Impact of Energy Prices on Agricultural and Industrial Sector Productivity: A Case Study of Pakistan

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Energy prices.

Energy consumption.


بسم الله الرحمن الرحيم

APPROVAL SHEET

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DECLARATION

I, **Iftikhar Yousafzai**, MS Economics Degree Program vide Registration 336-SE/MS-ECO-2/F13, hereby declare that this dissertation is original and has never been presented in any other institution. I, moreover, declare that any secondary information used in this dissertation has been duly acknowledged. I, have also incorporated all the changes suggested by the supervisor, internal examiner and external examiner.

Iftikhar Yousafzai

DEDICATION

DEDICATED TO MY GREAT AND LOVING PARENTS WHO'S LOVE, PRAYERS AND SACRIFICES MADE ME ABLE TO REACH THIS LEVEL

هسکه شمله دی ټیټه مه شه

د پښتنو په شمله ویاړي تاریخونه

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Abstract

In modern times, energy has assumed the most important position in the process of production and the traditional factors of production are practically redundant if energy factor is missing or inadequate. Keeping in view the importance of energy in the development of industry and agriculture, this study attempts to examine the impact of changes in energy prices on the productivity of these sectors in Pakistan. The study also examines the interdependence of the agricultural and industrial sectors, using a time series data spanning from 1972-2014.

A simultaneous equation model is proposed in which separate equations for productivity in agricultural and industrial sectors, with energy consumption as a specific factor of production have been specified. Keeping in view the possible simultaneity problem and issue of heteroscedasticity, the study employs the Generalized Method of Moments (GMM) which is to yield reliable estimates as compared to other classical estimators.

The empirical results obtained are generally consistent with the theory. The coefficients of most of the variables carry the correct signs and magnitudes that are statistically significant. The findings reveal that energy prices have negative impact on agriculture and industrial sector productivity. The findings also reveal a strong positive interdependence of both the agricultural and industrial sectors in Pakistan economy, which means that both the sectors will push each other forward and equally pull each other backward.

Keeping in view the adverse impacts of energy prices on the productivity of agricultural and industrial sectors and the mutual interdependence of both on each other's productivity, this study suggests the need to ensure smooth and consistent supply of energy to these sectors with stable prices

Chapter 1

Introduction

GDP growth plays a pivotal role in the overall economic development of a country. However, most of the developing economies of the world are still seeking to identify the determinants of their economic growth, despite the fact that this issue has been resolved in the developed world long before. Economic growth is still the leading objective of developing economies, which is dependent on a number of factors, including investment and capital formation, the availability of skilled workers, the magnitude of trade, employment and other socioeconomic indicators.

It is well established that overall economic growth depends on the domestic sectoral growth, since all the productive sectors reinforce one another and significantly contribute to the grand total results. So developing economies can potentially enhance their economic growth by focusing on domestic sectoral growth. Agricultural and industrial are generally the two major sectors of the developing economies, which contribute significantly to economic growth. These two sectors absorb a large portion of the labor force and also provide raw material to each other as well as final goods to the domestic population. The contribution of these two sectors to gross domestic product (GDP) is also noteworthy. We will discuss the importance of the key sectors below.

1.1 Importance of Agricultural and Industrial Sector

Pakistan is an agro-based developing country and agricultural sector plays a vital role in the economic performance of the economy. After independence, the contribution of the agricultural sector in the gross domestic product (GDP) was very large, i-e about 50 percent. However, with the passage of time, this proportion has decreased gradually and that of the industrial sector increased. There are a number of reasons that are responsible for this trends.

Most significantly, the industrial sector has developed over time that absorbs most of the raw material from agriculture sector. Other factors for industrial growth include environmental change as well as changes in social, political and technological conditions. The share of agricultural has decreased over time and currently it is the second largest component of GDP of Pakistan (21% by 2014-15). On the other hand, the base of Pakistan's economy widened over time and so the industrial sector became the most significant productive sector. However, these changes in the economic compositions do not imply that agricultural sector has turned less important. This sector is the major source of food provision to both urban and rural population. Besides food provision agricultural sector is still the major source of employment for the rural population and its share is 43.5 percent. Agricultural sector is also the major source of earning the precious foreign exchange and its share in total export earning is approximately 60 percent by 2014-15. According to Pakistan Economic Survey 2014-15, the contribution of agricultural sector in the Gross domestic Product (GDP) of Pakistan remained 20.9 percent and its share in total employment is 43.5 percent.

