosen as a useful target by many other inefficient units. The number of citations they then get is considered to rank them with the one having maximum number being ranked the most efficient. So, what we strictly adhere to in this study is the method proposed by Thanassoulis (2001) of finding the efficient peer and targeting and that of Sinuany-Stern *et. al.* (1994) for ranking the results so obtained. The results hence obtained are discussed in the next section.

IV.1.2. The Peer and Least Efficient States: Overall Findings

In this section, the relative performance of the states is undertaken to examine the sensitivity of the results for the entire period (refer Appendix table AIV.1). One main observation is that not many states have been able to maintain their better position of being a peer state to the others. The states' overall efficiency ranking is reported in table IV.1.

Table IV.1: The best and least performing states, 1979/80-1997/98

Industry	Best State	Least State
20-21 (Manufacture of food products)	KER	UP
22 (Manufacture of beverages, tobacco and related products)	MP	MH,HAR
23 (Manufacture of cotton textiles)	KER	UP
24 (Manufacture of wool, silk and man-made fibre textiles)	PUN	HAR
26 (Manufacture of textile products)	RAJ	AP
27 (Manufacture of wood and wood products)	ORI	PUN
28 (Manufacture of paper and paper products)	ASSM	UP
29 (Manufacture of leather and products of leather)	MH	ASSM
30 (Manufacture of basic chemicals and chemical products)	KAR	ORI
31 (Manufacture of rubber, plastic, petroleum and coal products)	ASSM	KAR
32 (Manufacture of non-metallic mineral products)	ORI	UP
33 (Manufacture of basic metal and alloys industry	PUN, ASSM	TN
34 (Manufacture of metal and metal products)	ASSM	KER
35-36 (Manufacture of machinery and equipment)	TN	WB
37 (Manufacture of transport equipment and parts)	KAR	UP
38 (Other manufacturing industries)	BH, WB	ASSM

Source: Table AIV.1 in Appendix.

From the above table IV.1, we find that states considered to be the leading industrialising ones seem to be falling behind in levels of efficiency ranking. The surprises are Assam and Kerala. The case of Assam coming up as an efficient state requires further probing since it seems to be a puzzling result. It may be the case that the state is an outlier and methods of bootstrapping or other non-parametric testing need to be taken up for estimation of results. Karnataka and Rajasthan seem to be the states that are catching up with the industrialised states. We find that Uttar Pradesh is one of the least efficient states in industrial efficiency. It may be noted that for certain industries we find a tie between the ranking as in the case of industry 33 (best states) and industry 22 (worst states). This case however is not resolved and is reported as it is. Altogether, it is observed that the 'leading industrial states' seem to be fading away and some others seem to be catching up. From the overall ranking over the entire time period, we now move on to the periodised analysis to see the stability of the peer states through shifts in efficiency performance during the reform period.

IV.2. Reforms and Efficient Peers

The impact of reforms on the states' performance in technical efficiency are given in Table IV.2. We find that a state, which has lost out completely after the reforms is Punjab, whose frequency as the peer state in the textile industries (24 and 26), basic metals (33) and others (38) has come down drastically, sometimes becoming an inefficient one. The state which has turned out to be the leading in textiles is the state of Karnataka, which has moved from being a very small player to a very efficient one.

Starting with the food industry, Kerala maintains its position as the most frequently followed peer state. One point to be noted is that Kerala is a consumer state and known for its ethnic food culture. Hence a lot of specificity exists with respect to this state's food habits. This could be a plausible explanation for the trend observed, which needs further statistical testing. The state, which had a good hold in the pre reform period but lost out after the initiation of reforms, is Madhya Pradesh. In the case of the tobacco industry, it is seen that from being the best player, Madhya Pradesh seems to have been overtaken by Bihar and Tamilnadu. The other states, excluding Kerala, are very small players in the game and hence cannot be considered significant.

Table IV.2: Best and least performing states by industry and by reform periodisation

Industry	Period 1		Period 2		Period 3	
	Best	Least	Best	Least	Best	Least
20-21 (Manufacture of food products)	KER	GUJ	KER	GUJ,UP	KER	BH
22 (Manufacture of beverages, tobacco and related products)	MP	AP	MP	AP	BH	AP
23 (Manufacture of cotton textiles)	KER	AP	MH	AP,GUJ, HAR	KAR	GUJ
24 (Manufacture of wool, silk and man-made fibre textiles)	PUN	ORI	MH	HAR,KER, WB	KAR	ASSM, UP
26 (Manufacture of textile products)	PUN	AP	RAJ	AP	RAJ	KER
27 (Manufacture of wood and wood products)	ORI	PUN	TN	RAJ	ASSM, ORI	GUJ
28 (Manufacture of paper and paper products)	MH	PUN	TN	AP,WB	ASSM	WB
29 (Manufacture of leather and products of leather)	HAR	KER, MP,RAJ	MH	ASSM,BH, PUN,UP	MH	GUJ, ORI
30 (Manufacture of basic chemicals and chemical products)	KAR	MP,WB	MH	KER,WB	RAJ	HAR
31 (Manufacture of rubber, plastic, petroleum and coal products)	ASSM	PUN	ASSM	TN	GUJ	MH
32 (Manufacture of non-metallic mineral products)	KER	ORI	ORI	AP,UP	TN	RAJ
33 (Manufacture of basic metal and alloys industry)	PUN	RAJ	KER	GUJ,RAJ, WB	ASSM, BH	WB
34 (Manufacture of metal and metal products)	HAR	BH	ASSM	MH,WB	ASSM, KAR	BH
35-36 (Manufacture of machinery and equipment)	HAR	KER,ORI, RAJ	TN	UP	TN	PUN
37 (Manufacture of transport equipment and parts)	KAR	HAR,WB	KER	GUJ	HAR	WB
38 (Other manufacturing industries)	PUN	TN	GUJ	ASSM,RAJ	BH	UP,MP, ASSM

Source: DEA results in Table AIV.2 in the Appendix.

The textile industry, if considered as a combination of 23, 24 and 26, we can see that they were dominated pre-reform by Kerala and Punjab and the reforms saw Karnataka and Rajasthan taking over as efficient, maintaining it since the quasi-reform period. In industry 27, of wood and wood products, Orissa was the leading player before the reforms were initiated after which Orissa was joined by Assam as an equally technically efficient state.

In paper and paper products industry, Maharashtra lost out to Assam during the reform process. While Haryana was the most efficient pre-reform, we see the state of Rajasthan displacing it during the quasi-reform period and maintaining its hold during the post reform period also in the case of leather and leather products manufacture (Industry 29). The chemical industry (30) saw the state of Karnataka as the topmost player pre-reform, losing out to Rajasthan by the end of the time period taken. Madhya Pradesh and Maharashtra are seen to be fast catching up.

In the case of industry 31, Assam was the leading player pre-reform and it lost out heavily to Gujarat which has become more efficient in the post reform period. We also find the state of Kerala to be not far behind with respect to this industry in the post reform era. Kerala, leading the non-metallic industry pre-reform is facing stiff competition from Tamilnadu, which is emerging as the topmost player post reform. The case of industry 33, where Punjab has been replaced by the state of Assam (followed very closely by Bihar) in the production of basic metals only reaffirm the losing nature of Punjab as a leading industrial state. Assam and Karnataka seem to have forged ahead of Haryana in the case of metal products manufacturing (34), being followed closely by Madhya Pradesh and Gujurat.

While Haryana was a strong player in the production of machinery and equipment, followed closely by Tamilnadu from the pre-reform time, the post reform period saw the former losing out to the latter. In the case of industry 37, transport and equipment, Karnataka lost out in a big way in terms of its share, to Haryana, which caught up very fast in the post reform period. The residual industry, 38, with the leading state Punjab in the pre reform period is totally wiped off from its position by Bihar. The reasons for these dramatic shifts in efficiency patterns need separate analysis.

Now that the regional variations across industry group and state are obtained, we move on to analyse the issue of productivity, which has been the most commonly studied aspect of Indian manufacturing. Since there is a causal relationship from efficiency to productivity, it would be interesting to test the validity of this relationship. This aspect is attempted only by the case study method. The details are examined below.

IV.3. Malmquist Index of Productivity Change

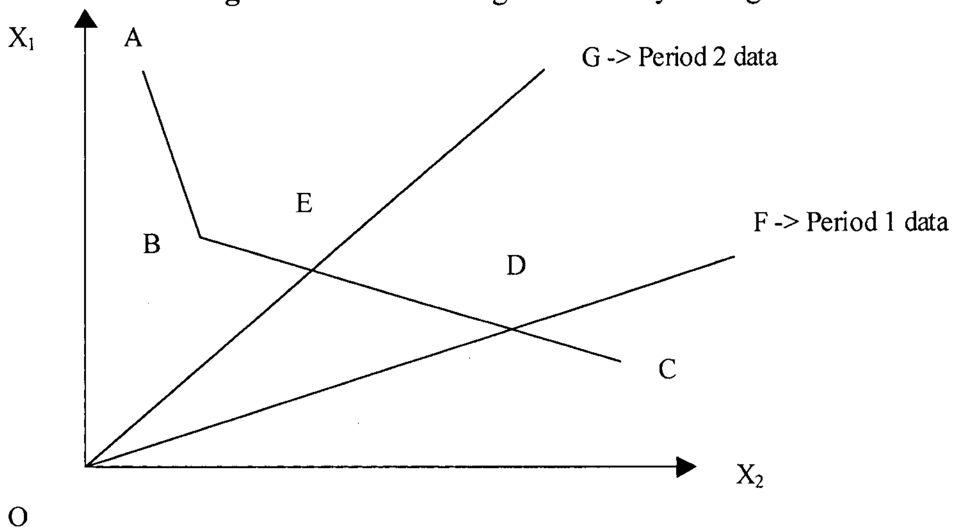
From the above analysis, we find a lot of variations in the states' efficiency movements within an industry. A question can then be raised as to whether the production frontier has shifted causing these changes other than the already discussed movements along the frontier. The aim is hence to analyse the shifts along, and in the production frontier among the different industrial classifications. From the two tables given above, we can get the best performing and worst performing states for each industry. Using these two details, what needs to be done is account for the shifts in the production frontiers. The method of analysis would be the Malmquist Index of productivity change. Fare et al. (1989, 1994) used DEA to compute the index and they decomposed the efficiency change component in the index to include both the technical and scale efficiencies. The Malmquist index is found under the constant returns to scale irrespective of the actual returns to scale.

IV.3.1. Graphical interpretation

To understand the impact of Malmquist Index of productivity change we need to contrast two situations- one where a boundary shift is not considered and one where a boundary shift is considered. In figure IV.1, the axes are the inputs used in production while the production frontier is the same in time periods, one and two. The productivity change of the DMU is measured by the ratio of its efficiency measures in different periods.

From the figure we can estimate the technical input efficiency of DMU F as (OD / OF) in the first period and (OE / OG) in the second. This ratio is less than one (as can be seen from the figure) and we can come to the conclusion that the productivity of the particular DMU is lower in second period than in the first. Since the boundary itself has not moved, the company is in the latter period, further away from the efficient boundary.

Figure IV.1: Measuring Productivity Change



Source: Thanassoulis (2001).

But this scenario of no shift in the boundary itself does not seem too realistic. So from the next graphical representation, we shall find the productivity change when the efficient boundary moves over time. The difference in this measure from the earlier version is that in this case we compute the ratios (as in the former case) relative to both the boundaries. The geometric mean of these two ratios is the measure of productivity change of the company.

The productivity change of the DMU operating at Fin the first period and at G in the second is:

$$\{[\frac{OE}{OG} \div \frac{OD}{OF}] \times [\frac{OI}{OG} \div \frac{OH}{OF}]\}^{0.5}$$

This geometric mean is the DMU's Malmquist index of productivity change between the two periods. This can be decomposed further into knowing the catch-up component and the boundary shift components.

$$\{[\frac{OE}{OG} \div \frac{OD}{OF}] \times [\frac{OI}{OG} \div \frac{OH}{OF}]\}^{0.5} = [\frac{OI}{OG} \div \frac{OD}{OF}] \times [\frac{OE}{OI} \div \frac{OD}{OH}]^{0.5}$$

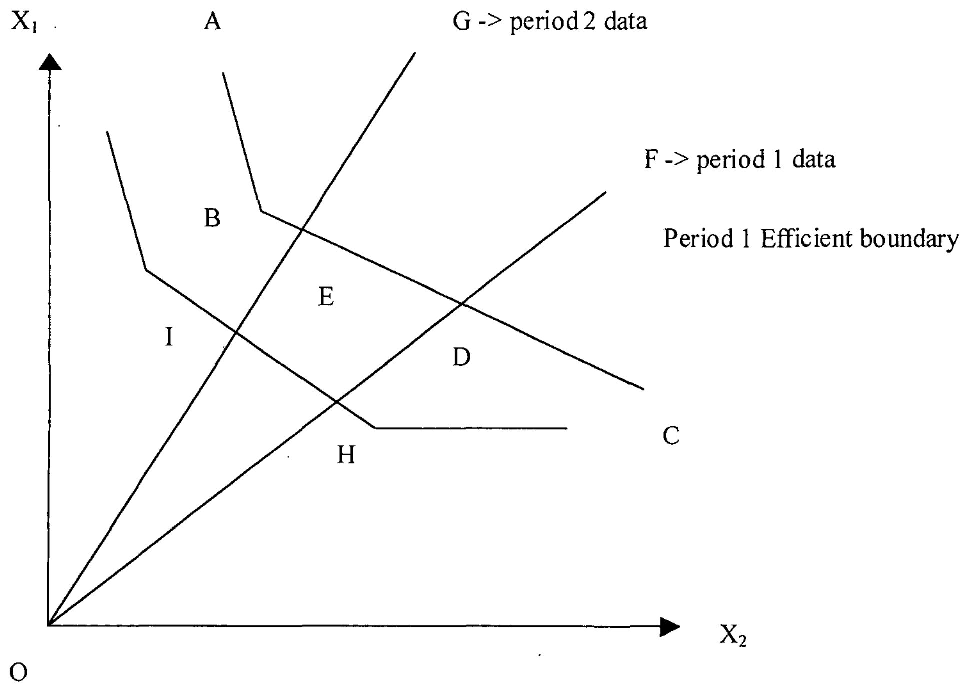
Malmquist index of productivity change — 'Catch-up' component — 'Boundary shift' component

The catch-up term measures how close to the boundary the DMU is in the second period as opposed to the first. This is represented by a ratio of the distance (OI / OG) of the DMU in the second period and distance from the efficient boundary in period 1, (OD / OF). If this term is

1, then the company has the same distance in the two periods from their respective efficient boundaries.

The boundary shift term measures the shift in the boundaries between the two periods. The ratio (OE / OI) measures the distance of the two boundaries at the input mix of the DMU in the second period. The ratio (OD / OH) measures the distance between the two boundaries at the input mix of the same DMU in the first period. The geometric mean of the two distances represents the value of boundary shift.

Figure IV.2: Measuring Productivity Change Across Time Periods



Source: Thanassoulis (2001).

IV.3.2. The Model

If for example, the boundary shift term is over one (like in the case seen in the above figure) we can conclude that there are productivity gains for that particular DMU. This means that given a controlled output level, less of the inputs need be used by the DMU in the second period as opposed to the first. Conversely, a boundary shift term under one implies that the unit is showing productivity loss as input levels would on average be higher in the second period as against the first, given that the output is controlled.

The above graphical framework can be done using the non-parametric method of DEA. In this model, assume DMUs (j = 1.... N) operating in two periods t and t+1, the jth one using in period t inputs x_{ij}^t (i = 1...m) to secure outputs y_{rj}^t (r = 1...s). The Malmquist index of DMU j_0 can be written as:

$$MI_{j_0} = \left[\frac{C\_EF_{T_t}^{D_{t+1}} C\_EF_{T_{t+1}}^{D_{t+1}}}{C\_EF_{T_t}^{D_t} C\_EF_{T_{t+1}}^{D_t}} \right]^{1/2}$$

The method used and the input orientation can be is given as follows:

$$\text{Min } k_0$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij}^t - k_0 x^t_{ij_0} \leq 0, i = 1....m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj_0}^t \geq y_{rj_0}^t, r = 1....s$$

$$\lambda_j \geq 0, j = 1....N \geq 0, k_0 free.$$

This model represents the initial graphical exposition where the boundary shift was not considered. Thus the radial technical input efficiency $C\_EF_{Tt}^{Dt}$ of DMU j_0 is $C\_EF_{Tt}^{Dt} = k_0^*$, where k_0^* is the optimal value of k_0 from the above model's solution. However the second case, where we had considered the boundary shifting, needs to be represented in a different way:

$$\text{Min } q_0$$

Subject to:

$$\sum_{j=1}^{N} \lambda_j x_{ij}^t - q_0 x^{t+1}_{ij_0} \leq 0, i = 1....m$$

$$\sum_{j=1}^{N} \lambda_j y_{rj}^t \geq y_{rj}^{t+1}, r = 1....s$$

$$\lambda_j \geq 0, j = 1....N \geq 0, q_0 free.$$

This model gives the cross-time period radial technical input efficiency $C\_EF_{Tt}^{Dt+1}$ of DMU j_0 so that $C\_EF_{Tt}^{Dt+1} = q_0^*$ where q_0^* is the optimal value of q_0 in the above model. The same model can be applied for finding the value of $C\_EF_{Tt+1}^{Dt}$ of DMU j_0. Here also the index can be split up into the two components of catch-up and boundary shift. In the next section, we will discuss the results obtained using this model.

IV.3.3. Productivity Changes in the Indian Industry

Using the results derived of the best and least performing states' cases (in the last section IV.2), we need to examine the performance of one DMU and analyse its behaviour over time by checking for boundary shifts and the catch up component to get the overall Malmquist index of productivity change. The states of Karnataka and Uttar Pradesh have been selected as case studies. Karnataka is used as it turns out to be a best performing state, never becoming a worse-off state; Uttar Pradesh is the one state which is a worse off state always and never a best performing one. So, using the estimates of these two states, we have calculated the Malmquist index of productivity change and the boundary shift.

We consider the estimation of productivity shifts between the time points of 1976, 1985, 1991 and 1997 as the start of data available, first reform period, second set of reforms and the last year of data available under the earlier classification. MI (1,2) refers to the difference in productivity of a particular state and industry between the years of 1976 and 1985. Similarly MI (2,3) and MI (3,4) refer to productivity difference between levels of technical efficiency in 1985 and 1991 and 1991 and 1997 respectively. The results of the change are given below.

(i) Productivity Changes: Karnataka and Uttar Pradesh

Table IV.3: Productivity change for the states of Karnataka and Uttar Pradesh

	MI(2,1)	**MI(3,2)**	**MI(4,3)**
KAR	0.8467	1.4888	0.6301
UP	1.0587	1.3272	0.779

Source: DEA estimates in Appendix Table AIV.3.

Consider the value of MI (3,2) for KAR in the table IV.3-the value of productivity change index is 1.489. This means that Karnataka has witnessed a productivity improvement of the order of forty nine percent, meaning that the input levels of this particular DMU would be higher in year 2 as compared to year 3 while controlling for the output levels. Hence we find that in the case of both Karnataka and Uttar Pradesh, the index has shown an increasing trend between the early 80s to early 90s and declined thereafter. However, what needs to be verified is the overall trend and if this is sensitive to estimation when the real values are used. So, in the following section, we estimate the real values and after that proceed to a comparison of the real and nominal values in the context of Malmquist Index of productivity change.

(ii) Estimation of Real Values

To bring the current series into constant series, we deflate each of the inputs and output. One data limitation exists to this estimation: since we are taking a regional comparison, it would have been apt to deflate using state-wise data. But other than for labour, only the all India level estimates are available; so they have been made use of in this study. The value of output is deflated by the Wholesale Price Index of all manufactured products. The price index corresponding to the years 1979-80 to 1997-98 have been converted to base year 1993-94 through splicing. In this case we have taken the WPI of manufactured products as opposed to different deflators for deflating the output of different industries.

The input of fixed capital, a proxy for capital, has been deflated by the WPI of machinery and machine tools including electrical machinery. This series has been calculated at a monthly index with base year 1993-94. The data for this is not available before 1980-81. So, following Mitra (1999), the WPI for primary articles has been used for this period. In the case of total emoluments, the total number of employees is taken to represent them. The input of fuels used has been deflated by the wholesale price index for fuel power light and lubricants, with base year 1993-94. The input series on materials used has been deflated by the industrial raw materials price index. The price index of raw materials is defined as the weighted average of the wholesale price index of food products, non-food crops, minerals, and fuel and power. The base year has been taken as 1973-74 for this. The current values are then divided by the deflators to obtain the constant price series.

(iii) Nominal v/s. Real Values of Technical Efficiency: A Sensitivity Analysis

For checking the sensitivity of results we examine the same data using different sets of deflators. First we run the method of DEA on the original data set, without using any deflator. While doing so, we obtain the result that there has been a significant change in productivity, a loss, between the third and fourth period – that is, in the post reform period. The same result seems to hold when we consider the other method where we deflate all the inputs and output by their respective deflators. Hence the trend in general remains the same with just the level of variations being quite different. The variations are quite prominent when we consider the values after deflating both the inputs and output by its deflators.

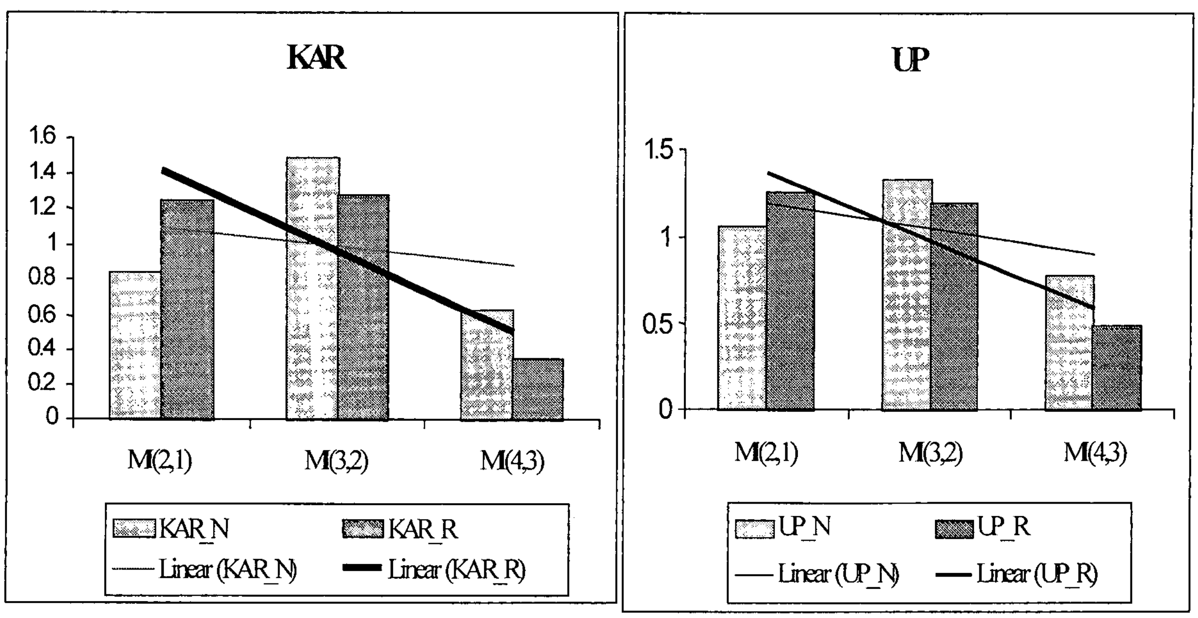
Table IV.4: Productivity change for the states of Karnataka and Uttar Pradesh: A comparison of the real and nominal values

	MI(2,1)	MI(3,2)	MI(4,3)
KAR_N	0.8467	1.4888	0.6301
KAR_R	1.249	1.285	0.338
UP_N	1.0587	1.3272	0.779
UP_R	1.261	1.189	0.481

Source: DEA estimates of in Appendix table AIV.3.

In the above table IV.4, KAR_N is the original data set being handled and KAR_R refers to all the inputs and output deflated by their respective deflators. The results given in Table IV.4 can be further explained in the following manner. While using either the real or nominal values, we find the same pattern to be emerging with regard to productivity change. Hence we find that there has been a productivity decline between the third and fourth time point concerned, whichever be the method used - with or without deflation. We also find that there has been a decline in the Malmquist Index values through time, by the trendline plotted in the figure IV.3.

Figure IV.3: The Malmquist Indices for Karnataka and Uttar Pradesh



Source: Table IV.3.

We hence conclude that the changes have taken place in the similar direction, be it using the deflated data set or the original.

Table IV.5: The catch-up component of the Malmquist Index

	CU(2,1)	CU(3,2)	CU(4,3)
KAR_N	0.858461	1.164854	1
KAR_R	1	1	0.739606
UP_N	0.99802	1.002039	1
UP_R	1	1	0.858315

Source: DEA estimates of in Appendix table AIV.3.

From the above Table IV.5, we find the catch-up component for the state of Uttar Pradesh to be just around one most of the time, meaning that the DMU has maintained virtually a constant distance in the two years from the respective efficient boundaries. Hence whatever productivity loss the state has faced is most likely to be due to the boundary shifts inward, signifying technological regress[2] during the period. One plausible explanation of technical regress could be the non-compliance of the assumption of free disposability of inputs. Often due to lack of demand, the optimal efficient levels of output are not produced; then the existent supply of inputs cannot be diverted into other useful purpose due to lack of institutions for such tasks. This could be a possible explanation for such a technological regress which is beyond the scope of the present study.

IV.4. Summary and Conclusion

Studies in the arena of Indian manufacturing industry have dealt in detail about the issue of productivity with relatively less emphasis on the concept of efficiency analysis. This chapter focuses on checking for the sensitivity of results already obtained. One well established method of benchmarking as modified by Thanassoulis (2001) has been used in this chapter. A byproduct of this estimation is the ranking of Indian states according to their overall technical efficiency. Since efficiency is only one component in any analysis of productivity, we take up the issue of showing the close association between the two by taking up two case studies. While examining productivity, we consider both the nominal and real values of the input and output to determine if the results are sensitive to such change.

From the analysis in the overall summary, we find that while some of the 'leading industrialised states' appear to be technically not so efficient (in relative comparison), there

[2] This finding is consistent with the results obtained by Ray (2002).

are some states like Karnataka and Rajasthan, which are coming up as upcoming industrialised states. We also find that changes have occurred during the reform period with some efficient states being displaced and others not. One striking result from the analysis is the way Kerala has maintained its stronghold in the manufacture of food and food products. Similarly we find that in the case of textiles, Karnataka is coming up to be a technically efficient state. Attempts can be made to study the underlying factors leading to the development of such a pattern in the states.

As to the analysis results of productivity change, since only a partial analysis has been conducted with two states Karnataka and Uttar Pradesh, not much can be voiced about the entire economy. Many studies have however pointed out to a decline in productivity in the 90s, so much so that there is a consensus about this period unlike the 80s. We have attempted to estimate the Malmquist Index using both real and nominal values, resulting in similar trends. The productivity shows a decline in the nineties and the Malmquist index is declining over time for both the states. When split into the catch up and boundary shift components, we find almost constant catch up levels with varying boundary shifts, mostly declining which leads to the overall fall in the Malmquist Index.

Another direction of study that can be attempted from this point would be to determine the factors which could lead to such disparity. Many studies do refer to the level of infrastructure as being a major determinant of industrial growth. What needs to be probed more is whether some additional factors like institutions exist which help in tiding over these variations.

Chapter 5

A SUMMING UP

The manufacturing sector in India witnessed major revamping in terms of policy changes it underwent mid 80s onward. These changes were intended to infuse competition and alter the industrial structure by focussing mainly on the removal of the commands and controls as well as opening up the manufacturing sector to more external as well as internal competition. This was done in anticipation of a positive response from the sector, which would enable a turnaround in terms of performance, hence leading the economy to a higher growth path through a growing industrial sector. This study attempts to focus on one aspect through which this higher growth path can be considered feasible - efficiency. Often focussing on productivity, most studies in Indian industry have ignored technical efficiency, an important component of productivity. In this study, while dealing with the technical efficiency as part of productive efficiency, emphasis has also been on the pure technical efficiency (PTE) and scale efficiency (SE) components.

Studies in this sector are usually attempted using the growth accounting method, the least-squares econometric production methods, stochastic frontiers, using either parametric or non-parametric methods. The study is the first comprehensive analysis of the Indian industries using the non-parametric method of Data Envelopment Analysis. It is done using the ASI data set for the time period 1976-1998 takes fixed capital, total employees, materials used, fuels used and value of output as the variables to be used. This method, based on the input orientation approach, explores the efficiency use of the inputs to achieve the maximum level of output. The study focuses on both the Constant and Variable Returns to Scale assumptions in order to account for the scale efficiency factor, which could lead to difference in estimates of technical efficiency. The core chapters of analysis pertain to the pure technical efficiency and scale efficiency across state and industry levels. The state-wise variations in overall technical efficiency under reforms are also examined here. Since efficiency is a major component in determining productivity, the productivity digression over time of two states- the best and least efficient, were also dealt with.

With respect to the pure technical efficiency analysis, the finding is that the reforms have not led to widespread changes of PTE, quite contrary to belief that reduced protection (with the introduction of the New Industrial Policy) would increase technical efficiency due to greater competition from foreign countries. The index numbers of PTE show five industries with a declining pattern, nine showing increase and two with a constant pattern over the period of analysis. The statistical significance of the trend analysis indicate that the states and industries which stand out significant maximum times are Karnataka and the manufacture of paper and paper products. Maharashtra exhibits high mean values whereas Kerala paints a dismal picture in the same. But when analysing the impact of reforms on PTE, the finding is a once-for-all change as opposed to a continuous one, in consonance with theoretical findings.

Scale efficiency, calculated using the non-parametric approach, is the ratio of the TE of a CRS model to the TE calculated under a VRS scheme. Usually when evaluating technical efficiency, the SE factor is often not taken into account, this leading to bias in the value of estimated pure technical efficiency. In the case of India, which opened up to the world economy with the NIP reforms, there should have been a tendency to increasing returns on the Kaldorian lines. However, consistent with the analysis of Tybout (2000), the case of India stands different from some of the other developing nations which initiated reforms in their economy.

Since the same number of industries show an increase and decline in index number analysis of scale efficiency over time, further estimation was required to know their pattern of change and statistical validity. Very small number of significant changes in the scale efficiency parameters are obtained even when considering the dummy variables analysis. On estimating the means of SE and their difference over the three periods considered, we find that in most cases in the post reform period, the values of SE are on the decline. A general trend of decreasing returns to scale is observed at the all India level. Maharashtra and Orissa depict significant changes in SE as does the manufacture of wool, silk and man-made fibre textiles. The use of 1985-86 as a time dummy estimates manufacture of machinery and equipment, manufacture of beverages and tobacco as industries showing a significant change as does Rajasthan and West Bengal in the case of states. However when 1991-92 is taken to be the time dummy, manufacture of wool, silk and man-made fibre textiles and Madhya Pradesh show statistically significant differences. Most of the statistically significant changes show a pattern of decreasing returns to scale in their respective industries.

