# Performance Analysis of the Indian Pharmaceutical Industry

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# Performance Analysis of the Indian Pharmaceutical Industry: A Global Outlook

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*This book is dedicated to our Parents and daughter SHRINIKA*

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# List of Abbreviations

| | |
|---|---|
| (X-M)/Y | Net Export Intensity |
| 2SLS | Two-Stage Least Square Method |
| AAGR | Average Annual Growth Rate |
| AE | Allocative Efficiency |
| AEMPS | Spanish Agency of Medicines and Medical Devices |
| AI | Advertisement Intensity |
| AIFA | Regulatory Framework of The Italian Medicines Agency |
| API | Active Pharmaceutical Ingredients |
| ASI | Annual Survey of Industries |
| BCC | Banker, Charnes, and Coope |
| BMI | Biennial Malmquist Index |
| CAGR | Compound Annual Growth Rate |
| CMIE | *Centre for Monitoring Indian Economy* |
| CRS | Constant Return to Scale |
| CSO | Chief Science Officer |
| D | Dummy Variable |
| DEA | Data Envelopment Analysis |
| DGCI&S | Directorate General of Commercial Intelligence and Statistics |
| DMU | Decision Making Units |
| E/L | Employee Per Production Worker / Composition of Work Force |
| EMA | European Medicines Agency |
| EU | European Union |
| FDA | Food and Drug Administration |
| FDI | Foreign Direct Investment |
| FGLR | Färe, Grosskopf, Lindgren and Roos |
| FGNZ | Färe, Grosskopf, Norris and Zhang |
| GAA | Growth Accounting Approach |
| GRM | Grand Mean |
| HFG | High Growth Firms |
| IDX | Indonesia Stock Exchange |
| IPI | Indian Pharmaceutical Industry |
| IPR | Intellectual Property Rights |
| K/L | Capital Per Production Worker/ Degree of Mechanisation |
| MF | Intermediate Inputs/ Firm Size |
| MFDS | Ministry of Food and Drug Safety |

| | |
|---|---|
| MI | Marketing Intensity |
| MLE | Maximum Likelihood Estimation |
| MNCS | Multinational Corporations |
| MOH | Ministry of Health |
| MPI | Malmquist Productivity Index |
| MS | Market Share |
| NHS | National Health Services |
| NXI | Net Export Intensity |
| OFDI | Outwards Foreign Direct Investment |
| PIAM | Perpetual Inventory Accumulation Method |
| PRC | People's Republic of China |
| R&D / R AND D | Research and Development |
| RBI | Reserve Bank of India |
| RDI | Research and Development Intensity |
| REER | Real Effective Exchange Rate |
| SEC | Scale Efficiency Change |
| SFA | Stochastic Frontier Analysis |
| SUR | Seemingly Unrelated Regression |
| SUS | Sistema Único De Saúde |
| TC | Technical Change |
| TE | Technical Efficiency |
| TEC | Technical Efficiency Change |
| TFP | Total Factor Productivity |
| TFPG | Total Factor Productivity Growth |
| TRIPS | Trade-Related Aspects of Intellectual Property Rights |
| VRS | Variable Returns to Scale |
| W | Real Wage Rate |
| WTO | World Trade Organisation |
| YOY | Year to Year Growth Rate |

# About the Authors

**Chandrima Chakraborty** is currently serving as an Assistant Professor in the Department of Economics, Vidyasagar University in West Bengal, India. Dr Chakraborty did her Post graduation in Economics from the University of Calcutta, India and then she obtained her M.Phil. degree and Ph.D. degree in Economics from Jadavpur University, India. Her major areas of academic interest include industrial growth, productivity and efficiency. She is also interested in environmental economics, gender issues, agricultural economics as well as health and economics of education.

**Dipyaman Pal** is presently serving as an Associate Professor in the Department of Economics, Bethune College, West Bengal, India. Dr Pal did his Post graduation, M.Phil. degree and Ph.D. degree in Economics from Jadavpur University, India. His major areas of academic interest include agricultural growth, productivity, volatility and efficiency. He is also interested in environmental economics and gender issues.