Agricultural sector is very important for economic growth of a country like Pakistan. This is due the fact that more than sixty percent of a population is directly or indirectly dependent on the agricultural sector. The growth of agricultural sector is also significant for successful industrialization since it provides the necessary raw material to the industrial sector and also the surplus labor (Lewis Model 1954).

Despite the above facts, it is the industrial sector that plays the key role in the economic performance of a country. Nations that have focused on industrial sector in the 18^{th} and 19^{th} centuries have attained high growth rates, where as those who relied on agricultural sector have remained underdeveloped. The developed nations not only promoted industry but also

channelized technological change into agricultural. The technological progress has brought revolution in agricultural production through mechanization. The performance of industry

ial sector plays a crucial role in terms of employment generation and exports promotion. The industrial sector growth has direct correlation with GDP growth of a country, industrial sector helps in the structural transformation of economies which is very essential for the development of an economy.

According to Pakistan Economic Survey (2014-15), the contribution of the industrial sector to the GDP of Pakistan is 20.3 percent and its share in total employment is 14.2 percent. The government of Pakistan has been constantly focusing on the development of this sector since the early 1960s. It has successfully widened and diversified the base of domestic industry and now it is potentially producing varieties of products like variety of consumer commodities steel, heavy engineering and chemicals and tools industries. In addition, the industrial sector is producing the imports substitute goods which has decreased reliance on imported goods and saved foreign exchange.

1.2 The Interdependence between Agricultural and Industrial Sector

The inter-relationship between agricultural and industry has been a long debated issue in literature on development. Agricultural and industrial sector have equal importance for the growth of an economy. Both the sectors are interdependent on each other for production, i.e. agricultural production needs the industrial products like machinery, fertilizers, pesticides, croppers and other mechanical tools like motor and pumps for irrigation purpose. It is the industrial sector which develops new technologies and designs equipment and instruments through research and development segments. Thus, growth of the agricultural sector is equally dependent on the growth of industrial sector.

On the other hand, industrial sector is also dependent on agricultural sector. The agricultural sector provides raw material to the industrial sector for further processing and production of finished goods. These include, for instance, raw cotton, sugar cane and wood provided to the textile, sugar and sports industries respectively. This means that development in agricultural leads to development in industrial sector. Therefore, growth of industrial sector is linked with growth of agricultural sector.

A number of studies have been carried out to investigate the interrelationship between agricultural and industrial sector. Some of the studies conclude that agricultural sector has passive role, i.e. it just provides food, fiber and raw materials etc for industrial sector growth (Rosenstein-Rodan, 1943; Lewis, 1954; Ranis and Fei, 1961). Other researchers argue that economic development is the result of structural transformation in agriculture sector that enhance industrial sector activities in turn (Lewis 1954; Chenery 1979; and Kuznets 1965). Moyen Uddin (2015) showed that there is a bidirectional causal relationship between agricultural and industrial sectors and both the sectors reinforce each other as in the case of Bangladesh economy. Onakoya & Babatunde (2013) confirmed a positive relationship between agriculture and industrial sector in Nigerian economy. Subramaniam & Reed (2009) also confirmed a strong positive relation between agriculture and industrial sector in Poland and Romanian economy. Rashid (2004) showed that growth rate of industrial sector positively affects agriculture sector, where agriculture GDP growth does not play any significant role in industrial sector growth of Pakistan. Koo & Lou (1997) found that the industrial growth contributes to agriculture growth, but agriculture growth does not contribute to industrial growth significantly in China economy. Yao (1996) confirmed that agriculture sector affects industrial sector positively, whereas, the industrial sector affect agricultural sector negatively in China economy. Hye (2009) showed positive relation between both agricultural and industrial output in Pakistani economy.

