AN ANALYSIS OF THE EFFECTS OF ECONOMIC REFORMS AND OPENNESS ON STRUCTURE CONDUCT AND PERFORMANCE OF AGRO-BASED INDUSTRIES IN PAKISTAN

By

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Saeed Ahmed Sheikh

DECLARATION

I declare that:

"An Analysis of the Effects of Economic Reforms and Openness on Structure Conduct and Performance of Agro-based Industries in Pakistan" is my own work, that all the sources used are quoted and acknowledged by means of complete references, that this thesis has not been previously submitted by me for a degree at any other university or degree awarding institution.

…….	…….
Saeed Ahmed Sheikh	DATE

SUMMARY

AN ANALYSIS OF THE EFFECTS OF ECONOMIC REFORMS AND OPENNESS ON STRUCTURE CONDUCT AND PERFORMANCE OF AGRO-BASED INDUSTRIES IN PAKISTAN

By

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DEGREE: Ph. D (ECONOMICS)

Manufacturing sector is one of the key sectors and plays an important role in the economy of Pakistan. At the time of independence Pakistan had no industrial base but soon after the independence efforts were made to create a domestic industrial base largely centered on agricultural raw materials. Private sector was seen to be the main driving force and liberal incentives were provided under import substitution and infant industry arguments. Much of the industrialization in the 1950s and 1960s was concentrated in large-scale consumer goods manufacturing units. These industries were mostly concentrated in the urban areas of Punjab, Sindh, and Khyber Pakhtoonkhawa. The share of manufacturing sector in GDP has risen from 2.2% in 1949-50 to 26% in the fiscal year 2008-09.

According to the latest Census of Manufacturing Industries (CMI: 2005-06) conducted by the Federal Bureau of Statistics (FBS), government of Pakistan, the share of agro-based industries in gross value added by the large scale manufacturing at constant prices of 1999-2000 is more than 50% (textiles 25.6%, food products 15.3%, wearing apparel 3.9%, ginning pressing and bailing 3.2%, paper and paper products 2.7% and tobacco 2.2%). Improvement in market structure and performance of these industries can play a pivotal role in poverty alleviation and overall development of the economy. These industries have an important role in earning foreign exchange and creating jobs and will continue to play important role in future development of the economy. Cotton, sugarcane, wheat and

rice are the major crops of Pakistan and are the important source of raw material for the agro-based industries. The spillover effects of agro-based industries are expected to have important effects on other industries and the agricultural sector itself. Agro-based industries have a large potential for growth and development because the natural endowment of the country (availability local raw material and cheap labor) is favorable.

The main focus of the most of the earlier studies on large scale manufacturing in Pakistan was on the estimation of structure profit relationship. These studies concluded that firms in the large scale manufacturing sector have high market shares and earn monopoly profits and that the concentration ratios have not changed much over time. The main focus of the present study is on the analysis of the effects of trade related domestic reforms and openness on the structure, conduct and performance of agro-based industries. The study of S-C-P is important for policy prescription.

It is a well-known fact that protection reduces efficiency and absence of foreign competition allows domestic firms to enjoy monopoly power and excess profits. Literature on the study of the effects of policy reforms on productivity and efficiency of industries in different developing countries of Asia, Africa and Latin America has provided mixed results. Some Researchers have found significant positive effects of trade and industrial policy reforms and openness on industrial productivity and efficiency in most of the developing countries while some others have found positive and significant effects of protectionist policies. Some of the researchers have found that industrial policy reforms and openness have significantly reduced the Price Cost Margins in the industrial sectors of many developing countries.

Census of Manufacturing Industries (CMI) data from 1970-71 to 2005-06 has been used for analyzing the effects of domestic economic reforms and openness on performance of agro-based industries. Eleven agro-based industries of three digits level of industrial classification have been used for this purpose. The analysis has been carried out in two parts. In part one, effects of economic reforms and openness have been analyzed under structure-conduct-performance approach and in the

second part efficiency analysis has been carried out using stochastic frontier production function.

Our results show that almost all the agro-based industries operate under imperfect market conditions, have positive price cost margins and no visible change has taken place in price cost margins overtime. During 1971-77 domestic reforms did not have a favorable effect but trade liberalization did have some favorable effect on price cost margins in agro-based industries. During 1978-90 a major policy change took place and privatization and deregulation policies were adopted instead of nationalization of the economy. Our analysis shows that trade liberalization had an insignificant favorable effect on price cost margins during this period. During 1991-06 many reforms were implemented for macroeconomic stability and structural adjustment of the economy. These reforms and openness policies adopted under WTO regime had a partial favorable effect on price cost margins in agro-based industries.

The stochastic frontier analysis was carried out to study the technical efficiency and technical change taking place in agro-based industries. Our analysis shows that agro-based industries have low output elasticities, depict constant returns to scale and suffer from high levels of technical inefficiency. No prominent technical change seems to have taken place overtime in agro-based industries in Pakistan.

Major policy implications that emerge from our analysis are that agro-based industries have an important place in the manufacturing sector of Pakistan. Presently these industries are operating under imperfect competitive market conditions and have positive price cost margins. Inefficiency is a special feature of these industries and no prominent technical change has taken place overtime in these industries. More vigorous and well coordinated efforts are needed to improve the performance and efficiency levels of these industries. This can be done by making these industries more competitive and by improving the quality of physical and human resources employed in these industries.

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ACRONYM

BOS	Bureau of Statistics
CMI	Census of Manufacturing Industries
CR	Concentration Ratio
CBR	Central Board of Revenues
DFI	Direct Foreign Investment
DD	Domestic Demand
FBS	Federal Bureau of Statistics
FTA	Free Trade Agreement
FY	Fiscal Year
GDP	Gross Domestic Product
EGLS	Estimated Generalized Least Squares
ERO	Economic Reform Order
FBR	Federal Board of Revenue (erstwhile CBR)
GRM	Growth Rate of Manufacturing
HDI	Human Development Index
ISI	Import Substituting Industrialization
LS	Least Squares
LSMI	Large Scale Manufacturing Industries
MES	Minimum Efficient Scale
PCM	Price Cost Margin
PIDE	Pakistan Institute of Development Economics
PIM	Perpetual Inventory Method
PPP	Purchasing Power Parity
PSIC	Pakistan Standard Industrial Classification
PTA	Preferential Trade Agreement
R&D	Research and Development
S-C-P	Structure-Conduct-Performance
S.D.	Standard Deviation
TC	Technical Change
TE	Technical Efficiency
TFP	Total Factor Productivity
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

1.1 ECONOMY OF PAKISTAN

Pakistan came into existence as a result of the division of British India into two separate states of India and Pakistan after World War-II, when the British colonial era came to an end. Pakistan gained independence on August 14, 1947 and consisted of two parts, Muslim-majority Bengal as East Pakistan and Muslim-majority Punjab, Sindh, Baluchistan and Khyber Pakhtoon Khawa (erstwhile North Western Frontier Province) as West Pakistan. The eastern part of Bengal declared independence in 1971 and became Bangladesh.

Total area of Pakistan is 803,940 square kilometers and total estimated population is about 169.9 million. Population growth rate is 1.6 percent. Nominal GDP is $ 166.515 billion. Nominal GDP per capita is $1,016 whereas GDP at purchasing power parity (PPP) is $435.807 billion and GDP per capita (PPP) is $ 2,662 respectively. Urban population is 34.9 percent and the average annual growth rate of urban population is 3.3 percent. Gini coefficient for Pakistan is 30.6 (medium) and human development index (HDI) is 0.572 (medium). Forest area as percentage of total area is 2.5, which is the lowest among the South Asia group (forest area for South Asia group is 16.8%). Gross fixed investment is 21.3% and direct foreign investment (DFI) is about $ 8.00 billion.[1]

1.1.1 Structural changes

At the time of independence Pakistan was predominantly an agrarian economy but since then many structural changes heave taken place. Table-1.1 shows the composition of gross domestic product (GDP) at constant factor cost for some selected years. The share of agriculture in GDP has fallen from 53.3% in 1949-50 to 21.5% in 2009-10 meanwhile the share of manufacturing in GDP has increased from

[1] All these figures have been taken from www.data.worldbank.org/country/Pakistan

9.6% to 25.2% during the same period. Similarly, the share of services sector, which was 37.1 percent in 1949-50, has increased to 53.3 percent in the year 2009-10.

Table1.1

Composition of Gross Domestic Product for Some Selected Years

(Percent)

	1949-50	1959-60	1969-70	1979-80	1989-90	1999-00	2009-10
Agriculture	53.3	45.9	38.8	29.6	25.8	25.9	21.5
Manufacturing	9.6	15.4	22.7	23.2	25.5	23.4	25.2
Services	37.1	38.7	38.5	47.2	48.7	50.7	53.3

Source: Pakistan Economic Survey (various issues), Finance Division, Economic Advisor's Wing, Government of Pakistan.

1.1.2 Growth performance

Pakistan's long-term growth performance has been impressive as compared to many low income countries of Asia, Africa and Latrine America (Bangladesh 1.0%, India 2.3%, Egypt 4.0%, Uganda 2.8% and Jamaica-0.5%).[2] Decade-wise average growth rates of GDP and some other key sectors are given in Table-1.2.

Table-1.2

Average Growth Rates of GDP and other Sectors at Constant Factor Cost of 1999-2000

(Percent)

	1960s	1970s	1980s	1990s	2000-05
GDP	6.8	4.8	6.5	4.6	4.9
Agriculture	5.1	2.4	5.4	4.4	2.2
Manufacturing	9.9	5.5	8.2	4.8	11.0
Services	6.7	6.3	6.7	4.6	5.4

Source: Pakistan Economic Survey (various issues), Finance Division, Economic Advisor's Wing, Government of Pakistan.

[2] These figures are for the period 1985-1995 and have been taken from Todaro, M. P. (2001), *Economic Development*, Seventh Edition, Addison-Wesley, N.Y, USA.

The table shows that the average growth rate of GDP during 1960s was 6.8% which declined to 4.8% in the 1970s. This decline is attributed mainly to nationalization policy; fall in private investment and poor performance of the agricultural sector during the period. Growth rate during 1980's was good but again declined in the 1990s. The average growth rate of GDP for 1990s was 4.6 percent. Although many structural and macroeconomic stabilization reforms were introduced in the 1990s, it is generally believed that decline in investment and employment level were the main reasons for the lowering of the growth rate in the 1990s. Economic reforms introduced in early 1990s seemingly paid their dividend and growth rate was picked up in the post 1990s period. Average growth rate of manufacturing sector (11%) and services sector (5.4%) were quite impressive during this period.

1.2 AN OVERVIEW OF MANUFACTURING SECTOR IN PAKISTAN

Development of manufacturing industries is an essential part of the overall economic development of a country. At its earlier stages the development of manufacturing sector depends on demand and savings generated in the primary sector. The role of other factors like natural resource endowment, country size, location, education, foreign aid and investment and political and social conditions is also very important. Market structure, protection and incentives can affect the profitability of the manufacturing sector. Outward orientation, the degree of openness and preferential ties also play an important role in the development of the manufacturing sector.

At the time of independence in 1947 Pakistan had no industrial base. There were only a few simple industries like flour and rice mills, cotton ginning factories and only two cement factories. Over the past sixty three years Pakistan followed the policies that were heavily biased towards the industrial sector especially during the fifties and the sixties. Private sector was supposed to play the important role during the earlier period of industrialization in Pakistan. During the fifties and sixties the industrial sector developed rapidly but generous fiscal incentives high rates of protection, export subsidies and favorable exchange rates led to the creation of an

industrial structure which was highly inefficient both economically as well as technically.

1.2.1 Value addition by large-scale manufacturing sector

Manufacturing sector in Pakistan consists of two sub sectors, large-scale manufacturing and small-scale manufacturing.[3] This sector plays an important role in the economy of Pakistan. It absorbs a large proportion of labor force and is an important source of foreign exchange earning. Data on large-scale manufacturing industries have been collected through census of manufacturing industries (CMI) conducted by the Federal Bureau of Statistics.[4] Table-1.3 shows group-wise gross value addition by large-scale manufacturing industries to GDP at constant prices of 1999-2000 for the fiscal years 2000-01 and 2005-06 (census years).

[3] The definition of large-scale and small-scale industry varies from country to country. In Pakistan, according to Factories Act 1934, firms employing twenty or more workers on any working day during the year and using power in the manufacturing process are considered to be large-scale manufacturing establishments.

[4] Data for the year 2001 and 2006 are also available on the official website of Federal Bureau of Statistics, www/statpak.gov.pk.

Table-1.3

Contribution to GDP by Large-scale Manufacturing Industries in Pakistan (1999-2000=100)

Industry	Gross Value Added (Rs. Million)		Percent of all Industries	
	2000-01	2005-06	2000-01	2005-06
All Industries	263542	843762	100.0	100.0
Manufacture of textiles	76695	223873	29.1	26.5
Food manufacturing	39592	129234	15.0	15.3
Chemicals and chemical products	40296	121121	15.3	14.4
Other non-metallic mineral products	7534	61423	2.9	7.3
Petroleum	18179	44210	6.9	5.2
Motor vehicles & trailers	5930	37960	2.3	4.5
Tobacco products	1078	18697	0.4	2.2
Basic metals	16524	39512	6.3	4.7
Wearing apparels	9640	33245	3.7	3.9
Cotton ginning, pressing & bailing	9776	26914	3.7	3.2
Paper and paper products	2505	22742	1.0	2.7
Machinery and equipment	10033	16799	3.8	2.0
Electric machinery & apparatus	4074	14134	1.6	1.7
Other transport equipment	684	10591	0.3	1.3
Rubber & plastic products	3072	8216	1.2	1.0
All other industries	17930	35091	4.5	6.8

Source: CMI 2005-06 conducted by Federal Bureau of Statistics, Government of Pakistan.

The table shows that agro-based industries like Textiles and Food manufacturing are the major contributors to GDP. During the fiscal year 2000-01, twenty nine percent of total manufacturing output was contributed by textiles sector and fifteen percent by Food manufacturing industries. During the fiscal year 2005-06 Textiles industry with 26.5% share in total Manufacturing output was the largest

contributor followed by the Food manufacturing industries with 15.3% share at the second place. According to the latest CMI census conducted in 2005-06, gross value addition[5] to GDP by all the agro-based industries is more than fifty percent of the total value added by the large-scale manufacturing sector.

The Economic Reform Order (ERO) of 1972 started an unprecedented nationalization of industries. The constant fear of nationalization shook the confidence of the private sector resulting in marked decline in investment and production. Post 1977-78 period, was that of the return of the private sector. High priority was given to privatization process for revitalizing and restructuring the economy. The industrial policy during the nineties remained focused on broadening and diversification of industrial base. This era is characterized by the continuation of privatization process and provision of incentives and regulatory framework for industrialization.

The main focus of the economic reforms in Pakistan is on the following points.

1. Achievement of self reliance.
2. Development of value added exports.
3. Development of skills that help in improving efficiency, productivity and quality.
4. Encouragement of labor intensive industries.
5. Development of infrastructure facilities with active cooperation of private sector.
6. Containment of rural-urban migration.

Pakistan's economy is still agrarian in nature with 21% share in GDP and 45% share in employment being contributed by the agricultural sector.[6] Cotton, sugar cane, rice, wheat and maize are the major crops of Pakistan. Agricultural sector provides raw material for industries like cotton textiles, food processing and manufacturing, leather products and paper and paper products etc. It is believed in the policy making circles that the complementary nature of agricultural development

[5] Gross value added is equal to gross output less intermediate consumption.
[6] Pakistan Economic Survey 2009-10, Chapter 2, p. 13.

and the industrial development can lead to overall economic development of the country.

1.3 LARGE-SCALE AGRO-BASED INDUSTRIES IN PAKISTAN

Pakistan is basically an agrarian economy and the industrialization of the economy is largely centered on agriculture. Agricultural sector not only provides industrial raw materials but also provides labor force for growing industrial sector. Pakistan is one of the poorest countries of the world with its 24% population living below poverty line. Policy makers are very much concerned to increase income and employment levels to alleviate poverty. Agro-based industries[7] in Pakistan have great potential for growth, foreign exchange earnings and generating employment opportunities both directly as well as indirectly. These industries thus can play an important role in economic development and poverty alleviation in Pakistan. The detail of large scale agro-based industries in Pakistan is given below.

1. Food Manufacturing and Processing
2. Beverages Industries
3. Tobacco Manufacturing
4. Manufacture of Textiles
5. Manufacture of Wearing Apparel
6. Manufacture of Leather and Leather Products (except footwear)
7. Manufacture of Footwear (except rubber and plastic footwear)
8. Ginning, Pressing and Bailing of Fibers
9. Manufacture of Wood and Wood Cork Products (except furniture)
10. Manufacture of Furniture and Fixture (except primarily metal)
11. Manufacture of Paper and Paper Products

1.3.1 Distribution of agro-based industries

The distribution of some of the large scale agro-based industries covered in the census of manufacturing industries (CMI) 2005-06 is given below:

[7] The industries that are mainly based on locally produced agricultural raw materials including raw materials obtained from livestock and forests.

Food Products and Beverages

Punjab:	1122
Sindh:	556
Khyber Pakhtoonkhawa	118
Baluchistan:	36
Islamabad	29

- Manufacture of Textiles

Punjab:	764
Sindh:	447
Khyber Pakhtoonkhawa	42
Baluchistan:	74
Islamabad:	1

- Leather and Leather Products

Punjab:	108
Sindh:	30
Khyber Pakhtoonkhawa	3
Baluchistan:	-
Islamabad:	1

- Paper & Paper Products

Punjab:	71
Sindh:	29
Khyber Pakhtoonkhawa:	27
Baluchistan:	4
Islamabad:	2

- Wood and Wood Products

Punjab:	26
Sindh:	19
Khyber Pakhtoonkhawa:	12
Baluchistan:	3
Islamabad:	2

- Wearing Apparel

Punjab:	160
Sindh:	165
Khyber PakhtoonKhawa:	1
Baluchistan:	-
Islamabad:	-

- Tobacco Manufacturing

Punjab:	2
Sindh:	3
Khyber Pakhtoonkhawa:	8
Baluchistan:	-
Islamabad:	-

Most of the agro-based industries are located in the urban areas of the Punjab where labor and raw material is easily available. The province of Sindh is in the second place; Khyber Pakhtoonkhawa is in the third place followed by Baluchistan at the fourth place. Few agro-based industrial units are also located in the industrial area of the federal capital Islamabad. Brief profiles of some of the large scale agro-based industries in Pakistan are given in the following sub-section.[8]

1.3.2 Cotton textile industry

Cotton Textile Industry is one of Pakistan's leading and the most important manufacturing industries. This industry is a major source of employment and foreign exchange earnings. Currently Pakistan is providing13% yarn and 8% cotton cloth in the world market. The share of textiles in export earnings is 68% with a value of around $ 7.00 billion. The share in overall employment is roughly 38 %. Pakistan ranks among the top 5 countries of the world in terms of production of cotton, cotton yarn and exports of cloth. Table-1.4 displays basic information about the textile sector in Pakistan.

[8] These profiles are based on information obtained from the *Investors' Information Guides* prepared by the Board of Investment, Government of Pakistan. Other sources have also been acknowledged.

Table-1.4

Textile Sector at a Glance

Contribution to GDP	10.5% of total GDP
Contribution to exports	68% of total exports
Share in manufacturing	46% of total manufacturing
Share in employment	38% of total industrial workers
Share in investment	31% of total investment
Technology	Medium to high[9]
Sources of machinery	Japan, Germany, Switzerland, Belgium and China

Source: Pakistan Investment Guide: 2004, Expert Advisory Cell, Ministry of Production, Government of Pakistan.

Cotton Textile sector is divided into the small scale and the large-scale manufacturing units. The large-scale cotton textile units are also divided into two sub-groups i.e. spinning units (code 32011) and weaving units (code 32012). According to Investment Board of Pakistan there are 445 Spinning units with installed capacity of 9.7 million spindles, and 204,000 rotors. Total production of yarn during 2003-04 was around 1425 million kilograms. The total number of weaving units is 190. Annual production of these units during 2003-04 was 2700 million square yards. There are 106 finishing units in the organized sector and about 5000 garment producing units having 450,000 sewing machines capable of producing 650 million pieces annually.

1.3.3 Sugar industry

Sugar industry is one of the important industries in the Food Manufacturing group. Pakistan is one of the top ten producers of sugarcane in the world. Following wheat and cotton, sugarcane is the third largest crop of Pakistan. Total area under sugarcane as reported by Ministry of Food, Agriculture and Livestock in 2004-05 was

[9] High technology is the most advanced, at the cutting edge technology using >5% R&D/Turnover and medium technology has 3% to 5% R&D/Turnover according to the Standard OECD Classification (2002).

907 thousand hectares with 4,244 thousand tones of sugarcane production. There are 77 large-scale manufacturing units with an installed capacity of 5.5 million tons of refined sugar (code 31181). Out of these 38 are in Punjab, 32 in Sindh, 6 in NWFP and one in Azad Jammu& Kashmir. In terms of value sugar industry contributes 15.5% to the total agricultural output. Total production reported in 2004-05 was 3.092 million tons. The share of sugar industry in GDP is 1.9% and this industry provides 40,000 jobs directly and 100,000 seasonally. Over the last ten years the production of sugar has increased by 4.5% per annum. In 2004-05 however sugar industry experienced a negative growth rate of 2.4% due to unfavorable weather conditions and damage to the sugarcane crop by excessive frost in the month of January 2004. The sugar industry in Pakistan is characterized by a low recovery rate and an inefficient cost structure. The average recovery rate due to poor quality of sugarcane in Pakistan is 8.9% whereas the World average is 9.9%. Sugar industry in Pakistan, has emerged from a small base to an important status and is now mature enough although there is a dire need to modernize this industry.

1.3.4 Vegetable ghee and cooking oil industry

Vegetable ghee and cooking oil industry is also a major industry in the Food Manufacturing group. There are 166 manufacturing units in Pakistan, all in the private sector. The overall installed capacity of vegetable ghee (code 31151) and cooking oil (code 311523) is estimated at 2.7 million tons. Only 70% of the capacity is being utilized. Total demand of edible oil in the country is approximately 2.00 million Tons out of which approximately 30% edible oil is produced from local oil seeds and 70% from imported raw material. Sunflower, soybeans, rapeseed, corns and canola are used for producing soft oils and palm oil is used for the production of hard oils. Waste material used for poultry and livestock feed whereas residual fatty acids are used in soap industry.

About 40 thousand people are employed by the vegetable ghee and cooking oil sector. Total contribution to GDP is 2.8%. The entire output is domestically consumed hence contribution to exports is nil. Due to growing demand of edible oil imports have been growing at a compound rate of 5%. The major imports are from the European Union, Australia, Argentina, Malaysia and Indonesia. Key players in this

sector are Farmers/Growers, Solvent Extractors and Edible Oil/Vegetable Ghee processors.

1.3.5 Leather and leather products industry

This industry is closely linked with live stock population in the country. The production of leather garments, leather products and leather footwear has a very large potential in Pakistan. Leather and leather products industry carry significant importance in Pakistan. This industry contributes approximately 5% to GDP and 7% to the total exports of the country. It employs 0.25 million people and has a share of less than one percent in national employment [Ministry of Production, GOP, 1999-2000]. Being an agricultural country Pakistan has a natural advantage in the area of live stock population, which is the main source of input (Hides and Skins) in the leather industry. According to the estimates provided by the Ministry of Production, the country produces approximately 7.5 million Hides and 36.2 million Skins annually with growth rates of 2.97 and 1.47 percent respectively. Despite steady growth rates in the live stock population the country has to import hides and skins to keep the tanneries running.