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# About the Foreword Author

**Bishwanath Goldar** is a retired Professor of Economics of Institute of Economic Growth (IEG), Delhi. He was a member of the National Statistical Commission and a National Fellow of the Indian Council of Social Science Research. He was a Professor at the ICRIER, during 2003–2004 and a Visiting Professor at the Centre for International Trade and Development, School of International Studies, Jawaharlal Nehru University, during 2012–2013. He is currently a Non-Resident Senior Fellow at the IEG. His areas of research interest include productivity measurement, industry, trade, foreign direct investment, energy use of industries, river water pollution, and rural water supply.

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# Foreword

India's pharmaceutical industry is one of the most important industries in the manufacturing sector. It is a high-technology industry, contributing significantly to India's merchandise exports. In contrast to petroleum refining, which is also a significant contributor to India's merchandise exports, manufacturing of pharmaceuticals is much more job-creating. The ratio of employment to fixed capital stock in the pharmaceutical industry is about 19 times that of petroleum refining. This ratio in the pharmaceuticals industry exceeds that in manufacturing computers, another important high-tech industry, and is about half of that in textiles, a highly labour-intensive industry.

In India's pursuit of becoming a developed country by 2047, a manufacturing-led growth strategy is at the heart of the development efforts. The expansion of India's pharmaceutical industry, alongside significant increases in pharmaceutical product exports, will play a crucial role in India's growth process in the next 25 years. According to *Economic Survey*, 2021, India's domestic pharmaceuticals market is expected to grow from about US$ 41 billion in 2021 to about US$ 130 billion by 2030. Enhancing the competitiveness of India's pharmaceuticals industry is essential for sustaining rapid growth, and a study of the efficiency and productivity of the industry, as done in this book, thus assumes great significance.

There are many challenges facing the Indian pharmaceutical industry. There is significant spending on research and development (R&D), but R&D intensity is relatively low compared to international standards. The number of patent applications in pharmaceuticals made with the Indian patent office increased from 2,741 in 2017–2018 to 5,622 in 2019–2020, and the number of patents granted in this area rose from 733 in 2017–2018 to 3,317 in 2021–2022. While there was a setback to the process of pharmaceutical patent applications in the years affected by the COVID-19 pandemic, the upward trend has probably resumed in the post-pandemic era.

India can produce low-cost generic medicine and provide it to the world, and it is recognised as a strategic partner in the drug discovery value chain. India has about 1,400 World Health Organization Good Manufacturing Practices (WHO-GMP)-approved pharmaceutical plants and about 250 European Directorate of Quality Medicines (EDQM) approved plants with modern state-of-the-art technology. However, many relatively small pharmaceutical plants have not been able to implement WHO-GMP. There is a problem of getting employees with requisite talent and skills, and the pharmaceutical industry is affected by a relatively high

attrition rate. This factor has an impact on the efficiency and productivity of Indian pharmaceutical firms.

The book contains an excellent, careful analysis of the technical efficiency and productivity of Indian pharmaceutical firms using sophisticated econometric methodology. By examining several vital issues, the book enhanced our understanding of the performance of the Indian pharmaceutical industry and what is needed for performance improvement. Some of the interesting questions examined in the book include the impact of the product patent regime on firm performance and the state-wise differences in the productivity performance of pharmaceutical firms. The book will be of immense value to policymakers, industry experts and scholars. Post-graduate students and researchers will find the empirical applications of efficiency and total factor productivity measurement methodologies useful for their studies.

Bishwanath Goldar
Non-Resident Senior Fellow
Institute of Economic Growth, Delhi

# Preface

Pharmaceutical industries have been a favourite sector for policy makers and academicians in both developed and developing countries. Indian pharmaceutical industry (IPI) is the major source of low-cost, quality drugs in the global market. It is imperative to assess its performance.