1.3 Problem of Energy Shortage and Hike in Energy Prices

As discussed above, both the agricultural and industrial sectors play a very significant role in economic development of a country. However, the performance of these major sectors of the economy depends on a number of factors. In Pakistan, the agricultural sector has been facing many problems. One of the major issue is the low productivity, i-e low yield per acre. Another issue with the agricultural sector is the underutilization of the available land, i.e. only 28 percent of total area is used for cultivation and this is because of non-availability of water for irrigation. Water logging and salinity is the another major problem in canal-irrigated areas that leads to the wastage of cultivable land and decrease in overall agricultural production. According to a report, total loss of the cultivable land due to waterlogging and salinity in Pakistan is about 0.10 million acres per year which is a severe threat to the agricultural production. Other factors responsible for the low productivity include a proportion of unskilled labors employed in the agricultural sector and use of outdated production techniques. The inadequate and irregular use of pesticides and fertilizers etc. is also responsible for the low crop yield. Likewise, poor irrigation system, inappropriate transportation and storage facilities also adversely affect the agricultural sector production.

The industrial sector in Pakistan is also subject to many problems like non-availability of sufficient funds, poor planning, political instability and terrorism. During the past two decades terrorism has emerged as a major problem in big cities which is responsible for the downturn of investment and the resulting poor performance of the industrial sector. This has led to the withdrawal of foreign investment from the economy near to collapse of domestic industry. As evident from low production and the resulting decreasing trend of exports. However, the most severe problem nowadays faced by both the agricultural and industrial sectors is the energy shortage, which has in turn led to a hike in energy prices. As

both agricultural and industrial sector make intensive use of energy, therefore a rise in energy prices has adversely affected production in both sectors. Most of the industries are either shutting down or being shifted to other neighboring countries (Imran Naseem and Jawad Khan 2015).

Energy is a critical input which is used both in the agricultural and industrial sectors. Agricultural sector makes use of energy for running tractors, tube wells and other machinery used in farms, where, the industrial sector uses energy for running motor engine in industries and other machines. Hike in energy prices badly affect both the sector, due to rise in energy prices the costs of production increase which in turn affect the production of both the sectors. Due to rise in energy prices the transportation cost of supplying raw materials and finished good in to the market rises. The rise in energy prices leads to decrease in demand which in turn results into a downturn in the domestic production.

Over last few years, the world in general and Pakistan in particular, has been facing severe energy crisis. These crisis have multiple adverse effects on various sectors, particularly agricultural and industrial sectors. Like other developing economies, Pakistan is also one of the energy intensive growing economy. Its energy needs are met by large quantities of oil imports such as in most other non-oil producing countries. The production, industrial and trade activities of Pakistan have been badly affected due to the current energy crisis. Due to these reasons industry's management is continuously releasing labors and so unemployment increases continuously. The industrial sector of Pakistan is not capable of generating their own power. So the costly energy supply with continuous disturbance which results in loss of output production. Due to these reasons most of industries are shutting down or either shifting to the neighbor countries (Imran Naseem & Jawad Khan 2015).

Different researchers have examined the impact of energy prices on the agricultural and industrial sector productivity. For example Shaari et al, (2013) point out that oil prices adversely affect the agricultural sector. Similarly, Ikram & Waqas (2014) confirmed a negative effect of oil prices on the agricultural sector productivity of Pakistan. Jimenez-Rodriguez (2008) showed that oil price shock negatively affect the manufacturing sector output. Eksi et al, (2011) indicate that oil prices has negative impact on industrial output of OECD countries. Binuomote & Odeniyi (2013) show that world crude oil price negatively affect agricultural sector productivity of Nigeria. Nwosa & Ajibola (2013) highlight that the rise in gasoline price has negative impact both on agricultural and manufacturing sector production of Nigeria. Klinesen (2006), Linn (2006) showed that oil prices affect the manufacturing sector production of USA negatively, similarly Farzanegan & Markwardt (2009) confirmed it for Iranian economy. Twimukye & Matovu (2009) found that rise in the oil prices will significantly reduce the agricultural and manufacturing sectors output of Uganda. Sultan & Waqas (2014) showed that oil price has negative impact on the agricultural sector GDP in Pakistan.