The major leather products manufactured by the sector include footwear, leather garments, gloves, handbags purses, key chains and wallets etc. Table1.5 shows the Installed capacity, average annual production and capacity utilization of leather industry in Pakistan.

Table-1.5

Installed Capacity and Average Annual Production of Leather Industry in Pakistan

Type of Industrial Unit	Total No.	Installed Capacity	Avg. Annual Production	Capacity Utilization
Tanneries	723	90.00 million Sq. meters	60.00 million Sq. meters	67%
Leather Garment Units	461	7.00 million Pieces	5.00 million Pieces	71%
Leather Footwear	524	200.00 million Pairs	100.00 million Pairs	50%
Leather Gloves	348	10.00 million Pairs	5.00 million Pairs	50%

Source: Investors Information Guide (2004), Board of Investment, Ministry of Production, Government of Pakistan.

The leather sector is basically an export-oriented sector and the major buyers are the European Union, South Korea and the Middle East Countries. The share of Pakistan in the total world exports of Leather and leather made products is around 3.0 percent.

1.3.6 Paper and paperboard industry

The industry comprises of about 95 units of which 70% are located in Punjab due to availability of raw material and abundant water supply. In the year 1999-2000, the sector produced paper and paperboard worth Rs.10.73 billion contributing 2.39% to the total manufacturing value. The sector directly as well as indirectly is responsible for providing jobs on a large scale to the skilled, semi-skilled and un-skilled workers. Local agricultural waste like wheat straw and river grass are used to produce pulp, which is used to produce paper and paperboard of different quality. The role of this sector is important in saving foreign exchange by substituting imports of paper and paperboard. Total installed capacity of Paper and Paperboard industry is approximately 0.5 million Tons per annum with only 70 to 90 percent capacity

utilization. Besides local raw materials wood pulp and waste paper is imported from Sweden, Finland, Brazil, Canada and Far East.

Presently the industry is poorly developed mainly because of non availability of local wood fiber and deficient technological base. Other factors are non-availability of trained manpower and lack of infrastructure. To fill the gap between the demand and supply paper and paperboard are imported from Finland, Canada, USA and China. Newsprint constitutes about 50% of the total imports of this sector.

1.3.7 Readymade garment industry

This is the most dynamic segment of Textile Down-Stream Industry. The production of garments and made-ups in Pakistan is concentrated mainly in Lahore, Faisalabad and Karachi. Major industrial units in this sector are vertically integrated and are involved in knitting, dying, finishing and stitching. Pakistan's exports of ready-made garments are approximately worth US$ 1.00 billion per annum. The USA market and the European Union are the major markets for Pakistani exports. The apparel export product mix from Pakistan is heavily titled towards men's wear and knitted garments.

Readymade garment industry has tremendous possibilities for further expansion. The industry enjoys duty free import of machinery and income tax exemptions. The share of exports from this sector in global market can be increased through product diversification, quality improvement and by searching new markets.

1.4 STATEMENT OF PROBLEM

The main objective of this study is to analyze the effects of economic reforms and openness on structure-conduct-performance (S-C-P) of agro-based industries in Pakistan. These industries operate under imperfect competitive market conditions and are believed to have positive price cost margins and inefficient price and cost structures. This issue is important because agro-based industries have a major share in total large scale manufacturing output and are an important source of employment. The industrial base developed in Pakistan is largely centered on the agricultural raw materials. The main purpose of economic reforms introduced from time to time has

been to improve the output and efficiency of manufacturing industries not only to meet the domestic demand but also to earn precious foreign exchange by boosting exports. The study of the effects of economic reforms and openness on agro-based industries is important because it exposes this sector to more competition and widens the opportunities for exporting to a larger international market.

Three major approaches have been used in empirical analysis designed to capture the effects of liberalization. First, static efficiency measures for individual countries such as effective rate of protection (ERP) and domestic resource cost (DRC). Secondly, cross-country studies which compare the performance before and after reforms or performance with and without reforms (performance of reformers and non-reformers). Thirdly, single country analysis based on structure-conduct-performance approach. This study will concentrate on the S-C-P approach. Production Function analysis will also be carried out to study the level of inefficiency in agro-based industries.

1.5 PURPOSE OF STUDY

Development economists routinely argue that protection reduces efficiency and absence of foreign competition allows domestic producers to enjoy monopoly power and excess profits. It is also believed that pressure from foreign competition forces all firms towards higher levels of efficiency. Empirical evidence is also supportive of the fact that exposure to foreign competition together with trade and industrial reforms forces suboptimal producers towards minimum efficient scale (MES).

The agro-based industries in Pakistan operate under imperfect market conditions, earn monopoly profits; have high concentration ratios and these ratios have not changed much overtime. The main objective of this study is to analyze the effects of trade related domestic reforms and the degree of openness on the structure, conduct and performance of agro-based industries in Pakistan. The study of structure, conduct and performance of these industries is important for policy prescription because if concentration leads to collusion then this suggests intervention and if concentration arises due to technological innovation then no intervention is needed.

The pattern of growth of large scale industries in Pakistan is well researched but the effects of economic reforms and openness need more in depth analysis. The study of the effects of economic reforms and openness on S-C-P of agro-based industry in Pakistan is important because little is known about these effects and further investigation is needed. Why the study of the effects of economic reforms and openness on agro-based industry should be a matter of concern? It is because of three reasons. First, the spillovers from these industries are critical for the growth of other industries as well as the agricultural sector itself due to the complementary nature of the two. Second, the growth of output and efficiency of these industries is important for the overall sustained growth of the economy. Third, agro-based industries are the major source of earning foreign exchange and employment in Pakistan.

1.6 STRUCTURE OF THESIS

The remainder of the thesis is organized as follows. Chapter 2 is devoted to conceptual and theoretical framework. It reviews structure-conduct performance approach and explains the methodology for analyzing the effects of economic reforms and openness on structure, conduct and performance of agro-based industries in Pakistan. It reviews the literature on the study the effects of market power on structure, conduct and performance on industry level. It also reviews literature on frontier analysis and the use of stochastic production functions in the estimation of efficiency.

Chapter 3 focuses on effects of economic reforms and openness on structure, conduct and performance of agro-based industries in Pakistan during different time periods since 1971-72, using structure-conduct-performance approach. Chapter 4 investigates the efficiency of agro-based industries using stochastic frontier analysis. Chapter 5 nests all the empirical results generated in chapter 3 and chapter 4 to derive some conclusions and policy implications.

CHAPTER 2

THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 INTRODUCTION

This chapter provides an overview of the issues that are going to be analyzed in the rest of the study. It starts with a brief overview of the manufacturing sector in Pakistan in section 2.2. Structure-Conduct-Performance and Production Function approach are discussed in section 2.3. Economic reforms and openness and their link with structure-conduct-performance at industry level are discussed in section 2.4. Choice of variables, data and data characteristics are discussed in section 2.5. Pooling of time series and cross-sectional data is discussed in section2.6. Stochastic frontier analysis is discussed in section 2.7 and finally, some concluding remarks are given in section 2.8.

2.2 ECONOMIC REFORMS AND OPENNESS

Economic reforms basically include trade and tariff reforms, privatization and deregulation reforms, financial sector and capital market reforms and tax reforms. The ultimate goal of economic reforms is to increase the welfare of the society by improving static resource allocation and removing inefficiencies and rent seeking behavior. Foroutan (1992) found a positive correlation between growth in import penetration and total factor productivity growth in Turkey. He also found that import penetration was correlated with lower price cost margins. Tybout et al. (1991) observed that total factor productivity growth was better in industries that experienced the largest decline in protection in Chile. The purpose of our study is to investigate the effects of domestic economic reforms and openness on the structure conduct and performance of agro-based industries in Pakistan.

The effects of trade liberalization and economic reforms on growth and efficiency of have been extensively examined at cross-country, country and industry level. The cross-country level empirical research includes, ‘before and after reform’

studies (Greenaway et al, 1997) and 'with and without reform' studies (Mosley et al. 1991). The country specific time-series analysis includes studies like Kim (2000), Krishna and Mitra (1998), Greenaway and Spasford (1994), Hadad et al. (1996) and Urata and Yokota (1994). Many of these studies suggest that the effects of trade liberalization on growth are ambiguous and complex. Some countries show an improvement in growth as well as other indicators such as investment, others show a marked deterioration. Greenaway et al. (1998) using panel data and alternative measures of liberalization have found a J-curve type effect of liberalization on GDP growth.

A large volume of empirical literature has focused on the dynamic effects of trade liberalization and has investigated the effects of trade policy and openness on total factor productivity (TFP) and efficiency at industry level. Evidence from these studies, so far, has been inconclusive. Some researchers have found support for the view that efficiency levels are highest amongst the industries experiencing the largest decline in protection (Tybout et al. 1991). Several studies including Hadad (1993), Tybout and Westbrook (1995) and Aw and Batra (1998) have found exporting firms to be more efficient than their domestically oriented counterparts. They have attributed this result to the positive learning effects, which accrue from contact with foreign buyers.

In the early periods of the 20th century protectionist theories became dominant and many of the developing countries implemented industrialization policies with a very limited degree of openness. These policies had their origins in the thinking of Raul Prebisch (1950) and Hans Singer (1950). During 1960s and 1970s a large number of development economists advocated protectionist view based on import substitution ideas. The debt crisis in 1982 played an important role in reshaping policy views regarding development strategies. Policies based on market orientation, tariff reduction and opening of international trade took over the inward oriented policies. Trade and industrialization policies adopted by the countries like South Korea, Taiwan, Hong Kong and Singapore has gradually created a formidable case for trade and industrial reforms in other developing countries of the world. World Bank and IMF conditionality also links external financing to such reforms.

Amsden (1989) describes the Korean government's use of trade protection, export subsidies, selective credit subsidies, export targets, public ownership of banking sector and price controls to achieve technological capabilities and building industries that will eventually compete in world markets. She argues that a key element in the success of government policy in Korea was that in exchange of trade protection and subsidies the government also set stringent performance standards.

Balassa (1981a) has demonstrated that export-oriented countries are better positioned to deal with external shocks than inward-oriented countries. Balassa (1981b) using a large sample of developing countries showed that out-ward oriented countries were able to increase their world market shares which resulted in higher rates of economic growth in those countries.

Rodrik (1995a) has identified the following four broad objectives of trade and industry related reforms.

1. Improvements in static resource allocation.
2. Dynamic benefits in the form of learning and growth.
3. Improved flexibility in face of external shocks.
4. Reduced rent seeking.

Economic liberalization reduces static inefficiencies, which are mainly due to misallocation and waste and enhances technological change and economic growth. Market based open economies are batter able to absorb adverse external shocks, prevent rent-seeking behavior and other governance issues.

Wade (1990) describes government's role in the development of trade and industry in Taiwan. He calls Taiwan a government market economy, characterized by high levels of investment, more investment in certain key industries and exposure of many industries to international competition. He concludes that import restrictions, entry requirements, domestic content requirements, concessional credit and fiscal incentives had played an important role in the Taiwanese strategy. Bardhan (1990), Biddle and Milor (1992), Biggs and Levy (1990), Johnson (1987) and Westphal (1990), all emphasize the usefulness of activist industrial policies. World Bank (1993)

confirmed that intervention was rampant in East Asian economies nonetheless found it unlikely that other developing countries could successfully replicate this experience.

Little, Scitovsky, and Scott (1970), Bhagwati (1978) and Kreuger (1978) have demonstrated that industrial protection and overvalued exchange rate policies had encouraged the development of the industries that were high cost and did little to ensure productivity growth overtime. Kreuger (1983), Bhagwati (1993), Meier and Steel (1989) and Frischtak (1989) have attributed dismal export performance of many developing countries to domestic economic policies. Balasa (1988) and Grossman and Horn (1989) have demonstrated that anti export and anti competition policies have discouraged innovation, cost-cutting, technological capabilities and eventual growth.

Edwards (1993) reviewed a large volume of literature on trade and development policies and concluded that cross-country aggregate data sets have little information regarding the relationship between trade policy and growth. Romer (1992), Helpman (1991) and Edwards (1992) have emphasized the role of freer trade and supported the view that more open economies grow faster than more restricted ones even in the long run.

The study of the effects of openness on productivity and growth has proven to be elusive and controversial. Krugman (1994) and Rodrik (1995a) argued that the effects of openness on growth are doubtful. On the other hand, Barro and Sala-i-Martin (1995) and Edwards (1998) among others have demonstrated that openness has positive effects on growth and productivity.

Theoretically, the gains from trade are based on the concept of allocative efficiency. In a static sense protection is costly because resources are not allocated according to the comparative advantage of the economy. In a protected market, dominated by few domestic firms, trade reforms increase competition but improving the allocation of resources or curbing the excess market power generates a onetime increase in growth. Endogenous growth theories, however, suggest that trade policies also effect long-run growth rates by accelerating the rate of technological change.[10]

[10] See, for example, Grossman and Helpman (1990) for an overview.

For the present study, analysis will be carried out in two parts. In part one, effects of policy reforms and openness on structure-conduct-performance of agro-based industries in different time periods from 1970-71 to 2005-06 will be carried out. In the second part, efficiency of agro-based industries will be studied using production function approach. Stochastic Frontier Analysis will be used to analyze the changes in productivity and efficiency of the agro-based industries over different time periods.

2.3 A BRIEF REVIEW OF STRUCTURE-CONDUCT-PERFORMANCE APPROACH

The subject matter of industrial economics is the study of the behavior of the firms in an industry. Industrial Economics studies how industries operate and how these contribute to economic growth and welfare. Industrial economics is mainly concerned with the policies of the firms towards rivals and towards customers such as pricing, R&D, advertising, choice of technology, entry barriers and predation etc. Industrial economics is also concerned with government policy towards business.

Two schools of thought have been popular in industrial economics, the Structure-Conduct-Performance (S-C-P) School and the Chicago School. The S-C-P approach emphasizes the empirical studies of industries and believes that conduct and performance are strongly linked with market structure. The S-C-P School believes that private exercise of monopoly power is the persistent feature of many markets and strategic behavior of some firms prevents other firms from competing on the basis of merit. One implication of this strategic behavior is that concentration gives rise to collusion, which suggests antitrust intervention and pro competition public policy.[11]

Bain (1956) has pointed out that the performance of an industry is a function of the conduct of buyers and sellers, which in turn is a function of industry's structure. The structure of industry depends on the number and size of buyers and sellers, technology, the degree of product differentiation, vertical integration and the level of barriers to entry. Conduct refers to the policies adopted towards product, consumers

[11] For further details see Martin, S. (1994) *Industrial Economics*, Second Edition, prentice Hall, New Jersey, Chapter 1, pp 3-10.

and competitors and includes the activities such as firm size and capacity utilization, pricing and promotion, research and development (R&D) and collusion and competition etc. The S-C-P paradigm implies that the level of concentration and the extent of barriers to entry have a significant effect on the ability of the firms to set price above the marginal cost. Consequently the structure characteristic can be expected to determine the performance of individual firm or industry.

The main focus of the S-C-P approach is based on the study of firm behavior under conditions of imperfect information and the requirement that behavior should occur as a long-run equilibrium phenomenon before being used for policy prescription. In industrial economics the research methodology developed in the tradition of Joe Bain is known as Structure-Conduct-Performance approach or the Harvard tradition. This approach is based on empirical analysis of the firms in an industry and tries to explain differences in performance on the basis of structure and conduct of large firms. The Bain tradition involves trying to explain differences in performance across fairly large group of industries.

The traditional interpretation of the structure-conduct-performance approach is based on the proposition that structure influences conduct and both structure and conduct influences performance. Smaller the number of firms, more likely it is to be collusive such as in repeated Bertrand game and more competitive behavior implies less market power such as in Bertrand pricing with no capacity constraint (severest competition leads to zero market power). If it is believed that structure influences performance directly then lower concentration leads to lower market power such as in Cournot symmetric n-firms oligopoly. A vast majority of empirical studies in the tradition of S-C-P have reported a weak positive association between market concentration and market power.

The Chicago School on the other hand believes that the main source of monopoly power is the government interference in the marketplace. This implies that government should avoid regulating the market. The only role of the government in the market should be the prevention of collusion. The Chicago tradition rests on the belief that technology and freedom of entry determine market structure with freedom

of entry determine market structure with freedom of entry guaranteeing optimal conduct and performance.[12]

Chicago School is one of the most influential bodies of economic thought in recent times. The School is associated with the economics department at the University of Chicago. George Stigler (1911-91), Milton Friedman (1912-2006), Ronald Coase (1910-), Gary Becker (1930-) and Robert Lucas (1937-) are some of the Nobel Prize laureates belonging to this School.

During 1970s Chicago School tradition dominated the research circles and from the mid 1970s to mid 1980s industrial economics was among the most popular areas of research. The research based on game theoretical models of imperfectly competitive markets overshadowed the Chicago School tradition and permitted a reformation of empirical research in industrial economics.

Contemporary industrial economics concerns itself with the analysis of market structure, firm conduct and market performance in oligopolistic markets. Industrial economists continue to study the determinants of performance for groups of industries as well as single firms or industries and the idea of existence of a positive relationship between market share, market concentration and market power is probably acceptable to most economists. It is generally believed that protection reduces efficiency and absence of foreign competition allows producers to enjoy monopoly power and excess profits. New industrial economics incorporates the strategic behavior of all agents, firms as well as governments.

2.3.1 Elements of structure-conduct-performance

Market structure is defined as the organizational characteristics of a market that seem to determine the conduct of a firm. Market structure depends upon the number of sellers, degree of product differentiation, entry and exit conditions, the cost structure, the vertical integration and so on.

Structure describes the way in which market departs from the conditions of perfect competition. In the long run a competitive industry will supply a product at a

[12] See, for example, Miller (1962), Prosner (1979) and Adams and Brock (1991).

price equal to its opportunity cost. In contrast a monopolized market is supplied by a single seller who is able to restrict output and hold price above the opportunity cost. If market is concentrated it allows for collusion and collusion allows for profit if entry is difficult. These effects however are observed only by large firms. Perfect competition and perfect monopoly are two extremes, which are not generally observed. The most common form of real-world market is oligopolies. Firms in such markets are, in general, able to exercise some market power.

Firm conduct means its policies towards pricing, R&D, investment, advertising and so on. Broadly speaking conduct means the policies of a firm towards its rivals and towards its customers. Firm's behavior can be competitive or collusive depending upon market structure. Firm's conduct becomes important only when competition is imperfect. In imperfectly competitive markets the established producers may discourage the entry of new firms. Entry can be restricted by holding down the price, so that entry is less attractive. This sort of policy is socially beneficial because it works to the disadvantage of less efficient firms and gives the advantage of lower price to the society. Another sort of strategic behavior by the established firms raises the costs of actual or potential rivals and includes policies like vertical integration, advertising, R&D and predatory pricing. This sort of strategic behavior is not socially beneficial. The strategic behavior of the firm under oligopoly becomes important because of interdependence of the firms. The empirical research carried out in this field shows that profitability increases with concentration and that concentration allows for collusion.

Firm performance refers to social efficiency mainly defined by the extent of market power. Greater market power implies lower efficiency. Performance also depends on product variety, innovation rate, profits and distribution. Performance in the static sense means producing output at minimum cost whereas performance in the dynamic sense means technological progress. A firm will be progressive if it adds to its stock of factors of production, raises the quality and variety of its products and improves the technique with which it organizes factors of production. Under perfect competition firms are able to earn only a normal rate of return on their investment. To earn profit above the normal rate of return firms seek to acquire and maintain market power. The more concentrated the market the higher will be the cost as well as the

price. In a competitive market, the quantity demanded equals the quantity supplied at a price equal to marginal cost of production. Under these market conditions production is efficient, all firms have access to the same technology and the firms unable to use the available technology efficiently lose money in the short run and disappear in the long run. In a competitive market firms are able to earn only a normal rate of return that is why firms seek to acquire and maintain market power. But the closer the price to marginal cost, the better is the market performance.

2.3.2 Linking structure-conduct-performance to economic reforms and openness

The main objective of the study is to analyze the effects of economic reforms and openness on structure-conduct-performance (SCP) of a panel of eleven agro-based industries in Pakistan. Trade liberalization is believed to promote productivity through innovations and technological change associated with foreign trade. Through exposure to external markets industrial efficiency can be increased by; abolishing monopoly profits, increasing capacity utilization and allowing optimal resource allocation in the economy. The theory of industrial organization has recognized the role of international trade in the determination of imperfect competition and industrial efficiency. The argument is that international trade variables can have an impact on productivity and profitability by introducing changes in the structural characteristics of the economy. Kim (2000), Weiss (1992), Krishna and Mitra (1993) and Tybout and Westbroke (1995) have found some support in favor of the hypothesis that trade opening has a positive impact on manufacturing sector's total factor productivity growth. Amjad (1977), Beng and Yan (1977), De Melo and Urata (1984), Weiss (1992), and Weiss and Jayanthakumaran (1994) tested the reform induced price cost margins (PCM) and obtained some support in favor of their hypotheses that in more open economies the ability of the domestic firms to hold price above the average cost is reduced.

Following Amjad (1977), Ravenscraft (1983), De Melo and Urata (1984), Weiss (1992) and Tybout (1996); market share (CR), capital output ratio (COR) and some policy variables will be used as independent variables with price cost margins (PCM) as the dependent variable. To link economic reforms and openness to structure-

conduct- performance of agro-based industries, growth rate of manufacturing (GRM) will be used as a proxy for domestic reforms and trade (X+M) to GDP ratio will be used as a measure for openness.

The dependent Variable PCM is a function of CR, COR, UR and (X+M) and the stochastic error term ε. It is assumed that PCM is determined within the system and all explanatory variables are determined outside of it. But if one or more explanatory variables are correlated with the error term endogeneity is said to occur. Endogeneity may occur due to omission of some important explanatory variable(s) or due to measurement error. Endogeneity may also arise when one or more of the independent variables are jointly determined with the dependent variable. In case of single equation OLS will provide inconsistent estimators in the presence of endogeneity. Ad Hoc solution to the problem of endogeneity suggests looking for a proxy variable that is closely related to the variable causing endogeneity and uncorrelated with the error term. Another Ad Hoc solution is to lag the suspect variable by one or more periods [Greene (2005), Gujarati (2000)]. In their studies, Strickland and Weiss (1976), Amjad (1977), Beng and Yen (1977), Ravenscraft (1983) and De Melo and Urata (1984) have used PCM as dependent variable and COR as one of the explanatory variables. For this study, however, we will use one period lagged value of capital output ratio (COR_{-1}) to avoid the problem of endogeneity.

As already discussed in Section-2.4, the ultimate goal of economic reforms is to improve welfare through improving resource allocation and removing inefficiencies. Both unemployment rate and trade to GDP ratio are expected to reflect the effects of domestic economic reforms and openness on Price Cost Margins through promoting competition and removing inefficiencies due to imperfect market conditions.

2.3.3 Pooling time series and cross-sectional data

When dealing with cross-sectional and time series data, it is common practice in applied work to pool data together and estimate a common regression. Pooled data refers to data with relatively few cross-sections, where variables are held in cross-

section specific individual series. If model is properly specified, pooling provides consistent and efficient estimates of the common intercept and the slope vector.[13]

The following pooled cross section and time series regression specification can be tested for studying the effects of economic reforms and openness on structure conduct and performance of agro-based industries during the study period.

$$y_{it} = \alpha + x'_{it}\,\beta + \varepsilon_{it} \quad \text{with } i = 1,\ldots..., N;\ t = 1,\ldots\ldots,T \qquad (2.4)$$

Where,

y_{it} is the dependent variable

α is the intercept

vector x'_{it} contains K regressors for unit i at time t

vector β contains K regression coefficients to be estimated

ε_{it} is the error term with $N(0, \sigma^2_{\varepsilon})$

Both fixed effects model (FEM) and random effects model (RAM) can be used for estimation and one of these models can be selected on the basis of Hausman specification test for interpreting the results.