IPI has developed currently as the active as well as most eminent one, worthy of special consideration. IPI has emerged as the major source of low-cost, quality drugs in the global market. As medicines serve the population with safe well-being, it is favoured for policies in both the advanced and less advanced countries.

The scenario of IPI has changed over time. Till 1970s, about 70% of the Indian market was controlled by the foreign firms and the Patent Act of 1911 dominated IPI (Chaudhuri, 2005). Indian drug prices were very high. But with the modification of the Indian Patent Act 1970, medicine prices in the country declined. Fascinatingly after 1970, the global market recognised IPI with the introduction of process patents.

With the trade liberalisation and the signing of trade-related aspects of intellectual property rights (TRIPS) agreement, substantial changes occurred in the industry. IPI started a complete product patent regime since 2005. This enactment of the Product Patent Act is another milestone in this regard, which considerably changed the scenario and IPI became the frontrunners among the generic drugs producer. Thus, companies were unable to reverse engineer & produce new drugs invented abroad & protected by patents (Chaudhuri, 2005).

Therefore, to encounter the emergent challenge of global competition, enhanced efficiency and productivity of IPI are indispensable. The efficiency and productivity gained extraordinary prominence as in persistent economic slowdown only efficient firms are expected to withstand and develop.

The IPI holds a significant place in the global economy. The IPI is ranked 3rd in the world for producing medicines by volume. The country through the pharma sector is considered to be one of the most valuable nations.

Therefore, to encounter the emergent challenge of global competition, enhanced efficiency and productivity of IPI are indispensable. The efficiency and total factor productivity growth (TFPG) per se has assumed a very high importance in view of the fact that only efficient firms are likely to sustain and grow during a period of all pervasive economic slowdown.

The success of the pharmaceutical industry in India has allowed the country to not only meet these needs but also to export its expertise and knowledge to other countries, helping to improve global health and well-being. Overall, the

growth and success of the pharmaceutical industry in India is a testament to the hard work and innovation of its companies and workers, and the important role they play in addressing some of the world's most pressing healthcare challenges.

The commitment to produce high-quality medications, while adhering to strict rules and regulations, using the expertise and innovation to address the healthcare needs of people everywhere has helped to achieve success in the IPI and to make a positive difference in the lives of people around the world.

This deserves analysis of efficiency and productivity of IPI, identification of different factors encouraging efficiency and productivity as well as the variables deterring efficiency and productivity. Also, it is needful to understand the global position of IPI in order to achieve growth and sustainable solutions for IPI around the world.

In view of the above perspective, the present book tries to touch upon a range of issues which may be considered as important as well as critical in analysing the performance of IPI in the context of global economy.

There are seven chapters in this book. Brief sketch of all the chapters is presented below:

**Chapter 1: Introduction and the Relevance of the Study**
Chapter 1 contains the introduction of IPI and its position in the global economy. Then the relevance of the present study will be discussed.

**Chapter 2: Survey of Literature**
Chapter 2 discusses survey of literature on pharmaceutical industry in India and across the globe. It discusses the existing study highlighting the gaps and presents the connection of the present study with the existing literature.

**Chapter 3: Analysis of Efficiency and Total Factor Productivity Growth of Indian Pharmaceutical Industry Using Firm-Level Data**
Chapter 3 estimates efficiency and productivity of IPI using non-parametric method of data envelopment analysis (DEA) approach. For doing that it measures output-oriented technical efficiency of IPI and total factor productivity growth considering each firm as a decision-making unit. Also, the factors behind the variation in technical efficiency and total factor productivity growth are identified using panel regression. Another important contribution of this chapter is that it verifies the presence of structural breaks, if any, in the total factor productivity growth series at firm level by using panel structural break methodology.

**Chapter 4: Analysis of Efficiency and Total Factor Productivity Growth of Indian Pharmaceutical Industry Using State-Level Data**
Chapter 4 investigates the performance of IPI using state-level data. It looks at the performance of pharmaceutical industries in major Indian states. It estimates technical efficiency and total factor productivity growth of Indian states. This chapter helps to compare the Indian states as well as to identify the position of the major states in terms of pharmaceutical industries. Also, the major factors responsible for variation in technical efficiency (TE) and TFPG of IPI are found

using a panel regression. Another important contribution of this chapter is that it verifies the presence of structural breaks, if any, in the total factor productivity growth series at state level by using panel structural break methodology.