When checking the convergence, for both the PTE and SE, we find that most of the estimates are not statistically significant. In the case of PTE, we find that contrary to any significant σ-convergence after implementation of reforms, the standard deviation is showing a declining trend for most industry groups. The possibility of duplicablity of PTE examined through sigma convergence gives only few statistically significant results to make any emphatic statements of low levels of duplicability. Hence even though there is a tendency showing no technological diffusion, since these results are not statistically valid, we cannot stress any emphatic conclusion. On the other hand in the case of SE, we find two estimates which hold statistically showing convergence. So the same result cannot be held at the national level due to problem of statistical validity. It is possible that the answer to the question of impact on efficiency of reforms could lie in the third component of the overall efficiency which is the allocative efficiency, another area of research beyond the scope of the present analysis.

One shortcoming suggested for this approach is the plausibility of sensitive estimates. We tried to overcome this problem by the method of peer state analysis as was done in the fourth and previous chapter in this thesis, where, we found a shift in the leaders of each industry group with the reforms undertaken. While ranking the states for their overall technical efficiency, some states have maintained their stronghold, like for example Kerala in the case of food products' manufacture, whereas some others have been replaced by other more competent states. The overall picture shows the displacement of many states considered to be relatively industrialised by some states which are rising stars in some industry groups. The state of Punjab which was seen to be performing well in the manufacture of textiles, basic metals and other manufacturing industries in the pre reform period seem to be replaced by states like Karnataka, Rajasthan and few others.

We estimate productivity indices using both real and nominal values. The nominal values are deflated by the various indices to get the real values: output by the Wholesale Price Index of all manufactured products; fixed capital by the WPI of machinery and machine tools including electrical machinery; fuels used by the wholesale price index for fuel power light and lubricants; materials used by the industrial raw materials price index; in case of labour the number of employees has been used. Karnataka and Uttar Pradesh are taken up as case studies, them being the best and least efficient states from the earlier sensitivity analysis. So, in the case of productivity of the states of Karnataka and Uttar Pradesh, we find an overall declining trend for both the states through time. The Malmquist index also shows a decline with the boundary shifts being more prominent than the catch-up component.

So, we can conclude that economic reforms, initiated to enhance competition and increase productivity growth, do not seem to have widespread impact on industries and region. This points out the need for the analysis of institutional and external factors hindering the performance. This is the most important area of research in this field. Reconciling the productivity results' using the four methods of growth accounting, regression analysis, frontier estimation (parametric) and non-parametric analysis could be another interesting appendage to this study. Another method by which we can tide over this problem of sensitivity is using the super-efficiency method. Using this method, Anderson and Peterson (1993) rank even the efficient units by removing each of the efficient units one by one and re-running the linear programming model. Adler *et. al.* (2000) discuss the other feasible models to overcome this problem.

Productivity variations can occur due to other factors like production technology and also due to difference in the environment in which production occurs other than the major factor of efficiency. Such a deviation of the study from efficiency to productivity can be taken up, an extension of the partial examination of the case of two states, Karnataka and Uttar Pradesh in this study. From that juncture, the factors leading to changes in technical efficiency can be studied as another interesting researchable issue. There have been studies in the Indian context, which have tried to account for changes due to reforms (these have already been discussed within the chapters). However, since most of them emphasise levels of infrastructure facilities being a crucial factor in differential growth, it would be worthwhile to consider other spatial variations. For this a more intense study of economic geography and location economics could be undertaken.

There is a consensus in the argument that first-generation reforms, which focused mainly on setting the prices right by unleashing the forces of competition both from within and outside the economy, would not by themselves ensure sustained growth. Studies have now started to emphasise the need to go in for the second generation reforms in the Indian economy. In other words, for India and other developing countries to do well, greater openness to trade, technology and investment should be complemented by a host of other institutional factors and policies that can be classified under the broad heading 'investment climate', which would essentially be part and parcel of the second-generation reforms. So it may be the non-existence of these additional reform requirements that have resulted in a less efficient manufacturing sector. So, the Kaldor hypothesis may be valid only if these are implemented along with the already existent policies.

BIBLIOGRAPHY

Ahluwalia, I. J. (1991): *Productivity and Growth in Indian Manufacturing*, Oxford University Press, New Delhi.

Ahluwalia, I. J. (1988): "Indian Industrialisation in the Seventies", in Y. K. Alagh (ed.), *Process of Industrialisation and Technological Alternatives*, Lancer International, New Delhi.

Ahluwalia, I. J. (1985): *Industrial Growth in India: Stagnation since the Mid-Sixties*, Oxford University Press, New Delhi.

Adler N., Friedman L. and Z. Sinuany-Stern (2002): "Review of ranking methods in the Data Envelopment Analysis context", *European Journal of Operations Research*, 140, pp. 249-265.

Aggarwal R. N. (2001): "Technical efficiency and Productivity growth in the Central Public Sector Enterprises in India during the 1990s", *Working paper no. 28, Institute of Economic Growth,* New Delhi.

Aigner, D. and S. Chu (1968): "On estimating the Industry Production Function", *American Economic Review*, Vol. 58, pp. 826-839.

Annual Survey of Industries, Summary Results for the Factory sector (various years), Central Statistical Organisation, Ministry of Planning, Government of India, New Delhi.

Bajpai N. (2002): "A Decade of Economic Reforms in India: the Unfinished Agenda", *Centre for International Development Working paper No. 89,* Harvard University.

Balakrishnan, P. and K. Pushpangadan (2002): 'TFPG in Manufacturing: The 80s Revisited', *Economic and Political Weekly*, Vol. 37, No. 4, pp. 323-325.

Balakrishnan, P. and K. Pushpangadan (1994): "Total Factor Productivity in Manufacturing Industry: A Fresh Look", *Economic and Political Weekly*, Vol. 29, No. 31, pp. 2028-35.

Balakrishnan, P., K. Pushpangadan and M. Suresh Babu (2000): "Trade Liberalisation and Productivity Growth in Manufacturing: Evidence from Firm-level Panel Data",*Economic and Political Weekly*, Vol. 35, No. 41, pp. 3679-3682.

Banker, R. D., A. Charnes and W. W. Cooper (1984): "Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis", *Management Science*, Vol. 30, No. 9, 1078-1092.

Banker R. D., R. F. Conrad and R. P. Strauss (1986): "A comparative application of DEA and Translog methods: an illustrative study of hospital production", *Management Science*, 32, pp. 30-44.

Banker, R. and A. Maindiratta (1988): "Non-parametric analysis of technical and allocative efficiencies in production", *Econometrica*, Vol. 56, No. 6, pp. 1315-1332.

Banker, R. D. and R.M. Thrall (1992): "Estimation of Returns to Scale using Data Envelopment Analysis", *European Journal of Operational Research*, Vol. 62, 74-84.

Barro R.L. and X. Sala-i-Martin (1995): *Economic Growth*, Mcgraw-Hill, New York.

Bhagwati, J.N. (1993): *India in Transition: Freeing the Economy*, Clarendon Press,Oxford.

Bhagwati, J.N. and P. Desai (1970): *India: Planning for Industrialisation*, Oxford University Press, London.

Bhagwati, J.N. and T.N. Srinivasan (1975): *Foreign Trade Regimes and Economic Development: India*, National Bureau of Economic Research, New York.

Bhat, R., B. B. Verma and E. Reuben: "*Data Envelopment Analysis*", Note prepared for the effort of Health Policy Development Network (HELPONET), India *(from www.iimahd.ernet.in/~rbhat/Download/Methodology%20note.pdf)*.

Biesebroeck, J.V. (2004): "Robustness of productivity estimates", *Working paper no. 10303, National Bureau of Economic Research.*

Caves, R.E. (1992): *Industrial Efficiency in six nations*, Cambridge, M.I.T. Press.

Charnes A., W.W. Cooper and E. Rhodes (1978): "Measuring the efficiency of decision-making units", *European Journal of Operations Research* 2, 429-444.

Charnes, A., W. Cooper, A. Y. Lewin and L.M. Seiford (1993): *Data Envelopment Analysis: Theory, Methodology and Application*, Kluwer Academic Publishers, Boston.

Chaudhuri S. (2002): "Economic Reforms and Industrial Structure in India", *Economic and Political Weekly*, Vol 37, No. 2, pp. 155-162.

Chaudhuri, S. (1998): "Debates on Industrialisation" in T. J. Byres (ed.) *Indian Economy: Major debates since Independence*, Oxford University Press, Delhi.

Coelli, T. (1996): *A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer Program), CEPA Working Paper 96/08,* Department of Econometrics, University of New England, Armidale.

Coelli T., S. Singh and E. Fleming (2000): "Efficiency and Productivity Analysis of Cooperative Dairy Plants in Haryana and Punjab States of India", *No. 2000-2, Working Paper Series in Agricultural and Resource Economics, Graduate School of Agricultural and Resource Economics,* University of New England.

Cooper W. and L.M. Seiford (2000): *Data Envelopment Analysis: A Comprehensive text with models, applications, references and DEA-Solver software*, Kluwer Academic Publishers, Boston.

Debreu, G. (1951): "The Coefficient of Resource Utilisation", *Econometrica*, Vol. 19, No.3, pp 273-292.

Dollar, Iarossi and Mengistae, (2002): "Investment Climate and Economic Performance: Some Firm Level Evidence from India", *Working Paper No.143, Center for Research on Economic Development and Policy Reform,* Stanford University.

Driffeld, N.L. and U.S. Kambhampati (2003): "Trade liberalisation and the efficiency of firms in Indian Manufacturing", *Review of Development Economics*, Vol. 7(3), pp 419-430.

Fare, R., and C.A.K. Lovell (1978), "Measuring Technical Efficiency of Production", *Journal of Economic Theory*, Vol. 19, No. 1, pp. 150-162.

Fare, R., S. Grosskopf and C. A. K. Lovell (1994): *Production Frontiers*, Cambridge University Press, Cambridge.

Fare, R.S., S. Grosskopf, B. Lindgren, and P. Roos (1989): "Productivity Developments in Swedish hospitals: A Malmquist Output Index Approach", *Working Paper, Department of Economics, Southern Illinois University,* Carbondale, Illinois.

Farrel, M.J. (1957): "The measurement of productive efficiency", *Journal of Royal Statistical Society*, Series A, Vol. 120, Part III, pp. 253-281.

Fikkert B. (1996): "An open or closed technology policy?: The impacts of international knowledge diffusion on self-reliance and productivity in less developed countries", *Working paper at the University of Maryland.*

Fikkert, B. and R. Hassan (1998): "Returns to scale in a highly regulated economy: evidence from Indian firms", *Journal of Development Economics*, Vol. 56, pp. 51-79.

Forsund F.R. and N. Sarafoglou (2000): "On the origins of Data Envelopment Analysis", *Memorandum No.24, Department of Economics, University of Oslo.*

Forsund, F. R., (1995): "A Note on the Calculation of the Scale Elasticity in DEA Models", Unpublished working paper, Department of Economics, University of Oslo.

Forsund, F.R., K. Lovell and P. Schmidt (1980): "A Survey of frontier production functions and their relationship to efficiency measurement", *Journal of Econometrics*, Vol. 13, No. 1, pp. 5-25.

Fried, H., C.A.K. Lovell, and S. Schmidt (1993): *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford University Press, London.

Greene W. H. (1997): "Frontier production functions " in Pesaran, M.H. and Schmidt, P. (ed.) *Handbook of Applied Econometrics-Volume Two*, Oxford: Blackwell Publications.

Greene W.H. (1993): "The Econometric Approach to Efficiency Analysis", in Fried, Lovell, and Schmidt (Ed.), *The Measurement of Productive Efficiency*, Oxford University Press, pp. 68-119.

Greene W.H. (1980): "Maximum Likelihood Estimation of Econometric Frontier Functions", *Journal of Econometrics*, Vol. 13, No. 1, 27-56.

Goldar, B. N. (2000): "*Productivity Growth in Indian Manufacturing in the 1980s and 1990s*", Paper presented at the Conference to honour Prof. K. L Krishna, December 2000, New Delhi: Delhi School of Economics.

Goldar, B.N. (1997): 'Econometrics of Indian Industry', in K. L. Krishna (ed.), *Econometric Applications in India*, Delhi: Oxford University Press.

Goldar B. and A. Mitra (2002): 'Total Factor Productivity in Indian Industry: A Review of Studies', in B.S.Minhas (ed.) *National Income Accounts and Data Systems*, Delhi: Oxford University Press.

Goldar, B. and V. Seth (1989): "Spatial variations in the rate of Industrial Growth in India", *Economic and Political Weekly*, Vol. 24, No. 22, pp. 1237-1240.

Hanoch, G. and M. Rothschild (1972): "Testing Assumptions of Production Theory: A Nonparametric Approach", *Journal of Political Economy,* Vol. 80, 256-275.

Havrylyshyn, O. (1990): 'Trade Policy and Productivity Gains in Developing Countries', *The World Bank Research Observer*, 5, January, pp 1-24.

Jalan, B. (1996): *India's Economic Policy-Preparing for the 21st Century*, Penguin Books, New Delhi.

Jha R. *et. al.* (1993): "An Analysis of Technological change, Factor substitution and Economies of Scale in Manufacturing Industries in India", *Applied Economics*, Vol. 25 (10) pp. 1337-43.

John, B. (1997): "*Institutions, inert areas and X-efficiency: An analysis of State transport undertakings in India*", M.Phil. Dissertation, Centre for Development Studies, Thiruvananthapuram.

Joshi, V. and I.M.D. Little (1996): *India's Economic Reforms 1991-2000*, Oxford University Press, New Delhi.

Kaldor, N. (1966): "*Causes of the Slow Rate of Economic Growth of the UK*" An Inaugural Lecture. Cambridge: Cambridge University Press. (Reprinted in F. Targeti and A.P. Thirlwall (eds.): *The Essential Kaldor*, Gerald Duckworth & Co., London, 1989).

Koopmans, T.C. (1951): "An Analysis of Production as an efficient combination of Activities" in T.C. Koopmans, (ed.,) *Activity Analysis of Production and Allocation*, Cowles Commission for Research in Economics, Monograph no. 13, John Wiley and Sons, New York.

Krishna, P. and D. Mitra (1998): 'Trade Liberalisation, Market Discipline & Productivity Growth: New Evidence from India', *Journal of Development Economics*, Vol.56, no.2, 447-462.

Lall, S.V., J. Koo and S. Chakravorthy (2003): "Diversity Matters: The economic geography of industrial location in India," *World Bank Policy Research Working Paper No. 3072.*

Lall, S.V. and C.G. Rodrigo (2000): "Perspectives on the Sources of Heterogeneity in Indian Industry", *World Bank Policy Research Working Paper no. 2946.*

Leon-Ledesma, M.A. (1999): "Increasing Returns and Verdoorn's Law: an Empirical Analysis of the Spanish Regions", *Applied Economics Letters*, Vol. 6, issue 6, pp. 373-76.

Lothgren, M. and M. Tambour (1996): "Alternative Approaches to Estimate Returns to Scale in DEA models", *Working paper no. 90, Stockholm School of Economics.*

Lovell C.A.K. (1993): "Production Frontiers and Productive Efficiency", in Fried, Lovell, and Schmidt (Ed.), *The Measurement of Productive Efficiency*, Oxford University Press, pp. 1-67.

Majumdar, S.K. (1996): "Fall and Rise of Productivity in Indian Industry: Has Economic Liberalisation Had an Impact?", *Economic and Political Weekly*, November 30, pp. M-46-M-53.

Mamgain, V. (2000): *Productivity growth in developing countries: The role of efficiency*, Garland Publications, New York.

Mitra A., A. Varoudakis and M. Veganzones (1998): "State Infrastructure and Productive Performance in Indian Manufacturing", *Technical Paper 139, OECD Development Centre*.

Mitra, A. (1999): "Total Factor Productivity Growth and Technical Efficiency in Indian Industries: A study based on Panel Data for Fifteen Major States", *Working Paper no. E/203/99, Institute of Economic Growth*, Delhi.

Moran, C. (1987): 'Aggregate Production Functions, Technical Efficiency and Trade Orientation in Developing Countries', *Working paper, World Bank*, Washington, DC.

Nayyar, D. (1994): "Introduction" in D. Nayyar (ed.) *Industrial Growth and Stagnation: The Debate in India*, Oxford University Press, Bombay.

Nickell, S. J. (1996): "Competition and Corporate Performance", *Journal of Political Economy*, 104, pp 724-766.

Nishimizu, M., and J. M. Page (1982): "Total Factor Productivity Growth, Technological Progress, and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965-1978", *Economic Journal*, 92, pp 920-38.

Nouroz, H. (2001): *Protection in Indian Manufacturing: An Empirical Study*, Macmillan, New Delhi.

Page, J. M. (1984): 'Firm Size and Technical Efficiency: Application of Production Frontiers to Indian Survey Data', *Journal of Development Economics*, Vol. 16, pp 129-52.

Parameswaran M. (2002): "Economic Reforms and Technical Efficiency: Firm level evidence from selected industries in India", *Working paper No. 339, Centre for Development Studies*, Thiruvananthapuram.

Pattnayak S. and S.M. Thangavelu (2003): "Economic Reform and Productivity Growth in Indian Manufacturing Industries: An Interaction of technical change and scale economies", *Working Paper No. 0307, Department of Economics, National University of Singapore*.

Pradhan, G. and K. Barik (1998): 'Fluctuating Total Factor Productivity in India: Evidence from Selected Polluting Industries', *Economic and Political Weekly Review of Industry and Management*, Feb 28, pp M-25- M-30.

Ramanathan R. (2003): *An Introduction to Data Envelopment Analysis: A tool for Performance Measurement*, Sage Publications, New Delhi.

Ray, S. (2004): "MNEs, Strategic Alliances and Efficiency of firms: Emerging Trends", *Economic and Political Weekly*, Vol. 39, No. 5, pp.434-440.

Ray, S.C. (1997): "Regional Variation in Productivity Growth in Indian Manufacturing: a Non-Parametric Analysis", *Journal of Quantitative Economics*, Vol. 13, No.1, pp 73-89.

Ray, S.C. (2002): "Did India's Economic Reforms improve Efficiency and Productivity? A Non-Parametric Analysis of the Initial Evidence from Manufacturing", *Indian Economic Review*, Vol. 37, No. 1, pp. 23-57.

Rodrick, D. (1992): "The Limits of Trade Policy Reform in Developing Countries", *Journal of Economic Perspectives*, Vol. 6, pp 87-105.

Sachs J., N. Bajpai and A. Ramiah (2002): "Understanding Regional Economic Growth in India", *Centre for International Development Working paper No. 88*, Harvard University.

Schmidt, P. (1976): "On the Statistical Estimation of Parametric Frontier Production Functions", *Review of Economics and Statistics*, Vol. 58, pp. 238-239.

Seiford L. and R. Thrall (1990): "Recent Developments in DEA: the mathematical programming approach to frontier analysis", *Journal of Econometrics*, Vol. 46, pp. 7-38.

Shepard R.W. (1953): *Cost and Production Functions*, Princeton University Press, Princeton.

Sinuany-Stern, Z., A. Mehrez and A. Barboy (1994): "Academic Departments efficiency via DEA", *Computers Operations Research*, Vol. 21, No. 5, pp 543-556.

Srivastava, V. (2001): "The Impact of India's Economic Reforms on Industrial Productivity, Efficiency and Competitiveness: A Panel Study of Indian Companies 1980-97", *National Council for Applied Economics Research*, New Delhi.

Srivastava, V. (1996): *Liberalisation, Productivity and Competition: A Panel Study of Indian Manufacturing*, Delhi: Oxford University Press.

Sunil Kumar (2000): "Regional variations in Technical efficiency", *The Indian Economic Journal*, Vol. 48, No. 2.

Suresh Babu, M. (2001): '*Competition, Barriers to Entry and Productivity Growth in Indian Manufacturing*', Ph.D. dissertation, Centre for Development Studies, Thiruvananthapuram.

Thanassoulis, E. (2001): *Introduction to the theory and Application of Data Envelopment Analysis*, Kluwer Academic Publishers.

Trivedi, P., A. Prakash and D. Sinate (2000): '*Productivity in Major Manufacturing Industries in India: 1973-74 to 1997-98*', Development Research Group Study no. 20, Reserve Bank of India.

Tybout J. (2000): "Manufacturing Firms in Developing Countries: How well do they do and Why?", *Journal of Economic Literature*, Vol. 38, pp. 11-44.

Tybout, J. J., DeMelo and V. Corbo (1991): 'The Effects of Trade Reforms on Scale and Technical Efficiency: New Evidence from Chile', *Journal of International Economics*, 31, pp 231-50.

Varian, H. (1984): "The Non-parametric Approach to Production Analysis", *Econometrica*, Vol. 52, No. 3, pp. 579-97.

Wadhva, C. D. (1994): *Economic Reforms in India and the Market Economy*, Allied Publishers, New Delhi.

APPENDIX

1. Factory Sector Data:

For the sample period, the singlemost comprehensive source of industrial statistics is the ASI. This database covers the entire registered manufacturing sector (excluding factories under the Defence Ministry, Oil storage depots and training institutes). A factory is defined as any premise where ten or more workers with the aid of power, or twenty or more without the aid of power are engaged in the manufacturing process. This section of the industry which uses less than ten workers in the process of manufacturing is not considered by this Survey. The ASI divides the registered factories into two groups-units operating on power with fifty or more workers or hundred or more workers without power (known as the census sector) and the remaining smaller factories known as the sample sector. The Census and the sample sector combined gives the total 'factory sector' data, which has been used in this present study.

2. Estimation of Real Values

While finding the real values, we need to deflate the nominal values by some value. As per some studies the deflators I have taken are:

(i) Output prices: Price index for manufacturing products base 1993-94=100represents the price of manufactured goods.

(ii) Raw material price index: The raw material costs are represented by a price index. For its construction, the value of primary inputs into manufacturing output was used to construct the shares of individual items in total material costs after which they were aggregated to yield the weights given in the composite index. The value of primary inputs were taken from the "Input-Output Transactions table" (commodity into Industry Absorption matrix) for the Indian economy for the year 1993-94 published by the CSO.

(iii) Labour: Total employment is used drawn from the various issue of the Annual Survey of Industry.

(iv) Fixed Capital: This has been deflated by the wholesale price index of machinery and machine tools to get its real value, following Mitra (1998).

Chapter 4

PARETO-EFFICIENCY: A SENSITIVITY ANALYSIS[1]

One of the main drawbacks of the non-parametric approach used in this study is that the reliability of the results is unknown and hence should be evaluated. To overcome this shortcoming, the sensitivity of the estimates needs to be analysed. Though different approaches like bootstrapping and ranking exist to check the sensitivity of the results, we apply the relative ranking method. The different methods of ranking are benchmarking, super-efficiency, cross-efficiency matrix, statistics based models ranking of inefficient units and the multiple-criteria decision making (Adler *et al.*, 2002) of which the first two are the most widely used. We employ the benchmarking approach to analyse the sensitivity of Pareto efficiency of the DMUs, as used in Sinuany-Stern *et. al.* (1994) and modified in Thanassoulis (2001). This would also give us a ranking of regions in terms of technical efficiency.

The methodology provides enough scope to estimate the Pareto-efficient states at the disaggregate level of industry. The peer state methodology further brings out the differences in the distribution of technical efficiency across regions and industries and also the most and least efficient DMU in a particular industry. The trend analysis provides the impact of reforms on efficiency ranking.

Another aspect considered in this chapter is the relationship between technical efficiency and productivity, a problem not dealt with so far in the analysis. While efficiency is one major component of productivity change, it is not the sole determining factor; for example, productivity changes can occur without technical efficiency changes. The measurement is based on Malmquist Index of productivity change introduced by Fare *et. al.* (1994). The same method is also used for analysing the sensitivity of ranking with nominal and real values of the inputs and output used. These are examined only by the case-study method.

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[1] *This is a substantial revised version of a paper presented at the Indian Econometric Society Conference held at Bangalore from 13th to 15th February, 2004. The author is grateful for comments received from the seminar participants especially Dr. Mitra.*

Table AII.1: Values of pure technical efficiency under variable returns to scale.

	20-21	22	23	24	26	27	28	29	30	31	32	33	34	35-36	37	38
ANDHRA PRADESH																
1976-77	1.000	1.000	0.925	1.000	0.658	1.000	0.849	1.000	1.000	1.000	0.999	0.959	0.971	0.988	0.927	0.845
1977-78	1.000	1.000	0.931	1.000	0.637	1.000	0.966	1.000	0.971	1.000	0.899	1.000	0.987	1.000	0.877	0.861
1979-80	1.000	1.000	1.000	1.000	0.634	0.910	0.969	0.889	0.808	0.943	1.000	0.991	0.950	0.965	0.925	1.000
1980-81	1.000	1.000	1.000	1.000	0.673	0.533	1.000	0.938	0.833	1.000	0.851	1.000	1.000	0.916	0.784	0.841
1981-82	1.000	1.000	0.993	0.969	0.744	0.906	1.000	0.642	0.824	0.972	1.000	0.977	0.955	1.000	0.821	0.806
1982-83	1.000	1.000	1.000	1.000	0.883	0.935	1.000	1.000	0.874	1.000	1.000	0.933	0.902	1.000	0.786	0.852
1983-84	1.000	1.000	1.000	1.000	1.000	0.988	0.878	0.934	1.000	0.790	1.000	1.000	0.960	1.000	0.851	0.727
1984-85	1.000	1.000	1.000	0.778	1.000	0.987	0.997	0.853	0.881	0.876	1.000	1.000	1.000	1.000	0.776	0.740
1985-86	1.000	1.000	1.000	1.000	0.855	1.000	0.997	0.818	0.901	0.957	0.957	1.000	0.987	0.952	0.944	0.515
1986-87	1.000	1.000	1.000	1.000	1.000	0.994	0.994	0.972	0.922	0.931	1.000	1.000	0.931	0.963	0.819	1.000
1987-88	1.000	1.000	0.991	1.000	0.764	1.000	0.973	1.000	1.000	0.928	0.941	1.000	0.938	0.977	0.866	1.000
1988-89	1.000	1.000	0.973	1.000	0.861	1.000	0.818	0.901	0.928	0.954	0.974	1.000	1.000	0.970	0.930	1.000
1989-90	1.000	1.000	0.980	1.000	0.851	1.000	0.943	0.877	0.965	0.831	0.932	0.991	0.959	1.000	0.935	1.000
1990-91	1.000	1.000	0.993	0.958	0.693	1.000	0.944	0.920	0.912	0.920	0.942	1.000	0.913	0.987	0.957	0.696
1991-92	1.000	1.000	0.925	0.922	0.632	1.000	0.942	0.913	1.000	0.944	1.000	0.843	0.969	0.966	1.000	0.867
1992-93	1.000	1.000	0.943	1.000	0.799	1.000	0.885	0.877	1.000	0.909	1.000	0.910	0.973	0.958	0.894	0.630
1993-94	1.000	1.000	1.000	1.000	0.643	1.000	1.000	0.822	0.998	0.942	1.000	0.849	1.000	0.920	1.000	0.334
1994-95	1.000	1.000	0.927	1.000	0.661	1.000	0.906	0.886	1.000	1.000	1.000	0.959	0.990		0.901	0.825
1995-96	1.000	1.000	1.000	0.835	0.775	1.000	0.953	1.000	1.000	0.985	1.000	1.000	1.000		1.000	0.984
1996-97	1.000	1.000	0.940	1.000	0.790	1.000	0.903	1.000	0.970	0.979	1.000	1.000	1.000		0.899	1.000
1997-98	0.980	1.000	1.000	0.897	0.835	1.000	1.000	1.000	0.890	0.851	1.000	1.000	1.000		0.936	0.559
ASSAM																
1976-77	1.000	0.000	1.000	0.000	1.000	1.000	1.000		1.000	1.000	0.948	1.000	1.000	1.000	1.000	
1977-78	1.000	1.000	1.000	0.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1979-80	1.000	1.000	1.000	0.000	0.763	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	0.939	
1980-81	1.000	1.000	1.000	0.000	1.000	0.700	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1981-82	1.000	1.000	1.000	0.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1982-83	1.000	0.000	1.000	1.000	0.000	1.000	1.000		1.000	1.000	0.930	1.000	1.000	1.000	1.000	
1983-84	1.000	0.000	1.000	0.000	0.000	1.000	1.000		1.000	0.916	0.874	1.000	1.000	1.000	1.000	

1984-85	1.000	1.000	1.000	0.000	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1985-86	1.000	1.000	1.000	1.000	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1986-87	1.000	1.000	1.000	0.000	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1987-88	1.000	1.000	1.000	1.000	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1988-89	1.000	1.000	1.000	0.983	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1989-90	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1990-91	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1991-92	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1992-93	1.000	0.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1993-94	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1994-95	1.000	1.000	1.000	0.841	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	
1995-96	1.000	1.000	1.000	1.000	0.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	
1996-97	1.000	0.000	1.000	0.920	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	
1997-98	1.000	0.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000		1.000	
BIHAR																
1976-77	0.960	1.000	0.918	1.000	0.785	0.899	0.917	0.776	0.823	1.000	1.000	1.000	1.000	0.979	1.000	1.000
1977-78	0.903	1.000	0.888	1.000	0.834	0.935	0.852	0.731	0.832	1.000	0.894	1.000	0.921	0.910	1.000	1.000
1979-80	0.967	0.769	1.000	1.000	0.856	0.839	0.910	1.000	0.889	1.000	0.870	1.000	0.951	0.968	1.000	1.000
1980-81	1.000	0.935	0.919	1.000	1.000	1.000	1.000	1.000	0.725	1.000	0.883	1.000	0.937	0.864	1.000	1.000
1981-82	1.000	0.910	1.000	1.000	1.000	0.852	1.000	0.795	0.834	1.000	0.910	1.000	0.982	0.900	1.000	1.000
1982-83	1.000	1.000	0.818	0.880	1.000	0.907	0.775	0.718	0.809	1.000	1.000	1.000	0.991	0.953	1.000	1.000
1983-84	1.000	0.750	0.913	1.000	1.000	0.952	0.764	0.896	0.985	0.884	0.990	1.000	0.957	1.000	0.957	1.000
1984-85	0.901	0.809	1.000	1.000	1.000	1.000	1.000	0.908	1.000	0.997	0.935	1.000	0.941	1.000	1.000	1.000
1985-86	1.000	0.785	1.000	1.000	1.000	0.979	1.000	0.975	1.000	0.860	0.938	1.000	0.908	1.000	0.940	1.000
1986-87	1.000	0.840	0.941	1.000	1.000	0.981	1.000	0.943	1.000	0.907	1.000	1.000	0.757	1.000	0.965	1.000
1987-88	0.997	0.659	1.000	1.000	1.000	0.970	1.000	0.837	1.000	1.000	1.000	1.000	0.893	1.000	0.925	1.000
1988-89	1.000	1.000	0.898	1.000	1.000	1.000	0.997	0.862	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989-90	0.954	1.000	1.000	1.000	0.773	1.000	0.927	0.936	1.000	0.951	1.000	1.000	1.000	0.971	1.000	1.000
1990-91	0.925	1.000	1.000	1.000	1.000	0.917	1.000	0.983	1.000	1.000	1.000	1.000	1.000	0.954	0.937	0.935
1991-92	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.924	0.913	0.917	1.000
1992-93	0.993	1.000	1.000	1.000	1.000	0.953	1.000	0.803	1.000	1.000	1.000	1.000	0.970	0.909	0.907	1.000
1993-94	1.000	1.000	1.000	1.000	1.000	0.934	1.000	1.000	0.993	1.000	0.861	1.000	0.855	0.967	0.864	0.956
1994-95	1.000	1.000	1.000	1.000	1.000	0.905	1.000	1.000	0.976	1.000	0.798	1.000	0.918		0.936	1.000
1995-96	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.910	1.000	0.922		0.899	1.000