2.3.4 Fixed effects model

The fixed effects model (FEM) takes the following form:

$$y_{it} = \alpha_i + x'_{it}\,\beta + \varepsilon_{it} \qquad \text{with } i = 1,\ldots\ldots., N \qquad (2.5)$$

The intercept α_i capture the effect of omitted variables and are treated as fixed constants or the regression coefficients. Alternatively, equation 2.5 can be written as:

$$y_{it} = \alpha_1\delta_{it} + \alpha_2\delta_{it} + \ldots\ldots + x'_{it}\,\beta + \varepsilon_{it} \qquad (2.6)$$

This model is similar to the least squares dummy variable (LSDV) model and can be estimated using ordinary least squares method. The main advantage of the fixed effect model (FEM) is its relative ease of estimation and that it does not require independence of fixed effects from other explanatory variables.

[13] Greene, W.H. (2005), *Econometric Analysis,* 5th edition, Pearson Education, Inc. Chapter 13.

2.3.5 Random effects model

The random effects model (RAM) takes the following form:

$$y_{it} = \alpha_i + x'_{it}\beta + u_i + \varepsilon_{it} \quad (2.7)$$

The random effects specification assumes that u_i is a group specific random element with constant mean and variance. The individual effects are strictly uncorrelated with the regressors and ε_{it}. Random effects model (RAM) broadens the amount of heterogeneity across individuals while retaining some commonalities for example the parameter still shares a common mean. Random effects model can be estimated through generalized least squares (GLS) or maximum likelihood (ML) method.

2.3.6 Market power and market concentration

The standard structure-conduct-performance approach relates industry profitability to the level of concentration under oligopoly behavior. Industry profitability is expected to be positively correlated with the level of concentration. Several measures of market power have been developed. A brief description of some of these measures is given below.

- Lerner Index of Market Power: This index was developed by Abba P. Lerner[14] and in standard form is written as:

$$\frac{P-C}{P} = \frac{1}{\varepsilon_{PQ}} \quad (2.5)$$

  Where P stands for price and C represents the marginal cost. The expression on the left hand side is the price-cost margin and the expression on the right hand side is the inverse of the price elasticity of demand. Lerner index thus shows that market power is the inverse of the price elasticity of demand.

- Concentration Ratios: Concentration ratios are often used as measure of fewness. Percentage of industry sales accounted for by the largest 4 firms or the largest 8 firms or the largest 20 firms or the largest 50 firms are used as measure of concentration.

[14] Lerner, Abba. P. "The Concept of Monopoly and the Measurement of Monopoly Power," Review of Economic Studies, Vol. 1, June 1934, pp. 157-175.

- Herfindahl Index: Concentration ratios provide information about the share of the largest few firms and ignore smaller forms. An alternative measure of concentration is the Herfindahl Index.[15] This Index is the sum of the squares of the market shares of all the firms in the industry and is expressed as:

$$H = \sum_{i=1}^{N} S_i^{\,2} \qquad 0 \leq H \leq 1 \tag{2.6}$$

Where, S_i is the share of the i^{th} firm in the industry. The larger the value of H the fever will be the number of firms supplying the industry.

2.4 CHOICE OF VARIABLES

In empirical analysis choice of variables, construction of variables for analysis and identification of correct sources of data is very crucial. The quality and appropriateness of data set is as important as the technique itself. In case of S-C-P analysis variables like market concentration ratios, capital output ratios, import shares and protection ratios have frequently been used as exogenous or independent variables with profitability ratios like gross return on sales or price cost margins as dependent variables. For the present study price cost margins will be used as dependent variable with 4 firm concentration ratios (CR), capital output ratio lagged by one time period (COR_{-1}), growth rate of manufacturing (GRM) and trade (X+M) to GDP ratio will be used as independent variables. Pooled time series and cross-sectional data on 11 large- scale agro-based industries from 1971 to 2006 will be used for analyzing the effects of economic reforms and openness on price cost margins in agro-based industries. Census of large scale manufacturing industries (CMI) will be the main source of industrial data where as the main source for national income accounts data will be the Finance Division, Economic Advisor's Wing, Government of Pakistan.

2.5 PRODUCTION FUNCTION APPROACH

In Case of firms producing multiple outputs using multiple inputs we represent change of productivity by total factor productivity (TFP) or a multifactor productivity

[15] See Herfindahl, Orris c. (1950), on the properties of Herfindahl index.

index (MFP). We can measure the change in productivity of one firm or industry from period t_1 to period t_2, assuming that the firm makes use of the state of knowledge as represented by the production technology s^1 and s^2 in period t_1 and t_2. We also have to assume that firm produces q_1 and q_2 level of outputs using x_1 and x_2 level of inputs in the period t_1 and t_2 respectively. If information on output prices p_1 and p_2 and input prices w_1 and w_2 is available then Hicks-Moorsteen[16] index of total productivity change is given by:

H-M TFP Index = Growth in output／Growth in inputs

= Output Quantity Index／Input Quantity Index (2.1)

Another method of measuring Total Factor Productivity Index is based on the profitability ratio. After making adjustments for movements in input and output prices over the time period t_1 and t_2, TFP index is defined as:

$$\text{TFP index} = \frac{R_1^* / R_2^*}{C_1^* / C_2^*} \qquad (2.2)$$

Where,

R_1^*, R_2^* and C_1^*, C_2^* are the revenues and costs of the firm or industry in period t_1 and t_2 respectively.

The third approach is based on Caves, Christensen and Diewert (1982) and is known as Malmquist TFP Index. This index is constructed by measuring the radial distance of the observed output and input vectors in period t_1 and t_2 relative to a reference technology. The advantage of this index is that no *a proiri* assumption regarding returns to scale is required.

Another approach of measuring TFP index is based on sources of productivity growth. Balk (2001) identifies following four sources of productivity growth:

1. Technical Change (TC)
2. Efficiency Change (EC)

[16] See Hicks, J.R. (1961) and Moorsteen, R.H. (1961).

3. Scale Efficiency Change (SEC)
4. Output Mix Effect (OME)

Total productivity change index can be measured by bringing all these components together.

$$\text{TFP Change} = TC \times EC \times SCE \times OME \qquad (2.3)$$

2.5.1 Stochastic frontier analysis

Stochastic frontiers have been used in the study of firm efficiency since they were first independently proposed by Aigner, et al. (1977) and Meeusen and Broek (1977). Stochastic frontier production functions facilitate the measurement of firm level technical efficiency and make it possible to differentiate between random errors and differences in inefficiency. The production frontier represents the maximum output that can be produced from a given level of inputs. The deviations of actual from maximum become the measure of inefficiency. Stochastic frontier literature for panel models has two main groups. First, assumes technical efficiency to be time-invariant[17] and the second assumes technical efficiency to be time-varying.[18]

Panel data version of stochastic production function can be written in the form:

$$\ln q_{it} = x'_{it}\beta + v_{it} - \mu_{it} \qquad (2.7)$$

Where q_{it} is the output or value added for the i^{th} industry in year t, x_{it} is a vector of input variables of the i^{th} industry in year t and β is a vector of unknown parameters to be estimated. The Cobb-Douglas stochastic frontier model takes the form;

$$\ln q_{it} = \beta_0 + \beta_1 \ln x_{it} + v_{it} - \mu_{it} \qquad (2.8)$$

$$\text{Or} \quad q_{it} = \exp(\beta_0 + \beta_1 \ln x_{it} + v_{it} - \mu_{it}) \qquad (2.9)$$

$$\text{Or} \quad q_{it} = \exp(\beta_0 + \beta_1 \ln x_{it}) \text{ X } \exp(v_{it}) \text{ X } \exp(-\mu_{it}) \qquad (2.10)$$

Where,

$\exp(\beta_0 + \beta_1 \ln x_{it})$ = deterministic component;

[17] See, for example, Pit and Lee (1981), Schmidt and Sickles (1984) and Battese and Coelli (1988).
[18] See, for example, Cornewell, C. P. et al. (1990), Kumbhakar (1990), Battese and Coellie (1992) and Lee and Schmid (1993).

$\exp(v_{it})$ = noise, and

$\exp(-\mu_{it})$ = technical efficiency.

The conventional error term v_{it} is assumed to be independent and identically distributed as $N(0, \sigma^2_v)$ and captures the effects that are beyond the control of the industry. The remainder component of the error term μ_{it} captures industry specific technical inefficiency in production. Since μ_{it} is by definition a non-negative random variable, the technical efficiency assumes a value between zero and unity, where unity indicates the firm is technically efficient.

2.5.2 Time-invariant inefficiency decay models

In this specification the inefficiency term is assumed to have a truncated normal distribution that is constant over time within panel. In case of time-invariant models we can impose the following restriction on inefficiency effect.

$$\mu_{it} = \mu_i \qquad i = 1, 2, \ldots\ldots, I \qquad t = 1, 2, \ldots\ldots, T \tag{2.11}$$

Where μ_i is treated as a fixed parameter in case of fixed effects models and as a random variable in case of random effects models. These models can be estimated using either least squares (LS) or maximum likelihood (ML) method.

2.5.3 Time-varying inefficiency decay models

This analysis follows Battese and Coelli (1988) parameterization of time effects. The inefficiency term is modeled as a truncated normal random variable multiplied by a specific function of time.

$$\mu_{it} = \mu_i \exp [\eta (t - T)] \tag{2.12}$$

Where, T corresponds to last time period, η is decay parameter to be estimated and μ_i is distributed $N (\mu, \sigma_\mu)$.

Kumbhakar (1990) has proposed the following time-varying inefficiency model.

$$f(t) = [1+ \exp (\alpha t + \beta t^2)]^{-1} \tag{2.13}$$

Where, $u_{it} = f(t).u_i$ and α, β are unknown parameters to be estimated. This function lies in the unit interval and can be non-increasing, non-decreasing, concave or convex depending on the signs and magnitude of α and β.
Battese and Coelli (1992) have also proposed the following inefficiency model:

$$f(t) = \exp [\, \eta (t - T) \,] \qquad (2.14)$$

Where, $u_{it} = f(t).u_i$, η is an unknown parameter to be estimated and T is the last time period. This function can be either non-increasing or non-decreasing depending on the sign of η, however, it is convex for all values of η.

2.5.4 Inputs

In productivity analysis inputs are classified in the following categories. Capital (K), labor (L), materials (M) and energy (E). Measurement of capital in productivity analysis is very important. The measurement of capital in productivity analysis is very important because capital inputs are purchased in one period and used in the production process through the life of the asset until it is replaced by a new asset. Both sales value of the asset or replacement cost may be used for measuring the quantity of capital. In productivity analysis measurement of capital stick is usually based on the perpetual inventory method (PIM), which requires the following data.

- A time series of investment expenditure on particular asset over the productive life of the asset.
- A price index of investment goods to deflate investment expenditures.
- Retirement pattern for different assets.
- Age efficiency patterns of the productive asset.

For large-scale manufacturing industries in Pakistan census of manufacturing industries (CMI) uses the value fixed assets at the beginning of fiscal year plus investment during the fiscal year less sales of fixed assets plus additions to fixed assets out of own production for measuring the vale of capital stock. Energy and material inputs constitute significant part of input costs. In practice, these inputs are aggregated into one category consisting of “other” inputs. Quantity and price data for energy and material inputs are usually easily available. CMI provides data on inputs

as Capital Cost (value of fixed assets at the end of the year), Employment Cost and Industrial Cost (raw material fuel and electricity cost). Appropriate deflator can be used to obtain real values that can be used as a measure of quantity of material inputs.

2.5.5 Output quantities

Measurement of outputs is relatively easy task when the firms under consideration are involved in producing tangible goods and services that are sold in the market place. However, it is difficult to identify the output of an enterprise involved in delivering services in particular in the non market place.

In general there are two possibilities, firms producing a single output and those producing multiple products. In case of single output quality variation among the firms has to be accounted for. In case of multiple product firms, aggregates are used in measuring productivity across firms over time. CMI provides data on value of production (exclusive of indirect taxes) during the year and value added during the year by each industry. For the present study real value of output of each industry will be used for analysis.

2.6 LINKING ECONOMIC REFORMS AND OPENNESS TO PRODUCTIVITY GROWTH

Productivity trends are important and widely used as a measure of change and as a benchmark for evaluating the economic progress of a country. The higher the productivity, the higher would be the prospectus for development of a country. The

study of growth trends in factor inputs and total factor productivity in association of economic policies are important in understanding the growth process because:

- Productivity growth leads to economic growth.
- Higher productivity raises efficiency in the economy.
- Increase in productivity is anti inflationary.

Urata and Yokota (1994), Tybout (1995) and Kim (2000) have obtained strong evidence of increase in total factor productivity due to trade related reforms. Krishna and Mitra (1998) have obtained some weaker evidence of an increase in the rate of growth of total factor productivity for India due to trade related reforms. Hadad, De Melo and Horton (1996) on the other hand have found no evidence that greater competition from imports enhanced productivity.

2.6.1 Decomposition of total factor productivity

The measurement of productivity pioneered by Solow (1957) has been used extensively to analyze technical change in both developed and developing countries. Solow derived a productivity measure referred to as multi-factor productivity or total factor productivity (TFP), which depends on the assumption that product markets are perfectly competitive. Yet shifts in trade policy are likely to alter the competitive environment particularly in the developing countries where domestic markets are often small and dominated by several firms.

Growth accounting techniques can be used to estimate productivity and efficiency change but it is not possible to distinguish between the components of productivity. An underlying production function is used to decompose TFP change into technological change and efficiency change. One of the advantages of stochastic frontier analysis is that it allows for decomposition of productivity change into technological change and changes in efficiency. Efficiency changes are reflected by movements toward or away from the production frontier whereas technological changes imply movements of the production frontier. Improvements in efficiency are attributed to accumulation of knowledge, diffusion of new technologies and improved managerial skills while technological changes are attributed to innovations and acquisition of new technologies. This decomposition is helpful for policy formulation and also helps to identify the effects of economic reforms on efficiency and technical change.

2.7 CONCLUDING REMARKS

This chapter provided a conceptual framework for the analysis of the effects of policy reforms and openness on structure, conduct and performance of agro-based

industries in Pakistan. The main focus of Structure-Conduct Performance approach is on the study of firm behavior under imperfect market conditions. The Structure-Conduct-Performance approach is based on empirical analysis and tries to explain difference in performance on the basis of structure and conduct of large firms. Absence of competition allows domestic firms to enjoy monopoly power and earn excess profits. Trade liberalization reinforced with domestic economic reforms can have reducing effect on price cost margins by increasing the size of the market and competitiveness of the firms in an industry. Trade liberalization is also believed to enhance efficiency through innovations, cost cutting and acquisition of new technologies.

For empirical analysis pooled time series and cross sectional data for eleven agro-based large-industries[19] over the period 1970-71 to 2005-06 will be used. Both fixed effects model and random effects model will be used to study the effects of economic reforms and openness on structure-conduct-performance of agro-based industries. Total time period will be divided into three sub-periods keeping in view the major policy reforms introduced in Pakistan. First sub-period will be from 1971 to 1977. During this period nationalization policies were adopted by the Peoples Party government. Second sub-period consists of 1978 to 1990 time period during which privatization and deregulation policies were reintroduced. The third sub-period covers the 1991 to 2006 time period. During this period structural reforms and openness policies were followed rigorously. The analysis will help to understand the effects of trade and industrial policy reforms and openness on structure-conduct-performance of agro-based industries under different policy regimes. Stochastic frontier analysis will also be carried out to estimate and analyze the efficiency and technical change during each sub-period. Both time-invariant and time-varying models will be used to study the efficiency and technical change, taking place in agro-based industries during the study period.

[19] The detail of these industries along with industrial classification codes is given in appendix-III.

CHAPTER 3

STRUCTURE CONDUCT AND PERFORMANCE OF AGRO-BASED INDUSTRIES

3.1 INTRODUCTION

The theory of industrial organization has recognized the role of policy reforms in the determination of imperfect competition and industrial efficiency. The argument is that international trade variables can have impact on productivity, profitability and exports by introducing changes in the structural characteristics of domestic market. Over the past two decades, a substantial body of literature has accumulated on firm/industry level effects of openness in developing countries. It is generally believed that trade liberalization squeezes price-cost margins among import competing firms, increases productivity gains and efficiency gains from market-share reallocation. Empirical studies that have used productivity growth, export growth and changes in Price Cost Margins as yardstick of performance have obtained mixed results. Kim (2000), Krueger (1997), Edwards (1993), Balassa (1991) and Westphal (1990) have emphasized the role of policy reforms in improving industrial growth and efficiency. Rodrick (1995), Wade (1990) and Amsden (1989), have shown that interventionist policies played important role by changing comparative advantage and were the important source of growth in developing economies. In this chapter we will analyze the impact of policy reforms and openness on structure- conduct and performance of agro-based industries in Pakistan. A brief introduction of policy reforms and openness in Pakistan is presented in section 3.2. Review of the effects of policy reforms and openness on structure profit relationship is presented in section 3.3. Hypothesis to be tested is discussed in section 3.4. Estimation and results are presented in section 3.5 and finally some concluding remarks are given in section 3.6.

3.2 ECONOMIC REFORMS AND OPENNESS IN PAKISTAN

During 1950s and 1960s, like most of the developing countries, Pakistan adopted import substituting industrialization (ISI) and protectionist policies to protect infant industries. Liberal fiscal incentives, import and export subsidies and overvalued exchange rates were introduced to encourage investment in the large scale manufacturing industries. Encouragement of the private sector resulted in the emergence of a new elite class deriving monopoly rents from the foreign trade sector. Economic policies during this period were heavily biased towards industrial sector and resources were transferred from agriculture to the industrial sector.

During 1970s government tried to establish a powerful public sector that could govern the commanding heights of the economy and spearhead the industrialization. Nationalization of heavy industries, price control policies and regulations were introduced during this period. Pak Rupee was devalued approximately by 58%. Land reforms were also introduced but these reforms could not succeed due to opposition of powerful land lord class and poor implementation of the reforms. Social sector reforms were introduced and all educational institutions were nationalized. The focus of the government narrowed on availability of food but ignored the basic needs of education and health (Zaidi, 2009).

The period of 1980s is characterized by the reversal of the nationalization policies and liberalization of the economy. Deregulation, fiscal incentives and removal of price distortions were instituted to encourage private sector investment. Privatization, de-regulation and free trade policies were adopted during this period. As a result of these reforms private sector thrived, however, human capital development was neglected during this period (Bhatia, 1990).

Many structural and macroeconomic reforms were introduced during 1990s with main focus on privatization, liberalization and deregulation. Liberalization of exchange controls was introduced to reverse the capital flight. Policies were introduced to bring about qualitative improvements in social services through Social Action Program (SAP) in 1993. The program could not realize sufficient improvements

in social indicators; however, high growth in primary enrolment especially for females (8.6% per annum) is attributed to this program (Gera, 2007).

Privatization and deregulation policies continued during post 1990s period. Economic policies aimed at removing microeconomic distortions and improving efficiency of resource use. Trade and tariff reforms, tax reforms, financial sector and capital market reforms were introduced in 2000-0. Presently the government of Pakistan is pursuing an open and outward oriented trade policy.

An economy having share of 15% or more of exports in GDP is known as trade economy. The details of exports to GDP ratio for different time periods in real terms are given below in Table 3.1. During 1970s despite massive devaluation of 58 percent the average exports to GDP ratio in Pakistan was 11%. In the 1980s average exports to GDP ratio rose to 12.6%, in the 1990s this ratio increased to 16% as a result of more open trade and industrial policies adopted under WTO regime. During 2001-06 this ratio slightly declined to15.6%.

Table-3.1

Share of Exports in GDP (%)

Period	Minimum	Maximum	Average	S.D.
1970s	8.0	15.0	11.0	2.00
1980s	10.0	15.0	12.0	7.00
1990s	13.0	17.0	16.0	1.00
2001-06	15.0	17.0	15.6	4.00

Source: Pakistan Economic Survey (various issues).

Table-3.2 provides the details of share of imports in GDP. The average share during the seventies was 17.1% which increased to 20.8% in the eighties but declined to 18.8% in the nineties and 17.5% in the post nineties period at constant prices of 2004-05.

Table-3.2

Share of Imports in GDP (%)

Period	Minimum	Maximum	Average	S.D.
1970s	10.0	23.0	17.1	4.00
1980s	19.0	23.0	20.8	4.00
1990s	15.0	22.0	18.8	5.00
2001-06	15.0	23.0	17.5	9.00

Source: Pakistan Economic Survey (various issues).

Table-3.3 shows the average share of trade (X+M) in GDP. During 1970s the share of foreign trade was 28.5%, which increased to 33.5% in 1980s. Average share of trade in GDP further increased to 34% during the 1990s but declined to 33% during the post 1990s period in real terms.

Table-3.3

Share of Trade in GDP (%)

Period	Minimum	Maximum	Average	S.D.
1970s	18.0	36.0	28.5	5.00
1980s	31.0	35.0	33.5	1.00
1990s	28.0	38.0	34.0	3.00
2001-2006	30.0	38.0	33.0	3.00

Source: Pakistan Economic Survey (various issues).

The growth rate of manufacturing is given in Table-3.4. The average growth rate of manufacturing was 5.7% during 1970s. The average growth rate increased to 8.2% during 1980s but declined to 4.2% in the 1990s. The average growth rate of manufacturing once again increased to 9.8% during 2001-06.

Table-3.4

Growth Rate of Manufacturing (%)

Period	Minimum	Maximum	Average	S.D.
1970s	1.00	10.00	5.70	3.00
1980s	4.00	14.00	8.20	3.00
1990s	-1.00	8.00	4.20	3.20
2001-2006	4.00	16.00	9.80	3..20

Source: Pakistan Economic Survey (various issues).

Phasing down of import tariffs is one of the indicators of outward orientation. Table-3.5 shows the phasing down of the tariff rates in Pakistan. Average rate of tariff which was in excess of 35 percent in the seventies and eighties has been reduced to about 12 percent in the post 1990s period.

Table-3.5

Effective Tariff Rate (%)

Period	Minimum	Maximum	Average	S.D.
1970s	23.0	39.0	29.8	5.00
1980s	25.0	36.0	29.9	2.00
1990s	12.0	33.0	21.3	5.00
2001-06	8.0	12.0	11.8	1.00

Source: Federal Board of Revenue, Revenue Division, Government of Pakistan, Annual Report (various issues).

Pakistan is a member of the World Trade Organization (WTO) since its inception in 1995 and is following an export led growth strategy. Pakistan has been reducing trade restrictions overtime. The process of liberalization has been slow during the seventies and eighties but it gained momentum in the 1990s and post 1990s period. Recent trade and investment policy[20] lays emphasis on the following:

[20] Trade Policy 2010, Ministry of Commerce government of Pakistan.

- Export led growth.
- Development and facilitation.
- Deepening and diversification of export markets.
- Skill up-gradation.
- Rationalizing Tariff Policy.
- Improving physical infrastructure.

3.3 EFFECTS OF ECONOMIC REFORMS AND OPENNESS ON STRUCTURE PROFIT RELATIONSHIP

Economic reforms, in general, include trade and industrial policy reforms, fiscal policy reforms, monetary policy and exchange rate policy reforms. For the present study by policy reforms we mean specifically the trade and industrial policy reforms. The literature on trade liberalization differentiates between static and dynamic gains from trade policy reforms. It is generally acknowledged that the magnitude of the static gains is fairly low. Static gains arise when misallocation of resources under protection and import substitution is corrected and resources shift from inefficient to efficient sectors. The dynamic or long-term gains accrue due to correction of anti competition, anti export bias of protectionism. Increased levels of competition are believed to generate innovative activity and productivity gains across all sectors.