**Chapter 5: Total Factor Productivity Convergence in Pharmaceutical Industry Across Indian States**
Chapter 5 tries to understand whether total factor productivity of pharmaceutical industry across the major states of India converges or not in terms of sigma and beta convergence by employing the conventional sigma convergence as well as the modern panel data approach of beta convergence.

**Chapter 6: Moving Towards a Growing Indian Pharmaceutical Industry**
Chapter 6 considers that IPI is one of the few industries which have been affected in a major way due to TRIPS agreement as from the year 2005 the existing process patent regime gave way to the product patent regime although the process of establishing a new patent regime in India started since 1995. In such an environment, it will be interesting to examine whether there has been any improvement in the performance of IPI after 1995, i.e. after the period of first version of the product patent regime. For this econometric analysis has been carried out for some selected variables like output, employment, productivity of labour, productivity of capital, capital labour ratio, export intensity, export price, import intensity and price by applying a recent development using unit root test to estimate the break point of these major variables using All India level data. This chapter clearly identifies the variables whose performance are satisfactory and other showing relatively poor performance and hence needs special attention.

**Chapter 7: Position of Indian Pharmaceutical Industry in the Global Economy**
Chapter 7 examines the performance of IPI and pharmaceutical industries of leading countries namely the United States, China, Germany, Japan, Ireland, Switzerland, France, Italy, Belgium, United Kingdom, Spain, Brazil, Canada, South Korea and the Netherlands. This chapter looks at the trends of three lead variables namely production, export and import of IPI and pharmaceutical industries of leading countries and tries to compare IPI with the other countries in terms of the above three variables and thus helps to identify the position of IPI in the global context. Also, this chapter verifies the presence of structural breaks, which may appear due to changes in economic regime over time, in the different series of production, export and import using panel structural break methodology.

**Chapter 8: Summary and Overall Conclusion**
Chapter 8 summarises the whole study and makes the concluding observations on each of the seven chapters and recommends some policies for the betterment of the pharmaceutical industries in the Indian states and for IPI as a whole.

The purpose of the study is to improve IPI and to raise awareness among the stakeholders and institutions, and among the Indian planners to take care to remove economic backwardness of the country and to make it a developed

economy, equal development across different firms such that the people of weaker segments benefit from the country's economic progress. Thus, to reduce firm-level disparities the knowledge about the growth performance of different firms and the firms which are lagging behind are very much needed. Along with it state level analysis of Indian states will be helpful for interstate comparison and special care may be taken for the lagging states. The evaluation of IPI in the global economy, i.e. to understand the global position of IPI may lead to more developed IPI and sustainable one and may help to upsurge the rank of IPI with respect to the global economy.

We hope that the book will provide immense knowledge base to post graduate students, industry people, researchers and faculty members around the globe related to various subjects such as Economics, Industrial Economics; Medicine, Pharmacy, Health economics, Biotechnology, Microbiology, Business & Management among others. The volume will also be helpful for policy makers, multi-nationals and government officials as well as the general readers interested in the field.

Chandrima Chakraborty
Dipyaman Pal
The Authors

# Acknowledgements

With extensive hard work on the stages from submission of the book proposal to final submission of the proposed book titled, *Performance Analysis of the Indian Pharmaceutical Industry: A Global Outlook*, it is an abundant pleasure for the authors as well as everyone related that the book is now published.