1996-97	1.000	1.000	1.000	1.000	0.959	1.000	1.000	1.000	1.000	1.000	0.773	1.000	1.000		0.877	1.000
1997-98	1.000	1.000	1.000	1.000	0.893	1.000	1.000	1.000	0.894	0.992	0.972	1.000	1.000		1.000	1.000
GUJARAT																
1976-77	1.000	1.000	1.000	1.000	0.910	1.000	0.887	0.997	0.936	1.000	1.000	0.817	1.000	0.966	1.000	0.910
1977-78	1.000	1.000	1.000	1.000	0.661	1.000	1.000	0.917	1.000	1.000	1.000	0.923	1.000	0.970	1.000	1.000
1979-80	1.000	1.000		1.000	0.807	1.000	0.902	0.871	1.000	1.000	1.000	0.975	1.000	1.000	0.942	0.951
1980-81	1.000	1.000		1.000	0.783	0.843	0.872	0.691	1.000	1.000	1.000	0.957	1.000	0.912	0.907	1.000
1981-82	1.000	1.000		1.000	0.850	1.000	0.885	0.685	1.000	1.000	1.000	0.946	1.000	0.989	0.987	0.970
1982-83	1.000	1.000		1.000	0.729	0.894	0.838	0.895	1.000	1.000	0.985	0.880	1.000	0.984	0.852	1.000
1983-84	1.000	1.000		1.000	0.846	0.825	0.853	0.987	1.000	1.000	0.826	0.999	1.000	0.974	0.930	0.857
1984-85	1.000	1.000		1.000	0.878	1.000	1.000	0.730	1.000	1.000	0.908	0.971	1.000	1.000	0.910	0.847
1985-86	0.958	1.000		1.000	0.943	1.000	1.000	1.000	1.000	1.000	1.000	0.940	1.000	0.942	0.883	1.000
1986-87	0.982	0.836		1.000	0.843	1.000	1.000	0.918	1.000	1.000	0.930	0.977	1.000	1.000	0.833	1.000
1987-88	0.965	0.908		1.000	0.865	0.978	1.000	1.000	1.000	0.872	0.948	0.966	1.000	1.000	0.689	1.000
1988-89	1.000	0.820		1.000	0.833	0.971	1.000	0.919	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000
1989-90	1.000	1.000		1.000	0.858	1.000	1.000	0.849	1.000	1.000	0.953	0.989	1.000	1.000	0.945	1.000
1990-91	1.000	0.980		1.000	1.000	1.000	1.000	0.860	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1991-92	1.000	0.934		1.000	0.978	0.985	1.000	0.863	1.000	1.000	0.922	1.000	1.000	1.000	1.000	1.000
1992-93	1.000	0.900		1.000	0.882	1.000	1.000	0.838	1.000	1.000	1.000	1.000	0.983	0.951	1.000	0.958
1993-94	1.000	0.723		0.837	0.676	0.993	0.990	0.881	1.000	1.000	0.997	1.000	1.000	1.000	1.000	0.527
1994-95	1.000	1.000		1.000	0.897	0.976	1.000	0.870	1.000	1.000	1.000	0.999	1.000		1.000	0.921
1995-96	1.000	1.000		1.000	0.807	1.000	1.000	0.880	1.000	1.000	0.949	1.000	1.000		1.000	1.000
1996-97	1.000	1.000		1.000	0.844	0.963	1.000	0.792	1.000	1.000	1.000	1.000	1.000		1.000	0.992
1997-98	1.000	0.830		1.000	0.793	0.793	0.971	1.000	1.000	0.893	1.000	1.000	0.859		1.000	0.916
HARYANA																
1976-77	1.000	1.000	1.000	0.884	0.814	1.000	1.000	0.000	1.000	1.000	1.000	0.960	0.992	1.000	0.968	0.741
1977-78	1.000	0.723	1.000	0.880	0.906	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.939	0.919
1979-80	0.995	0.685	1.000	0.967	0.924	1.000	0.933	1.000	1.000	1.000	1.000	0.986	1.000	1.000	1.000	1.000
1980-81	0.982	0.743	0.932	0.941	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.802
1981-82	0.939	0.679	1.000	1.000	0.874	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.987	0.867
1982-83	0.950	0.873	0.975	1.000	1.000	1.000	1.000	0.932	1.000	1.000	1.000	1.000	1.000	1.000	0.977	0.794
1983-84	1.000	0.583	0.873	1.000	0.904	1.000	0.953	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1984-85	1.000	0.812	0.841	1.000	0.726	1.000	0.943	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.777
1985-86	1.000	0.834	0.949	1.000	1.000	1.000	0.860	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.625

1986-87	1.000	0.704	0.965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.932	1.000	1.000	0.975
1987-88	1.000	0.676	1.000	1.000	1.000	1.000	0.964	0.995	1.000	0.826	1.000	1.000	0.918	1.000	1.000	1.000
1988-89	0.986	0.635	0.993	1.000	1.000	1.000	0.845	1.000	1.000	1.000	1.000	1.000	0.852	1.000	1.000	0.978
1989-90	1.000	0.927	1.000	1.000	0.863	1.000	0.939	1.000	0.994	1.000	1.000	1.000	0.982	1.000	1.000	0.972
1990-91	1.000	0.732	1.000	0.914	0.944	1.000	1.000	1.000	0.991	0.973	0.981	1.000	1.000	1.000	1.000	1.000
1991-92	1.000	0.678	1.000	1.000	0.802	1.000	0.952	1.000	0.929	1.000	1.000	1.000	0.870	0.976	1.000	0.994
1992-93	1.000	0.761	1.000	0.884	0.819	1.000	1.000	1.000	1.000	1.000	0.912	1.000	0.886	0.903	1.000	1.000
1993-94	1.000	0.600	0.982	0.903	0.843	1.000	1.000	1.000	1.000	0.995	0.895	1.000	0.876	0.997	1.000	0.489
1994-95	1.000	0.718	0.970	0.737	1.000	1.000	1.000	0.967	1.000	0.999	1.000	1.000	0.881		1.000	0.979
1995-96	1.000	0.687	1.000	0.939	1.000	1.000	0.926	0.965	1.000	0.854	1.000	1.000	0.912		1.000	0.946
1996-97	1.000	0.722	1.000	0.840	1.000	0.890	1.000	1.000	0.988	0.898	0.992	1.000	0.951		1.000	0.961
1997-98	0.950	0.987	0.881	1.000	1.000	1.000	1.000	1.000	0.989	1.000	0.934	1.000	0.998		1.000	0.909
KARNATAKA																
1976-77	0.965	0.625	1.000	1.000	0.833	1.000	0.993	1.000	0.975	0.977	1.000	0.996	0.960	1.000	1.000	1.000
1977-78	0.948	0.807	0.972	0.799	0.926	1.000	1.000	0.879	1.000	0.844	1.000	1.000	1.000	1.000	1.000	1.000
1979-80	0.945	0.872	0.971	1.000	0.902	0.991	1.000	0.927	1.000	0.851	1.000	0.993	0.983	0.970	1.000	1.000
1980-81	0.949	0.994	1.000	0.920	0.925	0.519	0.902	1.000	1.000	1.000	0.958	1.000	1.000	0.926	1.000	1.000
1981-82	0.977	0.715	0.978	0.925	1.000	1.000	0.861	0.710	1.000	0.830	1.000	1.000	1.000	0.922	1.000	1.000
1982-83	0.949	0.867	0.994	1.000	0.988	1.000	0.803	1.000	1.000	0.986	1.000	0.919	1.000	1.000	1.000	1.000
1983-84	0.976	1.000	1.000	1.000	1.000	0.981	0.958	1.000	1.000	0.765	0.837	0.819	1.000	1.000	1.000	1.000
1984-85	0.963	0.877	1.000	1.000	0.958	0.986	1.000	1.000	1.000	0.807	0.963	0.911	0.978	0.962	1.000	0.956
1985-86	1.000	0.823	0.963	1.000	1.000	1.000	0.978	1.000	1.000	0.837	1.000	0.954	1.000	1.000	1.000	0.532
1986-87	0.990	0.775	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.938	1.000	0.963	1.000	1.000	1.000	1.000
1987-88	0.963	0.845	1.000	1.000	1.000	1.000	0.947	1.000	0.954	0.901	1.000	1.000	1.000	1.000	0.979	1.000
1988-89	0.967	0.784	1.000	1.000	0.965	0.928	0.836	1.000	0.955	0.981	1.000	1.000	1.000	1.000	1.000	1.000
1989-90	0.949	1.000	0.960	1.000	1.000	0.964	0.949	1.000	1.000	0.916	1.000	1.000	1.000	1.000	0.937	1.000
1990-91	0.958	1.000	0.991	1.000	1.000	1.000	1.000	1.000	1.000	0.966	1.000	1.000	1.000	1.000	1.000	1.000
1991-92	0.946	0.950	1.000	1.000	1.000	0.932	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992-93	0.972	0.996	0.987	1.000	0.941	0.868	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993-94	0.959	1.000	0.984	1.000	1.000	0.957	1.000	1.000	0.931	1.000	1.000	1.000	1.000	1.000	1.000	0.415
1994-95	0.999	0.769	1.000	0.888	1.000	0.999	1.000	1.000	1.000	0.839	0.902	1.000	1.000		1.000	0.994
1995-96	0.990	0.841	1.000	1.000	0.998	1.000	1.000	1.000	1.000	0.970	0.950	1.000	1.000		1.000	1.000
1996-97	0.914	1.000	0.959	1.000	1.000	0.808	1.000	1.000	1.000	1.000	1.000	0.949	1.000		1.000	0.997
1997-98	1.000	1.000	1.000	1.000	1.000	0.723	0.987	1.000	1.000	1.000	1.000	1.000	1.000		1.000	0.803

KERALA																
1976-77	1.000	0.958	1.000	0.845	0.794	0.979	0.848	0.000	0.907	1.000	1.000	0.947	0.983	0.885	1.000	0.873
1977-78	1.000	0.737	1.000	0.774	0.757	1.000	0.977	0.000	0.861	1.000	1.000	0.968	0.971	0.844	1.000	1.000
1979-80	1.000	1.000	1.000	0.891	0.926	0.997	0.895	0.740	0.786	1.000	1.000	1.000	0.926	1.000	1.000	1.000
1980-81	1.000	0.964	1.000	0.939	0.778	0.499	0.887	0.000	0.875	1.000	1.000	1.000	0.915	0.909	1.000	1.000
1981-82	1.000	1.000	1.000	1.000	0.882	1.000	0.792	0.743	0.857	1.000	1.000	1.000	0.967	0.859	1.000	1.000
1982-83	1.000	1.000	1.000	1.000	0.865	1.000	0.879	0.000	0.979	0.976	1.000	1.000	1.000	0.938	1.000	1.000
1983-84	1.000	1.000	1.000	0.000	0.901	1.000	0.825	1.000	1.000	0.808	1.000	0.967	0.925	0.890	1.000	1.000
1984-85	1.000	1.000	1.000	1.000	0.584	0.930	0.915	0.000	1.000	1.000	1.000	1.000	0.993	0.909	1.000	1.000
1985-86	1.000	1.000	1.000	1.000	1.000	0.968	1.000	1.000	0.999	0.914	0.990	1.000	0.977	1.000	1.000	0.985
1986-87	1.000	0.934	1.000	0.000	0.957	0.940	0.995	1.000	0.986	0.929	1.000	1.000	1.000	0.921	1.000	0.891
1987-88	1.000	1.000	0.987	0.000	0.951	0.939	1.000	0.000	1.000	1.000	1.000	1.000	0.932	0.970	1.000	1.000
1988-89	1.000	1.000	0.999	0.000	0.867	0.918	0.985	1.000	1.000	0.978	1.000	1.000	0.861	1.000	1.000	1.000
1989-90	1.000	1.000	1.000	0.910	0.790	1.000	1.000	0.000	1.000	1.000	1.000	1.000	0.929	1.000	0.984	1.000
1990-91	1.000	1.000	1.000	0.000	1.000	1.000	0.994	0.000	0.981	1.000	1.000	1.000	0.960	1.000	1.000	1.000
1991-92	1.000	1.000	1.000	0.000	0.927	1.000	1.000	0.000	0.903	1.000	1.000	1.000	0.934	0.991	1.000	1.000
1992-93	1.000	1.000	1.000	0.000	0.931	1.000	1.000	0.000	0.968	1.000	1.000	1.000	0.831	1.000	1.000	1.000
1993-94	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.921	1.000	1.000	0.968	0.877	1.000	1.000	0.996
1994-95	1.000	1.000	1.000	1.000	1.000	1.000	0.940	1.000	0.956	0.887	1.000	1.000	0.834		1.000	1.000
1995-96	1.000	0.899	1.000	0.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	0.874		1.000	0.984
1996-97	1.000	1.000	0.967	1.000	1.000	1.000	1.000	1.000	0.973	1.000	1.000	1.000	0.926		1.000	1.000
1997-98	1.000	1.000	1.000	1.000	0.887	0.918	1.000	0.000	0.867	1.000	0.878	0.891	0.767		1.000	1.000
MADHYA PRADESH																
1976-77	1.000	1.000	1.000	1.000	0.694	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.799	1.000
1977-78	1.000	1.000	1.000	0.924	0.741	1.000	1.000	0.868	1.000	0.840	1.000	0.855	1.000	1.000	1.000	1.000
1979-80	1.000	1.000	1.000	0.946	0.805	0.839	0.941	0.895	1.000	1.000	1.000	0.959	1.000	1.000	1.000	1.000
1980-81	1.000	1.000	1.000	0.933	0.943	0.681	0.983	0.898	1.000	1.000	1.000	1.000	0.991	0.977	0.983	1.000
1981-82	1.000	1.000	0.986	0.908	0.819	0.881	0.865	0.964	1.000	1.000	1.000	1.000	0.963	0.941	0.974	1.000
1982-83	1.000	1.000	1.000	0.968	0.952	1.000	0.944	0.842	0.931	1.000	1.000	0.971	0.931	0.973	1.000	1.000
1983-84	0.952	1.000	1.000	0.974	0.967	0.802	0.818	0.870	1.000	1.000	1.000	1.000	1.000	0.870	1.000	1.000
1984-85	0.984	1.000	0.990	0.971	0.919	1.000	1.000	1.000	1.000	1.000	1.000	0.971	1.000	0.993	0.990	1.000
1985-86	0.912	1.000	0.961	1.000	1.000	1.000	1.000	1.000	1.000	0.877	1.000	1.000	1.000	0.921	0.859	1.000
1986-87	0.966	1.000	0.946	1.000	0.950	1.000	1.000	1.000	1.000	0.874	1.000	0.986	1.000	0.941	0.898	1.000
1987-88	0.972	1.000	0.966	1.000	0.783	1.000	0.962	1.000	1.000	1.000	1.000	1.000	1.000	0.979	1.000	0.967

1988-89	1.000	1.000	1.000	1.000	0.865	0.953	1.000	1.000	1.000	1.000	1.000	0.995	1.000	1.000	1.000	1.000
1989-90	1.000	1.000	0.970	1.000	0.749	0.980	1.000	1.000	1.000	0.934	1.000	1.000	0.986	0.980	1.000	0.738
1990-91	1.000	1.000	1.000	1.000	0.754	0.944	1.000	1.000	1.000	0.873	1.000	1.000	0.968	0.999	0.975	0.813
1991-92	1.000	1.000	0.957	1.000	0.712	1.000	0.991	0.919	1.000	1.000	1.000	0.961	1.000	0.999	1.000	0.947
1992-93	1.000	1.000	0.943	0.890	0.646	0.913	0.939	0.925	1.000	0.784	1.000	1.000	1.000	1.000	0.937	0.927
1993-94	1.000	1.000	0.947	1.000	0.679	0.915	0.902	1.000	0.989	0.915	1.000	1.000	1.000	1.000	0.953	0.437
1994-95	1.000	1.000	0.894	0.966	0.720	1.000	0.800	1.000	1.000	0.887	1.000	1.000	1.000		0.966	0.804
1995-96	1.000	1.000	0.976	1.000	0.905	1.000	0.888	1.000	1.000	0.916	1.000	1.000	1.000		1.000	1.000
1996-97	1.000	0.687	1.000	0.978	0.754	0.711	0.852	1.000	1.000	0.901	1.000	1.000	1.000		0.943	- 1.000
1997-98	1.000	0.925	1.000	1.000	0.834	1.000	0.902	1.000	1.000	1.000	0.913	1.000	0.905		0.897	0.795
MAHARASHTRA																
1976-77	1.000	0.621	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1977-78	1.000	0.857	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979-80	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1980-81	1.000	0.990	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1981-82	1.000	0.962	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1982-83	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983-84	1.000	0.527	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1984-85	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.957	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1985-86	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986-87	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.926	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1987-88	1.000	0.819	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1988-89	1.000	0.804	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989-90	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990-91	1.000	0.949	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1991-92	1.000	0.746	1.000	1.000	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992-93	1.000	0.855	1.000	1.000	1.000	0.991	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993-94	1.000	0.862	0.869	1.000	1.000	0.942	1.000	0.959	1.000	1.000	0.935	1.000	1.000	1.000	1.000	1.000
1994-95	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000
1995-96	1.000	1.000	1.000	1.000	1.000	0.992	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000
1996-97	1.000	0.822	1.000	1.000	0.978	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		1.000	1.000
1997-98	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.960	0.968	1.000		1.000	1.000

ORISSA																
1976-77	1.000	1.000	0.943	0.000	1.000	1.000	0.971	0.000	0.957	0.000	1.000	1.000	1.000	1.000	1.000	1.000
1977-78	1.000	1.000	0.890	1.000	0.990	1.000	1.000	0.810	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979-80	1.000	0.754	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.946	1.000	1.000
1980-81	1.000	0.900	0.941	0.000	1.000	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.758
1981-82	1.000	0.941	0.892	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1982-83	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.982	0.952	1.000	1.000
1983-84	1.000	1.000	0.944	0.000	1.000	0.840	1.000	1.000	1.000	1.000	0.933	1.000	1.000	0.977	1.000	1.000
1984-85	1.000	0.772	0.988	0.000	1.000	1.000	1.000	1.000	1.000	1.000	0.959	0.842	1.000	0.826	1.000	1.000
1985-86	1.000	1.000	0.981	0.000	1.000	0.920	0.975	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986-87	1.000	0.806	0.914	0.000	1.000	1.000	1.000	1.000	0.927	1.000	1.000	0.950	1.000	1.000	1.000	1.000
1987-88	1.000	1.000	0.873	0.000	1.000	0.926	1.000	1.000	0.900	1.000	1.000	1.000	1.000	1.000	1.000	0.868
1988-89	1.000	1.000	0.902	0.000	1.000	1.000	0.905	1.000	0.938	1.000	1.000	1.000	0.840	1.000	1.000	1.000
1989-90	1.000	0.962	0.927	0.000	0.756	1.000	0.937	1.000	0.884	1.000	1.000	1.000	0.910	1.000	1.000	1.000
1990-91	1.000	1.000	0.947	1.000	0.731	1.000	1.000	1.000	0.688	1.000	1.000	0.987	1.000	1.000	1.000	1.000
1991-92	1.000	0.715	0.902	1.000	1.000	1.000	0.921	1.000	0.931	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992-93	1.000	1.000	1.000	1.000	0.965		0.921	1.000	0.904	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993-94	1.000	0.847	1.000	1.000	0.693	1.000	0.873	1.000	0.836	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1994-95	1.000	0.995	0.964	0.877	0.720	1.000	0.913	1.000	0.946	1.000	1.000	1.000	1.000		1.000	1.000
1995-96	1.000	0.686	1.000	1.000	0.901	1.000	0.853	1.000	0.973	1.000	1.000	0.978	0.977		1.000	1.000
1996-97	1.000	1.000	1.000	1.000	0.774	1.000	0.819	1.000	0.879	1.000	1.000	1.000	0.969		1.000	1.000
1997-98	1.000	1.000	0.959	0.000	0.685	0.818	0.880	0.000	0.866	1.000	1.000	0.986	0.723		1.000	1.000
PUNJAB																
1976-77	0.994	0.816	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.983	1.000	1.000	1.000	1.000	1.000	0.135
1977-78	1.000	0.846	1.000	1.000	1.000	1.000	1.000	0.844	0.914	0.836	1.000	1.000	1.000	1.000	1.000	1.000
1979-80	1.000	0.754	1.000	1.000	1.000	1.000	1.000	0.974	1.000	0.854	1.000	1.000	1.000	0.986	1.000	1.000
1980-81	1.000	0.859	1.000	1.000	1.000	0.809	1.000	0.815	1.000	0.957	1.000	1.000	1.000	1.000	1.000	1.000
1981-82	1.000	1.000	1.000	1.000	1.000	1.000	0.897	0.800	1.000	0.957	1.000	1.000	1.000	0.988	1.000	1.000
1982-83	1.000	0.878	1.000	1.000	1.000	0.978	0.836	1.000	1.000	1.000	1.000	1.000	0.903	1.000	1.000	1.000
1983-84	1.000	0.539	1.000	1.000	1.000	1.000	0.896	0.711	1.000	0.958	1.000	1.000	0.953	0.999	1.000	1.000
1984-85	1.000	0.820	1.000	1.000	1.000	0.985	1.000	0.769	1.000	0.937	1.000	1.000	0.895	0.947	1.000	1.000
1985-86	1.000	1.000	1.000	1.000	1.000	0.949	0.954	0.853	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.948
1986-87	1.000	0.990	1.000	1.000	1.000	1.000	1.000	0.915	1.000	1.000	1.000	1.000	0.889	1.000	1.000	1.000

1987-88	1.000	0.976	1.000	0.991	1.000	0.939	0.801	0.961	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1988-89	1.000	0.686	1.000	1.000	1.000	1.000	1.000	0.891	0.989	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1989-90	1.000	0.818	1.000	1.000	1.000	0.954	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990-91	0.986	0.909	1.000	1.000	0.929	0.956	1.000	0.967	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.935
1991-92	0.992	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.930
1992-93	1.000	0.911	1.000	1.000	1.000	1.000	1.000	0.780	1.000	1.000	1.000	1.000	1.000	1.000	0.934	1.000
1993-94	1.000	0.892	1.000	1.000	0.939	1.000	1.000	0.851	1.000	1.000	1.000	1.000	1.000	1.000	0.921	1.000
1994-95	1.000	0.830	1.000	1.000	1.000	0.860	1.000	0.931	1.000	0.980	1.000	1.000	1.000		0.847	1.000
1995-96	1.000	0.838	1.000	0.984	0.941	1.000	1.000	0.891	1.000	1.000	1.000	1.000	1.000		0.916	1.000
1996-97	0.970	0.785	1.000	0.993	1.000	0.599	1.000	0.817	1.000	1.000	1.000	1.000	1.000		0.826	1.000
1997-98	1.000	0.919	0.982	1.000	1.000	1.000	1.000	0.846	1.000	1.000	1.000	1.000	1.000		0.869	1.000
RAJASTHAN																
1976-77	1.000	1.000	1.000	1.000	0.778	1.000	1.000	1.000	1.000	1.000	0.899	1.000	1.000	1.000	0.898	1.000
1977-78	1.000	0.973	1.000	0.922	0.874	1.000	1.000	0.687	1.000	0.849	0.991	0.915	1.000	0.862	0.654	1.000
1979-80	1.000	0.861	1.000	0.968	1.000	1.000	1.000	0.000	0.965	1.000	0.928	1.000	1.000	0.950	1.000	0.968
1980-81	1.000	0.792	1.000	0.977	1.000	1.000	1.000	0.642	1.000	0.952	1.000	0.972	1.000	0.997	1.000	0.777
1981-82	0.962	0.907	1.000	0.955	1.000	1.000	1.000	0.647	1.000	1.000	0.967	0.947	1.000	0.955	0.941	0.789
1982-83	1.000	0.904	0.975	0.964	0.757	1.000	1.000	0.882	0.861	1.000	1.000	0.879	0.993	0.945	0.790	0.795
1983-84	1.000	0.663	1.000	1.000	0.925	1.000	1.000	0.000	1.000	1.000	1.000	0.995	1.000	0.938	0.903	0.790
1984-85	1.000	0.826	0.977	0.997	0.736	1.000	1.000	0.748	1.000	0.895	1.000	1.000	0.972	0.864	1.000	0.823
1985-86	1.000	0.787	1.000	0.996	0.909	1.000	0.997	0.000	0.989	0.891	0.969	0.920	1.000	0.836	0.987	0.805
1986-87	1.000	0.745	0.988	1.000	1.000	1.000	1.000	0.662	0.885	0.860	1.000	1.000	0.997	1.000	1.000	1.000
1987-88	1.000	0.671	0.996	1.000	1.000	1.000	1.000	0.000	0.991	0.892	0.980	0.951	1.000	0.911	1.000	1.000
1988-89	1.000	0.701	1.000	0.982	1.000	1.000	1.000	1.000	0.959	1.000	1.000	0.919	0.916	0.917	0.833	1.000
1989-90	1.000	0.894	1.000	1.000	1.000	1.000	1.000	0.000	1.000	0.921	0.995	0.991	0.999	0.925	0.975	0.980
1990-91	1.000	0.769	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.941	0.916	0.970	0.949	0.918	0.831
1991-92	1.000	0.935	1.000	1.000	1.000	1.000	1.000	0.000	0.985	0.929	0.952	0.884	0.975	0.944	0.983	0.913
1992-93	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.940	0.892	0.973	1.000	0.890	0.950	0.940
1993-94	0.979	0.890	1.000	1.000	1.000	1.000	1.000	1.000	0.940	1.000	0.921	0.801	1.000	0.925	0.845	0.603
1994-95	1.000	0.903	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.936	0.923	0.831	0.997		1.000	1.000
1995-96	1.000	1.000	1.000	1.000	0.942	1.000	1.000	1.000	1.000	0.867	1.000	0.871	1.000		1.000	0.906
1996-97	1.000	1.000	0.990	0.874	0.861	1.000	1.000	1.000	1.000	0.926	0.983	0.813	1.000		1.000	1.000
1997-98	1.000	0.823	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.819	1.000		1.000	1.000

TAMILNADU																
1976-77	0.989	0.698	1.000	0.830	0.820	0.980	1.000	1.000	0.997	1.000	1.000	0.894	1.000	1.000	1.000	0.838
1977-78	1.000	0.833	1.000	0.850	0.805	1.000	1.000	1.000	0.944	1.000	1.000	0.956	1.000	1.000	1.000	1.000
1979-80	0.996	0.955	1.000	0.914	0.836	1.000	1.000	1.000	1.000	1.000	1.000	0.928	1.000	1.000	1.000	0.917
1980-81	1.000	0.958	1.000	0.966	0.911	0.758	0.990	1.000	1.000	1.000	1.000	0.956	1.000	1.000	1.000	0.957
1981-82	1.000	0.920	1.000	0.861	0.936	1.000	1.000	1.000	1.000	1.000	1.000	0.891	1.000	1.000	1.000	1.000
1982-83	1.000	1.000	1.000	0.917	0.796	1.000	1.000	1.000	1.000	1.000	1.000	0.898	1.000	1.000	1.000	0.982
1983-84	1.000	0.831	1.000	0.947	0.946	1.000	1.000	1.000	1.000	0.861	1.000	1.000	1.000	1.000	1.000	0.938
1984-85	1.000	1.000	1.000	0.907	0.902	1.000	1.000	1.000	1.000	1.000	1.000	0.977	1.000	1.000	1.000	0.885
1985-86	0.990	1.000	1.000	0.912	1.000	1.000	1.000	1.000	0.989	0.884	1.000	0.941	0.890	1.000	1.000	0.780
1986-87	1.000	0.867	1.000	0.969	1.000	1.000	1.000	1.000	1.000	0.948	1.000	1.000	1.000	1.000	1.000	0.907
1987-88	1.000	1.000	1.000	0.985	1.000	1.000	1.000	1.000	0.961	0.931	1.000	0.961	0.903	1.000	1.000	1.000
1988-89	1.000	1.000	1.000	1.000	1.000	0.983	1.000	1.000	1.000	1.000	1.000	0.998	0.999	1.000	1.000	1.000
1989-90	1.000	1.000	1.000	1.000	1.000	1.000		1.000	0.987	0.991	1.000	0.948	0.974	1.000	1.000	1.000
1990-91	1.000	1.000	1.000	0.982	1.000	1.000	1.000	1.000	1.000	0.993	1.000	0.904	0.938	1.000	1.000	1.000
1991-92	1.000	0.928	1.000	0.993	1.000	0.889	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1992-93	1.000	1.000	1.000	0.956	1.000	0.801	1.000	1.000	0.925	0.829	1.000	0.934	1.000	1.000	1.000	1.000
1993-94	1.000	0.951	1.000	0.920	1.000	1.000	1.000	1.000	0.995	0.883	1.000	0.931	1.000	1.000	1.000	0.576
1994-95	0.984	1.000	1.000	1.000	1.000	0.996	0.950	1.000	0.983	1.000	1.000	0.913	0.972		1.000	1.000
1995-96	1.000	1.000	1.000	0.857	1.000	0.899	0.999	1.000	0.919	0.897	1.000	0.892	1.000		1.000	0.989
1996-97	0.981	1.000	1.000	0.847	1.000	0.823	1.000	1.000	0.975	0.867	1.000	0.806	1.000		0.990	1.000
1997-98	1.000	1.000	1.000	0.782	1.000	1.000	1.000	1.000	0.865	0.989	1.000	0.871	0.960		0.980	0.731
UTTAR PRADESH																
1976-77	1.000	1.000	0.956	0.939	1.000	0.714	0.963	0.814	1.000	0.919	0.814	0.969	0.922	1.000	0.902	0.748
1977-78	1.000	1.000	0.929	0.970	1.000	0.838	0.942	1.000	1.000	0.952	0.828	1.000	0.907	0.925	0.988	0.974
1979-80	1.000	1.000	0.932	1.000	1.000	0.940	0.945	0.931	0.979	0.958	0.881	1.000	0.961	0.944	0.935	0.826
1980-81	1.000	0.963	0.900	0.812	1.000	0.610	0.881	0.976	0.971	1.000	0.878	1.000	0.929	0.874	1.000	0.863
1981-82	1.000	0.936	0.899	0.972	1.000	0.903	0.870	0.956	0.837	1.000	0.918	0.979	0.966	0.931	0.723	0.754
1982-83	0.989	0.910	0.945	0.969	1.000	0.931	0.863	0.927	0.913	1.000	0.818	0.976	0.902	0.987	0.862	0.896
1983-84	1.000	0.441	0.960	1.000	1.000	0.816	0.885	0.817	1.000	0.445	0.795	1.000	0.892	0.909	0.874	0.980
1984-85	1.000	0.906	0.890	1.000	0.768	0.930	0.896	0.978	0.963	0.951	0.763	1.000	0.942	0.971	0.796	1.000
1985-86	1.000	0.894	0.935	1.000	1.000	1.000	0.905	0.958	0.964	0.846	0.964	1.000	0.988	0.975	0.691	0.953
1986-87	1.000	0.783	0.942	1.000	1.000	1.000	0.893	0.926	0.880	1.000	1.000	1.000	0.888	0.980	0.930	1.000
1987-88	1.000	0.763	0.899	1.000	1.000	0.873	0.976	1.000	0.980	1.000	1.000	1.000	0.907	1.000	0.804	1.000