Goldar and Aggarwall (2005) using tariff and non-tariff barriers among the independent variables have found a significant pro-competitive effect of trade liberalization on price cost margins for Indian industries.

Hadad, de Melo and Horton (1996) using 3 digit industry data for the period 1984 to 1989 studied the impact of import penetration for Morocco and found that there was a negative association between PCM and imports. They found that a one point increase in import penetration would reduce PCM ratio by 0.200 points.

Foroutan (1996) studied the impact of trade liberalization on Turkey's 3 digit industries for the period 1976 to 1985 and found a week negative relationship between imports growth and price cost margins. He found that for privately owned

industries one point increase in import share would reduce PCM by 0.002. For public sector industries this relationship was found to be insignificant.

Tybout (1996) using time series industry data for the period 1979 to 86 for Chile found a positive correlation between import shares and price cost margins. He also concluded that when industry effects are controlled import shares and price cost margins show a negative association and a one point increase in import share reduces PCM by 0.093 points.

De Melo and Urata (1984) studied the relationship between PCM and trade liberalization for Chile for the years 1967 (before trade reforms) and 1979 (after trade reforms). They found a positive association between import share and PCM and a negative relationship between PCM and export shares. Their results showed that a one point increase in import share would increase PCM by 0.05 point and a one point increase in export share would reduce PCM by 0.34 point.

Import substitution, learning by doing, and economies of scale were found to be the main components of growth of large scale manufacturing in the earlier periods of industrialization in Pakistan. A large number of studies including that of Cheema (1978) and Kemal (1978) have pointed out that factor accumulation was the major contributor in industrial growth in Pakistan. Bain (1941) studied the influence of entry conditions and market concentration on market power. His model was based on static limit price theory. He tested the concentration profit hypothesis and derived the conclusions that large firms with high entry barriers generally earn high profits, there is a positive effect of concentration on profits (in general) and concentration allows collusion.

Most of the earlier studies on industrialization in Pakistan such as Lewis and Soligo (1965), White (1974), Sharwani (1976), Guisinger (1976), Amjad (1977) and Kemal (1978) concentrated on the study of structure profit relationship and the patterns of growth of large-scale industries. These earlier studies have shown that large scale manufacturing sector in Pakistan is highly concentrated and that profitability and concentration are positively correlated whereas concentration and

efficiency have a negative correlation. Moreover, concentration ratio has not changed significantly in Pakistan overtime.

White (1974) studied the concentration, origins of concentration and the consequences of industrial concentration in Pakistan. He found a positive relationship between profit rates, industrial concentration and import licensing. He also found a positive and significant relationship between tariffs and profits. White pointed out that barriers to entry were the major source of industrial concentration in Pakistan.

Sharwani (1976) investigated the existence of excessive profits for most concentrated industries in Pakistan for the period 1967-73. He studied the effect of concentration on the level of profits and capacity utilization and found that concentration ratios remained fairly stable and showed a small increase over the study period. Profits and concentration ratios were strongly correlated except for the year 1973.

Guisinger (1976) while exploring the patterns of industrial growth in Pakistan for the period 1950-70, found a high growth rate for the industries, which used agricultural inputs and used labor intensively. The main sources of industrial growth during the study period were identified as domestic demand, export expansion and import substitution.

Amjad (1977) studied the impact of concentration on profitability in the large-scale manufacturing sector in Pakistan for the period 1965 to 1970. He found that when Price Cost Margins were used as an indicator of profitability, concentration was an important factor in explaining the differences in profitability between different industries. His findings show that Price cost margins were positively and significantly related to capacity utilization in large scale manufacturing industries. Profitability however was not significantly related to capital output ratio. He also found a negative association between import penetration and price cost margins.

Cheema (1978) studied inter industry differentials in productivity levels for the period 1959-70. He used ratio method as well as production function method, for inter industry comparison of productivity. Cheema estimated trend growth rates based on value added and output. His results support the view that capital input has played

important role in industrial growth in Pakistan. Productivity growth was also impressive during the study period except for the paper industry for which a declining productivity rate was observed.

Kemal (1978) has pointed out that economies of scale and other entry barriers were responsible for high concentration ratios in Pakistan. He also pointed out that the choice of different measures of concentration may change the statistically significant results to statistically insignificant results. Kemal has found very high productivity growth rates from mid 1965 to mid 1975 but the growth rates vary across the industries. Using ratio analysis he found that productivity grew at a trend rate of 5% per annum during 1965-1975. His production function analysis also shows very high productivity growth rates during the same period.

3.4 HYPOTHESIS

Keeping in view the theory of industrial economics and the literature reviewed so far, the following hypothesis under S-C-P approach can be postulated to study the effects of trade and industry related reforms on the performance of agro-based industries in Pakistan for each time period.

Economic reforms and openness have a reducing effect on price cost margins.

Lowering of price cost margins indicates a reduction in monopoly power, which brings price closer to marginal cost and reduces the deadweight loss due to monopoly. There is almost a consensus among the economists that there exists a significant positive association between concentration ratios and price cost margins. High price cost margins are believed to exist due to monopoly power. If domestic policy reforms aim at curtailing monopoly power then there will be a negative effect of reforms on price cost margins. Similarly, trade orientation or openness is believed to broaden the market, increase competition and bring technological innovations; hence it too has a negative effect on price cost margins and a positive effect on industrial performance.

3.5 ECONOMETRIC SPECIFICATION

The methodology and analytical basis for this study has been drawn from the empirical literature focusing on trade liberalization and its impact on price cost margins in developing countries.

To test the postulated hypothesis following pooled regression model has been specified.

$$PCM_{it} = \alpha_0 + \beta_1 CR_{it} + \beta_2 COR_{it} + \beta_3 GRM_{it} + \beta_4 (X+M)_{it} + \varepsilon_{it} \quad \text{with } i = 1,\ldots., 11; \quad t = 1,\ldots.,T \qquad (3.1)$$

Where,

PCM = Price Cost Margin;

CR = Four firm Concentration Ratio;

α_0 = the constant term or the common intercept

COR = Industry Capital Output Ratio lagged by one period.

GRM = Growth Rate of Manufacturing;

(X+M) = Trade to GDP Ratio, and

ε = Random Error with zero mean and constant variance.

The dependent variable, PCM is a measure of return on sales and has been calculated from the CMI data following Amjad (1976), in the following manner;

PCM = (Gross value of output – Employment Cost – Industrial Cost – depreciation – interest – other overhead costs)/Gross Value of Output

The variable CR is the four firm concentration ratio and shows the share of the largest four firms in the total output of an industry. Higher concentration ratios imply higher degree of oligopoly power. It is now generally believed that price cost margins and market concentration are positively associated with each other. The variable COR is the ratio of rental cost of capital and the total value of output (p.K/p.Q) lagged by one time period. Since capital earns a normal profit under perfect competition, rates of return on sales like PCM will be larger more capital intensive the production techniques even in the absence of market power. The variable COR, therefore, controls for differences in price cost margins across industries that may arise due to

differences in capital intensity. Unemployment rate (UR) and Trade to GDP ratio are the control variables. Unemployment rate is used to capture the effect of domestic policy reforms on price cost margins whereas trade (X+M) to GDP ratio is used to measure the effect of openness on price cost margins in the agro-based industries in Pakistan.

3.6 ESTIMATION AND RESULTS

Time series data from Census of Manufacturing Industries of Pakistan at current prices were obtained and then converted into constant prices. GDP deflator[21] was used for conversion of current values into constant values Data on National Income was obtained from *Pakistan Economic Survey* (various issues) and *50 Years of Pakistan in Statistics (1947-97)*. Data on national income was converted to a single base (2004-05) using splicing method. Values of all variables therefore, are expressed in base year's prices.

Pooled data for eleven agro-based industries of three digits classification were taken from Census of Manufacturing Industries (CMI) and used for the analysis. Both fixed effects model and random effects model will be used for estimation and comparison of the results. Since latest CMI was conducted in the year 2005-06 and was published in the year 2008-09, therefore, the analysis will be carried out from 1970-71 to 2005-06. Decade wise analysis will be carried out keeping in view the major political and economic changes and policy shifts taking place in the country. Total time period thus has been divided into four sub-periods i.e. the Seventies, the eighties, the nineties and the post nineteen nineties. Major economic and political events taking place during each sub-period are briefly discussed in the following sub-sections.

3.6.1 The nationalization period: 1971-77

The decade of the seventies was an eventful decade in the history of Pakistan. It started with the separation of East Pakistan to become an independent state of Bangladesh. Pakistan Peoples Party took over the rule in Pakistan and introduced many structural and economic reforms. The most controversial of these were the

[21] Details on GDP deflator are provided in Annexure-I, Table-A1.1 to Table-A1.4.

nationalization policies towards large-scale industrial sector and the banking sector of the economy. The performance of the economy was not good during the seventies due to a number of internal and external factors. Loss of East Pakistan's market, adverse effects of oil price shocks of 1973 and 1979, adverse effects of nationalization policies, failure of land reforms, non realization of expected benefits of devaluation of Pakistani currency due to global recession, political riots and declaration of military rule in 1977 were some of the factors responsible for poor performance of the economy. Although GNP showed a respectable growth rate of 5% per annum, the growth rate of agricultural sector was around 2.3% per annum and the growth rate of manufacturing sector was a little less than 4% per annum. After the separation of East Pakistan in 1971, priorities changed towards investment in large scale industrial units through the public sector but the large scale manufacturing sector performed very sluggishly having a growth rate of only 3% per annum.

During 1971-77 almost all large scale agro-based manufacturing industries had positive price cost margins. Tobacco, Beverages and Paper and Paper products had high Price Cost Margins whereas Cotton Ginning Pressing and Bailing, Wearing Apparel and Wooden Furniture had relatively low Price Cost Margins. During this period the following industries had high concentration ratios (40% or above).

- Tobacco
- Wearing Apparel
- Leather and Leather Products
- Leather Footwear
- Wood and Cork Products
- Wooden Furniture
- Paper and Paper Products

On the other hand following industries had concentration ratios below 40%.

- Manufacturing of Foods
- Beverages
- Manufacturing of Textiles
- Ginning, Pressing and Bailing of Fiber

Table-3.6 shows pooled least square regression results obtained through fixed effects model with AR(1) term. Our results show that concentration ratio (CR) and trade to GDP ratio (TRADE) have expected signs but are statistically insignificant. Domestic reforms proxy variable (GRM) has an unexpected sign and shows an insignificant positive effect on price cost margins. High values of R^2 and F-statistics show the goodness of fit and significance of the model. Akaike info criterion and Schwarz criterion support model selection. The D-W statistics also shows the absence of autocorrelation.

Table-3.6

Pooled Fixed Effects Regression Results

(1971 to 1977)

Dependent Variable: PCM Method: Pooled Least Squares Cross-sections included: 11 Total pool (balanced) observations: 66				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.188	0.064	2.934	0.005
CR	0.039	0.091	0.432	0.667
COR_{-1}	-0.002	0.020	-0.126	0.900
GRM	0.206	0.172	1.200	0.235
TRADE	-0.119	0.149	-0.80	0.427
AR(1)	0.733	0.106	6.952	0.000
Cross-section fixed (dummy variables)				
R-squared	0.984	Mean dependent var		0.187
Adjusted R-squared	0.979	S.D. dependent var		0.141
S.E. of regression	0.020	Akaike info criterion		-4.742
Sum squared resid	0.021	Schwarz criterion		-4.211
Log likelihood	172.475	F-statistic		204.555
Durbin-Watson stat	1.972	Prob(F-statistic)		0.000

Source: Pooled EGLS, Fixed Effects regression results obtained from CMI data.

Table-3.7 shows the regression results obtained through pooled random effects model. The coefficients of concentration ratio (CR) and TRADE variables have expected signs. The coefficient of concentration ratio is statistically insignificant but the coefficient of trade variable is statistically significant. The coefficient of domestic reform proxy variable shows a significant positive association with price cost margins. The values of R^2, F-Statistics and D-W statistics, however, are found to be very low.

Table-3.7

Pooled Random Effects Regression Results

(1971 to 1977)

Dependent Variable: PCM Method: Pooled EGLS (Cross-section random effects) Cross-sections included: 11 Total pool (balanced) observations: 66 Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.303	0.063	4.809	0.000
CR	0.134	0.094	1.427	0.158
COR_{-1}	-0.032	0.026	-1.248	0.216
GRM	0.308	0.153	2.017	0.047
TRADE	-0.249	0.074	-3.340	0.001
Weighted Statistics				
			S.D.	Rho
Cross-section random			0.154	0.960
Idiosyncratic random			0.032	0.040
R-squared	0.234	Mean dependent var		0.015
Adjusted R-squared	0.191	S.D. dependent var		0.035
S.E. of regression	0.031	Sum squared resid		0.071
F-statistic	5.494	Durbin-Watson stat		0.601
Prob(F-statistic)	0.001			

Source: Pooled EGLS, Random Effects Regression results obtained from CMI data.

To choose between the fixed effects model and the random effects model we conducted the Hausman specification test with the following null and alternate hypotheses.

H_0: Individual effects are uncorrelated with other regressors.

H_1: There is correlation between individual effects and other regressors.

Table-3.8 shows the correlated random effects Hausman test results. The 95 percent critical value from the Chi-squared distribution with 4 degrees of freedom is 9.49 whereas test statistic provided by Hausman specification test is equal to zero. Since the table value is larger than the calculated value we reject H_0 and conclude that the fixed effects model is the better choice. Hence during 197-77, trades liberalization had a favorable effect but domestic reforms had no significant effect on S-C-P of agro-based industries.

Table-3.8

Correlated Random Effects-Hausman Test

(1971-77)

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000	4	1.00
* Cross-section test variance is invalid. Hausman statistic set to zero.			
Cross-section random effects test comparisons:			
Variable	Fixed	Random	Var(diff.)	Prob.
CR	-0.174	-0.134	0.002	0.366
COR_{-1}	-0.033	-0.032	0.000	0.783
GRM	0.304	0.308	0.000	0.712
TRADE	-0.254	-0.249	0.000	0.314

Source: Hausman Fixed/Random Effects test results obtained from CMI data.

3.6.2 Return to privatization: 1978-1990

The decade of 1980s is characterized by the reversal of the nationalization policies and the return of the private sector by the successive government of General Muhammad Zia-ul-Haq. Attempts were made to deregulate and liberalize the economy during this period. The elimination of exchange controls and linking of domestic interest rates with international ones led to a significant increase in foreign direct investment (FDI). During the eighties average growth rate of GDP was about 4% per annum with manufacturing growing at the rate of 5.9% per annum. Investment constituted 18.7% of the GDP and domestic savings fluctuated around 14.8%. The growth rate of agriculture was also good and was around 4% per annum during this period. Adoption of liberal import policy, rationalization of import tariffs and doing away with the investment licensing were some of the important reforms introduced in the eighties.

According to CMI data during 1980s the following agro-based industries had high concentration ratios. In these industries average market share of the largest four firms was found to be higher than 40%.

- Tobacco
- Wearing Apparel
- Leather Footwear
- Wood and Cork Products
- Wooden Furniture
- Paper and Paper Products

During the same period in the following industries average market share of the largest four firms was found to be less than 30%.

- Manufacturing of Foods
- Beverages
- Manufacturing of Textiles
- Ginning, Pressing and Bailing of Fiber

- Leather and Leather Products

Regression results obtained through pooled fixed effects model for 1978-90 are presented in Table-3.9. The results show that concentration ratio (CR) is positively with price cost margins. The coefficient of growth rate of manufacturing (GRM) has an unexpected sign but trade to GDP ratio (TRADE) has an expected signs. Both the coefficients of unemployment rate (GRM) and TRADE variables are statistically insignificant but the coefficient of concentration ratio (CR) is statistically significant.

Table-3.9

Pooled Fixed Effects Regression Results

(1978 to 1990)

Dependent Variable: PCM Method: Pooled Least Squares Cross-sections included: 11 Total pool (balanced) observations: 132				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.086	0.098	0.877	0.382
CR	0.421	0.080	5.242	0.000
COR_{-1}	0.113	0.056	2.011	0.046
GRM	0.110	0.176	0.626	0.532
TRADE	-0.187	0.285	-0.658	0.512
AR(1)	0.363	0.085	4.266	0.000
Cross-section fixed (dummy variables)				
R-squared	0.956	Mean dependent var		0.186
Adjusted R-squared	0.950	S.D. dependent var		0.193
S.E. of regression	0.043	Akaike info criterion		-3.327
Sum squared resid	0.218	Schwarz criterion		-2.978
Log likelihood	235.592	F-statistic		166.152
Durbin-Watson stat	2.092	Prob(F-statistic)		0.000

Source: Pooled Fixed Effects regression results obtained from CMI data.

High values of R^2 and F-statistics indicate that the overall significance of the model is good. Akaike info criterion and Schwarz criterion also support model specification. D-W statistics shows the absence of autocorrelation.

The results obtained through pooled EGLS Random Effects model are shown in Table-3.10. Concentration ratio as expected is positively and significantly correlated

Table-3.10

Pooled Random Effects Regression Results

(1978 to 1990)

Dependent Variable: PCM Method: Pooled EGLS (Cross-section random Effects) Total pool (balanced) observations: 143 Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.037	0.096	0.385	0.701
CR	0.342	0.063	5.454	0.000
COR_{-1}	0.068	0.044	1.557	0.121
GRM	0.230	0.178	1.291	0.199
TRADE	0.033	0.215	0.156	0.876
Effects Specification				
			S.D.	Rho
Cross-section random			0.208	0.951
Idiosyncratic random			0.047	0.048
Weighted Statistics				
R-squared	0.223	Mean dependent var		0.012
Adjusted R-squared	0.201	S.D. dependent var		0.052
S.E. of regression	0.047	Sum squared resid		0.303
F-statistic	9.928	Durbin-Watson stat		1.180
Prob(F-statistic)	0.000			

Source: Pooled EGLS Regression results obtained from CMI data.

to price cost margins (PCM). The coefficients of growth rate of manufacturing (GRM) and trade to GDP ratio have unexpected signs but are statistically insignificant.

To choose between the fixed effects model and random effects model we conducted the correlated Fixed/Random effects Hausman test. The results obtained through Hausman effects are presented in Table-3.11. On the basis of Hausman Fixed/Random effects test we conclude that the fixed effects model is the better choice.

Table-3.11

Correlated Random Effects-Hausman Test

(1978- 90)

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000	4	1.00
* Cross-section test variance is invalid. Hausman statistic set to zero.			
Cross-section random effects test comparisons:			
Variable	Fixed	Random	Var(diff.)	Prob.
CR	0.362	0.342	0.000	0.157
COR_{-1}	0.077	0.068	0.000	0.145
GRM	0.212	0.230	0.000	0.159
TRADE	0.015	0.034	0.000	0.167

Source: Hausman Fixed/Random Effects Specification test results obtained from CMI data.

3.6.3 Structural reforms and openness: 1991-2006

Privatization, deregulation and liberalization policies continued during this period. In the early years of 1990s the process of reforms with its main focus on liberalization and privatization continued with full vigor. The government of Prime Minister Nawaz Sharif (1990-93) introduced a program of privatization, deregulation and liberalization that focused on achieving sound economic development.

During this period many structural and macroeconomic reforms were implemented successfully but due to a number of adverse internal and external factors the economy experienced very low growth rates. Widespread rains in 1992 followed by flash floods, failure of cotton crop and political uncertainty in the country caused heavy loss to the economy. The East Asian economic and financial crises and imposition of economic sanctions due to carrying out nuclear tests in May 1998 created difficulties for Pakistan economy. The overall performance of the economy in the nineties was not so good and a large fiscal deficit emerged as a source of macroeconomic instability. The average growth rate of the economy during 1990s was about 3.6% per annum.

During 1990s the following agro-based industries had high four firm concentration ratios (above 30%).

- Tobacco
- Leather Footwear
- Wood and Cork Products
- Wooden Furniture

The following industries had low four firms concentration ratios (below 30%) during the same period.

- Manufacture of Foods
- Beverages
- Textiles
- Wearing Apparel
- Leather and Leather Products
- Ginning, Pressing and Bailing of Fibers
- Paper and Paper Products

To encounter the large fiscal and current account deficits developed in 1990s, the government introduced a number of economic stabilization and structural reforms in the year 2001-02. As a result of these reforms higher than the targeted growth rates in real GDP were witnessed during this period.

Liberalization of foreign exchange regime and macroeconomic stability helped boosting the investors' confidence. Sharp increase in stock market performance and continued accumulation of foreign exchange reserves was observed. Workers' remittances and exports and imports also registered a considerable increase during 2000-04. Pakistan's economy attained an average growth rate of 7.5% during the first four years of the 21st century. The key drivers of this rapid growth were the large scale manufacturing and services sector. Large scale manufacturing sector registered an increase of 12.5% against the target of 10.2 percent during the FY 2003-04.

In the post 1990s period the following industries had high four firm concentration ratios (above 25 percent).

- Tobacco
- Leather Footwear
- Wooden Furniture

The following industries were found to have four firm concentration ratios below twenty five percent during the same period of time.

- Manufacture of Foods
- Beverages
- Textiles
- Wearing Apparel
- Leather and Leather Products
- Wood and Cork Products
- Ginning, Pressing and Bailing of Fibers
- Paper and Paper Products

Regression results obtained through pooled least squares fixed effects model for the period 1991-2006 are shown in Table-3.12. The estimated coefficients of concentration ratio (CR) and trade to GDP ratio (TRADE) have expected signs but proxy variable for domestic reforms (GRM) has an un expected sign and shows an insignificant positive association between the growth rate of manufacturing and price cost margins.

Table-3.12

Pooled Fixed Effects Regression Results

(1991 to 2006)

Dependent Variable: PCM Method: Pooled Least Squares Cross-sections included: 11 Total pool (balanced) observations: 132				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.067	0.142	-0.474	0.636
CR	0.370	0.100	3.743	0.000
COR_{-1}	0.024	0.010	2.490	0.014
GRM	0.055	0.030	1.824	0.070
TRADE	-0.040	0.050	-0.791	0.430
AR(1)	1.037	0.029	36.240	0.000
Cross-section fixed (dummy variables)				
R-squared	0.993	Mean dependent var		0.193
Adjusted R-squared	0.992	S.D. dependent var		0.180
S.E. of regression	0.016	Akaike info criterion		-5.320
Sum squared resid	0.039	Schwarz criterion		-5.019
Log likelihood	454.917	F-statistic		1348.455
Durbin-Watson stat	1.823	Prob(F-statistic)		0.000

Source: Pooled Fixed Effects regression results obtained from CMI data.

Table-3.13 shows the regression results obtained through pooled EGLS random effects model. Both the coefficients of concentration ratio (CR) and trade to GDP ratio (TRADE) have expected signs and are statistically significant. The coefficient of growth rate of manufacturing (GRM) has an unexpected sign and shows a significant positive association with price cost margins.

Table-3.13

Pooled Random Effects Regression Results

(1991 to 2006)

Dependent Variable: PCM Method: Pooled EGLS (Cross-section random Effects) Total pool (balanced) observations: 110				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.072	0.071	1.013	0.312
CR	0.706	0.128	5.516	0.000
COR_{-1}	0.069	0.031	2.239	0.026
GRM	0.637	0.086	7.401	0.000
TRADE	-0.153	0.109	-1.408	0.161
Effects Specification				
			S.D.	Rho
Cross-section random			0.192	0.949
Idiosyncratic random			0.044	0.051
Weighted Statistics				
R-squared	0.390	Mean dependent var		0.011
Adjusted R-squared	0.380	S.D. dependent var		0.056
S.E. of regression	0.044	Sum squared resid		0.337
F-statistic	27.301	Durbin-Watson stat		0.470
Prob(F-statistic)	0.000			

Source: Pooled EGLS Regression results obtained from CMI data.