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**Chandrima Chakraborty**
**Dipyaman Pal**

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Chapter 1

# Introduction and the Relevance of the Study


## Abstract

This chapter introduces the development of the Indian pharmaceutical industry (IPI) in different phases such as till the 1970s, with the modification of the Indian Patent Act 1970, i.e. after the 1970s, with the trade liberalisation and the signing of Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement and in the product patent regime, i.e. since 2005. This chapter also discusses the position of IPI in the global economy along with the top medicine-producing countries in the world. The objectives of the present study are presented separately with the firm-level data, state-level data as well as All India and global-level data. All the research questions are also presented in this chapter related to the firm-level data, state-level data as well as All India and global-level data. Then the relevance of the present study in the existing literature is discussed considering each of the book chapters separately while outlining the structure of the present study.



*Keywords*: Indian pharmaceutical industry; Indian Patent Act 1970; trade liberalisation; TRIPS agreement; product patent regime; global economy


## 1.1. Introduction

Indian pharmaceutical industry (IPI) has developed currently as the active as well as most eminent one, worthy of special consideration. IPI has emerged as the major source of low-cost, quality drugs in the global market. As medicines serve the population with safe well-being, it is favoured for policies in both advanced and less advanced countries.


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The scenario of IPI has changed over time. Till 1970s, about 70% of the Indian market was controlled by foreign firms and the Patent Act of 1911 dominated IPI (Chaudhuri, 2005). Indian drug prices were very high. However, with the modification of the Indian Patent Act 1970, medicine prices in the country declined. Fascinatingly after 1970, the global market recognised IPI with the introduction of process patent. With the trade liberalisation and the signing of TRIPS agreement, substantial changes occurred in the industry. IPI started a complete product patent regime since 2005. This enactment of the Product Patent Act is another milestone in this regard, which considerably changed the scenario and IPI became the frontrunners among the generic drugs producer. Thus, companies were unable to reverse engineer & produce new drugs invented abroad & protected by patents (Chaudhuri, 2005). Therefore, to encounter the emergent challenge of global competition, enhanced efficiency and productivity of IPI are indispensable. The efficiency and productivity gained extraordinary prominence as in persistent economic slowdown only efficient firms are expected to withstand and develop.

The economic reforms of 1991 further propelled the IPI onto the global platform by removing licencing restrictions. The IPI holds a significant place in the global economy. The IPI is ranked 3rd in the world for producing medicines by volume (Economic Survey, 2022-23). The country through the pharma sector is considered to be one of the most valuable nations.

As of 2021, India is the largest country for the production of low-cost generic drugs which is advantageous for exporting medicines to other countries. Therefore, the share of medicines in the global pharmaceutical export is 20% in terms of the generic pharma sector. It may provide a position of leadership to continue excelling and thriving through the help of a talent pool. This is possible through cultivating and promoting quality in pharmaceutical learning for formulation research within the country. The nation is the largest provider of generic medicines in the world and supplies medicines to many countries. The success of the pharmaceutical industry in India has allowed the country to not only meet these needs but also to export its expertise and knowledge to other countries, helping to improve global health and well-being.

The United States is the biggest pharmaceutical market in terms of consumption and import and the third largest in terms of export. The high level of healthcare spending alongside advanced healthcare infrastructure and a significant population plays an integral part in the strong demand for pharmaceutical products in the country. China has the distinction of being the biggest producer of pharmaceutical ingredients in the world. The most populous country in the world has a rising middle class, an increasing footprint of healthcare coverage, and an ageing population. Generic drugs and APIs make it the number one drug maker in the world in terms of volume. The country has a very tough drug approval process that takes significantly longer than other developed countries of the world. Germany is the biggest exporter of pharmaceutical products in the world and employs 143,000 people in the pharmaceutical industry. The country has the biggest pharmaceutical market in Europe and the fourth biggest in the world, with an annual consumption worth $64.6 billion. The significant level of pharmaceutical

consumption in Germany is due to high healthcare spending and a large population. Japan is the third biggest pharmaceutical market in the world, with an annual estimated consumption of over $100 billion. The country is a key export market for pharmaceutical goods manufactured in the United States. Japan has an ageing population that is playing an integral role in the strong demand for pharmaceutical products. Ireland is the fifth biggest exporter of pharmaceutical products in the world. The country has established itself as a leading global centre for pharmaceutical manufacturing. Due to the low corporate tax in the country, numerous leading pharmaceutical companies like Pfizer among others have established their manufacturing facilities in Ireland. The country provides convenient shipping facilities across the Atlantic as well.