1988-89	0.997	1.000	0.879	1.000	1.000	0.886	0.891	1.000	0.850	0.986	0.979	1.000	1.000	0.988	0.884	1.000
1989-90	1.000	1.000	0.885	1.000	1.000	1.000	0.936	0.938	1.000	1.000	1.000	1.000	1.000	1.000	0.902	0.906
1990-91	0.976	1.000	0.820	1.000	1.000	0.814	0.927	1.000	1.000	0.994	0.895	1.000	0.933	0.993	0.958	0.932
1991-92	0.961	1.000	0.834	1.000	0.871	0.940	0.930	0.916	1.000	1.000	0.889	1.000	1.000	1.000	0.879	0.933
1992-93	0.996	1.000	0.908	1.000	0.925	1.000	0.854	0.956	1.000	1.000	0.857	1.000	1.000	1.000	0.888	0.951
1993-94	1.000	1.000	0.917	0.999	0.866	0.877	0.823	1.000	1.000	1.000	0.844	1.000	1.000	1.000	0.916	0.848
1994-95	0.990	1.000	0.855	0.906	1.000	0.906	0.917	1.000	0.993	1.000	0.982	1.000	0.858		0.926	1.000
1995-96	0.983	1.000	0.921	1.000	0.871	0.826	0.885	1.000	1.000	1.000	0.851	1.000	1.000		0.900	1.000
1996-97	0.989	1.000	0.804	0.998	1.000	1.000	0.900	1.000	1.000	1.000	0.845	0.953	1.000		0.930	1.000
1997-98	0.944	1.000	0.886	0.844	0.830	0.913	1.000	1.000	1.000	1.000	0.863	0.913	1.000		0.886	1.000
WEST BENGAL																
1976-77	1.000	0.606	0.936	1.000	0.785	1.000	1.000	1.000	1.000	0.920	0.958	1.000	0.961	1.000	1.000	1.000
1977-78	1.000	0.798	0.919	0.978	0.721	1.000	0.989	1.000	1.000	0.960	1.000	1.000	1.000	1.000	1.000	1.000
1979-80	1.000	0.672	0.920	1.000	0.756	0.921	1.000	1.000	1.000	0.994	0.970	1.000	1.000	1.000	1.000	1.000
1980-81	0.941	0.640	0.916	0.992	0.816	0.958	0.933	1.000	1.000	1.000	1.000	1.000	1.000	0.985	1.000	1.000
1981-82	0.932	0.669	0.887	1.000	0.898	1.000	0.973	1.000	1.000	0.944	1.000	1.000	0.937	0.955	1.000	1.000
1982-83	0.970	0.651	0.898	1.000	0.940	0.936	0.967	1.000	0.902	0.984	1.000	0.992	1.000	1.000	1.000	1.000
1983-84	0.985	0.608	0.840	1.000	0.897	1.000	0.980	1.000	0.978	0.926	1.000	0.991	1.000	1.000	1.000	1.000
1984-85	0.952	0.832	0.904	1.000	1.000	1.000	1.000	1.000	0.933	0.964	1.000	0.987	1.000	1.000	1.000	1.000
1985-86	1.000	0.767	0.898	1.000	1.000	1.000	1.000	1.000	0.890	0.878	1.000	1.000	1.000	1.000	1.000	1.000
1986-87	0.995	1.000	0.930	1.000	1.000	0.921	0.985	1.000	0.967	0.981	1.000	0.917	1.000	1.000	1.000	1.000
1987-88	0.956	0.891	0.912	1.000	1.000	1.000	1.000	1.000	0.980	1.000	1.000	0.925	1.000	1.000	1.000	1.000
1988-89	0.967	0.915	0.852	0.970	0.847	0.943	1.000	1.000	1.000	0.919	1.000	0.947	0.851	0.943	1.000	1.000
1989-90	0.951	1.000	0.861	0.971	0.797	0.948	0.988	1.000	1.000	0.930	1.000	0.839	1.000	1.000	1.000	0.990
1990-91	0.985	0.798	0.912	0.964	0.721	1.000	0.971	1.000	1.000	0.998	1.000	0.887	1.000	0.992	1.000	0.833
1991-92	0.951	0.581	0.922	0.939	0.856	0.906	0.956	1.000	1.000	0.968	1.000	1.000	1.000	0.982	1.000	0.919
1992-93	1.000	1.000	0.958	1.000	0.965	0.859	0.969	1.000	1.000	0.944	0.951	1.000	1.000	0.938	1.000	0.925
1993-94	1.000	1.000	0.987	0.981	0.678	1.000	0.897	1.000	1.000	0.949	1.000	1.000	1.000	0.952	0.976	1.000
1994-95	0.967	0.916	0.887	0.537	1.000	0.964	1.000	1.000	1.000	0.962	1.000	1.000	1.000		1.000	1.000
1995-96	0.985	0.923	0.949	0.734	1.000	1.000	0.928	1.000	1.000	0.890	1.000	1.000	1.000		1.000	1.000
1996-97	0.989	1.000	1.000	0.845	0.835	1.000	1.000	1.000	1.000	0.873	1.000	0.804	1.000		1.000	0.974
1997-98	0.878	1.000	0.994	0.999	0.971	0.902	1.000	1.000	1.000	0.948	1.000	0.701	1.000		1.000	0.968

Table AII.2: Index numbers of the region and industry wise changes in pure technical efficiency through the time period 1976/77 to 1997/98

States		IN 20-21	IN 22	IN 23	IN 24	IN 26	IN 27	IN 28	IN 29	IN 30	IN 31	IN 32	IN 33	IN 34	IN 35-36	IN 37	IN 38
AP	1985-86	100.00	100.00	108.15	100.00	129.91	100.00	117.41	81.77	90.08	95.69	95.73	104.33	101.64	96.37	101.82	60.99
	1991-92	100.00	100.00	100.07	92.20	96.11	100.00	110.93	91.34	100.00	94.41	100.06	87.96	99.75	97.76	107.83	102.62
	1997-98	98.00	100.00	108.15	89.66	126.83	100.00	117.77	100.00	89.00	85.13	100.06	104.33	102.98		100.92	66.13
ASSM	1985-86	100.00		100.00	100.00	0.00	100.00	100.00		100.00	100.00	105.44	100.00	100.00	100.00	100.00	
	1991-92	100.00		100.00	100.00	100.00	100.00	100.00		100.00	100.00	105.44	100.00	100.00	100.00	100.00	
	1997-98	100.00		100.00	100.00	100.00	100.00	100.00		100.00	100.00	105.44	100.00	100.00		100.00	
BH	1985-86	104.16	78.53	108.99	100.00	127.36	108.85	109.01	125.60	121.56	85.98	93.76	100.00	90.76	102.09	94.05	100.00
	1991-92	104.16	100.00	108.99	100.00	127.36	111.18	109.01	128.88	121.56	100.00	100.00	100.00	92.40	93.19	91.66	100.00
	1997-98	104.16	100.00	108.99	100.00	113.74	111.18	109.01	128.88	108.69	99.21	97.20	100.00	100.00		100.00	100.00
GUJ	1985-86	95.84	100.00	100.00	100.00	103.64	100.00	112.69	100.28	106.86	100.00	100.00	115.15	100.00	97.51	88.25	109.90
	1991-92	100.00	93.44	100.00	100.00	107.44	98.48	112.69	86.53	106.86	100.00	92.23	122.46	100.00	103.50	100.00	109.90
	1997-98	100.00	82.96	98.07	100.00	87.10	79.30	109.46	100.28	106.86	89.35	100.00	122.46	85.87		100.00	100.71
HR	1985-86	100.00	83.43	94.87	113.09	122.92	100.00	86.00	100.00	100.00	100.00	100.00	104.18	100.86	100.00	103.33	84.44
	1991-92	100.00	67.82	100.00	113.09	98.53	100.00	95.21	100.00	92.95	100.00	100.00	104.18	87.78	97.61	103.33	134.19
	1997-98	95.05	98.67	88.10	113.09	122.92	100.00	100.00	100.00	98.89	100.00	93.45	104.18	100.60		103.33	122.75
KAR	1985-86	103.68	131.81	96.34	100.00	120.11	100.00	98.47	100.00	102.60	85.63	100.00	95.80	104.11	100.00	100.00	53.24
	1991-92	98.12	152.06	100.00	100.00	120.11	93.25	100.66	100.00	102.60	102.34	100.00	100.41	104.11	100.00	100.00	100.00
	1997-98	103.68	160.09	100.00	100.00	120.11	72.28	99.30	100.00	102.60	102.34	100.00	100.41	104.11		100.00	80.28
KER	1985-86	100.00	104.34	100.00	118.30	125.92	98.82	117.94	135.13	110.23	91.43	98.99	105.58	99.37	113.03	100.00	112.89
	1991-92	100.00	104.34	100.00	0.00	116.72	102.10	117.94	0.00	99.63	100.00	100.00	105.58	95.05	112.02	100.00	114.59
	1997-98	100.00	104.34	100.00	118.30	111.70	93.78	117.94	0.00	95.68	100.00	87.80	94.04	78.07		100.00	114.59
MP	1985-86	91.22	100.00	96.08	100.00	144.01	100.00	100.00	100.00	100.00	87.69	100.00	100.00	100.00	92.13	107.62	100.00
	1991-92	100.00	100.00	95.68	100.00	102.49	100.00	99.06	91.86	100.00	100.00	100.00	96.08	100.00	99.95	125.22	94.74
	1997-98	100.00	92.50	100.00	100.00	120.10	100.00	90.24	100.00	100.00	100.00	91.29	100.00	90.48		112.37	79.55
MH	1985-86	100.00	161.11	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	1991-92	100.00	120.21	100.00	100.00	100.00	99.82	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	1997-98	100.00	161.11	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	95.99	96.75	100.00		100.00	100.00
ORI	1985-86	100.00	100.00	104.01	0.00	100.00	91.98	100.44	123.40	104.45	100.00	100.00	99.97	100.00	100.00	100.00	100.00
	1991-92	100.00	71.54	95.63	100.00	100.00	100.00	94.88	123.40	97.24	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	1997-98	100.00	100.00	101.66	0.00	68.53	81.82	90.67	0.00	90.44	100.00	100.00	98.60	72.32		100.00	100.00
PUN	1985-86	100.64	122.50	100.00	100.00	100.00	94.92	95.36	85.28	100.00	101.75	100.00	100.00	100.00	100.00	100.00	702.68
	1991-92	99.88	122.50	100.00	100.00	100.00	100.00	100.00	100.00	100.00	101.75	100.00	100.00	100.00	100.00	100.00	689.15

	1997-98	100.64	112.55	98.16	100.00	100.00	100.00	100.00	84.60	100.00	101.75	100.00	100.00	100.00		86.91	741.01
RAJ	1985-86	100.00	78.69	100.00	99.57	116.76	100.00	99.66	0.00	98.89	89.12	107.78	92.02	100.00	83.64	109.94	80.52
	1991-92	100.00	93.50	100.00	100.00	128.48	100.00	100.00	0.00	98.51	92.85	105.87	88.36	97.50	94.41	109.50	91.26
	1997-98	100.00	82.34	100.00	100.00	128.48	100.00	100.00	100.00	100.00	100.00	111.21	81.92	100.00		111.40	100.00
TN	1985-86	100.12	143.28	100.00	109.97	121.98	102.01	100.00	100.00	99.15	88.44	100.00	105.26	88.98	100.00	100.00	93.02
	1991-92	101.09	133.01	100.00	119.73	121.98	90.65	100.00	100.00	100.25	100.00	100.00	111.90	100.00	100.00	100.00	119.28
	1997-98	101.09	143.28	100.00	94.25	121.98	102.01	100.00	100.00	86.74	98.88	100.00	97.47	95.99		98.04	87.25
UP	1985-86	100.00	89.35	97.80	106.49	100.00	140.03	93.91	117.79	96.42	91.99	118.43	103.25	107.21	97.50	76.56	127.47
	1991-92	96.08	100.00	87.31	106.49	87.12	131.66	96.59	112.54	100.00	108.76	109.20	103.25	108.46	100.00	97.39	124.68
	1997-98	94.43	100.00	92.73	89.92	83.00	127.85	103.80	122.92	100.00	108.76	106.01	94.29	108.46		98.15	133.70
WB	1985-86	100.00	126.48	95.96	100.00	127.39	100.00	100.00	100.00	89.04	95.40	104.35	100.00	104.09	100.00	100.00	100.00
	1991-92	95.07	95.81	98.53	93.92	109.07	90.56	95.60	100.00	100.00	105.21	104.35	100.00	104.09	98.22	100.00	91.94
	1997-98	87.76	164.95	106.23	99.87	123.75	90.22	100.00	100.00	100.00	103.02	104.35	70.06	104.09		100.00	96.79

Source: Appendix table AII.1

Table AII.3: Trends in pure technical efficiency by state at the two-digit industry classification 1979/80 to 1997/98

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
20	-0.0003		0.0008	0.0003	0.0008	-0.2320		0.0012			-0.0419	-0.1143	-0.0003	-0.2049	-0.0005
22		-0.0175	0.0115*	-0.0055	-0.3756	0.0052	-0.1689	-0.0056*	-0.1716	-0.4102	0.0022	0.0079	-0.2817	0.0096	0.0193*
23	-0.0421		0.0269	-0.0008	0.0015	-0.3687	-0.0965	-0.0019	-0.0588	0.0015	-0.0003	-0.2289		0.2020	0.0046*
24	-0.2292	0.3041	-0.0588	-0.0588	-0.0064	0.0009	-0.0116	0.0022		0.0601*	-0.0003	-0.0412	-0.0023	-0.0002	-0.0109
26	-0.0038	0.0283	-0.0004	0.0011	0.0014	0.0026*	0.0069	-0.0103*	-0.0588	-0.0166*	-0.1985	0.0029	0.0079*	-0.1671	0.0013
27	0.0100*	0.0042	-0.0588	0.0007	-0.0588	-0.0016	-0.1082	0.0046	-0.0007	-0.0011	-0.2824		-0.0024	-0.1580	-0.0007
28	-0.1099		0.0057*	0.0072*	0.0014	0.0054*	0.0086*	-0.0034		-0.0092*	0.0045	-0.0588	-0.0717	0.0012	-0.1717
29	-0.1472		0.0061	0.0042	-0.0001	-0.0758	-0.0938	0.0054*	-0.1952	-0.0158	0.0006	-0.3048		0.0934	
30	0.0080*		0.0078*		-0.0008	-0.0005	0.0027	-0.0842		-0.0081*	-0.0625	-0.2465	0.0126	0.0991	0.0024
31	-0.0003	-0.0625	0.0019	-0.0015	0.1235	0.0480	-0.0923	0.1664			0.0040*	-0.0016	0.0208	-0.0089	0.0830
32	-0.0884	0.0018	-0.0024	0.0015	-0.0028*	0.0006	-0.0019	-0.0014	-0.0012	0.0009		-0.0012		0.0005	0.0001
33	-0.0021			0.3043	0.0002	0.0028	-0.0017	-0.2949	-0.0005	0.0008		0.3433	-0.0038	-0.0015	-0.0075*
34	0.0023		0.0006	-0.0023	-0.0053*	-0.0695	-0.0072*	-0.0003		-0.0051	0.0819	-0.1309	-0.2293	0.0217	-0.1055
35-36	-0.0011		0.0009	-0.2749	0.1676	0.0040*	0.0069*	0.0033		-0.0057	-0.1147	0.0525		0.4615	-0.0022
37	0.2784	0.0010	-0.0052*	0.0068*	0.0004	-0.0982	-0.0588	-0.0020			-0.0083*	0.0017	-0.0004*	-0.0085	-0.0588
38	-0.0063		-0.1280	-0.0033	-0.0929	-0.0975	0.0002	-0.0121*		-0.1215	-0.0003	0.0064	-0.0220	0.0068*	-0.0024

Source: DEA estimates given in the Appendix table AII.1

Note: The slope coefficients, β, of the regression equation has been reported above. * indicates significant at 5% level of significance.

Table AIII.1: Scale efficiency across state and industry through 1979/80 to 1997/98

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
Industry 20-21															
1979-80	1.000	1.000	0.970	0.974	0.997	0.995	1.000	1.000	1.000	1.000	1.000	1.000	0.991	0.987	0.946
1980-81	0.975	1.000	1.000	0.972	0.990	0.998	1.000	1.000	0.967	1.000	0.983	1.000	1.000	0.994	0.934
1981-82	1.000	1.000	1.000	0.942	0.985	0.995	1.000	1.000	1.000	1.000	0.972	0.963	1.000	0.982	0.986
1982-83	0.973	1.000	0.976	0.946	0.999	0.995	0.992	1.000	1.000	1.000	1.000	1.000	0.994	0.980	0.960
1983-84	1.000	1.000	1.000	0.929	1.000	0.982	1.000	1.000	0.994	0.988	1.000	1.000	0.978	0.889	0.899
1984-85	0.905	1.000	0.967	0.899	0.993	0.993	1.000	0.985	0.945	0.956	1.000	1.000	0.956	0.934	0.912
1985-86	0.972	1.000	0.947	0.941	1.000	1.000	1.000	0.994	0.925	1.000	1.000	1.000	0.947	0.950	0.982
1986-87	0.985	1.000	0.999	0.957	1.000	0.995	1.000	0.997	0.980	1.000	0.995	1.000	0.998	0.985	0.932
1987-88	1.000	1.000	0.980	0.965	1.000	0.995	1.000	1.000	0.963	0.997	0.988	1.000	0.991	1.000	0.982
1988-89	0.942	1.000	1.000	0.926	0.994	0.998	1.000	1.000	0.993	0.945	1.000	1.000	1.000	0.945	0.985
1989-90	1.000	1.000	0.960	1.000	1.000	0.996	1.000	1.000	1.000	0.914	1.000	1.000	1.000	0.939	0.988
1990-91	0.951	1.000	0.942	0.982	0.985	0.974	1.000	1.000	0.930	0.912	0.968	1.000	0.956	0.922	0.963
1991-92	0.979	1.000	0.979	0.964	1.000	0.992	1.000	1.000	0.948	1.000	0.990	1.000	0.986	0.936	0.992
1992-93	0.988	1.000	0.951	0.989	1.000	1.000	1.000	1.000	0.977	1.000	1.000	1.000	1.000	0.960	1.000
1993-94	0.968	1.000	1.000	0.976	0.971	0.993	1.000	1.000	0.951	1.000	1.000	0.981	1.000	0.954	1.000
1994-95	0.980	1.000	0.938	0.950	1.000	0.997	1.000	1.000	1.000	0.961	1.000	1.000	0.995	0.998	0.990
1995-96	0.961	1.000	0.985	0.948	1.000	0.993	1.000	1.000	0.988	1.000	0.982	1.000	0.983	0.981	0.994
1996-97	0.937	1.000	0.921	0.999	1.000	0.992	1.000	1.000	0.976	1.000	0.988	1.000	0.975	0.978	0.947
1997-98	0.970	1.000	1.000	1.000	0.994	1.000	1.000	1.000	0.953	1.000	1.000	1.000	1.000	0.937	0.996
Industry 22															
1979-80	1.000	1.000	0.990	1.000	0.978	0.975	1.000	1.000	0.749	0.997	0.984	0.955	0.984	0.889	0.995
1980-81	1.000	1.000	0.995	1.000	0.964	0.981	0.978	1.000	0.806	0.935	0.991	0.924	0.969	0.891	0.989
1981-82	1.000	1.000	0.995	1.000	0.977	0.999	0.981	1.000	0.768	0.925	1.000	0.975	0.978	0.846	0.983
1982-83	1.000	0.000	1.000	1.000	0.850	0.979	1.000	1.000	0.774	0.878	0.946	0.818	1.000	0.931	0.968
1983-84	0.973	0.000	0.958	1.000	0.808	1.000	0.950	1.000	0.999	0.659	0.915	0.518	0.994	0.958	0.928
1984-85	0.916	1.000	0.978	1.000	0.935	1.000	1.000	1.000	0.809	0.966	0.973	0.975	1.000	0.897	0.997
1985-86	0.965	0.829	0.997	1.000	0.953	0.999	1.000	1.000	0.783	1.000	0.947	0.993	0.887	0.921	0.998
1986-87	0.788	1.000	0.966	0.978	0.923	0.999	0.988	1.000	0.759	0.922	0.985	0.976	0.988	0.952	1.000

1987-88	0.791	1.000	1.000	0.978	0.973	1.000	1.000	1.000	0.880	1.000	0.938	0.971	1.000	1.000	1.000
1988-89	0.764	1.000	1.000	0.979	1.000	0.983	1.000	1.000	0.888	0.832	0.999	0.997	1.000	0.773	0.947
1989-90	1.000	1.000	1.000	1.000	0.976	1.000	1.000	1.000	0.823	0.813	0.986	0.978	1.000	0.947	1.000
1990-91	0.864	1.000	1.000	0.984	0.996	0.978	1.000	1.000	0.831	0.789	0.989	0.992	1.000	0.881	0.998
1991-92	0.927	0.597	1.000	0.986	0.966	1.000	1.000	1.000	0.784	0.806	1.000	0.835	1.000	0.806	0.983
1992-93	0.896	0.000	1.000	0.963	0.962	0.989	1.000	1.000	0.854	0.822	0.982	0.920	1.000	0.947	0.937
1993-94	1.000	1.000	1.000	0.993	1.000	0.998	1.000	1.000	0.798	0.899	0.996	0.941	0.999	0.832	1.000
1994-95	1.000	1.000	1.000	0.990	0.997	1.000	1.000	1.000	0.788	0.795	0.999	0.981	1.000	0.808	0.999
1995-96	0.839	1.000	1.000	1.000	0.998	0.999	0.982	0.915	0.719	0.867	0.998	1.000	1.000	0.818	0.919
1996-97	1.000	0.000	1.000	0.962	0.832	0.947	1.000	0.995	0.745	0.528	0.965	0.644	1.000	0.720	0.923
1997-98	0.907	0.000	1.000	0.982	0.875	0.987	1.000	0.978	0.743	0.852	0.979	0.971	1.000	0.776	1.000
Industry 23															
1979-80	0.987	0.890	0.978	1.000	1.000	0.997	1.000	1.000	1.000	0.989	0.999	0.980	1.000	1.000	1.000
1980-81	1.000	0.968	0.975	1.000	0.999	1.000	1.000	1.000	1.000	0.986	1.000	1.000	1.000	0.999	0.987
1981-82	0.972	0.935	0.869	0.968	1.000	0.998	1.000	0.995	1.000	0.918	1.000	1.000	0.941	0.963	1.000
1982-83	0.946	0.877	0.932	0.891	0.980	0.864	1.000	1.000	0.810	1.000	1.000	0.954	0.925	0.830	0.839
1983-84	1.000	0.900	0.929	0.980	0.983	1.000	1.000	1.000	0.982	0.977	1.000	1.000	0.970	0.963	0.997
1984-85	0.969	0.934	0.783	0.939	0.997	1.000	1.000	0.994	0.980	0.982	1.000	0.999	1.000	0.988	0.999
1985-86	0.986	0.992	0.913	1.000	1.000	1.000	1.000	0.999	1.000	0.996	1.000	1.000	1.000	0.969	0.996
1986-87	0.986	0.994	0.904	0.953	0.995	1.000	1.000	1.000	1.000	0.999	1.000	0.999	1.000	0.975	0.998
1987-88	0.975	1.000	0.995	0.984	1.000	1.000	0.998	0.937	1.000	1.000	1.000	0.912	0.979	0.967	0.999
1988-89	0.991	1.000	0.996	0.958	0.996	1.000	0.997	0.958	1.000	0.993	1.000	1.000	0.971	0.938	0.999
1989-90	0.976	0.999	1.000	0.995	1.000	1.000	1.000	0.955	1.000	0.997	1.000	1.000	1.000	0.984	1.000
1990-91	0.999	1.000	1.000	0.929	1.000	1.000	1.000	0.938	1.000	0.998	1.000	1.000	1.000	0.988	0.968
1991-92	0.999	0.914	1.000	0.950	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.989
1992-93	0.997	0.958	1.000	1.000	1.000	0.999	1.000	0.998	1.000	0.998	1.000	1.000	1.000	1.000	0.998
1993-94	1.000	0.937	1.000	0.994	0.918	0.985	1.000	0.989	0.950	0.948	1.000	1.000	1.000	0.956	0.915
1994-95	0.948	1.000	1.000	0.937	1.000	1.000	0.948	1.000	0.985	0.997	1.000	1.000	0.918	1.000	0.999
1995-96	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000	0.979
1996-97	0.916	1.000	1.000	0.836	1.000	0.959	0.990	1.000	0.966	1.000	1.000	0.998	0.868	0.998	1.000
1997-98	1.000	1.000	0.951	0.999	0.992	1.000	1.000	1.000	0.957	0.955	0.998	1.000	1.000	0.978	0.998

Industry 24															
1979-80	1.000	0.000	1.000	1.000	0.999	1.000	0.956	0.998	1.000	0.000	1.000	0.973	0.999	0.843	1.000
1980-81	1.000	0.000	1.000	1.000	0.989	1.000	0.828	0.963	0.989	0.000	1.000	0.991	0.963	0.834	1.000
1981-82	0.987	0.000	1.000	1.000	1.000	0.998	0.836	1.000	1.000	0.000	1.000	0.973	0.999	0.888	1.000
1982-83	1.000	1.000	0.929	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	0.998	0.999	0.986	1.000
1983-84	1.000	0.000	0.846	1.000	0.996	1.000	0.000	0.999	0.993	0.000	1.000	0.990	1.000	1.000	1.000
1984-85	0.979	0.000	1.000	1.000	0.998	1.000	1.000	0.998	1.000	0.000	1.000	0.998	1.000	1.000	1.000
1985-86	1.000	1.000	0.948	1.000	0.999	0.880	1.000	1.000	1.000	0.000	1.000	0.990	0.999	1.000	0.999
1986-87	1.000	0.000	0.838	1.000	1.000	1.000	0.000	1.000	1.000	0.000	1.000	1.000	0.995	1.000	1.000
1987-88	0.957	1.000	0.960	1.000	0.996	1.000	0.000	1.000	1.000	0.000	0.999	1.000	0.999	1.000	1.000
1988-89	1.000	0.981	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.000	1.000	0.991	1.000	1.000	0.986
1989-90	0.966	1.000	1.000	0.991	1.000	1.000	0.995	1.000	0.943	0.000	1.000	1.000	1.000	1.000	0.938
1990-91	0.949	1.000	0.887	0.995	1.000	1.000	0.000	1.000	1.000	1.000	1.000	1.000	0.981	0.936	0.974
1991-92	0.999	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000	0.911	0.993	0.946	0.965
1992-93	1.000	0.916	0.766	0.843	0.949	1.000	0.000	0.887	0.943	1.000	0.846	0.868	0.941	0.911	0.991
1993-94	1.000	0.875	1.000	0.995	0.943	1.000	0.937	1.000	1.000	1.000	0.849	0.864	0.909	0.886	1.000
1994-95	1.000	0.952	1.000	0.849	0.974	0.861	1.000	0.820	0.688	0.480	0.826	0.876	1.000	0.915	0.995
1995-96	1.000	1.000	1.000	0.921	0.976	1.000	0.000	1.000	0.880	0.756	0.990	1.000	1.000	1.000	0.999
1996-97	1.000	0.843	1.000	1.000	0.993	1.000	1.000	0.990	0.911	1.000	0.953	0.983	0.976	0.989	0.999
1997-98	0.999	1.000	1.000	0.964	1.000	1.000	1.000	1.000	0.895	0.000	1.000	0.879	0.999	1.000	0.999
Industry 26															
1979-80	0.997	0.986	0.791	0.978	0.942	0.971	0.952	0.989	0.842	1.000	1.000	1.000	0.962	0.918	0.969
1980-81	0.989	1.000	0.871	0.992	1.000	0.975	0.943	0.993	0.840	0.771	1.000	1.000	0.978	0.979	0.968
1981-82	0.976	1.000	0.886	0.996	0.994	1.000	0.914	0.994	0.889	0.860	1.000	1.000	0.987	1.000	0.999
1982-83	0.945	0.000	0.712	0.996	1.000	0.996	0.999	0.896	0.791	1.000	1.000	0.989	0.995	0.947	0.994
1983-84	1.000	0.000	0.775	0.998	0.993	1.000	0.937	0.918	0.852	0.930	1.000	0.994	0.997	1.000	0.993
1984-85	0.903	0.000	0.529	0.999	0.932	0.994	0.998	0.679	0.747	0.762	1.000	0.931	1.000	0.995	1.000
1985-86	0.987	0.000	0.879	0.986	1.000	1.000	1.000	1.000	0.974	0.930	1.000	1.000	1.000	1.000	1.000
1986-87	1.000	0.000	0.982	0.974	1.000	1.000	0.997	0.837	0.920	0.848	1.000	1.000	1.000	0.993	1.000
1987-88	0.964	0.000	0.779	1.000	1.000	1.000	0.998	0.933	0.853	0.804	1.000	1.000	1.000	1.000	1.000
1988-89	0.958	0.000	0.734	0.978	1.000	0.996	0.991	0.961	0.914	0.807	1.000	1.000	1.000	1.000	0.976