To choose between the fixed effects model and the random effects model we have conducted the correlated random effects Hausman test. The results of Hausman test are presented in Table-3.14. Since the calculated value of the test statistics (1.135) is smaller than the table value of the test statistics at 4 degrees of freedom (7.8), we reject the hypothesis of no correlation between the individual effects and other regressors and conclude that the fixed effects model is the better choice.

Table-3.14

Correlated Random Effects-Hausman Test

(1991- 2006)

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.135	4	0.889
* Cross-section test variance is invalid. Hausman statistic set to zero.			
Cross-section random effects test comparisons:			
Variable	Fixed	Random	Var(diff.)	Prob.
CR	0.746	0.706	0.002	0.346
COR_{-1}	0.070	0.069	0.000	0.658
UR	0.632	0.637	0.000	0.353
TRADE	-0.154	-0.153	0.000	0.628

Source: Hausman Fixed/Random Effects Specification test results obtained from CMI data.

3.7 CONCLUDING REMARKS

Data on eleven agro-based industries of three digit industrial classification were taken from the census of manufacturing industries of Pakistan for the period 1971-72 to 2005-06. Pooled cross-sectional and time series data were used for studying the effects of domestic economic reforms and openness on the structure-conduct-performance of these industries. Agro-based industries have an important place in the large-scale manufacturing sector in Pakistan. These industries contribute more than 50% of total output in the large-scale manufacturing sector. These industries consume domestically produced raw materials and are a major source of employment and foreign exchange earnings. To find the effects of policy reforms and openness on these industries, decade-wise study was carried out keeping in view the major policy shifts and economic reforms introduced in the country from time to time. The results were obtained through pooled least squares fixed effects method as well as pooled estimated generalized least squares random effects method.

Our analysis shows that all agro-based industries have positive price cost margins and no discernable change has occurred in price cost margins overtime. Under WTO regime market based and open trade and investment policies have been introduced. Effective rates of protection have also declined and the share of exports and imports in GDP has increased. But despite all these efforts no visible change has occurred in S-C-P of agro-based industries. These industries still have positive price cost margins and there are frequent complaints of collusion and cartelization especially in the food manufacturing industries like sugar and edible oil industries.

During 1970s nationalization policies were adopted and the role of public sector was increased but at the same time private sector became shy due to nationalization of industrial and banking sectors. During this period domestic reforms did not have a desirable effect but trade liberalization policies had an insignificant desirable effect on structure conduct and performance of agro-based industries during 1970s.

During 1980s nationalization policies were reversed and privatization and deregulation policies were adopted. Our analysis shows that domestic reforms and trade liberalization policies had some desirable effect on price cost margins in agro-based industries during this period.

In the 1990s trade and tariff reforms, deregulation and privatization reforms and financial sector reforms were pursued vigorously. These domestic reforms had no significant effect on price cost margins in agro-based industries however the degree of openness had a favorable effect on price cost margins. This is perhaps due to the fact that agro-based industries are still operating under imperfect market conditions and are able to maintain high price cost margins. Furthermore, trade to GDP ratio is still very low in Pakistan. Export to GDP ratio remained between 13 to 17 percent and imports to GDP ratio varied between 15 to 22 percent during this period. All this indicates that more effort is needed to reform the trade and investment regimes in the country.

CHAPTER 4

EFFICIENCY ANALYSIS OF AGRO-BASED INDUSTRIES: PRODUCTION FUNCTION APPROACH

4.1 INTRODUCTION

This chapter deals with analysis of efficiency of agro-based industries in Pakistan. Our analysis in chapter 3 shows that all agro-based industries have positive price cost margins. These price cost margins have declined over time but the change has been very slow. The purpose of this study is to explore whether market concentration alone is responsible for high price cost margins or there are other internal and external factors involved. The basic difficulty in establishing the impact of trade on standards of living is that the countries that adopt liberal trade policies may also adopt free market domestic policies and stable monetary and fiscal policies. These policies also affect income and are likely to be correlated with factors that are omitted from the income equation.[22]

In this chapter we will carry out efficiency analysis using stochastic frontier production function. In developing countries like Pakistan existence of inefficiency is believed to be an important source of high price cost margins. Removal of inefficiency can lead to improvements in welfare gains because firms strive to adopt new technology and reorganize their operations to become more competitive at the world market. The study of the effects of increased exposure on industrial efficiency needs more empirical investigation but most of the researchers believe that openness raises industrial efficiency. In section 4.2 some empirical evidence on effects of trade and openness has been reviewed. Econometric specifications are presented in section 4.3. Data and characteristics of data have been discussed in section 4.4. The estimation and results are presented in section 4.5 and finally some concluding remarks are given in section 4.6.

[22] See, for example, William Easterly (1993), Ann Harrison (1991) and Delong and Summers (1991).

4.2 EMPIRICAL EVIDENCE

Although the relationship between trade and growth has been studied extensively yet efforts to measure gains from trade at micro level have been inconclusive. Especially in developing countries there is a lack of conclusive evidence on the linkages between trade and productivity growth. Only a few studies link trade reforms with increased competition and their effects on productivity and efficiency. There is, however, now plant level evidence confirming a positive relationship between trade reforms and efficiency for some countries.[23] Recent overviews on the links between trade and industrial policy reforms and productivity growth, however, suggest that the debate is still unresolved.[24]

Kim (2000) while investigating the dynamic impact of trade liberalization on productivity and scale efficiency in South Korean industries found that trade liberalization had a positive impact on productivity and scale efficiency. He estimated the effects of trade reforms on 3 digit industries of South Korea during the period 1966 to 1988 and found that trade reforms had resulted in 2.0 percentage point increase in TFP.

Dijkstra (2000) pointed out that trade liberalization leads to an increase in imports and exports. The growth of manufactured exports is an indicator of dynamic efficiency, which is very important for overall growth of the economy. Trade expansion is important because it affects the efficiency in industries, which has implications for employment in the manufacturing sector.

Urata and Yokota (1994) estimated the effects of trade related reforms on TFP of 2 digit industries of Thailand for 1976-82 and 1982-88. They obtained a strong evidence of an increase in TFP due to trade reforms.

Krishana and Mitra (1998) using firm level data for India obtained a weaker evidence of increase in the rate of total factor productivity growth due to trade reforms during 1986 to 1993.

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[23] See, for example, Tybout, J. et al. (1991).
[24] See, for example, Bhagwati (1988) and Tybout (1992).

Tybout and Westbrook (1995) using plant level data for Mexico for the period 1984 to 1990 found that openness was associated with relatively small-scale efficiency gains. Improvements in productivity and reductions in average cost were largest in open sectors where market shares shifted towards more productive plants.

Edwards (1993) while studying the effects of openness and trade on growth in developing countries pointed out that trade generates technological progress. Countries with high degree of openness absorb technology more rapidly than with lower degree of openness.

Frankell and Romer (1999) studied the effects of trade on GDP growth. They used data for sixty three countries and found that trade had a positive effect on GDP growth. Their results show that a 1% increase in trade raises income by ½%. They however pointed out that the role of geographical factors is very important in international trade. The characteristics like countries' size of the distance from one another, whether they share a common border and whether they are land locked are the important determinants of countries' overall trade.

Cornwell, Schmidt and Sickles (1990) using panel data and instrumental variable technique estimated the productivity of U.S airline industry. They used stochastic frontier production function approach and derived the results which are quite intuitive and reasonable. Their study shows that the rate of productivity growth was 1.5% and returns to scale were not significantly different from unity for U.S air industry.

De Long and Summers (1991) using cross country data over 1960-1985 found that investment in machinery and equipment has a stronger association with growth than with any of the other components of investment. They also found that the social return to equipment investment is higher than the private return in well functioning market economies.

Pack (1993) in his study on productivity and industrial development in Sub-Saharan Africa argues that if trade induces efficiency then the gains for the country should be large.

Young (1995) using the production function approach for East Asian countries found that over the 1966–90 period most of the growth was due to rapid growth of factor inputs and there was nothing abnormal about the growth of total factor productivity.

Rodric (1995a) pointed out that a large body of literature exists on the impact of growth of international trade on standards of living but despite all these efforts there has been a little persuasive evidence on the effects of trade on income. Cross-country regressions of per capita income on the ratio of exports or imports to GDP or any such other variables have found a moderate positive relationship[25].

Edwards (1998) using panel data for 93 countries studied the relationship between openness and total factor productivity growth. He used different measures of the degree of openness to measure the effect of openness on total factor productivity growth. His study shows that more open countries have experienced faster productivity growth.

Romer (1989) in his model of endogenous growth pointed out that more open trade regimes allows countries to specialize in the production of a subset of intermediate inputs in which they have a comparative advantage. Under freer trade, then, a large number of inputs are available at a lower cost and as a result there is a higher equilibrium growth. Export expansion due to reduction in production costs thus leads to reduction in x-inefficiency.

Wizarat (1988) while comparing the results obtained by OLS method and the Simultaneous equation method for large scale manufacturing sector in Pakistan for 1955-56 to 1980-81 pointed out that the magnitude of coefficients changes when simultaneous model is used. The magnitude of capital coefficient changed from 0.552 to 0.039, the magnitude of labor coefficient changed from 0.457 to 0.846 and the coefficient of time trend changed from 0.043 to 0.0039. The single equation estimates give constant returns to scale while simultaneous model give increasing returns to scale. On the basis of simultaneous equation estimation Wizarat has found that the

[25] See, for example, Fischer (1991,1993),Dollar (1992), Edwards (1993), Rodric (1995b), and Harison (1996), among others.

contribution to large scale manufacturing growth by capital input was 36.84 percent, by labor input 34.13 percent, by technological change 25.79 percent and by economies of scale 18.39 percent in 1980-81.

Zahid, et al. (1992) estimated technical change, efficiency and capital labor substitution for the period 1960-86 for large-scale manufacturing sector of Pakistan. They used CES production function for the estimation of various parameters and divided the large scale manufacturing industries into consumer goods industries, intermediate goods industries and capital goods industries. They found that industry in Pakistan was capital intensive in general and the elasticity of substitution varied between 0 and 1. Most of the industries had a very low elasticity of substitution. The only exception was the pharmaceutical industry for which elasticity of substitution was greater than 1. Their study also shows that capital to labor ratio was fairly stable during the short-run however in the long run there is a possibility of replacement of capital with labor.

Mehmood and Siddiqui (2000) studied the state of technology and productivity in Pakistan's manufacturing industries in Pakistan. They computed partial and total factor productivities using production function approach. Their study indicates that total factor productivity growth was an important contributor to economic growth during 1960s.The low growth of economy during the 1970s was due to declining productivity. During 1980s total factor productivity increased at an average rate of about 5% per annum but in the 1990s it declined and became negative during 1995-1997. Mehmood and Siddiqui showed that capital (both physical and human), openness and government policies are crucial determinants of total factor productivity growth in the large-scale manufacturing sector of Pakistan.

Wizarat (2002) made an attempt to identify the sources of growth for the large-scale manufacturing sector in Pakistan for the period 1955-56 to 1990-91. Her findings reveal that 88.16 per cent contribution was made by capital input, 39.82 percent contribution by labor and 42.86 per cent by the economies of scale. The contribution by technological change was -27.26 percent. Her analysis supports the idea by the earlier Researchers that the major contribution to growth in LDCs is due to the use of inputs and not due to technological change.

4.3 THE HYPOTHESIS

In the light of the theory of industrial economics and literature reviewed on industrial efficiency we can postulate the following hypothesis with reference to agro-based industries in Pakistan.

Absence of competition promotes industrial inefficiency and discourages technological change

This implies that increased competition in the domestic market through reforms supplemented by openness will improve the efficiency and bring technological change in agro-based industries.

4.4 RESEARCH DESIGN

To study the efficiency of agro-based industries data over the period 1971-06 was obtained from census of manufacturing industries conducted by the Federal Bureau of Statistics. There are 11 industries of three digit industrial classification grouped together as agro-based industries. The data set includes output, employment cost, material cost and capital stock all expressed in 2004-05 prices. Following Stevenson (1980), Pit and Lee (1981), Jondrow et al. (1982) and Schmidt and Sickles (1984). Stochastic Frontier Production Functions[26] have been used to estimate the efficiency of agro-based industries. The Generalized Frontier Production Function can be specified as;

$$Y_{it} = f(X_{it}, \beta)e^{v_{it}}e^{\mu_{it}} \qquad (4.1)$$

In the log-linear form the model can be written as;

$$\ln Y_{it} = \ln f(X_{it}, \beta) + v_{it} - \mu_{it} \qquad (4.2)$$

Where, Y_{it} denotes the appropriate function of the production for the i^{th} firm in time period t, X_{it} is $(1\times k)$ vector of inputs associated with i^{th} firm in time period t, β is $(k\times 1)$ vector of the coefficients for the associated independent variables in the production

[26] Stochastic Frontier Production Functions have been used in the study of firm level technical efficiency since they were first independently proposed by Aigner et al. (1977) and Meeusen and Van den Broek (1977).

function. The error term v_{it} is distributed as $N(0, \sigma^2)$ representing uncontrolled random shock in production and μ_{it} is also distributed as $N(0, \sigma^2)$, where $\mu_{it} \geq 0$ and represents inefficiency. One advantage of the frontier production functions is that they allow the decomposition of productivity change into technical change and change in efficiency. Technical change shows the movement of the firm's actual output to its maximum possible level for given technology. Improvements in efficiency, on the other hand, occur due to the accumulation of knowledge in the learning by doing process, diffusion of new technologies and improved managerial practices.

To carry out efficiency analysis an underlying production function has to be fitted to the available data. For this study both Cobb-Douglas production function and Translog production function[27] will be used under time invariant and time varying propositions. The Cobb-Douglas production function would be of the following form.

$$\ln(Y_{it}) = \beta_0 + \beta_k \ln(K_{it}) + \beta_l \ln(L_{it}) + \beta_m \ln(M_{it}) + \sum_t \lambda_t D_t + (v_{it} - \mu_{it})$$

$$i = 1, \ldots\ldots\ldots,11 \quad t = 1, \ldots\ldots\ldots..,10 \text{ (except 2001-06)} \qquad (4.3)$$

Where,

Y = value of output produced annually,

K = value of fixed assets at the end of the year,

L = employment cost during the year,

M = material cost during the year,

D = time dummy having value of one for the t^{th} time period and zero otherwise.

In this specification the dummy D_t is introduced to capture pure technical change in line with the general index approach of Baltagi and Griffin (1988). The change in λ_t between successive periods becomes a measure rate of technical change and can be written as:

$$TC_{t,\, t+1} = \lambda_{t+1} - \lambda_t \qquad (4.4)$$

[27] Cobb-Douglas production is log linear and pre assumes a unitary elasticity of substitution whereas Translog production function is more flexible and does not impose any restriction on elasticity of substitution.

The stochastic form of translog production function in a panel context is given as;

$$\ln(Y_{it}) = \beta_0 + \beta_k \ln(K_{it}) + \beta_l \ln(L_{it}) + \beta_m \ln(M_{it}) + \beta_{kl} \ln(K_{it})\ln(L_{it}) + \beta_{km} \ln(K_{it})\ln(M_{it}) + \beta_{lm} \ln(L_{it})\ln(M_{it}) + \left(\frac{1}{2}\right)\{\beta_{kk} \ln(K_{it})^2 + \beta_{ll} \ln(L_{it})^2 + \beta_{mm} \ln(M_{it})^2\} + \sum_t \lambda_t D_t + (v_{it} - \mu_{it}) \quad (4.5)$$

Technical efficiency (TE) of the i^{th} industry at time t in the context of a stochastic frontier production function is given by the following expression.

$$TE_{it} = \frac{Y_{it}}{\exp(f(X_{it};\beta))} = \exp(-\mu_{it}) \quad (4.6)$$

This measure of technical efficiency takes a value between zero and one. It measures the output of the i^{th} industry relative to the output that could be produced by a fully efficient firm using the same input vector[28].

4.5 DATA AND DATA CHARACTERISTICS

The data for efficiency analysis has been taken from the Census of Manufacturing Industries (CMI) conducted by the Federal Bureau of Statistics, government of Pakistan. The data set includes value of output, employment cost, industrial cost and the value of fixed assets all expressed at constant factor cost of 2004-05. The Value of output (Y) consists of the value of finished products and by-products, receipts for work done for others, value of sales of semi-finished products and by-products, value of sales of goods purchased for resale and the value of wastes and used goods. Valuation is made at ex-factory prices that include indirect taxes and exclude transport cost out side the factory gate. Employment cost (L) includes the wages and salaries and other cash and non-cash benefits paid to the workers. Industrial cost (M) includes the cost of raw materials, fuels and electricity consumed, payments for repair and maintenance and payments for work done on establishment's materials. The value of capital stock (K) consists of the value of plant and machinery and other fixed assets which are expected to have a productive life of more than one year and are used for manufacturing activity. The value of capital stock includes the value of fixed assets at the beginning of the year plus additions to the

[28] Coelli et al. (2005), *An Introduction to Efficiency and Productivity Analysis*, Second Edition, P. 244.

fixed assets out of own production less decline in the current value of the stock of capital.

4.5.1 Panel data

Stochastic frontier analysis can be used to measure both technical change and efficiency change if panel data are available[29]. Panel data sets combine time series and cross sections to provide rich sources of information. The availability of panel data helps in separating technical change from inefficiency without making strong distributional assumptions on each error component of Equation-4.3 and Equation-4.5.

4.5.2 Summary statistics

The main characteristics of the major variables used for the study purposes are given below in Table-4.1 to Table-4.3. These tables are based on Appendix-II and all the values are expressed in constant prices of base period 2004-05. All the variables show large variations for each time period as is evident from the large standard errors.

Table-4.1

Summary Statistics

(1971- 77)

Variable	Minimum (Rs. billion)	Maximum (Rs. billion)	Average (Rs. billion)	S.D.
Value of Output (Y)	2.59	540.90	125.60	190.12
Capital Cost (K)	0.952	218.91	36.41	66.02
Labor Cost (L)	0.44	76.23	10.30	21.64
Material Cost (M)	1.32	333.77	78.77	121.07

Source: Appendix-II, Table A-2.1.1 to Table A-2 .1.11.

[29] Greene, W. H. (2005), Op. cit.

Table-4.2

Summary Statistics

(1978- 90)

Variable	Minimum (Rs. Million)	Maximum (Rs. Million)	Average (Rs. Million)	S.D.
Value of Output (Y)	11.10	2071.70	530.29	737.88
Capital Cost (K)	3.76	852.88	139.11	260.56
Labor Cost (L)	1.5	197.88	33.42	58.45
Material Cost (M)	7.16	1488.03	357.64	531.28

Source: Appendix-II, Table A-2.2.1 to Table A-2.2.11.

Table-4.3

Summary Statistics

(1991- 2006)

Variable	Minimum (Rs. Million)	Maximum (Rs. Million)	Average (Rs. Million)	S.D.
Value of Output (Y)	28.38	7174.68	1432.22	2218.87
Capital Cost (K)	6.59	3543.50	493.28	1019.84
Labor Cost (L)	1.71	458.53	72.64	130.58
Material Cost (M)	20.83	5055.94	986.26	1589.32

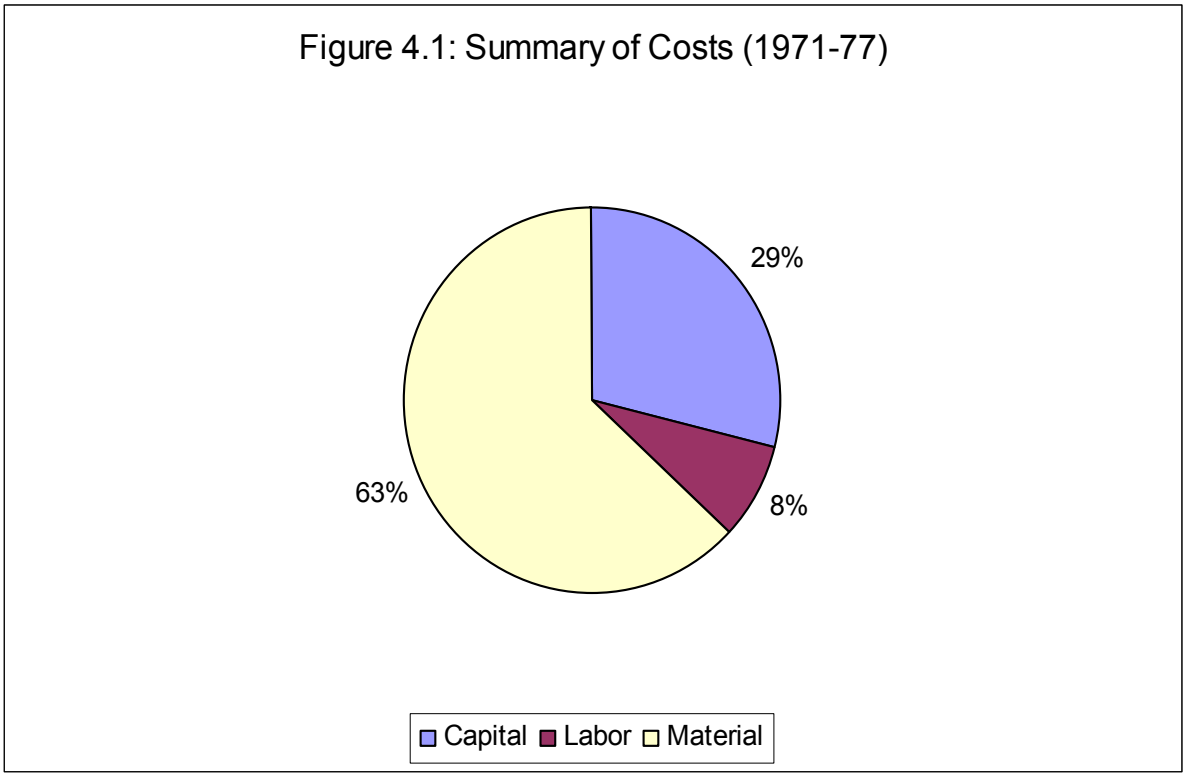
Source: Appendix-II, Table A-2.3.1 to Table A-2.3.11

4.5.3 Summary of Costs and average value of output

Summary of capital, labor and material costs at constant prices of 2004-05 for different time periods is shown in Figure-4.1 to Figure-4.3. It can be seen that the major cost component is the material cost including fuel and electricity charges. The second largest component is the capital cost. The share of labor cost in total cost is

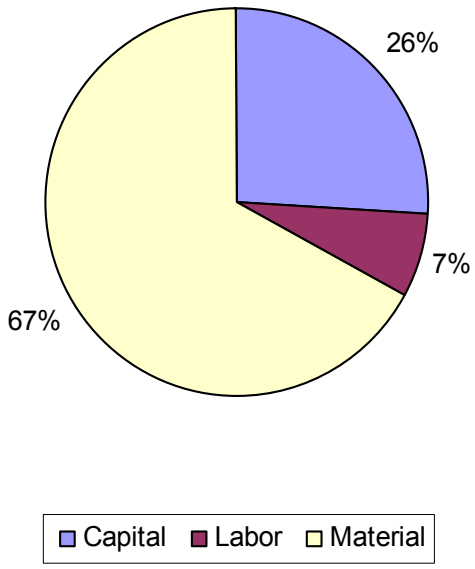
the smallest one. During 1971-77 the share of capital was 29%, labor cost was 8% and material cost was 63%. During 1978-90 the share of capital was 26%, that of labor was 7% and the share of material cost was 67%. During 1991-2006 the share of capital was 34%, labor cost was up to 6% and the material cost was about 60%. Over the time the share of capital has increased whereas the share of labor cost has declined. This shows that either capital has been substituted for labor or the increase in interest rate has been higher as compared to increase in wage rate.