The above discussion reveals that both the sectors are interdependent and none can develop without the development of other. However, the development of each sector is also constrained by some other factors. For example, fertilizer consumption in agricultural and trade openness to industrial sector. On the other hand, energy resources also play a very crucial role in the development of both the sectors and so the recent world-wide energy crises are believed to have adversely affected both the sectors. Energy issue has been much severe and so therefore received significant attention of researchers. This study is therefore carried out on the basis of two-fold objectives. The first fold is to examine the impact of energy crises (rise in the price of energy) on agricultural and industrial sectors and second is to examine the interdependence.

1.4 Statement of Problem

The agricultural and industrial sectors are considered as the back bone of an economy. Where the services act as the appendices (arms and legs) of the body. The energy shortage and rise in energy prices affect both the sectors adversely. So this study is design to address the impact of energy prices on the agricultural and industrial sectors. This study will also address the interdependence of both the agricultural and industrial sector. This study would enable us to explore the effect of energy prices on the key sectors (Agricultural and Industrial) of Pakistan. It would help us in identifying the key factors of the sectoral productivity and so in deriving useful policy recommendations. That is why this study is expected to be helpful in designing policies to overcome the energy crises to promote the sectoral productivity.

Specifically, the study is based on the following objectives.

1.5 Objectives of the Study

This study aims to meet the following objectives:

1. To investigate the impact of hike in the energy prices on agricultural and industrial sector productivity.
2. To examine, the relative magnitude of the impact of energy prices on agricultural and industrial sector productivity.
3. To examine the inter-sectoral dependence of agricultural and industrial sectors.

1.6 Research Questions

This study will address the following questions.

1. Do increase in the prices of energy sources affect the agricultural as well the industrial sector productivity?
2. Which of the two sector is greatly affected by hike in energy prices?
3. Is there any interdependence between agricultural and the industrial sectors?

1.7 Hypotheses

H_0: Increase in energy prices significantly and adversely affect the agricultural and industrial sectors productivity.

H_1: Increase in energy prices does not affect the agricultural and industrial sectors productivity.

H_0: The agricultural and industrial sectors significantly affect each other.

H_1: The agricultural and industrial sectors do not affect each other.

1.8 Rationale/ Significance of the Study

As it is evident that Pakistan has been facing severe energy crises in the form shortages in the sources. This shortage has led to a persistent rise in the energy prices particularly in the prices of petroleum products. These hikes in the prices of energy sources are considered to have serious impacts on the sectoral productivity, particularly the two major sectors: the agricultural and the industrial sectors. This study is therefore carried out to examine the sector-wise impacts of increase in energy prices on industrial and

agricultural sector productivity. A number of studies have been carried out to investigate the impact of the energy crises on the economy of Pakistan.

The above analysis reveal that there is no study which has simultaneously relied on both agricultural and industrial productivity for Pakistan. It is evident that both the sectors are interdependent and each of them is believed to have significant impact on the performance of the other one. This study therefore relies on the specification of separate equation for each agricultural and industrial sector productivity. It also makes sense to investigate the inter-sectoral impacts of both the sectors. That is; to evaluate the impact of agricultural sector productivity on the industrial sector productivity and that of the industrial on the agricultural sector productivity keeping in view the interdependence of both the sectors. That is; none of the studies has studied the impact of the agricultural sector productivity on industrial sector productivity so far, nor the impact of the industrial sector productivity on the agricultural sector productivity. This study is the first in this fashion that examine the inter-sectoral impacts of the agricultural and industrial sector productivity on each other.

Another distinction of this study is the way of estimation of our empirical model. That is; keeping in view the possible simultaneity in these equations, we estimate the model in the simultaneous equation framework as none of the equation in the simultaneous equations model can be estimated independently of the other.

1.9 Organization of the Study

The study is organized as follows: Literature Review is presented in Chapter 2. Chapter 3 discuss the theoretical framework of the study. In chapter 4 we discuss the model, variables definition, and estimation strategy and data sources. For results discussion we reserved chapter 5. Finally the conclusion and policy recommendations are discussed in chapter 6.