Coming to the pharmaceutical industry in India, its growth and success is a testament to the hard work and innovation of its companies and workers, and the important role they play in addressing some of the world's most pressing healthcare challenges. The commitment to produce high-quality medications, while adhering to strict rules and regulations, using the expertise and innovation to address the healthcare needs of people everywhere has helped to achieve success in the IPI and to make a positive difference in the lives of people around the world.

## 1.2. Objectives of the Present Study

Given the transformed situation of IPI, the following are the objectives of the present study:

With firm-level data:

- To estimate the extent of efficiency of the firms
- To identify the factors affecting such efficiency
- To find out the total factor productivity growth (TFPG) of the firms
- To break down TFPG into its diverse constituents
- To elucidate the causes of variation in TFPG
- To look at the common factors responsible for variation in efficiency and TFPG
- To verify the presence of structural breaks, if any, in the series of TFPG.

With state-level data:

- To estimate the extent of efficiency of the states
- To identify the factors affecting such efficiency
- To find out TFPG of the states
- To elucidate the causes of variation in TFPG of the states
- To examine whether total factor productivity converges in pharmaceutical industry across states
- To understand whether the total factor productivity (TFP) of the pharmaceutical industries across the 17 major states of India converges or not
- To check whether IPI is moving towards a growing industry or not
- To verify the presence of structural breaks, if any, in the series of TFPG.

Considering the data on leading countries along with All India:

- To test the growth performance of major selected variables of IPI at All India level
- To understand the position of IPI in the global economy in terms of production, export and import
- To make an inter-comparison of countries and their performance in terms of the above variables
- To verify the presence of structural breaks in the series of production, export and import.

Thus keeping in mind the above objectives, the following research questions can be framed:

Considering the sample firms:

- What is the efficiency score of the firms?
- What are the major determinants of the efficiency of IPI?
- What is the value of TFPG of the firms?
- Which component of TFPG dominates over the other?
- What are the determinants of TFPG of IPI?
- What are the common factors responsible for variation in efficiency and TFPG of IPI?
- Whether there exists any structural break in the series of TFPG?

Considering the sample states:

- What is the efficiency score of the states?
- What are the major determinants of efficiency of IPI?
- What is the value of TFPG of the states?
- What are the determinants of TFPG of IPI?
- What are the common factors responsible for variation in efficiency and TFPG of IPI?
- Whether total factor productivity converges in pharmaceutical industry across states?
- Whether IPI is moving towards a growing industry or not?
- Whether there exists any structural break in the series of TFPG?

Considering the leading countries along with All India:

- What is the growth performance of major selected variables of IPI at All India level?
- What is the position of India compared to other leading countries in terms of production, export and import?
- How the different countries performed in terms of the above three variables?
- Are there any structural breaks in the different series of production, export and import?

## 1.3. The Structure of the Present Study

The structure of the present study is as follows:

**Chapter 1: Introduction and the Relevance of the Study**
Chapter 1 introduces the development of the IPI in different phases such as till the 1970s, with the modification of the Indian Patent Act 1970, i.e. after 1970s, with the trade liberalisation and the signing of TRIPS agreement and in the product patent regime, i.e. since 2005. This chapter also discusses the position of IPI in the global economy along with the top medicine-producing countries in the world. The objectives of the present study are presented separately with the firm-level data, state-level data as well as All India and global-level data. All the research questions are also presented in this chapter related to the firm-level data, state-level data as well as All India and global-level data. Then the relevance of the present study in the existing literature is discussed considering each of the book chapters separately while outlining the structure of the current study.