1989-90	0.995	1.000	0.969	0.978	0.998	0.933	0.974	0.998	0.976	0.991	1.000	1.000	1.000	1.000	1.000
1990-91	0.998	0.664	1.000	1.000	0.975	0.927	1.000	0.991	0.890	0.987	0.916	1.000	0.958	0.932	0.983
1991-92	0.953	0.605	0.686	0.978	0.979	1.000	0.945	0.875	1.000	0.810	1.000	1.000	1.000	0.860	0.979
1992-93	0.986	0.848	0.686	0.978	1.000	0.942	0.884	0.978	0.908	0.742	1.000	1.000	1.000	0.807	0.994
1993-94	0.978	1.000	0.677	0.997	0.990	1.000	1.000	0.934	1.000	0.921	0.998	1.000	1.000	0.997	0.992
1994-95	1.000	0.966	0.820	0.948	0.966	0.953	1.000	0.999	0.902	0.999	0.961	1.000	0.877	0.928	1.000
1995-96	0.997	0.000	0.944	0.999	1.000	1.000	1.000	0.979	1.000	0.871	0.990	0.991	1.000	0.996	1.000
1996-97	0.999	1.000	0.960	1.000	1.000	1.000	0.811	0.986	0.994	0.976	0.957	0.999	1.000	1.000	0.999
1997-98	1.000	0.000	0.995	1.000	0.941	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.905	1.000
Industry 27															
1979-80	0.977	0.848	0.998	1.000	1.000	0.872	0.826	0.975	0.859	1.000	0.846	1.000	0.921	0.986	0.913
1980-81	0.966	0.924	1.000	0.990	1.000	0.996	0.998	0.982	1.000	0.997	0.995	1.000	0.945	1.000	0.972
1981-82	0.940	0.904	0.999	1.000	1.000	0.961	0.890	0.980	0.899	1.000	1.000	1.000	1.000	0.957	0.965
1982-83	0.983	0.868	0.992	0.990	1.000	0.961	0.975	0.941	0.906	1.000	0.994	1.000	1.000	0.985	0.947
1983-84	0.993	0.938	0.989	0.997	1.000	0.976	1.000	0.999	0.930	0.990	1.000	0.794	1.000	0.987	1.000
1984-85	0.995	1.000	1.000	1.000	1.000	0.978	0.967	1.000	1.000	1.000	0.967	0.970	1.000	0.988	1.000
1985-86	1.000	0.966	0.990	1.000	1.000	1.000	0.956	1.000	1.000	0.998	0.965	0.840	0.937	1.000	1.000
1986-87	0.995	1.000	0.961	1.000	1.000	1.000	0.967	1.000	1.000	1.000	0.938	1.000	1.000	1.000	0.994
1987-88	1.000	0.984	0.992	0.998	1.000	1.000	0.962	1.000	1.000	0.997	0.957	0.892	1.000	0.995	1.000
1988-89	1.000	1.000	1.000	0.999	1.000	0.932	0.991	0.999	1.000	1.000	0.932	0.969	0.978	0.996	1.000
1989-90	1.000	0.958	1.000	1.000	1.000	0.924	0.938	0.973	0.974	1.000	0.991	0.983	1.000	1.000	0.972
1990-91	1.000	1.000	0.991	1.000	1.000	0.998	0.956	0.998	1.000	1.000	0.974	0.919	1.000	0.997	0.972
1991-92	1.000	1.000	1.000	0.997	1.000	0.991	1.000	1.000	0.998	1.000	0.925	0.883	0.999	0.985	0.998
1992-93	1.000	1.000	0.977	1.000	1.000	0.960	0.854	0.999	0.958	1.000	0.909	0.941	0.987	1.000	0.922
1993-94	1.000	1.000	0.983	0.995	1.000	0.988	1.000	0.989	0.997	1.000	0.970	1.000	1.000	0.951	0.986
1994-95	0.906	1.000	0.970	0.989	1.000	0.987	1.000	1.000	1.000	1.000	0.950	0.889	0.989	0.994	0.957
1995-96	1.000	1.000	1.000	0.894	1.000	0.951	0.933	0.956	0.971	1.000	0.886	1.000	0.971	0.997	0.883
1996-97	0.891	0.640	0.905	0.971	0.870	0.928	1.000	0.906	1.000	0.842	0.949	0.774	0.943	1.000	1.000
1997-98	1.000	1.000	0.786	0.973	1.000	0.985	0.731	1.000	0.970	0.959	0.517	0.843	1.000	0.684	0.849

Industry 28															
1979-80	0.965	1.000	0.995	0.995	0.996	0.941	0.995	0.969	1.000	1.000	0.842	1.000	1.000	0.998	0.968
1980-81	0.972	1.000	1.000	0.996	1.000	0.963	1.000	0.991	1.000	1.000	0.791	1.000	0.944	0.984	0.961
1981-82	1.000	1.000	1.000	0.997	1.000	0.997	0.996	0.997	1.000	1.000	0.848	1.000	0.962	0.990	0.944
1982-83	1.000	1.000	0.970	0.999	1.000	0.999	0.963	0.999	1.000	1.000	0.965	1.000	0.992	0.974	0.946
1983-84	0.930	1.000	0.973	0.998	0.996	0.929	0.991	0.999	1.000	1.000	0.963	1.000	0.983	0.980	1.000
1984-85	0.968	1.000	0.931	1.000	0.946	1.000	0.970	1.000	1.000	1.000	0.833	1.000	1.000	0.997	1.000
1985-86	0.943	1.000	1.000	1.000	0.986	0.980	1.000	1.000	1.000	0.982	0.972	0.996	0.991	0.968	1.000
1986-87	0.969	0.904	1.000	1.000	1.000	0.996	0.987	1.000	1.000	1.000	0.892	0.995	1.000	0.999	0.906
1987-88	0.890	1.000	1.000	1.000	0.993	0.864	1.000	0.915	1.000	1.000	0.953	1.000	0.954	0.966	0.968
1988-89	0.999	0.953	0.980	1.000	0.953	0.992	0.984	1.000	0.935	0.966	0.750	1.000	1.000	0.975	0.897
1989-90	0.949	1.000	0.875	1.000	0.988	0.986	0.943	0.888	1.000	0.926	1.000	1.000	1.000	0.992	0.887
1990-91	1.000	0.864	1.000	1.000	1.000	0.992	0.997	1.000	0.975	0.963	0.983	1.000	1.000	0.987	0.981
1991-92	0.992	1.000	1.000	1.000	0.993	0.997	1.000	0.962	0.989	0.999	1.000	1.000	1.000	0.993	0.965
1992-93	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.990	0.946	0.997	1.000	1.000	1.000	0.993	0.985
1993-94	1.000	0.923	1.000	0.994	1.000	1.000	0.998	0.987	0.942	0.962	0.969	1.000	1.000	0.985	0.996
1994-95	0.974	1.000	1.000	1.000	0.995	1.000	0.996	0.956	1.000	0.981	1.000	1.000	0.948	0.881	0.935
1995-96	0.950	1.000	1.000	1.000	0.978	1.000	1.000	0.991	1.000	1.000	1.000	1.000	0.951	0.962	0.993
1996-97	0.950	1.000	1.000	1.000	1.000	0.957	1.000	0.979	0.999	0.993	1.000	1.000	1.000	0.980	1.000
1997-98	0.979	1.000	1.000	0.935	1.000	0.948	1.000	1.000	1.000	0.990	1.000	1.000	0.981	0.952	1.000
Industry 29															
1979-80	0.817		1.000	1.000	1.000	0.994	1.000	0.793	1.000	1.000	0.966	0.000	1.000	0.844	0.968
1980-81	0.710		1.000	0.955	1.000	1.000	0.000	0.671	1.000	1.000	0.945	0.966	0.760	0.786	0.957
1981-82	0.938		0.800	0.931	1.000	0.942	0.827	0.653	0.755	1.000	0.816	0.915	0.615	0.640	1.000
1982-83	1.000		0.928	0.919	0.943	0.959	0.000	0.977	1.000	1.000	1.000	0.841	1.000	0.851	1.000
1983-84	0.951		0.882	0.867	1.000	1.000	0.614	0.906	1.000	1.000	0.981	0.000	0.851	0.843	0.965
1984-85	0.955		0.998	0.963	1.000	1.000	0.000	1.000	0.965	1.000	0.875	0.819	1.000	0.992	1.000
1985-86	0.999		0.931	1.000	1.000	1.000	0.469	1.000	1.000	1.000	0.995	0.000	0.958	0.962	0.892
1986-87	0.939		0.996	0.990	1.000	1.000	1.000	1.000	0.989	0.978	0.996	0.943	0.984	0.974	1.000
1987-88	1.000		1.000	0.993	0.997	1.000	0.000	1.000	1.000	0.924	0.999	0.000	1.000	0.972	1.000

1988-89	0.991		0.988	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.932	0.936	1.000
1989-90	0.999		0.995	0.975	1.000	1.000	0.000	1.000	1.000	1.000	0.996	0.000	0.907	0.919	1.000
1990-91	1.000		0.982	0.974	1.000	1.000	0.000	1.000	1.000	0.883	0.979	1.000	0.913	0.946	1.000
1991-92	0.988		1.000	0.954	1.000	1.000	0.000	0.999	1.000	1.000	1.000	0.000	0.958	0.964	1.000
1992-93	0.993		0.998	0.956	1.000	1.000	0.000	1.000	1.000	1.000	0.999	1.000	0.935	0.884	0.824
1993-94	0.964		1.000	0.984	1.000	1.000	1.000	1.000	0.998	0.907	0.993	1.000	1.000	1.000	1.000
1994-95	0.996		1.000	0.999	0.989	1.000	1.000	0.970	1.000	0.931	0.999	1.000	0.940	0.929	1.000
1995-96	0.991		1.000	0.981	0.997	1.000	1.000	0.959	1.000	1.000	0.991	1.000	0.966	0.968	1.000
1996-97	0.964		1.000	0.985	0.962	1.000	1.000	1.000	1.000	0.990	1.000	1.000	0.911	0.889	0.877
1997-98	0.538		1.000	0.789	1.000	1.000	0.000	1.000	1.000	0.000	0.940	1.000	0.920	1.000	1.000
Industry 30															
1979-80	0.933	1.000	0.999	1.000	0.950	1.000	0.997	1.000	1.000	0.875	1.000	0.932	1.000	0.985	1.000
1980-81	0.925	0.860	0.988	0.828	0.858	1.000	0.994	0.990	1.000	0.763	1.000	0.949	1.000	0.975	0.978
1981-82	0.917	1.000	0.903	0.847	1.000	1.000	0.994	0.948	1.000	0.710	1.000	1.000	1.000	0.877	1.000
1982-83	0.944	1.000	0.938	0.868	1.000	1.000	0.994	0.978	1.000	0.604	1.000	0.874	1.000	0.910	0.948
1983-84	0.970	1.000	0.909	0.960	0.949	1.000	1.000	1.000	1.000	0.740	1.000	1.000	1.000	0.921	0.973
1984-85	0.982	1.000	0.982	0.976	1.000	1.000	1.000	1.000	1.000	0.930	1.000	1.000	1.000	0.969	0.949
1985-86	0.993	1.000	1.000	1.000	0.970	1.000	0.999	1.000	1.000	0.925	1.000	0.996	0.998	0.980	0.999
1986-87	0.989	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.996	1.000	1.000	0.958	0.965	0.977
1987-88	0.951	1.000	1.000	1.000	1.000	0.994	1.000	1.000	1.000	0.999	1.000	0.986	1.000	0.995	0.952
1988-89	0.981	0.825	1.000	1.000	1.000	0.909	0.991	1.000	1.000	0.762	0.997	0.998	1.000	0.989	1.000
1989-90	0.999	1.000	1.000	1.000	0.938	1.000	1.000	1.000	1.000	0.982	0.947	1.000	0.962	1.000	1.000
1990-91	0.993	1.000	1.000	0.998	0.999	1.000	0.999	1.000	1.000	0.994	0.993	1.000	1.000	0.940	1.000
1991-92	1.000	1.000	1.000	1.000	0.996	1.000	0.999	1.000	0.957	0.986	1.000	0.990	0.983	1.000	1.000
1992-93	1.000	0.976	1.000	0.990	0.935	0.977	0.989	1.000	1.000	0.850	1.000	1.000	0.993	1.000	1.000
1993-94	0.999	1.000	0.995	0.975	1.000	0.987	0.998	0.999	1.000	0.988	1.000	1.000	0.998	1.000	1.000
1994-95	0.927	0.874	0.991	0.908	0.896	1.000	0.989	1.000	0.907	0.834	1.000	1.000	0.899	0.931	1.000
1995-96	1.000	0.888	1.000	0.942	1.000	0.981	0.996	1.000	1.000	0.902	1.000	1.000	1.000	0.968	1.000
1996-97	0.999	1.000	1.000	1.000	0.943	1.000	0.984	1.000	1.000	0.844	1.000	1.000	0.984	1.000	1.000
1997-98	0.996	0.890	0.953	0.986	0.937	1.000	0.996	1.000	1.000	0.993	1.000	1.000	1.000	0.979	1.000

Industry 31															
1979-80	0.997	1.000	0.866	0.911	1.000	0.994	1.000	1.000	0.843	0.811	0.997	1.000	1.000	0.919	0.811
1980-81	0.991	1.000	1.000	1.000	1.000	0.997	1.000	1.000	1.000	0.931	0.998	0.999	1.000	0.982	0.978
1981-82	0.993	1.000	1.000	1.000	1.000	0.998	1.000	0.895	0.997	0.947	0.991	1.000	1.000	1.000	0.966
1982-83	1.000	1.000	1.000	1.000	1.000	0.956	0.989	1.000	0.923	1.000	1.000	1.000	0.931	0.946	0.918
1983-84	0.999	0.996	0.996	1.000	1.000	0.999	0.996	0.932	0.833	0.953	0.984	1.000	0.911	0.934	0.957
1984-85	0.999	1.000	0.953	1.000	1.000	0.991	1.000	1.000	0.877	1.000	0.998	0.995	0.960	0.924	0.887
1985-86	0.998	1.000	0.999	1.000	1.000	0.999	0.998	0.945	1.000	0.958	1.000	0.997	1.000	0.999	0.994
1986-87	0.995	1.000	0.998	1.000	1.000	0.994	0.998	0.968	0.979	0.885	1.000	0.992	0.990	1.000	0.987
1987-88	0.999	1.000	1.000	0.998	0.990	0.991	1.000	1.000	0.884	0.853	1.000	0.990	0.947	1.000	1.000
1988-89	0.991	1.000	1.000	1.000	1.000	0.990	0.996	1.000	1.000	1.000	0.932	1.000	1.000	0.997	0.977
1989-90	0.999	1.000	0.999	1.000	1.000	0.997	1.000	0.991	0.868	0.933	0.955	0.997	0.901	1.000	1.000
1990-91	0.999	1.000	1.000	0.954	0.990	0.992	1.000	0.977	1.000	1.000	1.000	1.000	0.979	0.969	0.999
1991-92	0.992	1.000	1.000	1.000	0.987	0.917	1.000	0.543	0.961	0.975	1.000	0.982	1.000	1.000	0.975
1992-93	0.967	1.000	1.000	1.000	0.991	0.896	1.000	0.958	0.925	0.977	0.903	0.964	1.000	1.000	0.999
1993-94	0.998	1.000	1.000	1.000	0.957	1.000	1.000	0.898	1.000	0.853	1.000	0.956	0.997	1.000	0.951
1994-95	1.000	1.000	1.000	1.000	0.997	0.944	0.997	0.851	0.897	1.000	0.999	0.835	0.945	1.000	0.917
1995-96	0.954	1.000	1.000	1.000	0.985	0.973	1.000	0.932	0.863	1.000	1.000	0.908	0.974	1.000	0.978
1996-97	0.975	1.000	1.000	1.000	0.985	0.950	1.000	0.878	0.919	1.000	1.000	0.887	0.996	1.000	0.998
1997-98	0.993	1.000	0.915	0.965	1.000	0.994	1.000	1.000	0.959	1.000	0.974	1.000	0.950	1.000	0.935
Industry 32															
1979-80	1.000	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	0.985	1.000	0.994	0.943	0.997	0.997
1980-81	1.000	1.000	0.975	1.000	1.000	0.996	1.000	1.000	1.000	0.911	1.000	1.000	0.964	0.999	1.000
1981-82	0.994	1.000	0.974	1.000	1.000	1.000	1.000	1.000	1.000	0.973	0.916	0.992	0.983	1.000	0.999
1982-83	1.000	1.000	0.913	0.931	1.000	0.970	1.000	1.000	0.997	1.000	1.000	1.000	1.000	0.999	1.000
1983-84	1.000	0.946	0.934	0.918	1.000	0.981	1.000	1.000	0.980	0.992	1.000	1.000	0.918	1.000	1.000
1984-85	1.000	0.952	0.991	0.978	1.000	0.984	1.000	1.000	1.000	0.985	0.833	1.000	1.000	0.991	1.000
1985-86	0.946	1.000	0.836	0.824	1.000	0.949	0.821	1.000	0.969	1.000	0.822	0.971	0.965	0.909	1.000
1986-87	1.000	0.880	0.966	0.986	1.000	1.000	1.000	1.000	1.000	1.000	0.869	1.000	1.000	0.937	1.000
1987-88	0.983	0.900	1.000	0.998	1.000	1.000	1.000	1.000	0.990	1.000	0.851	0.991	1.000	1.000	1.000

1988-89	0.921	1.000	1.000	0.967	1.000	1.000	1.000	0.889	1.000	1.000	0.954	1.000	0.973	0.911	1.000
1989-90	1.000	1.000	1.000	0.937	1.000	1.000	0.981	1.000	1.000	1.000	1.000	0.998	0.986	1.000	1.000
1990-91	0.992	0.881	1.000	0.949	0.996	1.000	1.000	1.000	1.000	1.000	0.924	0.997	1.000	1.000	1.000
1991-92	1.000	1.000	0.992	0.987	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.997	1.000	0.997	1.000
1992-93	1.000	1.000	1.000	0.977	0.996	1.000	1.000	1.000	0.934	1.000	1.000	0.997	1.000	0.999	0.996
1993-94	1.000	0.995	0.991	0.976	0.994	1.000	1.000	0.953	0.960	1.000	0.789	0.999	1.000	1.000	1.000
1994-95	1.000	1.000	0.809	1.000	0.938	0.981	1.000	0.956	0.883	1.000	0.910	0.998	1.000	0.893	1.000
1995-96	1.000	1.000	0.990	0.993	1.000	0.999	1.000	1.000	0.956	1.000	1.000	1.000	1.000	0.997	1.000
1996-97	1.000	1.000	0.977	1.000	0.999	1.000	1.000	0.935	1.000	1.000	1.000	0.998	1.000	0.995	0.979
1997-98	1.000	1.000	0.941	1.000	1.000	1.000	0.999	0.983	0.977	1.000	1.000	0.986	1.000	0.991	1.000
Industry 33															
1979-80	0.997	1.000	1.000	1.000	1.000	0.994	1.000	0.983	1.000	1.000	1.000	1.000	1.000	1.000	0.859
1980-81	1.000	1.000	0.908	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	0.997	0.999	0.983	0.992
1981-82	0.989	0.941	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.991	0.999	0.988	0.956
1982-83	0.986	1.000	1.000	1.000	1.000	0.988	1.000	0.992	0.902	1.000	1.000	0.987	1.000	0.957	0.924
1983-84	1.000	1.000	1.000	1.000	1.000	0.993	0.975	1.000	1.000	1.000	1.000	0.998	1.000	1.000	0.945
1984-85	1.000	1.000	1.000	0.998	1.000	0.999	0.998	0.967	1.000	0.991	1.000	0.999	0.987	1.000	0.959
1985-86	1.000	1.000	1.000	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986-87	1.000	1.000	1.000	0.986	1.000	0.963	1.000	0.983	1.000	0.950	1.000	1.000	0.911	1.000	0.904
1987-88	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.996	1.000	0.999
1988-89	1.000	1.000	1.000	0.997	1.000	1.000	1.000	0.994	0.986	1.000	1.000	0.990	0.991	1.000	0.985
1989-90	0.998	1.000	1.000	0.994	1.000	1.000	1.000	1.000	0.959	1.000	1.000	0.987	0.984	1.000	0.997
1990-91	1.000	1.000	1.000	1.000	1.000	1.000	0.936	0.894	0.923	0.998	1.000	0.996	1.000	1.000	0.905
1991-92	0.996	1.000	1.000	0.987	1.000	1.000	1.000	0.984	0.946	0.989	1.000	0.999	1.000	1.000	0.987
1992-93	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.987	1.000	1.000	0.997	0.998	1.000	1.000
1993-94	0.948	1.000	1.000	1.000	1.000	1.000	1.000	0.968	0.912	1.000	1.000	0.952	0.901	0.960	0.915
1994-95	0.726	1.000	0.999	0.876	0.976	0.717	0.908	0.811	0.701	0.950	1.000	0.727	0.714	0.928	0.777
1995-96	1.000	0.973	1.000	0.987	1.000	1.000	1.000	0.979	0.985	0.974	1.000	0.984	0.999	1.000	1.000
1996-97	1.000	0.977	1.000	0.967	1.000	0.935	1.000	0.876	0.889	1.000	1.000	0.985	0.995	0.959	0.999
1997-98	1.000	1.000	1.000	1.000	1.000	0.921	0.998	1.000	0.881	0.981	1.000	0.993	0.998	0.994	0.991

Industry 34															
1979-80	1.000	1.000	0.964	0.957	1.000	0.999	0.999	1.000	1.000	0.943	1.000	1.000	1.000	1.000	0.982
1980-81	1.000	1.000	0.964	1.000	1.000	1.000	0.978	0.997	0.964	0.857	1.000	1.000	1.000	0.999	0.957
1981-82	0.971	1.000	0.980	0.980	1.000	0.992	0.996	0.990	1.000	1.000	1.000	0.940	1.000	0.938	0.998
1982-83	0.983	1.000	0.961	1.000	1.000	1.000	0.974	0.980	0.986	0.947	0.996	0.966	1.000	0.996	1.000
1983-84	0.979	1.000	0.949	0.986	1.000	1.000	0.993	1.000	1.000	1.000	0.998	1.000	1.000	0.997	1.000
1984-85	1.000	1.000	0.999	0.945	0.967	0.997	0.995	1.000	1.000	1.000	0.967	0.991	1.000	0.973	1.000
1985-86	0.978	1.000	0.998	1.000	0.938	1.000	0.991	0.937	1.000	1.000	1.000	1.000	0.979	0.985	0.969
1986-87	0.950	1.000	0.973	0.844	0.901	0.896	0.989	1.000	0.965	1.000	0.916	0.954	0.940	0.987	0.983
1987-88	0.984	1.000	0.998	0.956	0.965	1.000	0.998	1.000	0.970	1.000	1.000	1.000	0.980	0.985	1.000
1988-89	0.975	1.000	1.000	0.989	0.981	0.910	0.993	1.000	0.970	0.989	1.000	0.977	0.924	0.961	0.931
1989-90	0.984	1.000	1.000	0.970	1.000	1.000	0.964	0.996	0.989	0.988	1.000	0.935	0.993	1.000	1.000
1990-91	0.977	1.000	0.964	1.000	1.000	1.000	0.995	0.992	0.902	1.000	0.987	0.998	0.979	0.987	0.986
1991-92	0.982	1.000	0.993	1.000	0.980	1.000	0.998	1.000	0.923	1.000	1.000	0.959	1.000	1.000	1.000
1992-93	0.973	1.000	0.978	0.920	1.000	1.000	0.990	1.000	0.954	1.000	1.000	1.000	1.000	0.889	0.985
1993-94	1.000	1.000	0.953	1.000	0.995	1.000	0.993	0.986	0.909	0.999	1.000	0.982	0.956	0.998	1.000
1994-95	0.980	1.000	0.978	1.000	0.998	1.000	0.997	1.000	0.925	1.000	1.000	0.999	0.994	1.000	1.000
1995-96	1.000	1.000	0.925	0.932	0.995	1.000	0.995	1.000	0.962	0.985	1.000	1.000	0.994	1.000	1.000
1996-97	1.000	1.000	1.000	0.973	1.000	1.000	0.988	1.000	0.915	0.997	1.000	1.000	1.000	1.000	1.000
1997-98	0.842	1.000	0.944	0.843	0.803	0.933	0.988	0.968	0.815	0.989	1.000	1.000	0.890	0.850	1.000
Industry 35-6															
1979-80	0.989	1.000	0.999	0.992	1.000	1.000	1.000	1.000	1.000	0.998	0.999	0.997	1.000	0.985	1.000
1980-81	1.000	1.000	0.999	1.000	1.000	0.993	0.997	0.998	1.000	0.977	1.000	0.994	1.000	1.000	0.976
1981-82	1.000	0.999	0.999	1.000	1.000	0.999	0.994	0.996	1.000	1.000	0.996	0.992	1.000	0.999	1.000
1982-83	1.000	1.000	0.990	0.992	1.000	1.000	0.992	0.979	1.000	0.999	1.000	0.982	1.000	0.992	1.000
1983-84	1.000	1.000	1.000	0.975	1.000	1.000	0.978	0.996	0.967	0.935	0.995	0.992	1.000	0.999	1.000
1984-85	1.000	0.998	1.000	0.977	1.000	1.000	1.000	0.990	1.000	0.942	0.992	0.997	1.000	0.967	1.000
1985-86	0.979	1.000	1.000	1.000	1.000	1.000	1.000	0.989	0.966	1.000	1.000	0.999	1.000	0.984	0.886
1986-87	1.000	0.947	1.000	1.000	1.000	0.963	1.000	0.997	1.000	1.000	1.000	1.000	1.000	0.985	0.973
1987-88	0.996	1.000	1.000	1.000	1.000	0.976	0.958	0.990	0.978	1.000	1.000	0.984	1.000	0.967	0.968
1988-89	0.988	0.987	1.000	1.000	1.000	0.988	0.984	1.000	0.961	1.000	1.000	1.000	1.000	0.957	0.990

1989-90	1.000	1.000	1.000	1.000	1.000	0.977	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000
1990-91	1.000	1.000	0.971	1.000	1.000	1.000	0.977	1.000	0.999	1.000	0.976	0.979	1.000	0.968	0.967
1991-92	1.000	1.000	1.000	1.000	0.999	1.000	0.997	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000
1992-93	0.982	1.000	0.995	0.995	0.999	1.000	1.000	0.985	0.960	1.000	1.000	0.995	1.000	1.000	0.981
1993-94	0.967	1.000	1.000	1.000	0.999	0.916	1.000	0.953	1.000	1.000	1.000	0.993	1.000	1.000	0.999
Industry 37															
1979-80	0.990	0.968	0.866	0.841	0.749	1.000	1.000	1.000	0.788	1.000	0.837	0.946	0.798	0.869	0.896
1980-81	0.994	1.000	1.000	0.992	1.000	1.000	1.000	0.986	0.987	1.000	1.000	0.893	0.960	0.963	0.927
1981-82	0.992	1.000	1.000	0.982	0.949	1.000	1.000	0.989	0.992	1.000	1.000	0.922	1.000	0.971	0.903
1982-83	0.624	1.000	0.769	0.805	0.887	0.645	0.659	0.776	0.807	1.000	1.000	0.716	0.826	0.695	0.517
1983-84	0.999	1.000	0.923	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.998	0.973	0.992	1.000
1984-85	1.000	1.000	1.000	0.996	1.000	1.000	1.000	0.992	1.000	1.000	1.000	1.000	1.000	0.984	0.920
1985-86	0.886	1.000	0.950	0.976	0.867	1.000	1.000	0.997	0.959	1.000	0.869	0.993	0.894	0.955	0.926
1986-87	0.997	1.000	0.966	0.995	1.000	1.000	1.000	0.997	0.983	1.000	1.000	1.000	1.000	0.988	1.000
1987-88	0.904	1.000	0.765	0.950	1.000	0.862	1.000	1.000	0.837	1.000	1.000	1.000	0.879	0.885	0.938
1988-89	0.810	1.000	0.934	0.954	1.000	0.943	0.707	1.000	0.959	1.000	1.000	0.961	0.882	0.890	0.773
1989-90	0.967	1.000	1.000	1.000	0.974	0.994	0.997	1.000	0.900	1.000	1.000	0.947	1.000	1.000	0.920
1990-91	0.990	1.000	0.985	1.000	1.000	0.993	1.000	1.000	0.922	1.000	1.000	0.998	1.000	1.000	1.000
1991-92	0.985	1.000	0.975	0.909	1.000	1.000	1.000	0.967	0.948	1.000	0.853	0.971	0.944	0.961	0.969
1992-93	0.969	1.000	0.942	1.000	0.954	1.000	1.000	0.957	0.990	1.000	0.944	0.994	1.000	0.979	0.990
1993-94	1.000	1.000	0.945	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	0.994	0.996	0.986	0.911
1994-95	0.999	0.983	0.956	1.000	1.000	0.998	1.000	0.992	1.000	1.000	0.991	1.000	1.000	0.996	1.000
1995-96	1.000	1.000	0.999	1.000	1.000	1.000	1.000	0.996	0.979	1.000	0.999	1.000	1.000	1.000	1.000
1996-97	0.917	1.000	0.949	1.000	1.000	0.943	1.000	0.996	0.956	0.677	0.890	1.000	0.954	0.972	1.000
1997-98	1.000	0.999	1.000	1.000	1.000	1.000	1.000	0.997	0.875	1.000	1.000	1.000	0.837	0.989	1.000
Industry 38															
1979-80	0.975		1.000	0.974	0.979	1.000	1.000	1.000	1.000	1.000	1.000	0.967	0.998	0.989	1.000
1980-81	0.999		0.000	1.000	1.000	1.000	1.000	1.000	0.970	0.997	1.000	0.998	1.000	1.000	1.000
1981-82	0.995		1.000	0.947	0.994	1.000	1.000	0.967	0.913	0.839	1.000	0.958	0.935	1.000	1.000
1982-83	0.994		1.000	0.919	0.991	1.000	1.000	1.000	0.931	0.847	1.000	0.961	0.992	0.898	1.000
1983-84	0.890		1.000	0.906	0.854	0.935	1.000	0.676	1.000	1.000	0.953	0.943	0.949	0.929	0.922