Figure 4.1: Summary of Costs (1971-77)



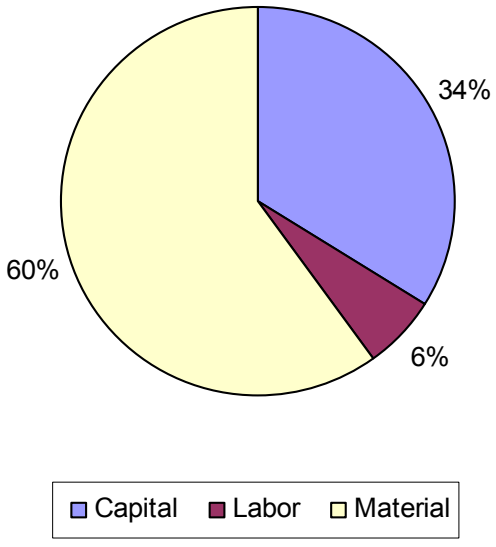
Source: Based on data given in Appendix-II, Table A-2.1.1 to Table A-2.1.11.

Figure 4.2: Summary of Costs (1978-90)



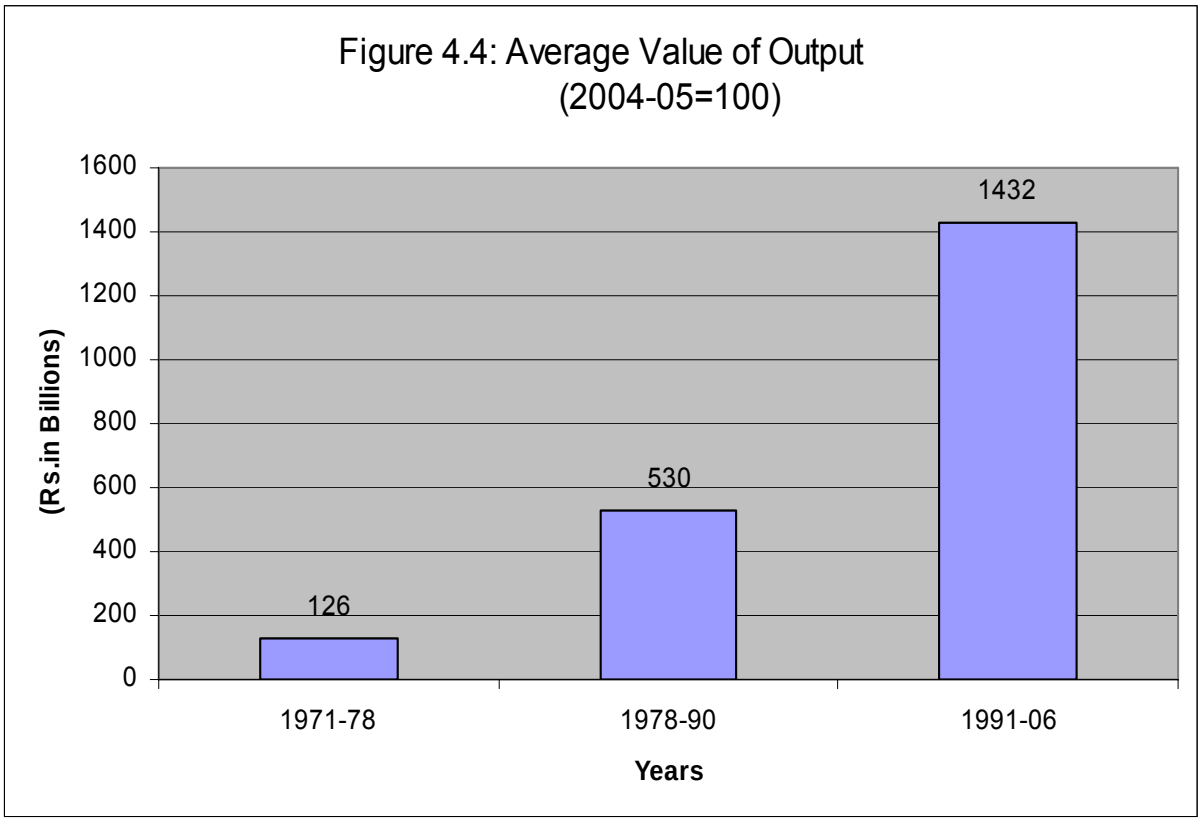
Source: Based on data given in Appendix-II, Table A-2.1.1 to Table A-2.1.11.

Figure 4.3: Summary of Costs (1991-2006)



Source: Based on data given in Appendix-II, Table A-2.1.1 to Table A-2.1.11.

Figure-4.4 shows the average Value of output of all the agro-based industries at constant prices of 2004-05. The average value of output has increased from Rs.125.60 billion in 1970-77 to Rs.1432.22 billion in 1991-2006.



Source: Based on data given in Appendix-II.

4.5.4 Correlation analysis

As a part of data analysis it is useful to investigate the nature of correlation between inputs and output.Table-4.4 to Table-4.6 display the nature of correlation between capital, labor and material inputs and output of the agro-based industries for different time periods of the study.

Table-4.4

Correlation between Inputs and Output
All Agro-based Industries
(1971-77)

	Capital	Labor	Material	Output
Capital	1.000			
Labor	0.942	1.000		
Material	0.868	0.881	1.000	
Output	0.823	0.887	0.945	1.000

Source: Author's own Calculations based on Appendix-II.

Table-4.5

Correlation between Inputs and Output
All Agro-based Industries
(1978-90)

	Capital	Labor	Material	Output
Capital	1.000			
Labor	0.944	1.000		
Material	0.862	0.910	1.000	
Output	0.939	0.903	0.960	1.000

Source: Author's own Calculations based on Appendix-II.

Table-4.6

Correlation between Inputs and Output
All Agro-based Industries
(1991-2006)

	Capital	Labor	Material	Output
Capital	1.000			
Labor	0.925	1.000		
Material	0.861	0.887	1.000	
Output	0.913	0.909	0.956	1.000

Source: Author's own Calculations based on Appendix-II.

The correlation analysis shows that all the inputs are highly correlated with output for all the time periods from 1971-77 to 1991-06.

4.6 ESTIMATION AND RESULTS

For the estimation of technical efficiency and technical change we will use two basic models, which have already been discussed in Section-2.5.2 and Section-2.5.3. One of these models takes inefficiency as time-invariant while the other treats inefficiency as time varying. Results derived from two different models will be helpful for comparison and analysis. The statistical package *StataSE 9* has been used for estimation of inefficiency in the time-invariant and time-varying inefficiency settings. For the estimation of stochastic frontier production functions, using longitudinal data, *Stata* is one of the most suitable statistical packages for its simplicity and easy data handling. However, other packages like Frontier, SHAZAM and STATPRO etc. can also be used for estimation of Stochastic Frontier production functions.

Maximum likelihood estimation (ML) is popular in empirical work because ML estimators have several desirable large-sample (asymptotic) properties. Specially the ML estimators are consistent and asymptotically normally distributed (CAN). Maximum likelihood estimation can be used with out making any distinction between linear or non linear models. Log likelihood ratio (LR), Wald (W) and Lagrange multiplier (LM) tests are justified for hypothesis testing when the sample size is large. Test statistic associated with each of these tests follows the chi-square distribution and gives identical answers. Most of the Statistical packages available for regression analysis use ML estimation for large-sample models and provide asymptotic test statistics for hypothesis testing.

Table 4.7 shows the regression results obtained from the estimation of Cobb-Douglas production in time-invariant context for the period 1971-77. Output elasticities of capital, labor and material inputs are 0.141, 0.805 and 0.101 respectively. The sum of output elasticities is 1.05 and shows the prevalence of constant returns to scale. Estimated value of inefficiency parameter (μ) is 0.639 and indicates presence of inefficiency. All the coefficients except that of time and inefficiency parameter are significant at 5 percent level of significance (critical value of $Z_{0.95}$ is 1.645).

Table-4.7

Time-invariant Cobb-Douglas Production Function

(1971- 77)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min			7
Time variable			Year	Obs per group avg			7
Log likelihood			47.486	Obs per group max			7
Number of obs			77	Wald chi^2 (4)			897.21
Number of groups			11	Prob>chi^2			0.000
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
ln(K)	β_k	0.141	0.048	2.90	0.004	0.046	0.236
ln(L)	β_l	0.805	0.056	14.76	0.000	0.724	0.946
ln(M)	β_m	0.101	0.041	2.47	0.014	0.021	0.181
Constant	β_0	2.932	0.288	10.18	0.000	2.368	3.497
Time	t	0.003	0.006	0.51	0.608	-0.008	0.014
Mu	μ	0.639	1.898	0.50	0.618	-1.872	3.149

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Table-4.8 shows the regression results obtained through time-varying inefficiency decay model for the period 1971-77 for Cobb-Douglas production function. The results are similar to those obtained under time-invariant setting. Estimated output elasticities of capital labor and material inputs are 0.154, 0.839 and 0.104 respectively. The sum of output elasticities is approximately equal to unity and indicates the presence of constant returns to scale. The value of inefficiency parameter is 0.657 indicating the presence of inefficiency in agro-based industries. All the estimated coefficients except that of inefficiency parameters (μ, η) and time variable are statistically significant at 5% level of significance. The Wald statistic and Log likelihood ratio also indicate that there is a strong association between dependent variables and the explanatory variables.

Table-4.8

Time-varying Cobb-Douglas Production Function

(1971- 77)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min		7	
Time variable			Year	Obs per group avg		7	
Log likelihood			47.675	Obs per group max		7	
Number of obs			77	Wald $chi^2(4)$		675.19	
Number of groups			11	Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	0.154	0.052	2.93	0.003	0.051	0.257
ln(L)	β_l	0.839	0.056	14.90	0.000	0.729	0.949
ln(M)	β_m	0.104	0.041	2.55	0.011	0.024	0.184
Constant	β_0	2.768	0.396	6.98	0.000	1.990	3.545
Time	t	0.008	0.011	0.79	0.427	-0.012	0.029
Mu	μ	0.657	1.267	0.52	0.604	-1.827	0.029
Eta	η	-0.004	0.006	-0.61	0.543	-0.016	0.009

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Regression results based on Translog production function in time-invariant settings are presented in Table-4.9. Output elasticities of capital, labor and material inputs are -0.543, 0.737 and 0.407 respectively and are statistically significant. The sum of output elasticities is 0.6 and shows decreasing returns to scale. The coefficient of inefficiency parameter (μ) has a value of 0.99 but is statistically insignificant because the estimated value of Z statistic (0.08) is less than the table value ($Z_{0.95}$ = 1.645).

Table 4-9

Time-invariant Translog Production Function

(1971- 77)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable		Industry		Obs per group min		7	
Time variable		Year		Obs per group avg		7	
Log likelihood		88.047		Obs per group max		7	
Number of obs		77		Wald chi^2 (10)		2968.72	
Number of groups		11		Prob>chi^2 0.000			
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	-0.543	0.256	-2.12	0.034	-1.044	0.042
ln(L)	β_l	0.737	0.203	3.64	0.000	0.340	1.134
ln(M)	β_m	0.407	0.169	2.41	0.016	0.075	0.738
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.242	0.509	4.76	0.000	0.142	0.342
$(\frac{1}{2})\ln(L^2)$	β_{ll}	0.359	0.133	2.70	0.007	0.098	0.620
$(\frac{1}{2})\ln(M^2)$	β_{mm}	0.168	0.052	3.21	0.001	0.066	0.271
$\ln(K)\times\ln(L)$	β_{kl}	-0.112	0.556	-2.02	0.043	-0.221	-0.003
$\ln(K)\times\ln(M)$	β_{km}	-0.043	0.035	-1.23	0.219	-0.111	0.025
$\ln(L)\times\ln(M)$	β_{lm}	-0.375	0.687	-2.69	0.007	-0.319	-0.050
Constant	β_0	3.501	0.969	3.61	0.000	1.602	5.401
Time	t	0.004	0.004	0.92	0.356	0.004	0.012
Mu	μ	0.990	1.666	0.08	0.936	-3.131	3.399

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

In case of Translog Production Function, Constant Returns to Scale require:

$$\beta_k + \beta_l + \beta_m = 1 \qquad (4.7)$$

Along with the following coefficient restrictions and the symmetry conditions also being fulfilled.

$$\beta_{kl} + \beta_{km} + \beta_{kk} = 0 \qquad (4.8)$$

$$\beta_{lk} + \beta_{lm} + \beta_{ll} = 0 \quad (4.9)$$

$$\beta_{mk} + \beta_{ml} + \beta_{mm} = 0 \quad (4.10)$$

Where, the symmetry condition states that $\beta_{lk} = \beta_{kl}$, $\beta_{lm} = \beta_{ml}$ and $\beta_{mk} = \beta_{km}$. In case of Translog production function the sum of coefficients of capital, labor and material inputs is less than unity and all the coefficient restrictions along with symmetry conditions are being fulfilled therefore, the Translog production function indicates decreasing returns to scale. The inefficiency parameter (μ) also indicates the presence of inefficiency.

The regression results obtained from Time-varying Translog production function are presented in Table-4.10. These results are also similar to those obtained for Translog production function in the time-invariant context. Estimated output elasticities of capital labor and material inputs are -0.558, 0.729 and 0.412 respectively indicating decreasing returns to scale. Inefficiency parameter has a value of 0.953 and shows the presence of inefficiency.

Table-4.10

Time-varying Translog Production Function

(1971- 77)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable		Industry		Obs per group min		7	
Time variable		Year		Obs per group avg		7	
Log likelihood		88.066		Obs per group max		7	
Number of obs		77		Wald chi^2 (10)		2711.72	
Number of groups		11		Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
Ln(K)	β_k	-0.558	0.256	-2.10	0.036	-0.078	-0.370
ln(L)	β_l	0.729	0.207	3.53	0.000	0.324	1.134
ln(M)	β_m	0.412	0.170	2.42	0.016	0.078	0.745
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.239	0.053	4.48	0.000	0.134	0.343
$(\frac{1}{2})\ln(L^2)$	β_{ll}	0.356	0.134	2.66	0.008	0.094	0.618
$(\frac{1}{2})\ln(M^2)$	β_{mm}	0.167	0.052	3.17	0.001	0.064	0.270
$\ln(K)\times\ln(L)$	β_{kl}	-0.108	0.053	-1.79	0.073	-0.226	0.010
$\ln(K)\times\ln(M)$	β_{km}	-0.041	0.035	-1.17	0.243	-0.110	0.028
$\ln(L)\times\ln(M)$	β_{lm}	-0.185	0.069	-2.70	0.000	-0.320	-0.051
Constant	β_0	3.547	0.997	3.56	0.000	1.592	5.502
Time	t	0.005	0.006	0.84	0.402	-0.006	0.016
Mu	μ	0.953	0.254	0.22	0.827	0.732	1.726
Eta	η	-0.001	0.004	-0.20	0.843	-0.008	0.007

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Regression results for the period 1978-90 are presented in Table- 4.11 to Table-4.14. Regression results obtained for Cobb-Douglas production function under time-invariant specification during 1978-90 are shown in Table-4.11. Estimated output elasticities of capital, labor and material inputs are low and approximately sum up to unity showing constant returns to scale. Inefficiency parameter μ has a value of 1.473 which shows the presence of inefficiency in agro-based industries.

Table-4.11

Time-invariant Cobb-Douglas Production Function

(1978- 90)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min			13
Time variable			Year	Obs per group avg			13
Log likelihood			-33.719	Obs per group max			13
Number of obs			143	Wald chi^2 (4)			731.14
Number of groups			11	Prob>chi^2			0.000
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	0.367	0.088	4.18	0.000	0.195	0.539
ln(L)	β_l	0.010	0.113	0.09	0.932	-0.212	0.231
ln(M)	β_m	0.720	0.096	7.53	0.000	0.533	0.508
Constant	β_0	1.531	0.666	2.30	0.022	0.225	2.838
Time	t	-0.003	0.010	-0.34	0.733	-0.022	0.016
Mu	μ	1.473	0.489	3.01	0.003	0.514	2.431

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Results obtained for Cobb–Douglas production function and time-varying inefficiency decay model are shown in Table-4.12. Here again the estimated output elasticities of capital, labor and material inputs are very low and approximately sum up to unity. All estimated coefficients except that of labor are statistically significant. The value of inefficiency parameter is equal to 2.131 and indicates the presence of inefficiency in agro-based industries during 178-90.

Table-4.12

Time-varying Cobb-Douglas Production Function

(1978- 90)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min			13
Time variable			Year	Obs per group avg			13
Log likelihood			-25.845	Obs per group max			13
Number of obs			143	Wald chi^2			257.74
Number of groups			11	Prob>chi^2			0.000
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	0.295	0.072	4.08	0.000	0.153	-0.436
ln(L)	β_l	0.070	0.112	0.62	0.535	-0.150	0.290
ln(M)	β_m	0.567	0.094	6.04	0.000	0.383	0.751
Constant	β_0	5.460	2.370	2.30	0.021	0.814	10.106
Time	T	-0.135	0.076	-1.78	0.075	- 0.284	0.014
Mu	μ	2.131	1.522	1.40	0.161	- 0.852	5.114
Eta	η	0.052	0.013	4.06	0.000	0.267	0.076

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Regression results obtained for Translog production function under time-invariant context are presented in Table-4.13. Estimated output elasticity of capital, is less than unity but that of labor and material inputs is greater than unity. The translog production function thus shows the prevalence of increasing returns to scale. The value of inefficiency parameter μ is 1.310 and indicates the presence of inefficiency in agro-based industries during 1978-90.

Table-4.13

Time-invariant Translog Production Function

(1978- 90)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min		13	
Time variable			Year	Obs per group avg		13	
Log likelihood			-21.677	Obs per group max		13	
Number of obs			143	Wald chi^2 (10)		903.38	
Number of groups			11	Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	-0.507	0.429	-1.18	0.237	-1.347	0.333
ln(L)	β_l	1.508	0.654	2.31	0.021	0.227	2.789
ln(M)	β_m	1.090	0.499	2.18	0.029	0.112	2.069
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.286	0.149	1.92	0.055	-0.006	0.579
$(\frac{1}{2})\ln(L^2)$	β_{ll}	-0.061	0.376	-0.16	0.871	-0.799	0.677
$(\frac{1}{2})\ln(M^2)$	β_{mm}	0.096	0.156	0.62	0.538	-0.209	0.401
$\ln(K)\times\ln(L)$	β_{kl}	-0.081	0.223	-0.36	0.717	-0.517	0.356
$\ln(K)\times\ln(M)$	β_{km}	-0.101	0.121	-0.84	0.401	-0.338	0.135
$\ln(L)\times\ln(M)$	β_{lm}	-0.059	0.197	-0.30	0.765	-0.444	0.327
Constant	β_0	-1.453	1.139	-1.28	0.202	-3.686	0.780
Time	t	0.000	0.010	0.01	0.991	-0.019	0.019
Mu	μ	1.310	0.492	2.65	0.008	0.340	2.272

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Regression results based on estimation of Translog production function through time-varying inefficiency decay model are presented in Table-4.14. Here again the coefficient of capital is less than unity but that of labor and material inputs are greater than unity. The sum of all the input coefficients is greater than unity and indicates the prevalence of increasing returns to scale during 1978-90. The value of inefficiency parameter (μ) is 2.612 and indicates the presence of inefficiency during 1978-90.

Table-4.14

Time-varying Translog Production Function

(1978- 90)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min			10
Time variable			Year	Obs per group avg			10
Log likelihood			-17.740	Obs per group max			10
Number of obs			110	Wald $chi^2(10)$			309.77
Number of groups			11	Prob>chi^2			0.000
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
Ln(K)	β_k	-0.156	0.452	-0.34	0.731	-1.042	0.731
ln(L)	β_l	1.086	0.690	1.57	0.115	-0.266	2.439
ln(M)	β_m	0.863	0.515	1.68	0.094	-0.146	1.872
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.248	0.151	1.64	0.100	-0.047	0.543
$(\frac{1}{2})\ln(L^2)$	β_{ll}	0.073	0.388	0.19	0.850	-0.687	0.833
$(\frac{1}{2})\ln(M^2)$	β_{mm}	0.117	0.158	0.74	0.462	-0.064	1.935
$\ln(K)\times\ln(L)$	β_{kl}	-0.116	0.226	-0.51	0.608	-0.559	0.327
$\ln(K)\times\ln(M)$	β_{km}	-0.800	0.115	-0.69	0.488	-0.498	0.335
$\ln(L)\times\ln(M)$	β_{lm}	-0.081	0.213	-0.38	0.702	-0.305	0.146
Constant	β_0	5.273	6.338	0.83	0.405	-7.149	17.694
Time	t	-0.184	0.126	-1.46	0.144	-0.430	0.062
Mu	μ	2.612	5.022	0.92	0.358	-2.231	4.455
Eta	η	-0.033	0.015	2.22	0.026	0.004	0.062

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Regression results for the time period 1991-2006 under time-invariant setting for Cobb-Douglas production function are given in Table-4.15. Output elasticites with respect to labor, capital and material inputs are low and approximately sum up to unity. This shows the prevalence of constant returns to scale in agro-based industries. The estimated value of inefficiency parameter (μ) is 1.267 and indicates the presence of inefficiency. Estimated coefficients of all the variables including inefficiency parameter are significant at 5 percent level of significance.

Table-4.15

Time-invariant Cobb-Douglas Production Function

(1991- 06)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable			Industry	Obs per group min			16
Time variable			Year	Obs per group avg			16
Log likelihood			35.454	Obs per group max			16
Number of obs			176	Wald chi^2 (4)			578.98
Number of groups			11	Prob>chi^2			0.000
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Ln(K)	β_k	0.477	0.040	11.96	0.000	0.398	0.555
ln(L)	β_l	0.188	0.060	2.14	0.032	0.011	0.245
ln(M)	β_m	0.291	0.032	5.59	0.000	0.118	0.344
Constant	β_0	4.582	0.463	9.90	0.000	3.675	5.489
Time	t	0.012	0.003	3.62	0.000	0.005	0.019
Mu	μ	1.267	0.270	4.70	0.000	0.739	1.796

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Table-4.16 shows the regression results obtained under time-varying inefficiency model for Cobb-Douglas production function during 1991-06. These results are similar to those derived for time-invariant model and reflect low elasticities of capital, labor and material inputs. All the estimated coefficients are significant at 5 percent level of significance. The coefficients of capital, labor and material inputs sum up to unity and indicate the prevalence of constant returns to scale. Inefficiency parameter (μ*)* has a value of 1.004 and indicates the presence of inefficiency.

Table-4.16

Time-varying Cobb-Douglas Production Function

(1991- 2006)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable		Industry		Obs per group min		16	
Time variable		Year		Obs per group avg		16	
Log likelihood		52.419		Obs per group max		16	
Number of obs		176		Wald chi^2		868.83	
Number of groups		11		Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
ln(K)	β_k	0.498	0.034	14.77	0.000	0.432	0.564
ln(L)	β_l	0.121	0.043	2.79	0.005	0.036	0.207
ln(M)	β_m	0.293	0.027	7.10	0.000	0.140	0.346
Constant	β_0	4.621	0.293	15.74	0.000	4.046	5.197
Time	T	-0.025	0.007	-3.35	0.001	-0.040	-0.010
Mu	μ	1.004	0.178	5.61	0.000	0.653	1.354
Eta	η	0.028	0.005	5.93	0.000	0.019	0.038

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

Table-4.17 shows time-invariant regression results obtained for Translog production function for 1991-06. Estimated output elasticities of capital and labor inputs are less than unity but the output elasticity of material input is greater than unity. The sum of the coefficients of capital, labor and material inputs is greater than unity and indicate the prevalence of increasing returns to scale. The estimated value of inefficiency parameter (μ) is 1.148 and indicates the presence of inefficiency.