**Chapter 2: Survey of Literature**
Chapter 2 discusses a survey of literature on the Pharmaceutical Industry related to efficiency, productivity and other issues in India and across the globe. Econometric theoretical literature on technical efficiency (TE) as well as econometric theoretical literature on TFPG are discussed in separate sections. Individual sections discuss studies on the performance of the pharmaceutical industries in the Indian context, studies on the performance of the pharmaceutical industries in the international context, studies on efficiency in the IPI, studies on TFPG in the IPI, other studies on IPI and also studies on the performance of the pharmaceutical industries in the international context (other than India). This chapter discusses the existing study highlighting the gaps and presents the connection of the present study with the existing literature in a separate section.

**Chapter 3: Analysis of Efficiency and Total Factor Productivity Growth of Indian Pharmaceutical Industry Using Firm-Level Data**
Chapter 3 estimates the efficiency of the IPI using non-parametric method of data envelopment analysis (DEA) approach. For doing that it measures output-oriented technical efficiency of the IPI considering each firm as a decision-making unit. Also, the factors behind the variation in technical efficiency are identified using panel regression. It also estimates the productivity growth of the IPI. For that, it measures TFPG considering each firm as a decision-making unit using non-parametric method of the DEA approach. Also, the major factors responsible for variation in TFPG of the IPI are found using panel regression. Also, this chapter compares the efficiency and productivity of the IPI, i.e. it compares TE and TFPG of the IPI. This chapter also tries to identify the common factors responsible for changes in these two performance indicators. Another important contribution of this chapter is that it verifies the presence of structural breaks, if any, in the TFPG series at the firm level by using panel structural break methodology.

**Chapter 4: Analysis of Efficiency and Total Factor Productivity Growth of Indian Pharmaceutical Industry Using State-Level Data**
Chapter 4 investigates the performance of the IPI using state-level data. It looks at the performance of pharmaceutical industries in major Indian states. It estimates technical efficiency and TFPG of Indian states. This chapter helps to compare between the Indian states as well as to identify the position of the major states in terms of pharmaceutical industries. Another important contribution of this chapter is that it verifies the presence of structural breaks, if any, in the TFPG series at the state level by using panel structural break methodology.

**Chapter 5: Total Factor Productivity Convergence in Pharmaceutical Industry Across Indian States**
Chapter 5 tries to understand whether total factor productivity of pharmaceutical industry across the major states of India converges or not in terms of sigma and beta convergence by employing the conventional sigma convergence as well as the modern panel data approach of beta convergence.

**Chapter 6: Moving Towards a Growing Indian Pharmaceutical Industry**
Chapter 6 considers that IPI is one of the few industries which have been affected in a major way due to TRIPS agreement as from the year 2005 the existing Process Patent regime gave way to the product patent regime although the process of establishing a new patent regime in India started since 1995. In such an environment it will be interesting to examine whether there has been any improvement in the performance of IPI after 1995, i.e. after the period of first version of the product patent regime. For this, econometric analysis has been carried out for some selected variables like output, employment, productivity of labour, productivity of capital, capital labour ratio, export intensity, export price, import Intensity and price by applying a recent development using unit root test to estimate the break point of these major variables using All India level data. This chapter clearly identifies the variables whose performance are satisfactory and other showing relatively poor performance and hence needs special attention.

**Chapter 7: Position of Indian Pharmaceutical Industry in the Global Economy**
Chapter 7 examines the performance of IPI and pharmaceutical industries of leading countries namely the United States, China, Germany, Japan, Ireland, Switzerland, France, Italy, Belgium, United Kingdom, Spain, Brazil, Canada, South Korea and the Netherlands. This chapter looks at the trends of three lead variables namely production, export and import of the IPI and pharmaceutical industries of leading countries and tries to compare IPI with the other countries in terms of the above three variables and thus helps to identify the position of IPI in the global context. Also, this chapter verifies the presence of structural breaks, which may appear due to changes in economic regime over time, in the different series of production, export and import using panel structural break methodology.

**Chapter 8: Summary and Overall Conclusion**
Chapter 8 summarises the whole study and makes the concluding observations on each of the seven chapters and recommends some policies for the betterment of the pharmaceutical industries in the Indian states and for the IPI as a whole.