1984-85	0.965		1.000	0.979	0.920	0.945	1.000	0.847	1.000	1.000	0.919	0.945	0.883	0.831	1.000
1985-86	0.981		1.000	1.000	1.000	0.995	0.964	0.571	0.712	0.753	0.966	0.956	0.992	0.981	1.000
1986-87	1.000		1.000	1.000	0.929	1.000	0.946	1.000	1.000	0.808	1.000	1.000	0.992	1.000	1.000
1987-88	1.000		1.000	1.000	1.000	1.000	0.992	0.916	1.000	0.941	1.000	1.000	1.000	0.990	1.000
1988-89	1.000		1.000	1.000	0.984	1.000	1.000	0.879	1.000	0.790	1.000	1.000	1.000	1.000	1.000
1989-90	1.000		1.000	1.000	0.916	0.842	1.000	0.994	1.000	1.000	1.000	0.999	1.000	0.965	0.948
1990-91	0.951		0.985	1.000	1.000	0.998	0.977	1.000	0.918	1.000	0.959	1.000	1.000	0.912	0.938
1991-92	0.960		1.000	1.000	0.989	1.000	0.945	0.985	1.000	1.000	0.995	0.993	1.000	0.984	0.985
1992-93	0.999		1.000	0.996	1.000	1.000	1.000	0.961	1.000	1.000	1.000	0.987	1.000	0.959	0.991
1993-94	0.948		0.672	0.990	0.970	0.998	0.907	0.655	0.933	0.315	1.000	0.902	0.995	0.993	1.000
1994-95	0.982		1.000	0.921	0.964	0.963	1.000	0.982	1.000	0.774	1.000	1.000	1.000	1.000	1.000
1995-96	0.898		1.000	1.000	0.981	0.843	0.900	1.000	1.000	1.000	1.000	0.972	0.961	1.000	0.956
1996-97	1.000		1.000	0.969	0.988	0.981	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.946
1997-98	0.995		0.888	0.998	0.999	0.999	1.000	0.971	0.724	0.652	1.000	1.000	0.999	0.744	0.998

Table AIII.2: Index numbers of scale efficiency by state and industry classification for selected years

States	NIC	20-21	22	23	24	26	27	28	29	30	31	32	33	34	35-36	37	38
AP	1985-86	99.00	96.50	98.65	100.00	99.63	100.00	95.11	99.88	102.52	99.78	96.15	101.80	99.34	99.40	88.69	117.51
	1991-92	99.66	92.68	99.94	99.91	96.19	100.00	99.99	98.83	103.19	99.19	101.65	101.44	99.81	101.53	98.52	115.08
	1997-98	98.77	90.71	100.00	99.85	100.91	100.00	98.72	53.78	102.76	99.30	101.65	101.80	85.53		100.05	119.19
ASSM	1985-86	100.00	87.43	107.12	100.00	0.00	100.11	115.43		100.00	100.00	123.01	100.00	100.00	100.00	100.00	
	1991-92	100.00	63.01	98.68	100.00	60.53	103.69	115.43		100.00	100.00	123.01	100.00	100.00	100.00	100.00	
	1997-98	100.00	0.00	107.98	100.00	0.00	103.69	115.43		89.03	100.00	123.01	100.00	100.00		99.89	
BH	1985-86	98.68	99.74	93.90	126.81	101.28	99.47	102.65	96.84	100.51	104.04	90.51	113.96	99.80	100.19	95.03	100.00
	1991-92	101.99	100.00	102.88	133.77	78.96	100.45	102.65	104.04	100.51	104.14	107.42	113.96	99.30	100.14	97.54	100.00
	1997-98	104.19	100.00	97.88	133.77	114.56	78.96	102.65	104.04	95.78	95.25	101.87	113.96	94.42		100.00	88.79
GUJ	1985-86	94.14	100.00	100.00	100.00	98.66	100.00	101.33	105.78	101.40	100.00	82.42	99.30	100.00	101.24	97.62	115.56
	1991-92	96.40	98.56	94.98	100.00	97.80	99.73	101.33	100.89	101.40	100.00	98.73	98.71	100.00	101.26	90.94	115.56
	1997-98	100.00	98.20	99.94	96.43	100.02	97.26	94.71	83.44	99.97	96.53	100.00	100.04	84.32		100.00	115.37
HR	1985-86	101.15	102.04	99.96	104.37	100.58	100.00	98.60	100.00	96.98	100.00	100.00	100.01	97.63	100.00	86.75	105.48
	1991-92	101.15	103.46	100.00	104.52	98.48	100.00	99.27	100.00	99.56	98.70	100.00	100.01	102.03	99.86	100.05	104.41
	1997-98	100.58	93.75	99.19	104.52	94.63	100.00	100.00	100.00	93.74	100.00	99.99	100.01	83.57		100.05	105.40

KAR	1985-86	100.21	104.08	99.98	88.04	103.13	117.54	98.32	114.62	100.84	99.95	94.91	100.02	100.21	102.24	100.00	110.50
	1991-92	99.43	104.15	100.00	100.00	103.13	116.48	100.03	114.62	100.84	91.74	100.00	100.05	100.21	102.24	100.00	111.05
	1997-98	100.21	102.80	100.00	100.00	103.13	115.80	95.05	114.62	100.84	99.42	100.00	92.18	93.49		100.00	110.96
KER	1985-86	100.00	103.71	100.00	100.77	111.53	114.18	100.01	46.92	100.05	99.80	82.10	101.87	99.24	101.64	100.00	110.27
	1991-92	100.00	103.71	100.00	0.00	105.38	119.37	100.01	0.00	100.11	100.00	100.00	101.87	99.97	101.36	100.00	108.16
	1997-98	100.00	103.71	100.00	100.77	111.53	87.22	100.01	0.00	99.73	100.00	99.87	101.71	98.99		100.00	114.43
MP	1985-86	99.40	100.00	99.87	100.00	100.59	106.55	100.00	115.91	100.00	94.94	100.00	117.14	93.71	98.92	100.48	57.05
	1991-92	100.00	100.00	99.98	100.00	88.00	106.55	96.24	115.81	100.00	54.56	100.00	115.31	100.00	100.00	97.38	98.46
	1997-98	100.00	97.80	100.00	100.00	100.59	106.55	99.96	115.91	100.00	100.45	98.28	117.14	96.75		100.40	97.08
MH	1985-86	96.62	89.77	100.00	105.84	124.56	108.98	100.00	100.00	100.00	101.41	99.95	117.83	100.00	96.59	99.73	93.26
	1991-92	99.03	89.86	100.00	105.84	127.87	108.79	98.92	100.00	95.75	97.42	103.14	111.45	92.30	100.00	98.62	130.89
	1997-98	99.55	85.13	95.73	94.75	127.87	105.70	100.00	100.00	100.00	97.21	100.81	103.81	81.48		91.00	94.70
ORI	1985-86	102.39	109.36	101.36	0.00	93.04	99.82	99.28	100.10	95.76	113.22	101.31	99.97	100.00	101.93	100.00	75.28
	1991-92	102.39	88.19	101.76	100.00	81.03	100.00	100.99	100.10	102.09	115.17	101.31	98.93	100.00	101.93	100.00	100.00
	1997-98	102.39	93.18	97.20	0.00	99.99	95.87	100.05	0.00	102.76	118.17	101.31	98.11	98.88		100.00	65.24
PUN	1985-86	100.86	96.83	100.00	100.00	100.00	96.50	97.22	108.14	100.00	101.91	82.17	100.00	100.00	100.00	86.89	113.65
	1991-92	99.83	102.30	100.00	100.00	100.00	92.48	100.00	108.69	100.00	101.91	100.00	100.00	100.00	100.00	85.32	117.06
	1997-98	100.86	100.14	99.81	100.00	100.00	51.70	100.00	102.13	100.00	99.23	100.00	100.00	100.00		100.00	117.59
RAJ	1985-86	100.00	205.25	102.43	99.04	102.83	83.97	99.57	0.00	99.64	99.71	97.50	99.96	100.00	99.93	99.77	95.58
	1991-92	100.00	172.51	102.43	91.15	102.84	88.26	100.00	0.00	99.03	98.21	100.11	99.90	95.87	99.91	97.52	99.31
	1997-98	100.00	200.65	102.43	87.93	102.84	84.29	100.00	123.31	100.00	100.00	98.94	99.29	100.00		100.46	100.00
TN	1985-86	96.41	88.72	104.97	100.00	103.32	102.07	99.13	95.79	103.05	101.87	107.27	100.02	97.91	100.00	89.36	105.01
	1991-92	100.36	99.98	104.97	99.38	103.32	108.83	100.00	95.82	101.54	101.90	111.19	100.06	100.00	100.00	94.36	105.91
	1997-98	101.83	100.02	104.97	99.94	103.32	108.97	98.12	91.96	103.24	96.79	111.19	99.87	89.01		83.66	105.84
UP	1985-86	105.36	92.13	100.21	102.84	100.00	100.95	97.27	100.18	97.98	100.03	91.15	113.28	105.90	98.36	96.40	113.69
	1991-92	103.75	80.59	103.34	97.31	86.00	99.44	99.80	100.37	100.00	100.11	99.96	113.28	107.47	100.00	96.98	114.02
	1997-98	103.94	77.64	101.15	102.81	90.55	69.03	95.69	104.14	97.88	100.11	99.36	112.65	91.31		99.79	86.27
WB	1985-86	106.74	108.07	100.37	99.93	104.59	113.85	107.85	89.18	103.78	108.00	106.22	110.82	101.64	88.56	103.59	100.00
	1991-92	107.81	106.44	99.67	96.52	102.41	113.65	104.13	100.00	103.84	105.95	106.22	109.36	104.92	99.96	108.35	98.51
	1997-98	108.26	108.25	100.53	99.87	104.57	96.67	107.85	100.00	103.84	101.56	106.22	109.86	104.92		111.83	99.84

Source: Appendix table AIII.1.

Notes: 1. The base year for the index numbers are 1976-77 except for Assam (industry 22: base year 1977-78, industry 24: base year 1982-83), Haryana (industry 29:base year 1977-78), Kerala (industry 29:base year 1979-80) and Orissa (industry 24: base year 1977-78, industry 29: base year 1977-78, industry 31: base year 1977-78).

2. The blank spaces indicate non-availability of data.

Table AIII.3: Trends in Scale Efficiency by States at the Two-Digit Industry Classification 1979/80 to 1997/98

NIC	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
20	-0.00119		-0.00138	**0.00221**	0.00004	0.00002	0.00009	0.00010	-0.00091	-0.00045	0.00007	0.00029	0.00015	-0.00049	**0.0031***
22	-0.00291	-0.01880	0.00093	**-0.00127**	0.00050	-0.00024	0.00080	-0.00145	-0.00272	-0.01029	0.00123	0.00091	0.00164	-0.00751	-0.00118
23	-0.00029	**0.0044***	**0.0052***	-0.00122	-0.00044	0.00080	-0.00069	-0.00021	0.00056	0.00051	-0.00002	0.00094	-0.00090	0.00215	0.00071
24	0.00012	**0.05701**	0.00097	**-0.00430**	-0.00129	-0.00080	-0.00947	-0.00225	**-0.00794**	**0.0529***	**-0.00502**	**-0.00498**	-0.00110	0.00316	-0.00054
26	0.00129	0.00430	0.00593	-0.00015	-0.00006	-0.00039	-0.00059	0.00321	0.00984	0.00296	-0.00146	0.00054	-0.00030	-0.00245	0.00078
27	-0.00066	0.00165	**-0.00493**	**-0.00203**	-0.00182	0.00078	-0.00132	-0.00049	**0.00386**	-0.00273	**-0.00840**	-0.00512	0.00098	-0.00450	-0.00232
28	0.00035	-0.00081	0.00090	-0.00089	0.00018	0.00100	0.00068	-0.00064	-0.00105	-0.00098	**0.00945**	0.00004	0.00016	-0.00195	0.00136
29	0.00031		**0.00456**	-0.00081	-0.00008	**0.00124**	0.00831	**0.01239**	0.00328	**-0.01767**	0.00344	0.02922	0.00497	0.00920	-0.00096
30	**0.00339**	-0.00265	0.00208	0.00401	-0.00009	-0.00050	-0.00028	**0.00099**	-0.00120	**0.00968**	-0.00012	**0.00310**	-0.00136	0.00251	**0.00162**
31	**-0.00103**	0.00004	0.00114	0.00069	**-0.00095**	-0.00219	0.00013	-0.00552	0.00040	0.00421	-0.00085	**-0.00507**	-0.00011	**0.00311**	0.00303
32	0.00036	0.00095	-0.00029	0.00176	-0.00077	0.00072	0.00089	-0.00207	**-0.00257**	**0.00199**	0.00079	0.00002	**0.00250**	-0.00056	-0.00026
33	-0.00304	0.00006	0.00128	-0.00066	-0.00023	-0.00473	-0.00098	**-0.00408**	**-0.00723**	-0.00096		-0.00356	-0.00360	-0.00093	0.00115
34	-0.00206		-0.00048	-0.00223	-0.00238	-0.00056	0.00017	0.00004	**-0.00642**	**0.00303**	0.00054	0.00082	-0.00199	-0.00204	0.00097
35-36	-0.00098	-0.00007	-0.00033	0.00064	**-0.00005**	-0.00235	-0.00013	-0.00098	-0.00075	0.00166	-0.00014	0.00005		-0.00008	-0.00016
37	0.00351	0.00031	0.00374	**0.00468**	**0.00610**	0.00313	0.00358	0.00204	0.00258	-0.00453	0.00044	**0.00600**	0.00304	**0.00572**	**0.00885**
38	-0.00054		0.00933	0.00148	0.00132	-0.00192	-0.00202	0.00267	-0.00150	-0.00816	0.00099	0.00125	0.00173	-0.00166	-0.00110

Source: DEA estimates given in the Appendix table AIII.1
Note: The values are significant at the five percent level.

Table AIII.4: Inter Industry (Two-Digit Level) Inter-State Scale Efficiency β(Slope) And α (Constant) Coefficients For The Period 1979/80 To 1997/98 (Dummy Year 1985/86)

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
20-21 β	0.037		-0.010	0.022	0.002	0.010	0.002	0.003	-0.009	0.014	0.005	0.001	0.009	0.050	0.050*
α	0.996		0.987	0.946	0.993	0.998	0.999	0.998	0.991	**1.011**	0.996	0.991	0.994	0.992	0.947
22 β	-0.104	0.684	0.009	-0.013	0.121*	0.009	0.015	0.011	-0.011	0.193	0.010	0.245*	-0.052*	0.095	0.027
α	0.985	0.900	0.987	**1.000**	0.957	0.991	0.986	**1.006**	0.810	**1.004**	0.969	0.938	0.962	0.956	0.985
23 β	0.017	0.073*	0.081	0.068	-0.002	0.033	-0.002	-0.019	0.064	0.023	0.000	-0.013	0.040	0.018	0.026
α	0.984	0.920	0.921	0.997	0.989	0.982	0.999	**1.003**	0.976	0.976	**1.000**	0.982	0.983	0.957	0.972
24 β	0.002	0.411	-0.078	-0.036	-0.021	-0.061	-0.386	-0.035	0.016	0.014	-0.065	-0.013	-0.025	-0.027	0.001
α	**1.002**	0.017	0.928	0.982	0.985	0.976	0.823	0.970	**1.009**	-0.147	0.965	0.981	0.979	0.879	**1.011**
26 β	0.037	0.128	0.099	-0.024	0.043	-0.015	0.033	0.115	0.091	-0.054	0.010	0.034*	-0.003	0.002	0.000
α	0.982	0.660	0.760	0.984	0.991	0.987	0.959	0.957	0.819	0.860	**1.012**	0.996	0.981	0.976	0.985
27β	0.023	0.081	0.046	0.019	0.020	0.012	0.010	0.027	0.039	0.037	0.065	0.054	-0.032	0.091	0.027
α	0.976	0.918	**1.024**	**1.005**	**1.011**	0.953	0.935	0.985	0.919	**1.017**	**1.009**	**1.008**	0.955	**1.026**	0.968
28 β	-0.017	-0.043	0.036	0.016	0.011	-0.005	0.014	-0.024	-0.029	-0.017	-0.005	-0.004*	0.002	-0.003	-0.044
α	0.968	0.998	0.997	**1.005**	0.997	0.968	0.993	0.994	0.992	**1.003**	0.837	0.999	0.975	0.988	0.960
29 β	0.125		0.044	0.131*	0.017	0.015	0.503	0.061	0.039	0.222	0.090*	-0.239	0.086	0.066	-0.067
α	0.913		0.931	0.986	0.995	0.981	0.707	0.776	0.950	**1.136**	0.944	0.553	0.874	0.793	0.944
30 β	0.010	-0.002	0.072	0.067	0.001	-0.021	0.000	0.011	0.002	0.139	-0.002	0.018	-0.019	0.054	0.022
α	0.928	0.977	0.967	0.902	0.946	0.996	0.995	0.984	**1.005**	0.749	**1.004**	0.949	0.997	0.947	0.978
31 β	-0.002	0.001	0.030	0.003	-0.005	0.003	0.001	0.064	0.080	-0.118*	-0.023	-0.004	0.053	0.059*	0.066
α	0.996	**1.000**	0.969	0.983	**1.000**	0.994	0.998	**1.034**	0.932	0.875	0.988	0.999	0.992	0.959	0.917
32 β	-0.039*	-0.022	-0.029	-0.046	-0.005	-0.004	-0.081	-0.011	-0.031	0.012	-0.122	-0.011	0.003	-0.074*	0.002
α	0.990	0.988	0.945	0.958	0.998	0.984	0.971	**1.003**	0.981	0.967	0.915	0.994	0.958	0.976	**1.000**
33 β	-0.018	0.012	0.001	-0.005	-0.001	0.007	0.009	0.022	0.048	-0.008		-0.014	-0.058	0.009	-0.007
α	0.984	0.991	0.977	0.999	0.999	**1.000**	**1.003**	**1.008**	**1.015**	0.998		0.987	0.974	0.986	0.920
34 β	0.015		0.022	-0.014	-0.007	-0.030	0.002	-0.016	0.031	0.010	-0.013	0.000	-0.024	0.011	-0.034*
α	**1.004**		0.971	0.977	**1.006**	0.996	0.990	0.989	**1.025**	0.942	0.990	0.987	**1.003**	0.988	0.976
35-36 β	-0.016*	-0.024	0.006	0.022*	0.000	-0.018	0.000	0.004	-0.022	0.054*	0.010	0.007		-0.010	-0.085*

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
α	0.992	0.992	**1.002**	0.995	**1.000**	0.995	0.997	0.994	0.987	0.991	**1.003**	0.995		0.991	0.965
37 β	-0.014	-0.004	-0.051	0.016	-0.065	0.044	0.032	0.047	0.001	0.050	-0.048	0.060	-0.008	0.006	0.047
α	0.925	0.990	0.892	0.927	0.871	0.949	0.953	0.962	0.929	**1.027**	0.954	0.908	0.913	0.893	0.847
38 β	0.048		-0.009	0.059*	0.050	0.045	-0.036	-0.114	-0.038	-0.200	0.038	0.016	0.070*	0.166*	0.038
α	0.988		0.740	0.961	0.974	**1.006**	0.994	0.858	0.960	0.866	0.994	0.954	0.976	**1.012**	**1.011**

Source: DEA estimates from Table AIII.1.

Note: The starred values (*) imply statistical significance at 5 percent level.

Table AIII.5: Inter Industry (Two-Digit Level) Inter-State Scale Efficiency β(Slope) And α (Constant) Coefficients For The Period 1979/80 To 1997/98 Using 1991/92 As Dummy Year

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
20-21 β	0.029		-0.003	0.019	-0.004	0.013*	0.000	0.003	0.024	0.064*	0.010	-0.008	0.023	0.071*	0.027
α	0.996		0.987	0.946	0.993	0.998	0.999	0.998	0.991	**1.011**	0.996	0.991	0.994	0.992	0.947
22 β	0.075	0.015	0.006	-0.005	0.045	-0.003	0.001	-0.008	-0.061	0.119	0.009	0.089	-0.029	0.020	-0.012
α	0.985	0.900	0.987	**1.000**	0.957	0.991	0.986	**1.006**	0.810	1.004	0.969	0.938	0.962	0.956	0.985
23 β	-0.002	0.001	0.039	0.058	-0.021	0.000	-0.011	0.038*	0.002	-0.014	0.000	0.001	-0.009	0.014	-0.008
α	0.984	0.920	0.921	0.997	0.989	0.982	0.999	**1.003**	0.976	0.976	**1.000**	0.982	0.983	0.957	0.972
24 β	0.033*	-0.201	-0.050	-0.103*	-0.049*	-0.050	0.470	-0.093*	-0.084	0.148	-0.154*	-0.084*	-0.051*	-0.118*	0.037*
α	**1.002**	0.017	0.928	0.982	0.985	0.976	0.823	0.970	**1.009**	-0.147	0.965	0.981	0.979	0.879	**1.011**
26 β	0.039	0.613	-0.016	-0.014	0.016	-0.002	-0.034	0.122	0.020	-0.014	0.018	0.018	-0.025	0.976	0.001
α	0.982	0.660	0.760	0.984	0.991	0.987	0.959	0.957	0.819	0.860	**1.012**	0.996	0.981	0.976	0.985
27β	-0.033	-0.039	-0.002	-0.013	-0.002	-0.020	-0.062	-0.010	-0.038	0.003	-0.014	0.070	-0.048	0.020	-0.055
α	0.976	0.918	**1.024**	**1.005**	**1.011**	0.953	0.935	0.985	0.919	**1.017**	**1.009**	**1.008**	0.955	**1.026**	0.968
28 β	0.005	0.024	0.056	0.002	0.021	0.005	0.025	0.019	-0.019	0.016	-0.008	-0.001	-0.023	-0.023	0.023
α	0.968	0.998	0.997	**1.005**	0.997	0.968	0.993	0.994	0.992	**1.003**	0.837	0.999	0.975	0.988	0.960
29 β	-0.048		0.009	0.053	0.000	-0.002	0.871	-0.117	-0.005	0.089	0.018	0.510	0.001	-0.070	-0.104*
α	0.913		0.931	0.986	0.995	0.981	0.707	0.776	0.950	**1.136**	0.944	0.553	0.874	0.793	0.944
30 β	-0.031	-0.037	0.015	-0.053	-0.060	-0.003	-0.008*	-0.003	-0.001	-0.087	0.016	-0.015	-0.012	0.011	0.017
α	0.928	0.977	0.967	0.902	0.946	0.996	0.995	0.984	**1.005**	0.749	**1.004**	0.949	0.997	0.947	0.978
31 β	-0.017	0.001	-0.014	-0.004	-0.010	-0.015	0.001	0.118	0.007	-0.092	-0.016	-0.068*	0.049	0.020	-0.032
α	0.996	**1.000**	0.969	0.983	**1.000**	0.994	0.998	**1.034**	0.932	0.875	0.988	0.999	0.992	0.959	0.917
32 β	0.005	0.057	-0.055	0.017	-0.016	-0.005	-0.025	-0.008	-0.071*	-0.014	-0.048	-0.004	-0.007	-0.027	-0.003
α	0.990	0.988	0.945	0.958	0.998	0.984	0.971	**1.003**	0.981	0.967	0.915	0.994	0.958	0.976	**1.000**
33 β	-0.075	-0.006	-0.015	-0.022	-0.006	-0.057	0.007	-0.007	-0.023	-0.008		-0.071	-0.093	-0.029	-0.056

α	0.984	0.991	0.977	0.999	0.999	**1.000**	**1.003**	**1.008**	**1.015**	0.998		0.987	0.974	0.986	0.920
34 β	0.018		-0.024	-0.023	0.020	0.013	0.003	-0.008	0.016	-0.031	0.008	0.031	0.007	-0.022	-0.009
α	**1.004**		0.971	0.977	**1.006**	0.996	0.990	0.989	**1.025**	0.942	0.990	0.987	**1.003**	0.988	0.976
35-36 β	-0.029*	0.000	0.007	0.005	0.000	-0.033	0.016	-0.027*	-0.015	0.020	0.011	0.003		0.020	-0.019
α	0.992	0.992	**1.002**	0.995	**1.000**	0.995	0.997	0.994	0.987	0.991	**1.003**	0.995		0.991	0.965
37 β	0.032	-0.012	-0.039	0.013	-0.097	0.035	0.060	0.004	0.037	-0.004	-0.025	0.008	-0.003	-0.004	0.026
α	0.925	0.990	0.892	0.927	0.871	0.949	0.953	0.962	0.929	**1.027**	0.954	0.908	0.913	0.893	0.847
38 β	0.019		-0.245	-0.008	0.042	0.036	-0.018	-0.084	-0.021	-0.260	0.039	-0.030	0.027	0.104	0.044
α	0.988		0.740	0.961	0.974	**1.006**	0.994	0.858	0.960	0.866	0.994	0.954	0.976	**1.012**	**1.011**

Source: DEA estimates from Appendix table AIII.1.

Note: The starred values (*) imply statistical significance at 5 percent level.

Table IV.1: Peer state analysis results

	1976-77	1977-78	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Industry 20-21																					
ANDHRA PRADESH	*	*	5	*	1	*	2	*	*	*	1	*	2	*	*	*	*	*	*	*	*
ASSAM	9	7	4	2	4	8	6	9	7	9	8	2	2	10	9	1	0	2	9	6	1
BIHAR	*	*	*	2	0	*	1	*	*	*	*	4	*	*	*	*	0	*	*	*	0
GUJARAT	1	*	*	*	*	*	*	*	*	*	*	*	1	*	*	*	*	*	*	*	1
HARYANA	*	*	*	*	*	*	7	*	1	7	8	*	1	*	0	1	*	3	3	3	*
KARNATAKA	*	*	*	*	*	*	*	*	7	*	*	*	*	*	*	*	*	*	*	*	5
KERALA	8	7	2	5	1	*	8	10	5	9	7	7	1	11	9	5	2	3	8	9	0
MADHYA PRADESH	8	6	1	6	6	9	*	*	*	*	*	4	0	5	1	1	1	2	3	0	0
MAHARASHTRA	*		0		1	6	*	*	*	*	*	*	2	*	*	*	*	6	*	*	*
ORISSA	*	6	4	1	1	1	*	*	1	1	*	*	*	*	0	0	6	*	0	1	3
PUNJAB	*	0	2	*	*	0	0	5	3	*	*	0	0	*	*	3	5	4	*	*	1
RAJASTHAN	2	2	2	2	*	0	0	0	0	1	0	0	0	1	3	0	*	1	0	3	3
TAMILNADU	*	*	*	3	3	*	*	*	*	*	*	7	5	*	*	5	4	*	*	*	*
UTTAR PRADESH	*	*	*	*	*	*	*	*	*	*	1	*	*	*	*	*	*	*	*	*	*
WEST BENGAL	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	3	*	*	*	*
Industry 22																					
ANDHRA PRADESH	0	0	0	0	0	0							0				0	0		0	
ASSAM			7	7	7			3		5		6	0	0			0	0	2		
BIHAR	9	9				5						7	5	7	8	9	4	7	10	10	4

GUJARAT	5	2	2	4	1	0	8	1	1				0						1		
HARYANA																					
KARNATAKA							11						4								
KERALA			7			3		3	5		5	2	1	2	4	5	1	1		3	4
MADHYA PRADESH	1	8	10	11	10	6	3	9	11	12	10	6	3	10	6	6	8	5			
MAHARASHTRA																					
ORISSA									5		2										
PUNJAB					3										6						
RAJASTHAN																			1		
TAMILNADU						8		6			3	5	1	8		5		8	5	7	6
UTTAR PRADESH	4																				
WEST BENGAL										5			5				8				1
Industry 23																					
ANDHRA PRADESH				1			0										1				3
ASSAM											7	10		3				1	2	2	2
BIHAR													5	4	5	2	8	0	0	1	
GUJARAT	5	8	1	1					0										0		
HARYANA	5	8	8		10						0		0	0	0	0			0	1	
KARNATAKA	2			4			2	10		1	7	6			4			10	3		5
KERALA	7	6	4	4	8	2	3	2	8	7			6	3	5	3	6		1		5
MADHYA PRADESH	2	1	3	1		4	8													8	0
MAHARASHTRA	2	0	2	3	9				7	7	7	3	4	6	6	6			2		
ORISSA						11													0	4	
PUNJAB	0	0		3	1	11	1	7	3	5	3	3	1	1	1	1	1	4	0	3	
RAJASTHAN				0	0		9		1			0	2	2	0	5	0	1	2		0
TAMILNADU			5	4				3	5	5			6	3	2	6	3		2		3
UTTAR PRADESH																					
WEST BENGAL																				2	
Industry 24																					
ANDHRA PRADESH	5	10	3	5		1	0		1	0		1				4	0	6		6	
ASSAM						3			5		0		0	1	0				0		0
BIHAR		9	6	8	3			0				1	3		1		1	1	4	3	0
GUJARAT	0		6	4	5	2	3	4	2	1	2	1			2					5	
HARYANA					0	1				0		0	1		0						1

KARNATAKA	0		1			0	4	0		0	0	1	0	2	2	9	6		6	7	6
KERALA						0		3	1									1		1	0
MADHYA PRADESH	1								1	0	2	1	2	1	2		3		6		1
MAHARASHTRA			2		4	3		3	5	1	2	0		1	2		7				
ORISSA		0												6	5	11	7			1	
PUNJAB	6	5	1	8	3	3	3	3	1	0		1	1	3	0						7
RAJASTHAN	3									0	3		1	2					5		
TAMILNADU												0	3					11			
UTTAR PRADESH							6	2	1	2	1	1	3						0		
WEST BENGAL	0		0		2	1	2	0		0	1										
Industry 26																					
ANDHRA PRADESH							0			0											
ASSAM	0	0		2	2								1				0			2	
BIHAR														11							
GUJARAT														3							
HARYANA				3		9			4	2	4	5							7	7	
KARNATAKA					1		8		0	5	4				6		8			5	1
KERALA									3					0			0	1	0		
MADHYA PRADESH									4												
MAHARASHTRA															4		6		4		3
ORISSA	7		12			5															
PUNJAB	10	5	10	9	9	11	9	9	3	0	0	1	8		1	3					2
RAJASTHAN			9	10	7					5	3	6	9	5	8	10	0	12			7
TAMILNADU									0	5	6	8	3		6	6	0		5	8	1
UTTAR PRADESH	11	12			5		6		3		3	3	9							3	
WEST BENGAL								10	0	1	3							1	1		
Industry 27																					
ANDHRA PRADESH	3	2							0		5	4	2	7	4	9	1		1		3
ASSAM		3						0		0		2		7	3	3	8	8	3		2
BIHAR				5				1				5	6		5				9		
GUJARAT	5	3	1		0			1	4	1			0	1		1					
HARYANA	5	2	4	6	2	8	6	0	2	0	3	4	7	1	0	2	0	1	3		10
KARNATAKA									2	1	4										
KERALA							10								5		3	2		7	