Table-4.17

Time-invariant Translog Production Function

(1991- 2006)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable		Industry		Obs per group min		16	
Time variable		Year		Obs per group avg		16	
Log likelihood		90.364		Obs per group max		16	
Number of obs		176		Wald $chi^2(10)$		1270.33	
Number of groups		11		Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
ln(K)	β_k	-0.230	0.262	-0.88	0.380	-0.744	0.284
ln(L)	β_l	0.058	0.275	0.21	0.832	-0.480	0.596
ln(M)	β_m	1.427	0.160	8.91	0.000	1.113	1.740
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.396	0.051	7.72	0.000	0.295	0.497
$(\frac{1}{2})\ln(L^2)$	β_{ll}	0.050	0.126	0.40	0.693	-0.197	0.298
$(\frac{1}{2})\ln(M^2)$	β_{mm}	-0.024	0.027	-0.87	0.385	-0.077	0.030
$\ln(K)\times\ln(L)$	β_{kl}	-0.129	0.064	-0.20	0.000	-0.255	-0.004
$\ln(K)\times\ln(M)$	β_{km}	-0.192	0.040	-4.94	0.000	-0.268	-0.116
$\ln(L)\times\ln(M)$	β_{lm}	0.097	0.047	2.07	0.038	0.005	0.189
Constant	β_0	1.369	0.837	1.64	0.102	-0.271	3.009
Time	t	0.011	0.003	3.67	0.000	0.005	0.016
Mu	μ	1.148	0.239	4.80	0.000	0.679	1.617

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

The results obtained for Translog production function and time-varying inefficiency model are given in Table-4.18. Here again capital and labor have less than unity output elasticities but material input has got greater than unity output elasticity. These results too are not much different from those derived in case of time-invariant model. Inefficiency parameter has a value equal to 0.945 indicating the presence of inefficiency during 1991-06.

Table-4.18

Time-varying Translog Production Function

(1991- 2006)

Stochastic Frontier Model: Dependent Variable ln(Y)							
Group variable		Industry		Obs per group min		16	
Time variable		Year		Obs per group avg		16	
Log likelihood		95.955		Obs per group max		16	
Number of obs		176		Wald $chi^2(10)$		1306.57	
Number of groups		11		Prob>chi^2		0.000	
Variable	Parameter	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
Ln(K)	β_k	-0.438	0.247	-1.77	0.077	-0.922	0.047
ln(L)	β_l	0.528	0.273	1.94	0.053	-0.007	1.062
ln(M)	β_m	1.306	0.157	8.33	0.000	0.999	1.613
$(\frac{1}{2})\ln(K^2)$	β_{kk}	0.345	0.050	6.89	0.000	0.248	0.445
$(\frac{1}{2})\ln(L^2)$	β_{ll}	0.049	0.120	0.41	0.685	-0.187	0.284
$(\frac{1}{2})\ln(M^2)$	β_{mm}	-0.005	0.025	-0.19	0.849	-0.054	0.045
$\ln(K)\times\ln(L)$	β_{kl}	-0.106	0.061	0.06	-1.73	-0.084	0.014
$\ln(K)\times\ln(M)$	β_{km}	-0.136	0.040	-3.44	0.001	-0.214	-0.058
$\ln(L)\times\ln(M)$	β_{lm}	0.020	0.048	0.43	0.669	-0.073	0.115
Constant	β_0	1.341	0.691	1.94	0.052	-0.014	2.696
Time	t	-0.013	0.008	-1.73	0.083	-0.028	0.002
Mu	μ	0.945	0.181	5.22	0.000	0.591	1.300
Eta	η	0.020	0.006	3.40	0.001	0.009	0.032

Source: Regression results obtained from Census of Manufacturing Industries (CMI) data.

4.6.1 Measuring technical efficiency

One of the advantages of the stochastic productions functions is that they allow for the estimation of technical efficiency and technical change. Once we have obtained the values of inefficiency parameter (μ*)* we can find the estimate of technical efficiency using Equation-4.6. The estimates of technical efficiency for different time

periods based on time-invariant and time-varying inefficiency decay models are given in Table-4.19. Technical efficiency estimated from Cobb-Douglas production was 53% and 52% respectively for Time-invariant and Time –varying models during 1971-77. On the other hand Translog production function provided the estimates of 37% and 38% of technical efficiency under Time-invariant and Time-varying efficiency decay models.

The level of technical efficiency during 1978-90 obtained for Cobb-Douglas production function through Time-invariant and Time-varying efficiency decay models are 23 percent and 12 percent respectively. The estimated technical efficiency is 27 percent and 12 percent respectively for Translog production function during the same period. Both C-D production and Translog production functions indicate a decline in technical efficiency during 1978-79. This seems to be the result of major policy changes taking place during early 1970s and late 1970s. Both C-D production and Translog production function indicate some improvement in technical efficiency during 1991-06. The table shows that technical efficiency varies between 28 percent to 39 percent for Cobb-Douglas and Translog production function respectively.

Table-4.19

Estimates of Technical Efficiency

Model	1971-77		1978-90		1991-06	
	C-D	TL	C-D	TL	C-D	TL
Time-invariant	0.53	0.37	0.23	0.27	0.28	0.32
Time-varying	0.52	0.38	0.12	0.10	0.36	0.39

Source: Calculations based on Table- 4.7 to Table- 4.18.

4.6.2 Measuring technical change

Once we have estimated the values of the coefficient of time variable (λ_t), we can estimate technical change using the relationship given in equation-4.4. Table-4.20 shows the estimates of technical change based on Cobb-Douglas technology. Both Time-invariant and Time-variant inefficiency models show a negative technical change for 1971-77 period. During 1978-90 we notice a positive technical change which can be attributed to the policy change taking place during this period.

Table-4.20

Technical Change: Cobb-Douglas Technology

Model	1971-77	1978-90	1991-06
Time-invariant inefficiency	-0.01	0.015	-
Time-varying inefficiency	-0.14	0.110	-

Source: Calculations based on Table-4.9 to Table-4.20.

Estimates of technical change based on Translog production function are given in Table-4.21 and like C-D production function Translog production function also shows a negative technical change during 1971-77 period and a positive technical change during 1978-90 period.

Table-4.21

Technical Change: Translog Technology

Model	1971-77	1978-90	1991-06
Time-invariant inefficiency	-0.004	0.011	-
Time-varying inefficiency	-0.189	0.171	-

Source: Calculations based on Table-4.9 to Table-4.20.

4.7 CONCLUDING REMARKS

In this chapter we carried out the analysis of efficiency using stochastic production function approach. Both Cobb-Douglas (C-D) and Translog (TL) production functions under time-invariant and time–varying inefficiency decay models were used for estimation purposes. The results indicate that agro-based industries have low output elasticities, exhibit constant returns to scale[30] and high inefficiency levels. The prevalence of constant returns to scale indicates the fact that domestic market may not be large enough to accommodate industrial output and hence the world market (outward orientation) may provide the necessary demand for the industry supply. Outward orientation may also provide access to information and technology transfer, which may influences the economies of scale in production. Low input elasticities indicate that productivity of agro-based industries cannot be increased by increasing the level of inputs it can however be increased by improving efficiency. This calls for removal of distortions and making agro-based industries more competitive. Another important conclusion that can be drawn from our analysis is that high price cost margins in agro-based industries are essentially due to structural problems and call for an active and comprehensive pro trade policy along with a package of domestic reforms to improve structure, conduct and performance of these industries.

[30] Cobb-Douglas production function indicates constant returns to scale for all the periods of study but Translog production function exhibits decreasing returns to scale during 1971-77 and 1991-06 and increasing returns to scale for 1978-90. Since all the input coefficients for Translog production function during 1978-90 are not statistically significant, we only accept the prevalence of constant or decreasing returns to scale in agro-based industries for all the study periods.

CHAPTER 5

CONCLUSIONS AND POLICY IMPLICATIONS

5.1 INTRODUCTION

In this study analysis of the effects of policy reforms and openness on structure, conduct and performance was carried out for different time periods from 1971 to 2006. Structure-Conduct-Performance approach as well as production function approach was used for obtaining the results. Our analysis shows the presence of high price cost margins in most of the agro-based industries. The results also indicate that there has been no visible effect of domestic policy reforms on price cost margins however trade liberalization and openness had some favorable effect on the structure-conduct-performance of agro-based industries. The efficiency analysis also shows the presence of high levels of inefficiency and occurrence of no prominent technical change in the agro-based industries. Both C-D production function and Translog production function indicate a negative technical change during 1971-77 and a negligible positive change during 1978-91 period. One of the important implications that emerge from our analysis is that overall efficiency of agro-based industries can be increased through improving S-C-P (static efficiency) as well as technical efficiency (dynamic efficiency).

5.2 LIMITATIONS

Data used for present analysis were taken from the following sources:

- Census of Manufacturing Industries of Pakistan (CMI) published by the Federal Bureau of Statistics, Government of Pakistan.
- Pakistan Economic Survey published by Finance Division, Government of Pakistan.
- 50 Years of Pakistan, Federal Bureau of Statistics, Government of Pakistan.

Data on National Income Accounts variables such as GDP, value of imports and value of exports were taken from *Pakistan Economic Survey* (various issues). Data from 1971 to 1988 were based on old methodology, which was discontinued in 1989. Federal Bureau of Statistics revised National Income Accounts data for this period according to the new methodology and published it in the "*50 Years of Pakistan"* in June 1995. Therefore the data from 1971 to 1988 on National Income Accounts Variables have been taken from the 50 years of Pakistan. Another problem confronted was the availability of National Income data in different base periods. Initially 1980-81 was used as base year then 1990-91 and most recently 1999-2000 were used as base years. For the present study data were converted to a common base using 2004-05 as base year. Accordingly all variables used in this study have been expressed at constant prices of 2004-05.GDP deflator was used to convert nominal values in to real values.[31]

Data on large scale manufacturing industries were taken from the census of manufacturing industries (CMI). Up to 1990-91, CMI was conducted on annual basis but after 1990-91, CMI is being conducted after every five years. The latest census was conducted in 2005-06 but the CMI data was released in 2008-09. The values of different variables on annual basis were generated using average growth rates. These values are just an approximation and may not represent the actual values. CMI for certain years was skipped due to unknown reasons, the missing data for the years 1971-72 to 1974-75, 1979-80 & 1988-89 were generated using average annual growth rates. Another problem with the CMI data is that provincial Bureaus of Statistics (BOS) collect data on large scale manufacturing industries through questionnaire from different establishments and it is believed that there is a considerable non-response and chances of under reporting of output values and over reporting of input values to evade taxation. Despite these limitations the CMI is the only major reliable source of data on large scale manufacturing industries in Pakistan.

[31] For details see Appendix-I, pp. 113-116.

5.3 AREAS FOR FURTHER RESEARCH

In the tradition of new industrial economics, other groups of large scale manufacturing industries or single industries or even firm level studies can be undertaken to explore changes in structure and changes in efficiency over time. Based on these studies measures can be suggested for improving the efficiency, productivity and competitiveness of these firms or industries.

There are many directions in which the study of Structure-Conduct-Performance can be extended. One potential area is the study of the existence of collusion or cartelization and its impact on efficiency and profitability of the firms. Another area is the study of the rent seeking behavior and its impact on efficiency and productivity of the firms or industries.

5.4 CONCLUSIONS

Agro-based industries in Pakistan operate under imperfect market conditions. These industries have an important place in the large-scale manufacturing sector of Pakistan. Agro-based industries contribute more than fifty percent of the total output of this sector. Cotton, Wheat, rice and sugarcane are the main crops grown in Pakistan. Agro-based industries mostly use locally produced raw material except vegetable ghee and cooking oil industry which currently is dependent on more than 70% of imported raw material. Textile manufacturing is the largest agro-based industry in Pakistan, followed by food manufacturing and processing industry. Ginning, pressing and bailing of fiber, wearing apparel, leather and leather products, wood and wood products, paper and paper products and leather footwear are other important agro-based industries in Pakistan. The existence of imperfect competition necessitates an increasingly important role for government in strengthening the competitive capacity of the economy because liberalization leads to output growth, export growth and productivity gains.

This study throws some light on the conditions under which agro-based industries operate in Pakistan. Since 1970-71 effective rates of protection have declined considerably and since late 1970s government has adopted more liberal and

outward oriented policies. The main emphasis of trade and industrial policies in Pakistan has been on improving market access, strengthening of trade promoting infrastructure, skill development, productivity enhancement and improvement of physical infrastructure. Government has also offered various incentives to the private investors in the form of financial and commercial support, R&D support and support for marketing abroad. Despite all these efforts no prominent change has taken place in the structure-conduct-performance of agro-based industries. These industries still have positive Price Cost Margins. The Price Cost Margins show high variability across industries but very little variability overtime. Industries with high Price Cost Margins have high concentration ratios and industries with low Price Cost Margins have low concentration ratios. This shows the existence of a direct relationship between Price Cost Margins and concentration ratios. Capital Output Ratios also show variation across industries but very little variation overtime. This means that the capital structure or the investment patterns overtime have almost remained the same.

Under S-C-P approach we tested the hypothesis that domestic reforms and openness have a negative effect on price cost margins. In case of agro-based industries only a weak support emerged in favor of our hypothesis. For 1971-77 period the coefficient of openness variable had an expected sign but the coefficient of domestic reforms had an opposite sign. This was perhaps due to the structural changes introduced in the economy of Pakistan during this period. During the subsequent study periods domestic reforms had no favorable effect on S-C-P of agro-based industries however openness had a reducing effect on price cost margins.

The stochastic production frontier analysis was carried out to measure the technical efficiency and technical change that has taken place in agro-based industries during the study period. Our analysis shows the prevalence of constant returns to scale, low output elasticities and presence of high level of inefficiency in agro-based industries in Pakistan. Economic literature recognizes three major sources of inefficiency i.e. existence of monopolies, uncorrected externalities and policy failures. In case of agro-based industries in Pakistan, the major causes of inefficiency seem to be; the lack of infrastructure facilities, lack of trained labor force, lack of research and development facilities and the lack of any comprehensive policy framework for the development of agro-based industries. The development of agro-

based industries is closely linked with the development of the agricultural sector. There is a large scope of increasing production of wheat, cotton, rice, sugarcane, vegetable oil seeds, fruits, vegetables and dairy products in Pakistan. Overall development of the large-scale manufacturing sector in Pakistan is closely linked with the development of the agro-based industries, which is linked with the development of the agricultural sector as a whole.

The study also points out some directions for the improvement of the performance of agro-based industries. These include increased availability of cheap raw materials, better pricing policies for raw materials as well as final products, improved infrastructure and storage facilities, better research and development facilities and adoption of more open and transparent trade and investment policies.

5.5 POLICY IMPLICATIONS

The major policy implications that can be drawn from our analysis are given below.

1. Agro-based industries are a major contributor of large scale manufacturing sector output and the share of these industries can further be increased to meet domestic demand and increase the volume of exports to improve balance of trade, which currently is not in favor of Pakistan. Presently Pakistan's exports are highly concentrated in few countries like USA, Germany, United Kingdom, Japan, China, Dubai and Saudi Arabia. We have to look for new markets in the regions neglected so far like Central Asia, Far East, Africa and Latin America.

2. Agro-based industries operate under imperfect market conditions and have high price cost margins and high levels of inefficiency. These industries are characterized by low levels of technical efficiency as well as low levels of technical change. Production and productivity of these industries can be increased through trade facilitation, diversification of exports, improving market access, increasing competitiveness, improving quality and compliance and adopting capacity building measures.

3. Agro-based industries have low output elasticities therefore input growth will have little effect on output levels. The productivity of these industries can be increased through containing input prices, adopting better managerial practices and reducing trade barriers.

4. Economic reforms, so far, seem to have no visible effect on the structure, conduct and performance of these industries therefore a new mechanism for successful implementation of economic reforms is needed with close monitoring and implementation strategy.

5. For removing inefficiency from these industries, availability of cheap raw materials (especially fuel and energy), better infrastructure facilities, better R&D facilities, reduction in red tape and adoption of transparent trade and investment policies is needed.

6. Sustained growth requires a transformation towards a competitive outward-oriented economy. More liberal trade policies should be formulated and implemented for neighboring countries as well as existing trade partners because foreign trade induces local entrepreneurs to improve quality of the products and brings other economic benefits through innovation and diffusion of new technologies.

7. Keeping in view the easy availability of local raw materials; textile industry, food processing and manufacturing industry, leather and leather products industry, leather footwear industry and wearing apparel industry have high growth potential. Adoption of modern production technologies, provision of better storage facilities easy access to import and export markets and improvements in managerial practices, the quality of product and labor is necessary to increase the output and efficiency of these industries.

8. Production and export of fruits, vegetables, seafood, dairy products and livestock should be encouraged to earn valuable foreign exchange.

9. Export of value added goods should be encouraged to earn more foreign exchange. Incentives should be provided to the exporters of agro-based industries to increase exports.

10. Import regime should be streamlined and duty free imports of inputs should be allowed to improve structure, conduct and performance of agro-based industries. Like exports, Pakistan's imports are also concentrated in few countries such as USA, United Kingdom, Germany Saudi Arabia, Kuwait, and Malaysia. To increase the share of foreign trade in GDP we will have to look for new trade partners in other parts of the world.

11. Growth of large scale manufacturing sector is linked with overall macroeconomic stability, which can be assured by low inflation rates, low budgetary deficits and high export growth.

12. Any future policy reforms should aim at improving productivity, reducing cost, increasing value addition, improving physical infrastructure and selling more in the existing markets as well as entering new markets.

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APPENDICES

Appendix-1

Table A-1.1

GROSS DOMESTIC PRODUCT AND
GDP DEFLATOR
(2004-05=100)

Year	GDP CURRENT (Rs. Million)	GDP CONSTANT (Rs. Million)	GDP DEFLATOR
1970-71	51355	1115539	4.60
1971-72	55268	1237468	4.47
1972-73	68253	1316953	5.18
1973-74	88915	1377907	6.45
1974-75	112054	1413209	7.93
1975-76	131330	1482752	8.86
1976-77	151045	1540761	9.80
1977-78	177904	1666203	10.68
1978-79	196471	1745114	11.26
1979-80	235168	1893908	12.42

Source: Column 2 taken from "*50 Years of Pakistan"* by Statistics Division, Federal Bureau of Statistics, Government of Pakistan, vol. I, Column 3 and 4, author's own calculations.

Table A-1.2

GROSS DOMESTIC PRODUCT AND
GDP DEFLATOR
(2004-05=100)

Year	GDP CURRENT (Rs. Million)	GDP CONSTANT (Rs. Million)	GDP DEFLATOR
1980-81	278196	2023278	13.75
1981-82	324159	2155550	15.04
1982-83	364387	2301400	15.83
1983-84	419802	2418246	17.36
1984-85	472157	2601840	18.15
1985-86	514532	2744986	18.74
1986-87	572479	2922101	19.59
1987-88	675389	3144920	21.48
1988-89	769745	3309900	23.26
1989-90	855943	3448074	24.82

Source: Column 2, Pakistan Economic Survey (1992-93), Finance Division, Government of Pakistan. Column 3 and 4, author's own calculations.

Table A-1.3

GROSS DOMESTIC PRODUCT AND
GDP DEFLATOR
(2004-05=100)

Year	GDP CURRENT (Rs. Million)	GDP CONSANT (Rs. Million)	GDP DEFLATOR
1990-91	1020600	3636136	28.07
1991-92	1211385	3921020	30.89
1992-93	1341629	3996105	33.57
1993-94	1573097	4151774	37.89
1994-95	1882071	4364337	43.12
1995-96	2141842	4583128	46.73
1996-97	2457381	4639178	52.97
1997-98	2736919	4792286	87.11
1998-99	3025683	4979598	60.76
1999-00	3826111	5094084	75.11

Source: Column 2, Pakistan Economic Survey (2000-01), Finance Division, Government of Pakistan. Column 3 and 4, author's own calculations.

Table A-1.4

GROSS DOMESTIC PRODUCT AND
GDP DEFLATOR

(2004-05=100)

Year	GDP Current (Rs. million)	GDP Constant (Rs. million)	GDP DEFLATOR
2000-01	4209873	5195071	81.04
2001-02	4452654	5362582	83.03
2002-03	4875648	5622470	86.72
2003-04	5640580	6036766	93.44
2004-05	6499782	6499782	100.00
2005-06	7623205	6901140	110.46

Source: Column 2, Pakistan Economic Survey (2006-07), Finance Division, Government of Pakistan. Column 3 and 4, author's own calculations.

Appendix-II

Table A-2.1.1

Real Value of Capital Stock, Output, Employment and Industrial Cost

(Food Manufacturing Industries)

2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	17072.00	2209.00	41145.00	58237.20
1971-72	16798.85	2469.66	42708.51	61731.43
1972-73	16525.70	2730.32	44272.02	65225.66
1973-74	116252.54	2990.99	45835.53	68719.90
1974-75	15979.39	3251.65	47399.04	72214.13
1975-76	15679.33	3522.22	48879.11	75876.00
1976-77	16633.50	4218.40	63527.80	95871.80

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.2

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost

(Beverages)

2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	473.80	66.80	543.20	1333.80
1971-72	507.91	94.19	790.90	1659.25
1972-73	542.03	121.58	1038.60	2251.45
1973-74	576.14	148.96	1286.30	2710.28
1974-75	610.25	176.35	1534.00	3169.11
1975-76	642.89	203.67	1779.78	3622.67
1976-77	635.70	252.20	2023.10	4193.00

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.3

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost

(Tobacco)

2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	1558.80	688.80	7225.60	18673.00
1971-72	1399.80	675.02	6676.45	17851.39
1972-73	1240.80	661.25	6127.31	17029.78
1973-74	1081.81	647.47	5578.16	16208.16
1974-75	922.81	633.70	5029.02	15386.55
1975-76	757.00	623.00	4481.22	14576.67
1976-77	1107.60	813.50	5186.80	22071.00

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.4

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Manufacture of Textiles)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	31001.20	8575.40	34253.80	66149.00
1971-72	31621.22	9415.79	38227.24	69721.05
1972-73	32241.25	10256.18	42200.68	73293.09
1973-74	32861.27	11096.57	46174.12	76865.14
1974-75	33481.30	11936.96	50147.56	80437.18
1975-76	33993.22	12755.75	54122.89	83791.67
1976-77	23715.20	12193.90	59628.60	90645.60

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.5

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Manufacture of Wearing Apparel)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	166.40	44.00	152.80	284.40
1971-72	138.12	36.46	280.99	432.29
1972-73	114.64	30.26	427.10	657.08
1973-74	95.13	25.11	649.19	998.76
1974-75	78.94	20.84	655.38	1008.27
1975-76	102.00	102.11	662.44	1017.78
1976-77	214.70	1606.6	1293.20	1823.00

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.6

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Leather and Leather Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	400.20	164.20	2965.00	4205.20
1971-72	461.04	138.31	3406.22	4541.62
1972-73	590.13	177.04	3678.71	4904.95
1973-74	755.36	226.61	3973.00	5297.34
1974-75	951.74	285.52	4290.85	5721.13
1975-76	970.33	184.56	4694.11	5978.78
1976-77	838.30	219.60	6450.90	8050.40

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.7

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Manufacture of Footwear)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	213.80	139.40	575.20	911.60
1971-72	175.56	105.34	587.07	838.67
1972-73	143.79	86.27	540.06	771.52
1973-74	117.82	70.69	496.86	709.80
1974-75	97.22	58.33	457.11	653.02
1975-76	120.11	87.44	382.22	539.11
1976-77	161.60	100.60	579.80	782.90

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.8

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Ginning, Pressing and Bailing of Fiber)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	2441.40	539.00	25914.00	29421.60
1971-72	1845.78	553.73	19771.13	24714.14
1972-73	1395.46	418.63	16607.90	20759.88
1973-74	1055.19	316.56	13950.64	17438.30
1974-75	798.36	239.51	11718.54	14648.17
1975-76	544.22	135.56	4362.22	5449.00
1976-77	315.90	171.10	6911.00	7970.20

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.9

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Wood and Wood Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	321.40	44.60	192.00	374.40
1971-72	303.73	75.93	286.95	409.93
1972-73	287.03	71.76	338.60	483.72
1973-74	271.25	67.81	399.55	570.79
1974-75	256.33	64.08	427.37	610.53
1975-76	397.44	72.89	465.89	658.44
1976-77	284.30	92.10	366.80	605.40

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.10

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Furniture and Fixtures)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	178.60	96.80	188.20	417.60
1971-72	175.39	91.19	192.34	406.74
1972-73	172.23	85.90	196.57	396.16
1973-74	169.13	80.91	200.90	385.87
1974-75	166.08	76.22	205.32	375.83
1975-76	162.56	68.78	208.22	361.44
1976-77	201.50	39.20	132.00	227.80

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.1.11

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Paper and Paper Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1970-71	5764.60	470.80	2791.00	4502.20
1971-72	5510.96	506.58	2908.22	4682.29
1972-73	5268.48	545.08	3030.37	4869.58
1973-74	5036.66	586.51	3157.64	5064.36
1974-75	4815.05	631.08	3290.26	5266.93
1975-76	4503.00	652.00	3379.22	5383.33
1976-77	3819.70	709.70	2638.40	4608.50

Source: Calculations based on CMI, FBS, Government of Pakistan, Various Issues.