Chapter 2

Literature Review

2.1. Energy Prices and Productivity in Agricultural and industrial Sectors

This section provides a brief overview of the some of the existing studies related to this study that has been carried out so far.

The literature that we have reviewed for the development of the thesis, points that there are different opinions regarding the relationship between energy price, agricultural and the industrial sectors productivity. For example Shaari et.al (2013) examined the relationship between oil prices and agricultural, manufacturing, construction and transportation sectors of Malaysia using quarterly time series data spanning from 2000 to 2011. The results revealed that there is long run effect of the oil prices on the economic sectors. The results of the study also showed that granger causality exist between oil prices and agricultural, manufacturing and construction sector GDP excluding transportation sector GDP. The findings of the study also revealed that oil price affect both agricultural and construction sector.

Ikram & Waqas, (2014) empirically investigated the relationship between agricultural productivity growth and crude oil price for Pakistan using a time series data spanning from 1980 to 2013. Agricultural gross domestic product, real effective exchange rate, real crude oil prices, water availability, cropped area and fertilizer intake are the variables used in this study. Johanson co-integration test was applied for short and long run relationship among the variables of the study. The results showed that there is negative effect of oil prices and

excess intake of fertilizers on Agricultural productivity growth. Cropped area and water availability both have positive relation with agricultural productivity.

Chughtai & Kazmi (2014) investigated the impact of rise in oil prices on economic growth of Pakistan. This study used annual time series data from 1971-2013 to estimate the model. The results revealed that unit change in the oil prices will bring 17.53% variation in the economic growth. The results also showed positive impact of oil demand and supply on economic growth of the country.

Wang & McPhail, (2012) examined the impact of energy shocks on agricultural productivity growth and food prices. This study estimated a Structural VAR Model, using annual time series data for US economy spanning from 1948 to 2009. To measure the importance of energy price shocks, this study used variance decomposition method. Results indicated that changes in food prices respond positively to energy shocks in short run. Higher food price growth is caused by positive shocks in oil market. There is negative relationship between food price change and productivity growth in first year, however in the long run the response become insignificant approaching to zero. Variance decomposition analysis shows that both energy shocks and productivity shocks affect food price volatility equally with share of 10% in short run. While in intermediate term (3 years) the contribution of energy shock increases from productivity shock, the energy shock increases two fold of productivity shock that is 16 percent energy shocks contribution and 8 percent productivity shock contribution. However, energy shocks are more important in explaining the increase in food prices.

Saari & Rashid, (2007) investigated the impact of increase in energy prices on sectorial cost of production in the Malaysian economy for 92 firms over a cross section. This study used input-output model and took inter-industry relationship in calculating the sectorial cost of production. Results indicated that domestic petroleum price shocks greatly affect the cost

of production, while the imported petroleum prices had lesser effect. Those industries which have high consumption of petroleum products as intermediate input in their production process are greatly affected due to increase in the petroleum prices.

Jimenez-Rodriguez, (2008) examined the impact of oil price shocks on the output of manufacturing industries in six OECD countries. Monthly data was used in study spanning from 1975:1 to 1998:12 for all countries except France and Spain where the data was available after 1980:1. The bivariate VAR was employed for estimation. Findings of the study showed that oil price shocks affect manufacturing output negatively. The aggregate manufacturing output level decreased with increase in oil prices.

Qazi & Yulin, (2013) investigated the relationship between energy input, prices and industrial output in Pakistan. Annual time series data is used spanning from 1972 to 2010. Findings of the study shows that in long run there is significant impact of employment level and disaggregate energy on industrial output. A unit increment in the consumption of oil and coal lead the industrial output to rise by 0.21 percent. Whereas a 1 percent increase in gas and electricity consumption of will rise industrial output by 0.57 percent and 0.05 percent respectively. In short run there is significant effect of electricity and oil products consumption on industrial output. Oil consumption and industrial output have bidirectional causality but there is unidirectional causality between electricity consumption and industrial output.