MADHYA PRADESH		3						0	3	3	2				4			3			1
MAHARASHTRA				12				6	2	5	4	4		1				7		11	
ORISSA	9	6	9		9	2		0		0		7	3	2	5	5	4	6	1		
PUNJAB	0				0		0														
RAJASTHAN	3	5	8		7	9				0							0		8		
TAMILNADU					1	0	0	0		5	2		6	5			3				3
UTTAR PRADESH									1	0			1			3				2	
WEST BENGAL							8	0	3		3									2	
Industry 28																					
ANDHRA PRADESH					5	8											4				
ASSAM		0	8	7	2	7	4	3	1		8		8		6	6		6	6	5	6
BIHAR				6	4				2	6	5			4	1	1	2	5	2	0	0
GUJARAT		0						1	2	1	0	2	1	1	3	0		1	1	1	
HARYANA	6	5		0	1	1				1				6		0	2			2	4
KARNATAKA		2														4	3	8	3		
KERALA									4		5				5	2			3	5	1
MADHYA PRADESH	3	0						0	6	1		3		4							
MAHARASHTRA	1	1	8	9	8	8	11	2	7	4	6		4					2	4		2
ORISSA		4	9	8	2	6	11	4		1	0										
PUNJAB	0	0											1		2	0		1	2	1	4
RAJASTHAN	3	1	5	0	0	0	0	0			2	7	2	2	1	1	0	1	1	0	0
TAMILNADU	9	4	5					6		5		11	4	3	4	3	7			4	
UTTAR PRADESH																					
WEST BENGAL								3	0											0	2
Industry 29																					
ANDHRA PRADESH	3	2				1					5										
ASSAM																					
BIHAR			2	3											1		0	0	1	2	0
GUJARAT									2												
HARYANA		2	6	8	11		5	4	4	4		3	0	4	1	3	2				1
KARNATAKA				1			8	6	2	2	1	4	6	2	5	2	1	6	1	4	1
KERALA										9		1					0	4	3	6	
MADHYA PRADESH								0	2	5	3	1	0	4		7	0			7	3
MAHARASHTRA	5	7	7	0		7	2		6		6	6	5	5	3	2		6	4	2	4

ORISSA			0	3	1	2	0	1	2			0	3		0	0			0		
PUNJAB						2									1						
RAJASTHAN												1		0		4	0	5	7	1	0
TAMILNADU	4	4	4			0		1			1						5				
UTTAR PRADESH		5															2				3
WEST BENGAL	0				2	2		2		8	0	0	1	2	3		0	0	4		0
Industry 30																					
ANDHRA PRADESH															4	1			5		
ASSAM	6	3	2		5	4	3	4	5	1	4		1	0	1		6			0	
BIHAR									1	1	2	1	0	2	4	3			3	1	
GUJARAT		2	1						0	1	7	6	1		4					2	
HARYANA	5	4			0	2		5		5	6	3					2		2		
KARNATAKA		3	6	11	7	8	3	2	5	5			4	4	0			9		0	3
KERALA							5	5			0		1								
MADHYA PRADESH	0		0				0	0	2	4	3	3	1	5	2	3		2	1	4	7
MAHARASHTRA	7	6	2	1	1	3	1	1	8	5	5	4	0	0		4	6		3	2	2
ORISSA																					
PUNJAB	0		2	4	1	2	4	0	4	2					2	0	6	2	1	3	2
RAJASTHAN	1	2			0		1	0					3	5		3		10	2	1	6
TAMILNADU			2	5	2	4	0	2				4		4							
UTTAR PRADESH	5	2											3		3	4	6			0	
WEST BENGAL			0		0							0	1	0	0	2	0	0	1	4	1
Industry 31																					
ANDHRA PRADESH	3	9				2												1			
ASSAM	8	6	8	0	1	5		6	4	7	3	2	5	8	2	2	5	4	6	1	3
BIHAR				1	6	3					1	4		1	3	5	0	1	0	0	
GUJARAT	1	3		6	0	4	12	6	5	2		3	0		0	10	6	5	7	6	
HARYANA	2		1	3	5	0	7	3	5	3		3	8								4
KARNATAKA																	2				
KERALA	2	1	4	1	0			3			4		10	3	5	4	3		3	4	3
MADHYA PRADESH			4	6		1		1			4	3									2
MAHARASHTRA				1					8			2		4			0				
ORISSA						3		7				0		1				5	4	0	1
PUNJAB						0			1	4	0			0	1		0		0	1	

RAJASTHAN	4		8		7	0	10					0		4							7
TAMILNADU		4	0	1	0							0			3						
UTTAR PRADESH					1					5	0		2		7	0	2	1	0	7	1
WEST BENGAL											7										
Industry 32																					
ANDHRA PRADESH			1			4	8	5		1					2	1	4	3	3	2	2
ASSAM		5	1	0	4				10			2	0		3	0		5	1	4	5
BIHAR											1	2	0	3		3					
GUJARAT	1	1	1	3	3													3		1	4
HARYANA	4	2	1	5	6	2	5	1	2	4	2	4	0		0				4		
KARNATAKA	5		3		3					1	5	1	4	3	0	3	3			2	0
KERALA	7	5	2	4	1	4	3	3		2	1	0		2	2	5	5	1	1	2	
MADHYA PRADESH	8	6	2	1	2	0	0	0	6	1	3		3	2	2	0			0		
MAHARASHTRA		2	3	2	4			5		0		2	3	2	2					3	
ORISSA						1			5	5	5	5	0	4	2	3	4	0	2	2	5
PUNJAB	7	1	2	0		2	4						2		1	1			1	2	2
RAJASTHAN				5		1	2	3		1		4							0		
TAMILNADU						1		5		0	2			4	0	5	9	7	4	1	3
UTTAR PRADESH											0		1								
WEST BENGAL		1		0		2	2	1	2	0	0	0	0	0	1		3	2	0		1
Industry 33																					
ANDHRA PRADESH		6		3			2	1	4	1	1	0		2					2	4	6
ASSAM	2	0	1	0		0	3	5	0	4	4	5	2	3	4	0	8	13			3
BIHAR		1	0		0	6	2	7	3	2	3	2	0	7	7	2	3		4	4	2
GUJARAT														1		4	3				2
HARYANA		2			0	0	1	4	2	1	4	4	4	1	2	0	1		6	3	1
KARNATAKA				2	2						0	0	2	2	1	2	0		0		
KERALA			2	2	2	3			2	5	3	6	5		3	1			3	4	
MADHYA PRADESH				4	5		2		0		0		3			0					4
MAHARASHTRA		6	3	2	2		2	0	4	2	3										
ORISSA	7	3	7	4	4	7	2					2	3			3	4		0		
PUNJAB	10	1	3	5	6	9	1	1	0	0	0	1	1	2	0	0	2	2	1	8	4
RAJASTHAN	8		5							1											
TAMILNADU							0								1						

UTTAR PRADESH			2				3	7	2	2	0	0	1	2	2	2			5		
WEST BENGAL		4							1							0			0		
Industry 34																					
ANDHRA PRADESH				0				2									1		4	1	
ASSAM	0		0	2	8	1	3	4	8	7	7	5	1	7	4	5	3	2	3	3	8
BIHAR	1											9	3							0	
GUJARAT	4	2		5		1			1					8	6		4	7			
HARYANA		5	6	4	7	7	6							5							
KARNATAKA		5		3		5	3		5		6		6	8	0	1	9	3	6	4	
KERALA																					
MADHYA PRADESH	1	2	6				1	4		11	1	10			1	4		0	3	2	
MAHARASHTRA	1	1	0		2		2	0	3												
ORISSA	1				0		0	1	0	7	6			4	1	0		1			
PUNJAB	3	3	2	1	4				1		0	1	2		0	0	2	3	0	1	3
RAJASTHAN	4		0	1			1		4		1					3			2	0	11
TAMILNADU	3	2	3	4	3	8	2	5							0	7				1	
UTTAR PRADESH													6		2				0	2	
WEST BENGAL						2	0	2			0		3		0		1	7	5	2	1
Industry 35-36																					
ANDHRA PRADESH					8	3	6	0					4								
ASSAM	4	4	6	3		2	1		4		6		1	7	1	5	1				
BIHAR							3	8	6	2	6	0									
GUJARAT										1	0	2	0	1	1		4				
HARYANA	3	3	4	7	8	2	3	3	1	0	1	0	2	0							
KARNATAKA		3				2	4		0					3	3	1					
KERALA			0						3				1			0	4				
MADHYA PRADESH	2		6									8									
MAHARASHTRA	1		2	9	7	4		5		1			1		6		1				
ORISSA					0				2	6	2	1	4	5	4	3	2				
PUNJAB	1	0		0		3			1	0	0	0	0		0	1	1				
RAJASTHAN	0									5											
TAMILNADU	5	9	1	2	1	1	0	3	5	7	5	2	1	7	2	5	7				
UTTAR PRADESH	2														0	7	0				
WEST BENGAL	0	0	0			1	0	0					2								

Industry 37																					
ANDHRA PRADESH																	6		0		
ASSAM	1			4	5	12	0	3	1	5	4	10	5	1	9	1	1		0	3	
BIHAR	5	1		3	2			0					7								5
GUJARAT	5													0		0	2	0	0	0	3
HARYANA				1			0	0		5	0	2		4	7		6	3	5	6	3
KARNATAKA	7	11	9	8	8		5	4	10	2					7	8	0		0		3
KERALA	5		1	0	1		3	2	10	6	4			6	2	7	0	6	0	7	2
MADHYA PRADESH			10				3				8	10	5								
MAHARASHTRA							1	1									3	3			
ORISSA	0	8	11	3	2	5	1	0	11	1	1	0	1	1	8	6	0	0	0		0
PUNJAB	1	7		6	5	12	4	3		0	4	0	2	0							
RAJASTHAN								3		3	6							3	0	9	3
TAMILNADU	2				2			2		1			5	7		3		2	5		
UTTAR PRADESH																					
WEST BENGAL							1			0				3				1	0	0	0
Industry 38																					
ANDHRA PRADESH										0	1	1	1							3	
ASSAM											0				0						
BIHAR	2	0	3		2	0	9	7	7	5	2	0	6		6	4		2	6	2	
GUJARAT				6					7	0	1	1	3	9	3				5		
HARYANA											1			9		3					
KARNATAKA		4	1	0	4	5				4	2	2			4	4					
KERALA			2	3	7	5	2	1				1	1			1		2		2	1
MADHYA PRADESH	0	0	4	0		1				1									0	0	
MAHARASHTRA			4				9	5		2	2	0	3		1	2		0	0	0	
ORISSA	2	3	0				7	0					0	8	1	1			5	3	
PUNJAB			3	7	8	8				0	1	0	2			0	1	0	0	0	1
RAJASTHAN	9	7								0	0	0						5		3	11
TAMILNADU		4									0	2	1	0	5	0		0		0	
UTTAR PRADESH										0		1						0	0	0	
WEST BENGAL	6	4	1	5	5	3		8	10	0	3	0					12	6			

Table AIV.2: The peer state analysis results for the three periods

	20	22	23	24	26	27	28	29	30	31	32	33	34	35-36	37	38
Period 1																
ANDHRA PRADESH	8	0	1	24	0	5	13	6	*	14	18	12	2	17	*	*
ASSAM	49	24	*	3	4	3	31	*	27	34	10	11	18	20	25	*
BIHAR	3	23	*	26	*	6	10	5	*	10	*	16	1	11	11	23
GUJARAT	1	23	15	24	*	10	1	*	3	32	9	*	12	*	5	6
HARYANA	7	*	31	1	12	33	13	36	16	21	26	7	35	33	1	*
KARNATAKA	*	11	18	5	9	*	2	*	40	*	11	4	16	9	52	14
KERALA	41	13	36	3	*	10	*	0	10	11	29	9	*	0	12	20
MADHYA PRADESH	36	58	19	1	*	3	3	0	0	12	19	11	14	8	13	5
MAHARASHTRA	7	*	16	12	*	18	48	28	22	1	16	15	6	28	2	18
ORISSA	13	*	11	0	24	35	44	7	*	10	1	34	2	0	30	12
PUNJAB	7	3	23	32	72	0	0	2	13	0	16	36	13	4	38	26
RAJASTHAN	8	*	9	3	26	32	9	0	4	29	11	13	6	0	3	16
TAMILNADU	6	14	12	*	*	1	24	13	15	5	6	0	30	22	6	4
UTTAR PRADESH	*	4	*	8	34	*	*	5	7	1	*	12	*	2	*	*
WEST BENGAL	*	*	*	5	10	8	3	6	0	*	6	4	4	1	1	32
Period 2																
ANDHRA PRADESH	3	0	0	2	0	18	0	5	*	*	1	8	*	4	*	3
ASSAM	38	11	20	6	1	9	17	0	11	29	12	18	35	18	26	0
BIHAR	4	19	9	4	11	11	17	0	7	6	6	17	12	14	7	20
GUJARAT	1	1	0	6	3	6	7	2	15	10	*	1	9	4	0	21
HARYANA	17	*	0	1	15	17	7	15	14	19	12	16	5	4	11	10
KARNATAKA	7	4	14	3	9	7	*	17	18	*	14	4	25	3	12	8
KERALA	40	15	24	1	3	*	9	10	1	17	5	21	*	4	26	2
MADHYA PRADESH	9	52	*	7	4	8	14	15	18	7	15	3	22	8	23	1
MAHARASHTRA		*	34	9	*	16	21	28	22	14	7	9	3	2	*	7
ORISSA	2	7	*	6	*	12	1	5	*	1	24	5	17	20	15	8
PUNJAB	3	*	16	6	12	*	1	0	6	5	2	4	4	1	6	3
RAJASTHAN	2	*	5	6	28	0	13	1	8	4	5	1	5	5	9	0
TAMILNADU	12	17	19	3	22	18	23	1	8	0	6	*	*	27	13	3
UTTAR PRADESH	1	*	*	8	18	2	*	0	3	7	1	7	6	0	*	1

WEST BENGAL		10	*	1	4	6	0	11	1	7	2	1	3	2	3	13
Period 3																
ANDHRA PRADESH	*	0	4	16	*	18	4	*	10	1	17	12	6	*	6	3
ASSAM	28	2	7	0	2	27	35	*	7	23	18	28	28	7	14	0
BIHAR	0	52	16	10	*	14	11	4	11	9	3	22	0	*	5	20
GUJARAT	1	1	0	7	*	1	6	0	6	34	8	9	17	5	5	8
HARYANA	10	*	1	1	14	16	8	7	4	4	4	13	0	*	30	3
KARNATAKA	5	*	22	36	20	*	18	20	12	2	8	3	23	4	18	8
KERALA	36	18	20	2	1	17	16	13	*	22	16	11	*	4	24	6
MADHYA PRADESH	8	25	8	12	*	8	*	17	19	2	2	4	10	*	*	0
MAHARASHTRA	6	*	14	9	17	18	8	21	17	0	5	*	*	7	6	3
ORISSA	10	*	4	24	*	21	*	0	*	10	18	7	2	9	14	10
PUNJAB	13	6	10	7	6	*	10	1	16	2	7	17	9	2	*	2
RAJASTHAN	10	1	8	5	37	8	4	17	22	7	0	*	16	*	15	19
TAMILNADU	9	31	16	11	26	6	18	5	*	3	29	1	8	14	10	5
UTTAR PRADESH	*	*	*	0	3	5	*	*	13	18	*	9	4	7	*	0
WEST BENGAL	3	9	2	*	2	2	2	7	8	*	7	0	16	*	1	18

Source: from the Appendix table IV.1

Table AIV.3: Overall technical efficiency across state and industry through 1976/77 to 1997/98

	AP	AS	BH	GUJ	HR	KAR	KER	MP	MH	ORI	PUN	RAJ	TN	UP	WB
Industry 20-21															
1979-80	1.000	1.000	0.938	0.974	0.991	0.940	1.000	1.000	1.000	1.000	1.000	1.000	0.987	0.987	0.946
1980-81	0.975	1.000	1.000	0.972	0.972	0.947	1.000	1.000	0.967	1.000	0.983	1.000	1.000	0.994	0.879
1981-82	1.000	1.000	1.000	0.942	0.924	0.972	1.000	1.000	1.000	1.000	0.972	0.926	1.000	0.982	0.918
1982-83	0.973	1.000	0.976	0.946	0.949	0.944	0.992	1.000	1.000	1.000	1.000	1.000	0.994	0.969	0.930
1983-84	1.000	1.000	1.000	0.929	1.000	0.958	1.000	0.951	0.994	0.988	1.000	1.000	0.978	0.889	0.886
1984-85	0.905	1.000	0.871	0.899	0.993	0.957	1.000	0.969	0.945	0.956	1.000	1.000	0.956	0.934	0.868
1985-86	0.972	1.000	0.947	0.902	1.000	1.000	1.000	0.907	0.925	1.000	1.000	1.000	0.938	0.950	0.982
1986-87	0.985	1.000	0.999	0.940	1.000	0.984	1.000	0.963	0.980	1.000	0.995	1.000	0.998	0.985	0.927
1987-88	1.000	1.000	0.977	0.932	1.000	0.958	1.000	0.972	0.963	0.997	0.988	1.000	0.991	1.000	0.939
1988-89	0.942	1.000	1.000	0.926	0.981	0.965	1.000	1.000	0.993	0.945	1.000	1.000	1.000	0.942	0.952
1989-90	1.000	1.000	0.915	1.000	1.000	0.945	1.000	1.000	1.000	0.914	1.000	1.000	1.000	0.939	0.940
1990-91	0.951	1.000	0.872	0.982	0.985	0.933	1.000	1.000	0.930	0.912	0.954	1.000	0.956	0.900	0.949
1991-92	0.979	1.000	0.979	0.964	1.000	0.939	1.000	1.000	0.948	1.000	0.982	1.000	0.986	0.899	0.943
1992-93	0.988	1.000	0.945	0.989	1.000	0.972	1.000	1.000	0.977	1.000	1.000	1.000	1.000	0.956	1.000
1993-94	0.968	1.000	1.000	0.976	0.971	0.952	1.000	1.000	0.951	1.000	1.000	0.960	1.000	0.954	1.000
1994-95	0.980	1.000	0.938	0.950	1.000	0.995	1.000	1.000	1.000	0.961	1.000	1.000	0.980	0.988	0.958
1995-96	0.961	1.000	0.985	0.948	1.000	0.983	1.000	1.000	0.988	1.000	0.982	1.000	0.983	0.964	0.979
1996-97	0.937	1.000	0.921	0.999	1.000	0.907	1.000	1.000	0.976	1.000	0.959	1.000	0.956	0.967	0.937
1997-98	0.951	1.000	1.000	1.000	0.945	1.000	1.000	1.000	0.953	1.000	1.000	1.000	1.000	0.885	0.874
Industry 22															
1979-80	1.000	1.000	0.761	1.000	0.670	0.850	1.000	1.000	0.749	0.752	0.742	0.822	0.940	0.889	0.668
1980-81	1.000	1.000	0.930	1.000	0.716	0.975	0.943	1.000	0.798	0.841	0.851	0.731	0.928	0.858	0.633
1981-82	1.000	1.000	0.906	1.000	0.663	0.714	0.981	1.000	0.739	0.870	1.000	0.884	0.899	0.792	0.658
1982-83	1.000	0.000	1.000	1.000	0.742	0.849	1.000	1.000	0.774	0.878	0.831	0.739	1.000	0.847	0.631
1983-84	0.973	0.000	0.719	1.000	0.471	1.000	0.950	1.000	0.527	0.659	0.493	0.344	0.825	0.422	0.564
1984-85	0.916	1.000	0.792	1.000	0.759	0.877	1.000	1.000	0.809	0.746	0.798	0.805	1.000	0.812	0.830
1985-86	0.965	0.829	0.783	1.000	0.795	0.822	1.000	1.000	0.783	1.000	0.947	0.782	0.887	0.823	0.766
1986-87	0.788	1.000	0.811	0.818	0.650	0.775	0.923	1.000	0.759	0.743	0.975	0.728	0.857	0.745	1.000
1987-88	0.791	1.000	0.658	0.888	0.658	0.845	1.000	1.000	0.721	1.000	0.916	0.651	1.000	0.762	0.891
1988-89	0.764	1.000	1.000	0.803	0.635	0.771	1.000	1.000	0.714	0.832	0.686	0.699	1.000	0.773	0.867

1989-90	1.000	1.000	1.000	1.000	0.905	1.000	1.000	1.000	0.823	0.782	0.806	0.874	1.000	0.947	1.000
1990-91	0.864	1.000	1.000	0.964	0.729	0.978	1.000	1.000	0.789	0.789	0.899	0.762	1.000	0.881	0.797
1991-92	0.927	0.597	1.000	0.921	0.655	0.949	1.000	1.000	0.585	0.577	1.000	0.781	0.928	0.806	0.571
1992-93	0.896	0.000	1.000	0.867	0.732	0.985	1.000	1.000	0.731	0.822	0.894	0.920	1.000	0.947	0.937
1993-94	1.000	1.000	1.000	0.718	0.600	0.998	1.000	1.000	0.688	0.762	0.888	0.838	0.950	0.832	1.000
1994-95	1.000	1.000	1.000	0.665	0.715	0.769	1.000	1.000	0.788	0.791	0.830	0.886	1.000	0.808	0.916
1995-96	0.839	1.000	1.000	1.000	0.685	0.841	0.883	0.915	0.719	0.595	0.837	1.000	1.000	0.818	0.848
1996-97	1.000	0.000	1.000	0.962	0.600	0.947	1.000	0.684	0.612	0.528	0.758	0.644	1.000	0.720	0.923
1997-98	0.907	0.000	1.000	0.815	0.864	0.987	1.000	0.905	0.743	0.852	0.899	0.799	1.000	0.776	1.000
Industry 23															
1979-80	0.987	0.890	0.978	1.000	1.000	0.968	1.000	1.000	1.000	0.989	0.999	0.980	1.000	0.931	0.920
1980-81	1.000	0.968	0.896	1.000	0.931	1.000	1.000	1.000	1.000	0.928	1.000	1.000	1.000	0.899	0.904
1981-82	0.965	0.935	0.869	0.968	1.000	0.976	1.000	0.981	1.000	0.819	1.000	1.000	0.941	0.866	0.887
1982-83	0.946	0.877	0.762	0.891	0.956	0.858	1.000	1.000	0.810	1.000	1.000	0.930	0.925	0.784	0.753
1983-84	1.000	0.900	0.849	0.980	0.858	1.000	1.000	1.000	0.982	0.923	1.000	1.000	0.970	0.924	0.838
1984-85	0.969	0.934	0.783	0.939	0.838	1.000	1.000	0.985	0.980	0.971	1.000	0.976	1.000	0.880	0.903
1985-86	0.986	0.992	0.913	1.000	0.948	0.963	1.000	0.960	1.000	0.977	1.000	1.000	1.000	0.906	0.894
1986-87	0.986	0.994	0.851	0.953	0.960	1.000	1.000	0.946	1.000	0.913	1.000	0.988	1.000	0.919	0.928
1987-88	0.966	1.000	0.995	0.923	1.000	1.000	0.985	0.905	1.000	0.873	1.000	0.908	0.979	0.870	0.912
1988-89	0.964	1.000	0.894	0.920	0.989	1.000	0.996	0.958	1.000	0.896	1.000	1.000	0.971	0.825	0.851
1989-90	0.956	0.999	1.000	0.897	1.000	0.959	1.000	0.926	1.000	0.924	1.000	1.000	1.000	0.871	0.861
1990-91	0.992	1.000	1.000	0.929	1.000	0.991	1.000	0.938	1.000	0.946	1.000	1.000	1.000	0.811	0.882
1991-92	0.925	0.914	1.000	0.950	1.000	1.000	1.000	0.957	1.000	0.902	1.000	1.000	1.000	0.834	0.912
1992-93	0.940	0.958	1.000	0.937	1.000	0.987	1.000	0.941	1.000	0.998	1.000	1.000	1.000	0.907	0.956
1993-94	1.000	0.937	1.000	0.994	0.901	0.969	1.000	0.937	0.825	0.948	1.000	1.000	1.000	0.876	0.903
1994-95	0.879	1.000	1.000	0.937	0.970	1.000	0.948	0.893	0.985	0.962	1.000	1.000	0.918	0.855	0.887
1995-96	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.974	1.000	1.000	1.000	1.000	1.000	0.921	0.929
1996-97	0.861	1.000	1.000	0.836	1.000	0.920	0.957	1.000	0.966	1.000	1.000	0.988	0.868	0.803	1.000
1997-98	1.000	1.000	0.951	0.980	0.874	1.000	1.000	1.000	0.957	0.916	0.980	1.000	1.000	0.867	0.992
Industry 24															
1979-80	1.000	0.000	1.000	1.000	0.967	1.000	0.851	0.944	1.000	0.000	1.000	0.942	0.913	0.843	1.000
1980-81	1.000	0.000	1.000	1.000	0.930	0.920	0.777	0.899	0.989	0.000	1.000	0.968	0.930	0.677	0.991
1981-82	0.956	0.000	1.000	1.000	1.000	0.923	0.836	0.908	1.000	0.000	1.000	0.930	0.860	0.862	1.000
1982-83	1.000	1.000	0.818	1.000	1.000	1.000	1.000	0.968	1.000	0.000	1.000	0.962	0.917	0.956	1.000

1983-84	1.000	0.000	0.846	1.000	0.996	1.000	0.000	0.973	0.993	0.000	1.000	0.990	0.946	1.000	1.000
1984-85	0.761	0.000	1.000	1.000	0.998	1.000	1.000	0.969	1.000	0.000	1.000	0.995	0.907	1.000	1.000
1985-86	1.000	1.000	0.948	1.000	0.999	0.880	1.000	1.000	1.000	0.000	1.000	0.986	0.912	1.000	0.999
1986-87	1.000	0.000	0.838	1.000	1.000	1.000	0.000	1.000	1.000	0.000	1.000	1.000	0.964	1.000	1.000
1987-88	0.957	1.000	0.960	1.000	0.996	1.000	0.000	1.000	1.000	0.000	0.990	1.000	0.983	1.000	1.000
1988-89	1.000	0.964	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.000	1.000	0.974	1.000	1.000	0.956
1989-90	0.966	1.000	1.000	0.991	1.000	1.000	0.905	1.000	0.943	0.000	1.000	1.000	1.000	1.000	0.910
1990-91	0.909	1.000	0.887	0.995	0.914	1.000	0.000	1.000	1.000	1.000	1.000	1.000	0.963	0.936	0.938
1991-92	0.921	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000	0.911	0.987	0.946	0.907
1992-93	1.000	0.916	0.766	0.843	0.839	1.000	0.000	0.789	0.943	1.000	0.846	0.868	0.900	0.911	0.991
1993-94	1.000	0.875	1.000	0.833	0.852	1.000	0.937	1.000	1.000	1.000	0.849	0.864	0.836	0.886	0.980
1994-95	1.000	0.800	1.000	0.849	0.718	0.765	1.000	0.792	0.688	0.421	0.826	0.876	1.000	0.829	0.534
1995-96	0.834	1.000	1.000	0.921	0.916	1.000	0.000	1.000	0.880	0.756	0.974	1.000	0.857	1.000	0.734
1996-97	1.000	0.776	1.000	1.000	0.834	1.000	1.000	0.968	0.911	1.000	0.946	0.859	0.827	0.987	0.845
1997-98	0.895	1.000	1.000	0.964	1.000	1.000	1.000	1.000	0.895	0.000	1.000	0.879	0.781	0.844	0.685
Industry 26															
1979-80	0.632	0.753	0.677	0.789	0.870	0.877	0.881	0.796	0.842	1.000	1.000	1.000	0.804	0.918	0.733
1980-81	0.666	1.000	0.871	0.777	1.000	0.901	0.734	0.937	0.840	0.771	1.000	1.000	0.891	0.979	0.790
1981-82	0.726	1.000	0.886	0.847	0.869	1.000	0.806	0.815	0.889	0.860	1.000	1.000	0.924	1.000	0.896
1982-83	0.834	0.000	0.712	0.726	1.000	0.984	0.864	0.852	0.791	1.000	1.000	0.748	0.792	0.947	0.935
1983-84	1.000	0.000	0.775	0.844	0.898	1.000	0.844	0.887	0.852	0.930	1.000	0.919	0.943	1.000	0.891
1984-85	0.903	0.000	0.529	0.878	0.677	0.953	0.583	0.624	0.747	0.762	1.000	0.685	0.902	0.764	1.000
1985-86	0.844	0.000	0.879	0.930	1.000	1.000	1.000	1.000	0.974	0.930	1.000	0.909	1.000	1.000	1.000
1986-87	1.000	0.000	0.982	0.821	1.000	1.000	0.954	0.795	0.920	0.848	1.000	1.000	1.000	0.993	1.000
1987-88	0.736	0.000	0.779	0.865	1.000	1.000	0.949	0.731	0.853	0.804	1.000	1.000	1.000	1.000	1.000
1988-89	0.825	0.000	0.734	0.815	1.000	0.962	0.860	0.832	0.914	0.807	1.000	1.000	1.000	1.000	0.827
1989-90	0.846	1.000	0.749	0.839	0.862	0.933	0.769	0.748	0.976	0.749	1.000	1.000	1.000	1.000	0.797
1990-91	0.692	0.664	1.000	1.000	0.920	0.927	1.000	0.747	0.890	0.721	0.851	1.000	0.958	0.932	0.709
1991-92	0.603	0.605	0.686	0.956	0.785	1.000	0.876	0.623	1.000	0.810	1.000	1.000	1.000	0.749	0.838
1992-93	0.788	0.848	0.686	0.862	0.819	0.886	0.823	0.632	0.908	0.716	1.000	1.000	1.000	0.746	0.959
1993-94	0.629	1.000	0.677	0.674	0.834	1.000	1.000	0.634	1.000	0.639	0.937	1.000	1.000	0.864	0.673
1994-95	0.661	0.966	0.820	0.851	0.966	0.953	1.000	0.719	0.902	0.720	0.961	1.000	0.877	0.928	1.000
1995-96	0.772	0.000	0.944	0.807	1.000	0.998	1.000	0.886	1.000	0.785	0.931	0.934	1.000	0.867	1.000
1996-97	0.789	1.000	0.921	0.844	1.000	1.000	0.811	0.744	0.972	0.756	0.957	0.860	1.000	1.000	0.834