Table A-2.2.1

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Food Manufacturing Industries)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	18011.82	4718.09	71296.45	102922.55
1978-79	20893.36	4718.35	73816.27	106071.18
1979-80	25698.83	4954.27	78983.41	115617.59
1980-81	30452.64	5182.07	84002.21	125230.29
1981-82	32270.13	6761.00	109705.87	156916.40
1982-83	32598.81	7323.69	111570.69	159841.69
1983-84	37522.12	7400.82	122515.76	168736.29
1984-85	36146.94	8362.39	121927.22	173239.94
1985-86	44802.74	9137.05	12309.05	174454.42
1986-87	45847.85	9562.10	136519.00	183412.15
1987-88	4814.24	10135.83	144027.55	192582.76
1988-89	50432.64	10709.55	151536.09	201753.37
1989-90	52725.03	11283.28	159044.64	210923.97

Source: Calculations based on CMI, various issues.

Table A-2.2.2

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Beverages)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	857.55	324.27	2558.45	5105.09
1978-79	1008.27	366.18	2869.82	5767.91
1979-80	1225.05	380.83	3113.75	6431.32
1980-81	1443.14	395.36	3359.64	7096.86
1981-82	1592.93	531.73	4135.60	9211.80
1982-83	1873.75	508.19	3943-75	9526.25
1983-84	1844.82	516.76	3802.06	9459.18
1984-85	2623.83	640.56	4503.67	11035.06
1985-86	4075.16	742.53	5637.26	12062.47
1986-87	8291.15	654.90	2046.10	9649.40
1987-88	7379.12	687.65	2905.46	10035.38
1988-89	6467.10	720.39	3764.82	10421.35
1989-90	5555.07	753.14	4624.19	10807.33

Source: Calculations based on CMI, various issues.

Table A-2.2.3

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost

(Tobacco)

2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	1339.00	791.45	5979.73	26302.45
1978-79	1330.18	910.18	6367.00	26742.73
1979-80	1257.02	942.04	6908.20	30745.14
1980-81	1188-43	973.71	7465.29	34643.71
1981-82	1516.67	1037.87	7162.27	33256.13
1982-83	1563.50	1035.75	6697.69	37580.50
1983-84	1588.65	1133.12	8246.65	42018.59
1984-85	2099.56	11096.39	8763.50	41653.89
1985-86	2254.37	971.26	7924.00	37458.79
1986-87	2004.35	987.40	8445.65	57324.25
1987-88	1994.33	942.97	7854.45	51018.58
1988-89	1984.31	898.53	7263.26	44712.92
1989-90	1974.28	854.10	6796.21	38407.25

Source: Calculations based on CMI, various issues.

Table A-2.2.4

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Manufacture of Textiles)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	33899.55	11947.64	55984.18	86657.27
1978-79	39173.18	12715.82	70069.82	100179.91
1979-80	40348.38	12588.66	71471.22	102183.51
1980-81	41335.43	12525.29	71913.21	104566.57
1981-82	46023.67	13158.93	82434.20	119093.73
1982-83	54869.00	13083.50	100364.06	138112.88
1983-84	56887.35	13318.35	113362.41	150994.65
1984-85	62062.50	13775.56	99751.94	145316.22
1985-86	68447.53	14946.47	103929.00	149169.00
1986-87	79271.55	16910.70	123253.95	176789.70
1987-88	94729.50	18939.98	147904.74	213915.54
1988-89	110187.45	20969.27	172555.53	251041.37
1989-90	125645.41	22998.55	197206.32	288167.21

Source: Calculations based on CMI, various issues.

Table A-2.2.5

Real Value of Capital Stock, Output, Employment and Industrial Cost
(Wearing Apparel)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	303.27	168.18	1385.36	2062.73
1978-79	305.36	243.82	1436.27	2035.45
1979-80	690.11	338.91	1982.05	3185.48
1980-81	1069.43	430.43	2524.50	4342.57
1981-82	874.60	443.60	2846.93	4697.93
1982-83	801.88	451.81	4114.75	5363.63
1983-84	993.41	561.82	3590.24	5195.94
1984-85	1224.54	748.00	7050.39	8625.67
1985-86	1314.32	1042.53	7885.16	11172.68
1986-87	2079.60	1344.10	11067.65	14148.20
1987-88	2495.52	1653.24	13225.84	16836.36
1988-89	2911.44	1962.39	15384.03	19524.52
1989-90	3327.36	2271.53	17575.43	22212.67

Source: Calculations based on CMI, various issues.

Table A-2.2.6

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Leather and Leather Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	992.27	249.45	5808.73	7762.00
1978-79	1254.55	269.45	10255.45	14294.00
1979-80	1185.55	281.58	8306.91	11435.20
1980-81	1117.36	292.71	6354.14	8533.29
1981-82	1316.20	327.80	6094.40	8919.33
1982-83	1850.25	391.63	7674.38	11424.13
1983-84	1628.12	464.59	10860.94	14896.76
1984-85	1681.94	500.28	13432.44	16507.72
1985-86	2378.53	548.74	13813.21	18780.79
1986-87	3057.65	718.80	20635.00	24600.60
1987-88	3439.86	812.24	21766.75	26199.64
1988-89	3822.06	905.69	22698.50	27798.68
1989-90	4204.27	999.13	23730.25	29397.72

Source: Calculations based on CMI, various issues.

Table A-2.2.7

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Leather Footwear)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	107.00	85.55	418.27	654.73
1978-79	402.55	122.64	1027.82	1285.18
1979-80	404.69	298.63	1695.90	2634.62
1980-81	408.71	474.79	2359.79	3986.29
1981-82	261.73	113.20	708.67	943.60
1982-83	177.19	92.13	951.19	1214.38
1983-84	231.59	84.24	1059.12	1373.35
1984-85	230.44	84.33	1091.89	1360.56
1985-86	341.58	122.21	1269.89	1888.63
1986-87	1160.35	922.40	4695.55	6362.75
1987-88	1311.20	963.91	4930.33	6649.07
1988-89	1462.04	1005.42	5165.11	6935.40
1989-90	1612.89	1046.92	5399.88	7221.72

Source: Calculations based on CMI, various issues.

Table A-2.2.8

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Ginning Pressing and Bailing of Fiber)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	1170.00	435.00	27411.82	29790.91
1978-79	1643.09	488.45	27139.55	31800.00
1979-80	1940.62	619.70	31120.70	36179.46
1980-81	2238.14	750.93	35101.86	40558.93
1981-82	1980.80	690.40	31759.67	37016.73
1982-83	1750.75	678.88	34419.69	39865.63
1983-84	1621.24	524.53	31607.18	36090.88
1984-85	2557.67	899.17	47412.56	54064.56
1985-86	1880.95	906.37	46225.95	53263.68
1986-87	2077.90	876.90	41019.75	47177.75
1987-88	2181.80	990.90	46147.22	53310.86
1988-89	2285.69	1104.89	51274.68	59443.97
1989-90	2389.59	1218.89	54402.16	65577.07

Source: Calculations based on CMI, various issues.

Table A-2.2.9

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Wood and Cork Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	171.73	63.91	309.91	380.73
1978-79	286.91	95.64	440.91	699.45
1979-80	737.36	114.29	652.55	1063.16
1980-81	1189.07	132.93	864.71	1426.57
1981-82	1238.93	167.47	831.40	1387.20
1982-83	827.13	180.25	858.19	1406.94
1983-84	2596.76	209.24	1454.06	2089.88
1984-85	1506.78	210.56	1168.00	1965.44
1985-86	2900.68	241.84	1521.58	2341.11
1986-87	2755.65	332.05	1658.65	2345.40
1987-88	2604.97	325.41	1691.82	2462.67
1988-89	2204.52	318.77	1725.00	2579.94
1989-90	1928.96	312.13	1758.17	2697.21

Source: Calculations based on CMI, various issues.

Table A-2.2.10

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Furniture and Fixtures)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	113.00	58.64	158.36	293.55
1978-79	251.27	68.91	180.09	319.91
1979-80	218.60	78.90	237.72	465.47
1980-81	185.29	88.71	293.21	610.57
1981-82	150.93	77.33	325.00	528.33
1982-83	177.56	88.00	322.94	543.75
1983-84	217.88	104.82	461.00	761.18
1984-85	223.74	162.94	823.78	1320.39
1985-86	364.79	108.58	402.68	632.89
1986-87	483.00	150.55	742.60	1033.85
1987-88	502.32	161.09	905.97	1281.97
1988-89	521.64	171.63	1069.34	1530.10
1989-90	540.96	182.17	1232.72	1778.22

Source: Calculations based on CMI, various issues.

Table A-2.2.11

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Paper and Paper Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1977-78	2649.00	670.36	2529.18	4553.82
1978-79	2913.90	565.36	2469.00	4710.73
1979-80	2811.91	679.66	3678.81	6312.38
1980-81	2699.71	921.21	4887.29	7922.43
1981-82	2518.07	808.27	4267.00	6988.47
1982-83	2591.63	859.56	4691.63	7740.00
1983-84	3312.47	924.24	4895.71	7597.12
1984-85	4533.22	944.67	6294.94	9215.33
1985-86	5472.63	1069.11	6304.16	9579.06
1986-87	4131.40	900.55	5923.55	8884.85
1987-88	5205.56	999.61	7878.32	11639.15
1988-89	6279.73	1098.67	9833.09	14393.46
1989-90	7353.89	1197.73	11787.86	17147.76

Source: Calculations based on CMI, various issues.

Table A-2.3.1

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Food Manufacturing Industries)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	55326.00	11859.39	166552.50	222267.79
1991-92	58202.95	11669.64	171882.18	230269.43
1992-93	61079.90	11479.89	177211.86	238271.07
1993-94	63956.86	11290.14	182541.54	246272.71
1994-95	66833.81	11100.39	187871.22	254274.35
1995-96	69443.85	10859.34	192534.79	261221.62
1996-97	67916.09	10153.48	187240.08	255997.19
1997-98	66388.32	9447.63	181945.38	250772.76
1998-99	64860.56	8741.77	176650.67	245548.32
1999-00	63332.79	8035.91	171355.96	240323.89
2000-01	62067.33	8019.30	170963.31	232851.95
2001-02	75722.14	9302.39	205155.97	288736.42
2002-03	89376.96	10585.48	239348.63	344620.89
2003-02	103031.77	11868.58	273541.30	400505.35
2004-05	116686.58	13151.65	307733.96	456389.82
2005-06	131070.20	14728.44	384112.32	559044.95

Source: Calculations based on CMI, various issues.

Table A-2.3.2

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Beverages)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	4651.75	777.93	5479.32	11043.46
1991-92	4493.59	781.04	5983.42	11860.68
1992-93	4335.43	784.15	6487.51	12677.89
1993-94	4177.27	787.27	6991.61	13495.11
1994-95	4019.11	790.38	7495.71	14312.32
1995-96	3875.81	791.30	7972.81	15182.83
1996-97	4011.46	842.73	8331.59	16207.67
1997-98	4147.12	894.17	8690.36	17232.51
1998-99	4282.77	945.60	9049.14	18257.35
1999-00	4418.42	997.04	9407.92	19282.19
2000-01	4419.35	1000.35	9429.54	19217.54
2001-02	4481.22	988.35	9863.30	20601.20
2002-03	4543.09	976.34	10297.06	21984.87
2003-04	4604.96	964.34	10730.82	23368.53
2004-05	4666.83	952.33	11164.58	24752.19
2005-06	4738.25	937.43	13756.91	26165.80

Source: Calculations based on CMI, various issues.

Table A-2.3.3

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost

(Tobacco)

2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	1958.21	804.79	6133.57	31311.14
1991-92	1966.04	824.10	6170.37	31874.74
1992-93	1973.88	843.42	6207.17	32438.34
1993-94	1981.71	862.73	6243,97	33001.94
1994-95	1989.54	882.05	6280.78	33565.54
1995-96	2004.30	903.28	6331.30	34273.40
1996-97	3267.01	801.66	6600.38	33073.83
1997-98	4529.72	700.04	6869.46	31874.26
1998-99	5792.43	598.42	7138.54	30674.69
1999-00	7055.14	496.80	7407.62	30347.04
2000-01	7057.19	493.68	7425.88	29573.27
2001-02	7353.59	691.15	7039.73	33181.21
2002-03	7649.99	888.62	6653.59	36789.15
2003-04	7946.40	1086.10	6267.44	40397.09
2004-05	8242.80	1283.57	5881.30	44005.03
2005-06	8534.89	1555.39	5504.36	47637.83

Source: Calculations based on CMI, various issues.

Table A-2.3.4

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Manufacture of Textiles)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	141087.36	25222.50	223161.14	327629.64
1991-92	153474.83	25146.83	243245.64	347287.42
1992-93	165862.30	25071.17	263330.15	366945.20
1993-94	178249.77	24995.50	283414.65	386602.98
1994-95	190637.24	24919.83	303499.15	406160.75
1995-96	203054.17	24834.26	323588.57	424500.11
1996-97	199500.72	24859.09	315498.86	418981.61
1997-98	195947.27	24883.93	307409.14	413463.11
1998-99	192393.83	24908.84	299319.43	407944.61
1999-00	188840.38	24933.60	291229.71	402426.10
2000-01	189552.17	24927.78	281376.98	396212.42
2001-02	229358.13	28866.37	315704.97	455644.28
2002-03	269164.08	32406.11	350032.96	515076.15
2003-04	308970.04	36145.28	384360.95	574508.01
2004-05	348775.99	39884.45	418688.95	633939.87
2005-06	388627.70	44734.08	452082.23	697254.95

Source: Calculations based on CMI, various issues.

Table A-2.3.5

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Wearing Apparel)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	3732.50	2592.79	19665.29	25066.14
1991-92	3799.69	2468.34	18800.02	24364.29
1992-93	3866.87	2343.88	17934.74	23662.44
1993-94	3934.06	2219.43	17069.47	22960.58
1994-95	4001.24	2094.97	16204.20	22258.73
1995-96	4083.32	1976.79	15334.81	21500.02
1996-97	5879.98	2688.43	19015.16	26660.02
1997-98	7676.64	3400.08	22695.52	31820.03
1998-99	9473.30	4111.72	26375.87	36980.03
1999-00	11043.42	4823.37	30056.23	4214.04
2000-01	13195.17	4868.77	33919.73	47225.26
2001-02	15306.40	5190.11	37176.02	56198.06
2002-03	17417.62	5511.45	40432.32	65170.86
2003-04	19528.85	5832.79	43688.61	74143.66
2004-05	21640.08	6154.13	46944.91	83116.46
2005-06	23880.29	6498.52	50344.67	93268.42

Source: Calculations based on CMI, various issues.

Table A-2.3.6

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Leather and Leather Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	4595.96	1099.32	26992.21	31305.25
1991-92	4320.20	1044.35	25021.78	229207.80
1992-93	4044.44	989.39	23051.35	26922.52
1993-94	3768.69	934.42	21080.92	25012.89
1994-95	3492.93	879.46	19110.48	22915.44
1995-96	3164.79	826.98	17115.04	20664.68
1996-97	2949.58	893.14	16943.89	21139.97
1997-98	2734.38	959.30	16772.74	21615.26
1998-99	2519.17	1025.46	16601.59	22090.54
1999-00	2303.97	1091.61	16430.44	22565.83
2000-01	2326.04	1087.64	16411.32	23031.36
2001-02	2721.47	1261.66	16214.38	23307.74
2002-03	3116.89	1435.68	16017.45	23584.11
2003-04	3512.32	1609.71	15820.51	23860.49
2004-05	3907.75	1783.73	15623.58	24136.87
2005-06	4325.65	1991.61	15387.66	24310.90

Source: Calculations based on CMI, various issues.

Table A-2.3.7

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Leather Footwear)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	1753.71	1087.07	5579.82	7500.18
1991-92	1680.05	1074.03	5646.78	7650.18
1992-93	1606.40	1060.98	5713.74	7800.19
1993-94	1532.74	1047.94	5780.69	7950.19
1994-95	1459.09	1034.89	5847.65	8100.19
1995-96	1379.04	1023.94	6001.23	8274.19
1996-97	1197.01	995.78	5569.14	7984.59
1997-98	1014.97	967.62	5137.05	7695.00
1998-99	832.94	939.46	4704.96	7405.40
1999-00	650.91	911.31	4272.88	7115.80
2000-01	650.40	906.19	4234.65	7117.65
2001-02	884.54	969.62	4166.90	7359.65
2002-03	1118.69	1033.06	4099.14	7601.65
2003-04	1352.83	1096.49	4031.39	7843.65
2004-05	1586.98	1159.92	3963.63	8085.65
2005-06	1819.36	1227.37	3898.04	8350.49

Source: Calculations based on CMI, various issues.

Table A-2.3.8

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Ginning Processing and Bailing of Fiber)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	2494.25	1329.43	62235.39	70849.11
1991-92	2452.60	1191.17	62795.51	71557.60
1992-93	2410.94	1052.91	63355.63	72266.09
1993-94	2369.29	943.41	63915..75	72974.58
1994-95	2334.62	914.65	64475.86	73683.07
1995-96	2285.83	631.83	66254.51	74524.53
1996-97	2354.40	641.31	63604.33	73332.14
1997-98	2422.98	650.78	60954.15	72139.75
1998-99	2491.55	660.26	58303.97	70947.35
1999-00	2560.13	669.74	55653.79	69754.96
2000-01	2656.69	658.99	55654.70	68608.54
2001-02	3985.04	795.75	63001.12	78625.39
2002-03	5313.38	905.51	70347.54	88642.23
2003-04	6641.73	1015.27	77693.96	98659.08
2004-05	7970.07	1125.02	85040.38	108675.93
2005-06	9489.69	1232.51	92449.05	118800.23

Source: Calculations based on CMI, various issues.

Table A-2.3.9

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Wood and Cork Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	1612.21	307.57	1771.82	2827.29
1991-92	1550.95	306.95	1821.43	2878.18
1992-93	1489.68	306.34	1871.04	2929.07
1993-94	1428.42	305.72	1920.65	2979.96
1994-95	1367.15	305.11	1970.26	3030.85
1995-96	1310.38	303.43	2027.60	3089.04
1996-97	1212.10	265.50	1845.12	2755.42
1997-98	1113.82	227.57	1662.63	2421.81
1998-99	1015.54	189.64	1480.15	2088.19
1999-00	917.27	151.72	1297.66	1754.57
2000-01	919.73	152.60	1077.06	1433.36
2001-02	2096.98	154.43	1174.00	3282.39
2002-03	3274.24	193.50	1270.97	5131.43
2003-04	4451.49	213.95	1367.87	6980.46
2004-05	5628.75	234.39	1464.80	8829.50
2005-06	6814.03	255.66	1561.74	10704.46

Source: Calculations based on CMI, various issues.

Table A-2.3.10

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Furniture and Fixtures)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	562.71	191.29	1386.36	2008.82
1991-92	492.93	168.34	1217.22	1755.71
1992-93	423.16	145.38	1048.09	1502.60
1993-94	353.38	122.43	878.95	1249.49
1994-95	283.61	99.47	709.82	996.37
1995-96	216.45	75.87	542.06	747.15
1996-97	389.61	94.84	946.44	1262.68
1997-98	562.77	113.81	1350.81	1763.27
1998-99	735.93	132.77	1755.19	2293.75
1999-00	909.09	151.74	2159.57	2809.28
2000-01	333.79	72.81	2564.96	3320.67
2001-02	310.42	71.35	2128.92	2789.36
2002-03	287.06	69.90	1692.87	2258.06
2003-04	263.69	68.44	1256.83	1726.75
2004-05	240.33	66.99	820.79	1195.44
2005-06	223.99	65.75	369.81	698.94

Source: Calculations based on CMI, various issues.

Table A-2.3.11

Real Value of Capital Stock, Output, Employment Cost and Industrial Cost
(Paper and Paper Products)
2004-05=100

(Rs. Million)

Year	Value of Capital Stock	Employment Cost	Industrial Cost	Value of Production
1990-91	8371.21	1284.89	13682.21	19912.50
1991-92	8823.26	1286.17	13901.13	20350.58
1992-93	9275.30	1287.46	14120.04	20788.65
1993-94	9727.35	1288.74	14338.96	21226.73
1994-95	10179.39	1290.03	14557.87	21664.80
1995-96	10623.66	1291.09	14838.02	22120.13
1996-97	9880.00	1284.63	16128.93	23226.14
1997-98	9136.35	1278.18	17419.84	24332.14
1998-99	8392.69	1271.72	18710.74	25438.15
1999-00	7649.04	1265.27	20001.65	26544.16
2000-01	763.36	1261.69	20040.94	26595.21
2001-02	10997.80	1375.24	21042.99	31382.35
2002-03	14358.24	1488.79	22045.03	36169.49
2003-04	17718.68	1602.35	23047.08	40956.62
2004-05	21079.11	1715.90	24049.13	45743.76
2005-06	24568.02	1835.47	25041.94	49959.40

Source: Calculations based on CMI, various issues.

Appendix-III

Table A-3.1

CMI NUMBER OF REPORTING UNITS WITH INDUSTRIAL CODES

Industry with Code No.	Number of Reporting Units							
	1971	1976	1981	1986	1991	1996	2001	2006
Food Manufacturing (311 & 312)	489	363	494	730	858	931	880	1284
Beverages (313)	19	25	35	51	47	38	43	36
Tobacco (314)	39	17	20	18	19	15	12	13
Mfg. of Textiles 320 & 321	719	850	914	980	1135	1068	1063	1329
Wearing Apparel (322)	25	19	56	76	153	130	209	326
Leather & Products (323)	64	59	61	81	80	77	82	106
Leather Footwear (324)	30	17	19	21	24	15	13	36
Ginning & Bailing (325)	174	43	261	283	343	290	334	540
Wood & Cork (331)	23	22	22	32	39	45	35	57
Furniture & Fixture (332)	38	34	35	46	59	36	33	52
Paper & Products (341)	25	28	38	49	74	75	99	133

Source: Census of Manufacturing Industries (2005-06), Federal Bureau of Statistics, Government of Pakistan.