1997-98	0.835	0.000	0.888	0.793	0.941	1.000	0.887	0.834	1.000	0.685	1.000	1.000	1.000	0.751	0.971
Industry 27														
1979-80	0.889	0.848	0.837	1.000	1.000	0.864	0.823	0.818	0.859	1.000	0.846	1.000	0.921	0.927	0.841
1980-81	0.515	0.647	1.000	0.834	1.000	0.516	0.498	0.669	1.000	0.992	0.805	1.000	0.716	0.610	0.931
1981-82	0.852	0.904	0.851	1.000	1.000	0.961	0.890	0.863	0.899	1.000	1.000	1.000	1.000	0.864	0.965
1982-83	0.919	0.868	0.899	0.885	1.000	0.961	0.975	0.941	0.906	1.000	0.972	1.000	1.000	0.917	0.887
1983-84	0.981	0.938	0.942	0.822	1.000	0.957	1.000	0.802	0.930	0.831	1.000	0.794	1.000	0.805	1.000
1984-85	0.982	1.000	1.000	1.000	1.000	0.964	0.900	1.000	1.000	1.000	0.952	0.970	1.000	0.919	1.000
1985-86	1.000	0.966	0.969	1.000	1.000	1.000	0.926	1.000	1.000	0.918	0.916	0.840	0.937	1.000	1.000
1986-87	0.989	1.000	0.943	1.000	1.000	1.000	0.908	1.000	1.000	1.000	0.938	1.000	1.000	1.000	0.915
1987-88	1.000	0.984	0.962	0.977	1.000	1.000	0.903	1.000	1.000	0.923	0.898	0.892	1.000	0.869	1.000
1988-89	1.000	1.000	1.000	0.971	1.000	0.865	0.909	0.951	1.000	1.000	0.932	0.969	0.961	0.883	0.943
1989-90	1.000	0.958	1.000	1.000	1.000	0.891	0.938	0.953	0.974	1.000	0.945	0.983	1.000	1.000	0.921
1990-91	1.000	1.000	0.909	1.000	1.000	0.998	0.956	0.943	1.000	1.000	0.931	0.919	1.000	0.812	0.972
1991-92	1.000	1.000	1.000	0.982	1.000	0.924	1.000	1.000	0.996	1.000	0.925	0.883	0.887	0.926	0.904
1992-93	1.000	1.000	0.931	1.000	1.000	0.833	0.854	0.912	0.949	1.000	0.909	0.941	0.791	1.000	0.792
1993-94	1.000	1.000	0.918	0.988	1.000	0.946	1.000	0.905	0.939	1.000	0.970	1.000	1.000	0.834	0.986
1994-95	0.906	1.000	0.878	0.966	1.000	0.985	1.000	1.000	1.000	1.000	0.816	0.889	0.985	0.900	0.923
1995-96	1.000	1.000	1.000	0.894	1.000	0.951	0.933	0.956	0.963	1.000	0.886	1.000	0.873	0.823	0.883
1996-97	0.891	0.640	0.905	0.935	0.774	0.750	1.000	0.644	1.000	0.842	0.568	0.774	0.776	1.000	1.000
1997-98	1.000	1.000	0.786	0.771	1.000	0.712	0.671	1.000	0.970	0.784	0.517	0.843	1.000	0.624	0.766
Industry 28														
1979-80	0.935	1.000	0.906	0.898	0.929	0.941	0.891	0.912	1.000	1.000	0.842	1.000	1.000	0.943	0.968
1980-81	0.972	1.000	1.000	0.868	1.000	0.869	0.887	0.975	1.000	1.000	0.791	1.000	0.935	0.867	0.896
1981-82	1.000	1.000	1.000	0.882	1.000	0.858	0.789	0.863	1.000	1.000	0.761	1.000	0.962	0.862	0.918
1982-83	1.000	1.000	0.751	0.838	1.000	0.802	0.846	0.943	1.000	1.000	0.807	1.000	0.992	0.840	0.915
1983-84	0.816	1.000	0.743	0.851	0.949	0.890	0.817	0.817	1.000	1.000	0.862	1.000	0.983	0.867	0.979
1984-85	0.965	1.000	0.931	1.000	0.892	1.000	0.888	1.000	1.000	1.000	0.833	1.000	1.000	0.892	1.000
1985-86	0.940	1.000	1.000	1.000	0.848	0.959	1.000	1.000	1.000	0.958	0.927	0.992	0.991	0.876	1.000
1986-87	0.964	0.904	1.000	1.000	1.000	0.996	0.982	1.000	1.000	1.000	0.892	0.995	1.000	0.892	0.892
1987-88	0.866	1.000	1.000	1.000	0.957	0.819	1.000	0.880	1.000	1.000	0.763	1.000	0.954	0.943	0.968
1988-89	0.818	0.953	0.977	1.000	0.805	0.829	0.970	1.000	0.935	0.874	0.750	1.000	1.000	0.869	0.897
1989-90	0.895	1.000	0.812	1.000	0.928	0.936	0.943	0.888	1.000	0.868	1.000	1.000	1.000	0.928	0.877
1990-91	0.943	0.864	1.000	1.000	1.000	0.992	0.991	1.000	0.975	0.963	0.983	1.000	1.000	0.915	0.953

1991-92	0.934	1.000	1.000	1.000	0.945	0.997	1.000	0.953	0.989	0.920	1.000	1.000	1.000	0.924	0.923
1992-93	0.884	1.000	1.000	1.000	1.000	1.000	1.000	0.929	0.946	0.918	1.000	1.000	1.000	0.848	0.954
1993-94	1.000	0.923	1.000	0.984	1.000	1.000	0.998	0.890	0.942	0.840	0.969	1.000	1.000	0.811	0.894
1994-95	0.883	1.000	1.000	1.000	0.995	1.000	0.936	0.765	1.000	0.896	1.000	1.000	0.901	0.808	0.935
1995-96	0.906	1.000	1.000	1.000	0.906	1.000	1.000	0.880	1.000	0.853	1.000	1.000	0.950	0.851	0.922
1996-97	0.857	1.000	1.000	1.000	1.000	0.957	1.000	0.834	0.999	0.813	1.000	1.000	1.000	0.882	1.000
1997-98	0.979	1.000	1.000	0.908	1.000	0.935	1.000	0.902	1.000	0.871	1.000	1.000	0.981	0.952	1.000
Industry 29															
1979-80	0.727		1.000	0.871	1.000	0.922	0.740	0.709	1.000	1.000	0.941	0.000	1.000	0.786	0.968
1980-81	0.666		1.000	0.660	1.000	1.000	0.000	0.602	1.000	1.000	0.770	0.621	0.760	0.767	0.957
1981-82	0.602		0.637	0.638	1.000	0.669	0.615	0.630	0.755	1.000	0.653	0.592	0.615	0.611	1.000
1982-83	1.000		0.666	0.823	0.879	0.959	0.000	0.823	1.000	1.000	1.000	0.741	1.000	0.789	1.000
1983-84	0.889		0.790	0.856	1.000	1.000	0.614	0.788	1.000	1.000	0.697	0.000	0.851	0.689	0.965
1984-85	0.814		0.906	0.703	1.000	1.000	0.000	1.000	0.923	1.000	0.672	0.613	1.000	0.970	1.000
1985-86	0.817		0.907	1.000	1.000	1.000	0.469	1.000	1.000	1.000	0.848	0.000	0.958	0.922	0.892
1986-87	0.913		0.940	0.908	1.000	1.000	1.000	1.000	0.916	0.978	0.911	0.624	0.984	0.902	1.000
1987-88	1.000		0.837	0.993	0.992	1.000	0.000	1.000	1.000	0.924	0.960	0.000	1.000	0.972	1.000
1988-89	0.894		0.852	0.916	1.000	1.000	1.000	1.000	1.000	1.000	0.891	1.000	0.932	0.936	1.000
1989-90	0.876		0.931	0.828	1.000	1.000	0.000	1.000	1.000	1.000	0.940	0.000	0.907	0.862	1.000
1990-91	0.920		0.966	0.838	1.000	1.000	0.000	1.000	1.000	0.883	0.946	1.000	0.913	0.946	1.000
1991-92	0.903		1.000	0.823	1.000	1.000	0.000	0.918	1.000	1.000	1.000	0.000	0.958	0.882	1.000
1992-93	0.871		0.801	0.802	1.000	1.000	0.000	1.000	1.000	1.000	0.779	1.000	0.935	0.846	0.824
1993-94	0.792		1.000	0.867	1.000	1.000	1.000	1.000	0.957	0.907	0.845	1.000	1.000	1.000	1.000
1994-95	0.882		1.000	0.870	0.957	1.000	1.000	0.898	1.000	0.931	0.931	1.000	0.940	0.929	1.000
1995-96	0.991		1.000	0.863	0.962	1.000	1.000	0.959	1.000	1.000	0.883	1.000	0.966	0.968	1.000
1996-97	0.964		1.000	0.780	0.961	1.000	1.000	1.000	1.000	0.990	0.817	1.000	0.911	0.889	0.877
1997-98	0.538		1.000	0.789	1.000	1.000	0.000	1.000	1.000	0.000	0.795	1.000	0.920	1.000	1.000
Industry 30															
1979-80	0.754	1.000	0.887	1.000	0.950	1.000	0.783	1.000	1.000	0.875	1.000	0.899	1.000	0.964	1.000
1980-81	0.771	0.860	0.716	0.828	0.858	1.000	0.869	0.990	1.000	0.763	1.000	0.949	1.000	0.947	0.978
1981-82	0.755	1.000	0.753	0.847	1.000	1.000	0.853	0.948	1.000	0.710	1.000	1.000	1.000	0.734	1.000
1982-83	0.825	1.000	0.759	0.868	1.000	1.000	0.973	0.911	1.000	0.604	1.000	0.753	1.000	0.831	0.855
1983-84	0.970	1.000	0.896	0.960	0.949	1.000	1.000	1.000	1.000	0.740	1.000	1.000	1.000	0.921	0.951
1984-85	0.865	1.000	0.982	0.976	1.000	1.000	1.000	1.000	1.000	0.930	1.000	1.000	1.000	0.933	0.886

1985-86	0.895	1.000	1.000	1.000	0.970	1.000	0.998	1.000	1.000	0.925	1.000	0.985	0.987	0.945	0.890
1986-87	0.912	1.000	1.000	1.000	1.000	1.000	0.986	1.000	1.000	0.923	1.000	0.885	0.958	0.850	0.944
1987-88	0.951	1.000	1.000	1.000	1.000	0.948	1.000	1.000	1.000	0.899	1.000	0.977	0.961	0.976	0.933
1988-89	0.911	0.825	1.000	1.000	1.000	0.868	0.991	1.000	1.000	0.715	0.986	0.957	1.000	0.841	1.000
1989-90	0.964	1.000	1.000	1.000	0.932	1.000	1.000	1.000	1.000	0.868	0.947	1.000	0.949	1.000	1.000
1990-91	0.906	1.000	1.000	0.998	0.989	1.000	0.980	1.000	1.000	0.684	0.993	1.000	1.000	0.940	1.000
1991-92	1.000	1.000	1.000	1.000	0.925	1.000	0.903	1.000	0.957	0.918	1.000	0.976	0.983	1.000	1.000
1992-93	1.000	0.976	1.000	0.990	0.935	0.977	0.957	1.000	1.000	0.768	1.000	1.000	0.919	1.000	1.000
1993-94	0.998	1.000	0.988	0.975	1.000	0.919	0.919	0.988	1.000	0.827	1.000	0.940	0.993	1.000	1.000
1994-95	0.927	0.874	0.967	0.908	0.896	1.000	0.946	1.000	0.907	0.789	1.000	1.000	0.884	0.924	1.000
1995-96	1.000	0.888	1.000	0.942	1.000	0.981	0.996	1.000	1.000	0.878	1.000	1.000	0.919	0.968	1.000
1996-97	0.969	1.000	1.000	1.000	0.931	1.000	0.957	1.000	1.000	0.742	1.000	1.000	0.959	1.000	1.000
1997-98	0.886	0.890	0.852	0.986	0.927	1.000	0.864	1.000	1.000	0.860	1.000	1.000	0.865	0.979	1.000
Industry 31															
1979-80	0.941	1.000	0.866	0.911	1.000	0.846	1.000	1.000	0.843	0.811	0.852	1.000	1.000	0.881	0.807
1980-81	0.991	1.000	1.000	1.000	1.000	0.997	1.000	1.000	1.000	0.931	0.955	0.951	1.000	0.982	0.978
1981-82	0.965	1.000	1.000	1.000	1.000	0.828	1.000	0.895	0.997	0.947	0.949	1.000	1.000	1.000	0.912
1982-83	1.000	1.000	1.000	1.000	1.000	0.942	0.965	1.000	0.923	1.000	1.000	1.000	0.931	0.946	0.903
1983-84	0.790	0.912	0.880	1.000	1.000	0.764	0.805	0.932	0.833	0.953	0.942	1.000	0.784	0.416	0.887
1984-85	0.875	1.000	0.950	1.000	1.000	0.800	1.000	1.000	0.877	1.000	0.935	0.890	0.960	0.879	0.855
1985-86	0.955	1.000	0.859	1.000	1.000	0.836	0.912	0.829	1.000	0.958	1.000	0.889	0.884	0.845	0.873
1986-87	0.926	1.000	0.906	1.000	1.000	0.932	0.927	0.846	0.979	0.885	1.000	0.853	0.938	1.000	0.968
1987-88	0.927	1.000	1.000	0.870	0.818	0.893	1.000	1.000	0.884	0.853	1.000	0.883	0.882	1.000	1.000
1988-89	0.945	1.000	1.000	1.000	1.000	0.971	0.974	1.000	1.000	1.000	0.932	1.000	1.000	0.983	0.899
1989-90	0.830	1.000	0.950	1.000	1.000	0.913	1.000	0.926	0.868	0.933	0.955	0.919	0.893	1.000	0.929
1990-91	0.919	1.000	1.000	0.954	0.963	0.958	1.000	0.853	1.000	1.000	1.000	1.000	0.972	0.964	0.997
1991-92	0.936	1.000	1.000	1.000	0.987	0.917	1.000	0.543	0.961	0.975	1.000	0.912	1.000	1.000	0.944
1992-93	0.879	1.000	1.000	1.000	0.991	0.896	1.000	0.752	0.925	0.977	0.903	0.907	0.829	1.000	0.943
1993-94	0.940	1.000	1.000	1.000	0.953	1.000	1.000	0.822	1.000	0.853	1.000	0.956	0.880	1.000	0.902
1994-95	1.000	1.000	1.000	1.000	0.996	0.791	0.884	0.754	0.897	1.000	0.978	0.781	0.945	1.000	0.882
1995-96	0.939	1.000	1.000	1.000	0.841	0.943	1.000	0.853	0.863	1.000	1.000	0.787	0.874	1.000	0.870
1996-97	0.954	1.000	1.000	1.000	0.885	0.950	1.000	0.791	0.919	1.000	1.000	0.822	0.864	1.000	0.871
1997-98	0.845	1.000	0.907	0.862	1.000	0.994	1.000	1.000	0.959	1.000	0.974	1.000	0.939	1.000	0.886

Industry 32															
1979-80	1.000	1.000	0.868	1.000	1.000	1.000	1.000	1.000	1.000	0.985	1.000	0.923	0.943	0.878	0.967
1980-81	0.851	1.000	0.862	1.000	1.000	0.954	1.000	1.000	1.000	0.911	1.000	1.000	0.964	0.877	1.000
1981-82	0.994	1.000	0.887	1.000	1.000	1.000	1.000	1.000	1.000	0.973	0.916	0.960	0.983	0.918	0.999
1982-83	1.000	0.930	0.913	0.918	1.000	0.970	1.000	1.000	0.997	1.000	1.000	1.000	1.000	0.817	1.000
1983-84	1.000	0.827	0.925	0.759	1.000	0.822	1.000	1.000	0.980	0.926	1.000	1.000	0.918	0.794	1.000
1984-85	1.000	0.952	0.927	0.888	1.000	0.947	1.000	1.000	1.000	0.944	0.833	1.000	1.000	0.757	1.000
1985-86	0.905	1.000	0.784	0.824	1.000	0.949	0.813	1.000	0.969	1.000	0.822	0.941	0.965	0.876	1.000
1986-87	1.000	0.880	0.966	0.917	1.000	1.000	1.000	1.000	1.000	1.000	0.869	1.000	1.000	0.937	1.000
1987-88	0.925	0.900	1.000	0.946	1.000	1.000	1.000	1.000	0.990	1.000	0.851	0.971	1.000	1.000	1.000
1988-89	0.897	1.000	1.000	0.967	1.000	1.000	1.000	0.889	1.000	1.000	0.954	1.000	0.973	0.891	1.000
1989-90	0.931	1.000	1.000	0.893	1.000	1.000	0.981	1.000	1.000	1.000	1.000	0.993	0.986	1.000	1.000
1990-91	0.935	0.881	1.000	0.949	0.977	1.000	1.000	1.000	1.000	1.000	0.924	0.939	1.000	0.895	1.000
1991-92	1.000	1.000	0.992	0.911	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.950	1.000	0.886	1.000
1992-93	1.000	1.000	1.000	0.977	0.909	1.000	1.000	1.000	0.934	1.000	1.000	0.890	1.000	0.857	0.947
1993-94	1.000	0.995	0.853	0.973	0.889	1.000	1.000	0.953	0.898	1.000	0.789	0.920	1.000	0.844	1.000
1994-95	1.000	1.000	0.646	1.000	0.938	0.885	1.000	0.956	0.883	1.000	0.910	0.922	1.000	0.877	1.000
1995-96	1.000	1.000	0.901	0.943	1.000	0.949	1.000	1.000	0.956	1.000	1.000	1.000	1.000	0.849	1.000
1996-97	1.000	1.000	0.755	1.000	0.991	1.000	1.000	0.935	1.000	1.000	1.000	0.981	1.000	0.841	0.979
1997-98	1.000	1.000	0.914	1.000	0.934	1.000	0.877	0.897	0.938	1.000	1.000	0.986	1.000	0.855	1.000
Industry 33															
1979-80	0.988	1.000	1.000	0.975	0.986	0.987	1.000	0.942	1.000	1.000	1.000	1.000	0.928	1.000	0.859
1980-81	1.000	1.000	0.908	0.956	0.999	1.000	1.000	1.000	1.000	1.000	1.000	0.969	0.955	0.983	0.992
1981-82	0.966	0.941	1.000	0.945	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.938	0.891	0.967	0.956
1982-83	0.920	1.000	1.000	0.880	1.000	0.908	1.000	0.964	0.902	1.000	1.000	0.867	0.898	0.933	0.916
1983-84	1.000	1.000	1.000	0.999	1.000	0.813	0.942	1.000	1.000	1.000	1.000	0.993	1.000	1.000	0.937
1984-85	1.000	1.000	1.000	0.970	1.000	0.910	0.998	0.939	1.000	0.834	1.000	0.999	0.965	1.000	0.947
1985-86	1.000	1.000	1.000	0.933	1.000	0.954	1.000	1.000	1.000	0.899	1.000	0.920	0.940	1.000	1.000
1986-87	1.000	1.000	1.000	0.964	1.000	0.927	1.000	0.969	1.000	0.939	1.000	1.000	0.911	1.000	0.828
1987-88	1.000	1.000	1.000	0.966	1.000	1.000	1.000	1.000	1.000	0.970	1.000	0.950	0.957	1.000	0.924
1988-89	1.000	1.000	1.000	0.997	1.000	1.000	1.000	0.988	0.986	1.000	1.000	0.910	0.989	1.000	0.933
1989-90	0.989	1.000	1.000	0.984	1.000	1.000	1.000	1.000	0.959	1.000	1.000	0.978	0.933	1.000	0.836
1990-91	1.000	1.000	1.000	1.000	1.000	1.000	0.936	0.894	0.923	0.986	1.000	0.913	0.904	1.000	0.803
1991-92	0.840	1.000	1.000	0.987	1.000	1.000	1.000	0.946	0.946	0.989	1.000	0.883	1.000	1.000	0.987

1992-93	0.909	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.987	1.000	1.000	0.970	0.932	1.000	1.000
1993-94	0.805	1.000	1.000	1.000	1.000	1.000	0.967	0.968	0.912	1.000	1.000	0.763	0.838	0.960	0.915
1994-95	0.697	1.000	0.999	0.875	0.976	0.717	0.908	0.811	0.701	0.950	1.000	0.604	0.652	0.928	0.777
1995-96	1.000	0.973	1.000	0.987	1.000	1.000	1.000	0.979	0.985	0.953	1.000	0.857	0.892	1.000	1.000
1996-97	1.000	0.977	1.000	0.967	1.000	0.887	1.000	0.876	0.889	1.000	1.000	0.801	0.801	0.914	0.803
1997-98	1.000	1.000	1.000	1.000	1.000	0.921	0.889	1.000	0.852	0.967	1.000	0.813	0.869	0.908	0.695
Industry 34															
1979-80	0.949	1.000	0.917	0.957	1.000	0.982	0.924	1.000	1.000	0.943	1.000	1.000	1.000	0.961	0.982
1980-81	1.000	1.000	0.903	1.000	1.000	1.000	0.895	0.988	0.964	0.857	1.000	1.000	1.000	0.928	0.957
1981-82	0.927	1.000	0.963	0.980	1.000	0.992	0.964	0.953	1.000	1.000	1.000	0.940	1.000	0.907	0.936
1982-83	0.887	1.000	0.953	1.000	1.000	1.000	0.974	0.912	0.986	0.930	0.899	0.959	1.000	0.898	1.000
1983-84	0.940	1.000	0.908	0.986	1.000	1.000	0.919	1.000	1.000	1.000	0.951	1.000	1.000	0.889	1.000
1984-85	1.000	1.000	0.940	0.945	0.967	0.975	0.988	1.000	1.000	1.000	0.866	0.963	1.000	0.917	1.000
1985-86	0.965	1.000	0.906	1.000	0.938	1.000	0.968	0.937	1.000	1.000	1.000	1.000	0.871	0.974	0.969
1986-87	0.885	1.000	0.737	0.844	0.840	0.896	0.988	1.000	0.965	1.000	0.814	0.951	0.940	0.876	0.983
1987-88	0.923	1.000	0.891	0.956	0.886	1.000	0.930	1.000	0.970	1.000	1.000	1.000	0.886	0.893	1.000
1988-89	0.975	1.000	1.000	0.989	0.836	0.910	0.855	1.000	0.970	0.832	1.000	0.895	0.923	0.961	0.793
1989-90	0.944	1.000	1.000	0.970	0.982	1.000	0.895	0.982	0.989	0.899	1.000	0.934	0.967	1.000	1.000
1990-91	0.892	1.000	0.964	1.000	1.000	1.000	0.955	0.960	0.902	1.000	0.987	0.968	0.919	0.920	0.986
1991-92	0.951	1.000	0.918	1.000	0.853	1.000	0.932	1.000	0.923	1.000	1.000	0.935	1.000	1.000	1.000
1992-93	0.947	1.000	0.949	0.905	0.886	1.000	0.823	1.000	0.954	1.000	1.000	1.000	1.000	0.889	0.985
1993-94	1.000	1.000	0.815	1.000	0.872	1.000	0.871	0.986	0.909	0.999	1.000	0.982	0.956	0.998	1.000
1994-95	0.970	1.000	0.897	1.000	0.879	1.000	0.831	1.000	0.925	1.000	1.000	0.996	0.966	0.858	1.000
1995-96	1.000	1.000	0.853	0.932	0.908	1.000	0.869	1.000	0.962	0.962	1.000	1.000	0.994	1.000	1.000
1996-97	1.000	1.000	1.000	0.973	0.951	1.000	0.914	1.000	0.915	0.966	1.000	1.000	1.000	1.000	1.000
1997-98	0.842	1.000	0.944	0.724	0.801	0.933	0.758	0.875	0.815	0.715	1.000	1.000	0.854	0.850	1.000
Industry 35-36															
1979-80	0.955	1.000	0.967	0.992	1.000	0.970	1.000	1.000	1.000	0.944	0.986	0.947	1.000	0.930	1.000
1980-81	0.916	1.000	0.863	0.912	1.000	0.919	0.907	0.975	1.000	0.977	1.000	0.991	1.000	0.874	0.962
1981-82	1.000	0.999	0.899	0.989	1.000	0.922	0.854	0.938	1.000	1.000	0.984	0.948	1.000	0.930	0.955
1982-83	1.000	1.000	0.944	0.976	1.000	1.000	0.931	0.952	1.000	0.951	1.000	0.928	1.000	0.979	1.000
1983-84	1.000	1.000	1.000	0.950	1.000	1.000	0.871	0.866	0.967	0.914	0.993	0.930	1.000	0.908	1.000
1984-85	1.000	0.998	1.000	0.977	1.000	0.962	0.909	0.983	1.000	0.778	0.939	0.861	1.000	0.939	1.000
1985-86	0.932	1.000	1.000	0.942	1.000	1.000	1.000	0.911	0.966	1.000	1.000	0.836	1.000	0.959	0.886

1986-87	0.963	0.947	1.000	1.000	1.000	0.963	0.921	0.938	1.000	1.000	1.000	1.000	1.000	0.965	0.973
1987-88	0.973	1.000	1.000	1.000	1.000	0.976	0.929	0.970	0.978	1.000	1.000	0.896	1.000	0.967	0.968
1988-89	0.959	0.987	1.000	1.000	1.000	0.988	0.984	1.000	0.961	1.000	1.000	0.916	1.000	0.946	0.934
1989-90	1.000	1.000	0.970	1.000	1.000	0.977	1.000	0.980	1.000	1.000	1.000	0.924	1.000	0.999	1.000
1990-91	0.987	1.000	0.926	1.000	1.000	1.000	0.977	0.999	0.999	1.000	0.976	0.930	1.000	0.962	0.960
1991-92	0.966	1.000	0.912	1.000	0.975	1.000	0.988	0.999	1.000	1.000	1.000	0.943	1.000	1.000	0.982
1992-93	0.940	1.000	0.905	0.947	0.903	1.000	1.000	0.985	0.960	1.000	1.000	0.885	1.000	1.000	0.921
1993-94	0.890	1.000	0.967	1.000	0.997	0.916	1.000	0.953	1.000	1.000	1.000	0.918	1.000	1.000	0.951
Industry 37															
1979-80	0.916	0.909	0.866	0.792	0.749	1.000	1.000	1.000	0.788	1.000	0.837	0.946	0.798	0.813	0.896
1980-81	0.779	1.000	1.000	0.899	1.000	1.000	1.000	0.969	0.987	1.000	1.000	0.893	0.960	0.963	0.927
1981-82	0.814	1.000	1.000	0.969	0.937	1.000	1.000	0.963	0.992	1.000	1.000	0.868	1.000	0.702	0.903
1982-83	0.490	1.000	0.769	0.686	0.867	0.645	0.659	0.776	0.807	1.000	1.000	0.566	0.826	0.599	0.517
1983-84	0.850	1.000	0.884	0.930	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.902	0.973	0.867	1.000
1984-85	0.776	1.000	1.000	0.907	1.000	1.000	1.000	0.982	1.000	1.000	1.000	1.000	1.000	0.784	0.920
1985-86	0.837	1.000	0.894	0.862	0.867	1.000	1.000	0.857	0.959	1.000	0.869	0.980	0.894	0.660	0.926
1986-87	0.816	1.000	0.933	0.829	1.000	1.000	1.000	0.896	0.983	1.000	1.000	1.000	1.000	0.919	1.000
1987-88	0.783	1.000	0.708	0.654	1.000	0.844	1.000	1.000	0.837	1.000	1.000	1.000	0.879	0.712	0.938
1988-89	0.753	1.000	0.934	0.953	1.000	0.943	0.707	1.000	0.959	1.000	1.000	0.800	0.882	0.787	0.773
1989-90	0.903	1.000	1.000	0.945	0.974	0.932	0.981	1.000	0.900	1.000	1.000	0.923	1.000	0.902	0.920
1990-91	0.947	1.000	0.924	1.000	1.000	0.993	1.000	0.975	0.922	1.000	1.000	0.916	1.000	0.958	1.000
1991-92	0.985	1.000	0.894	0.909	1.000	1.000	1.000	0.967	0.948	1.000	0.853	0.954	0.944	0.844	0.969
1992-93	0.866	1.000	0.854	1.000	0.954	1.000	1.000	0.896	0.990	1.000	0.881	0.944	1.000	0.870	0.990
1993-94	1.000	1.000	0.816	1.000	1.000	1.000	1.000	0.951	1.000	1.000	0.921	0.840	0.996	0.903	0.889
1994-95	0.900	0.983	0.895	1.000	1.000	0.998	1.000	0.958	1.000	1.000	0.839	1.000	1.000	0.922	1.000
1995-96	1.000	1.000	0.898	1.000	1.000	1.000	1.000	0.996	0.979	1.000	0.915	1.000	1.000	0.900	1.000
1996-97	0.824	1.000	0.832	1.000	1.000	0.943	1.000	0.940	0.956	0.677	0.735	1.000	0.945	0.904	1.000
1997-98	0.936	0.999	1.000	1.000	1.000	1.000	1.000	0.894	0.875	1.000	0.869	1.000	0.820	0.876	1.000
Industry 38															
1979-80	0.975		1.000	0.926	0.979	1.000	1.000	1.000	1.000	1.000	1.000	0.936	0.915	0.817	1.000
1980-81	0.841		0.000	1.000	0.802	1.000	1.000	1.000	0.970	0.756	1.000	0.775	0.957	0.863	1.000
1981-82	0.802		1.000	0.919	0.862	1.000	1.000	0.967	0.913	0.839	1.000	0.756	0.935	0.754	1.000
1982-83	0.847		1.000	0.919	0.787	1.000	1.000	1.000	0.931	0.847	1.000	0.763	0.974	0.804	1.000
1983-84	0.647		1.000	0.777	0.854	0.935	1.000	0.676	1.000	1.000	0.953	0.745	0.890	0.911	0.922

1984-85	0.714		1.000	0.829	0.714	0.904	1.000	0.847	1.000	1.000	0.919	0.778	0.781	0.831	1.000
1985-86	0.505		1.000	1.000	0.625	0.530	0.949	0.571	0.712	0.753	0.916	0.770	0.773	0.935	1.000
1986-87	1.000		1.000	1.000	0.906	1.000	0.843	1.000	1.000	0.808	1.000	1.000	0.900	1.000	1.000
1987-88	1.000		1.000	1.000	1.000	1.000	0.992	0.886	1.000	0.817	1.000	1.000	1.000	0.990	1.000
1988-89	1.000		1.000	1.000	0.962	1.000	1.000	0.879	1.000	0.790	1.000	1.000	1.000	1.000	1.000
1989-90	1.000		1.000	1.000	0.890	0.842	1.000	0.733	1.000	1.000	1.000	0.980	1.000	0.874	0.938
1990-91	0.662		0.921	1.000	1.000	0.998	0.977	0.813	0.918	1.000	0.897	0.831	1.000	0.850	0.781
1991-92	0.832		1.000	1.000	0.983	1.000	0.945	0.933	1.000	1.000	0.926	0.906	1.000	0.917	0.906
1992-93	0.629		1.000	0.955	1.000	1.000	1.000	0.891	1.000	1.000	1.000	0.927	1.000	0.911	0.917
1993-94	0.316		0.642	0.522	0.475	0.414	0.904	0.286	0.933	0.315	1.000	0.544	0.573	0.842	1.000
1994-95	0.810		1.000	0.848	0.944	0.957	1.000	0.789	1.000	0.774	1.000	1.000	1.000	1.000	1.000
1995-96	0.884		1.000	1.000	0.928	0.843	0.885	1.000	1.000	1.000	1.000	0.881	0.950	1.000	0.956
1996-97	1.000		1.000	0.960	0.949	0.978	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.922
1997-98	0.556		0.888	0.915	0.908	0.802	1.000	0.772	0.724	0.652	1.000	1.000	0.731	0.744	0.966