Melick, (2014) examined the relationship between energy boom and manufacturing in the United States. This study uses panel data for eighty industries. Findings of the study indicate that fall in the relative price of natural gas will rise capital expenditure by 50 percent and employment by 30 percent for energy intensive industries. The effect is modest for the whole manufacturing sector. As a whole capital expenditure increases by 10 percent,

industrial production by 3 percent and employment level rises by less than 2 percent. This fall in the relative price of natural gas decline imports by 30 percent for energy intensive industry while for whole manufacturing sector it declines by less than 1 percent. Energy boom have quite small effect on whole manufacturing sector.

Mehrara & Sarem, (2009) examined the impact of oil price changes on industrial production for three oil exporting countries namely Iran, Saudi Arabia and Indonesia. Annual time series data spanning from 1970 to 2005 is used for the analysis. Findings of the study shows that there is unidirectional causality between output and oil prices in the long run for Saudi Arabia and Iran. There is no significant role of oil price shocks in long run output for Indonesia.

Ferguson & Sanctuary, (2013) investigated heterogeneous effects of domestic electricity price increase on the structure of intermediate inputs. Annual time series data spanning from 1998 to 2007 for 4194 Swedish firms is used. Findings of the study indicate that 1 percent increase in the electricity price rises import intensity by 1.1 percent significantly. Firms increases the import of those intermediates which are high electricity intensive.

Bolaji & Bolaji, (2010) investigated the effect of increase in oil prices on the manufacturing companies of Nigeria by using primary data. The results show that cost and quantity of raw materials of companies is affected due to rise in oil prices. Majority of manufacturing companies (about 90 percent) experience decline in there production because of increase in oil prices. The production of 40 percent companies reduced by 20 percent, 30 percent company's production reduced by 30 percent, 10 percent company's production reduced by 60 percent and the production of remaining 10 percent companies declined below 50 percent. The market demand of the products declined which reduced the profit.

Ekşi, Izgı, & Şentürk, (2011) investigated relationship between oil prices and industrial production for some OECD countries. Monthly time series data was used spanning from 1997:1 to 2008:12 for the analysis. Findings of the study indicates that in short run there is statistically significant causality from crude oil price to industrial production except France. For France the causality is from industrial production to oil prices in short run. For US the causality is from oil prices to industrial production in long run. In simple the industrial production is affected from oil prices.

Binuomote & Odeniyi, (2013) examined the effect of crude oil prices on agricultural sector productivity of Nigeria. Annual time series data spanning from 1981 to 2010 is used for the analysis. Findings of the study shows that exchange rate has significant effect both in short run and long run with value 0.066 and 0.076 respectively, which rises the agricultural productivity. The crude oil is significant with negative coefficient of 0.04 in short run while insignificant in the long run with coefficient 0.034. There is negative effect of world crude oil price increase on agricultural productivity. Advent of crude oil negatively affect the agricultural sector of Nigeria. The agricultural productivity is positively affected by capital investment in the long run with coefficient of 73.07. The labor quantity negatively affect agricultural sector productivity with coefficient -18.032.

Mirza et al (2014) examined the impact of electricity consumption on industrial and services sectors output for Pakistan using annual time series data spanning from 1971-2001. Findings of the study revealed positive impact of electricity consumption on both industrial and service sector output. That is; the findings show that a one percent increase in electricity consumption would increase industrial output by 0.096 units and services sector output by 1.8 units. Technical efficiency have also positive and significant impact on both the sectors. The prices of electricity has negative relation with industrial output and services sector.

These results shows that a unit increase in the price of electricity will reduce industrial output by 1.7 unit.

Javid & Qayyum, (2013) investigated the relation between electricity consumption and sectorial (residential sector, commercial sector, industrial sector and agricultural sector) GDP for Pakistan using time series data spanning from 1972-2012. Findings of the study shows that the magnitudes of income and price elasticities at the aggregate level (aggregated over all the sectors) are 1.89 and -0.09 respectively. The long run income and price elasticities for residential sector are 0.20 and -0.07 respectively, whereas the long run income and price elasticities for commercial sector are 0.17 and -0.26 respectively. For industrial sector, the long run income and price elasticities are 1.29 and 0.21 and for agricultural sector the income and price elasticities are 0.43 and 0.08 respectively.

Alper & Tourl, (2010) examined the asymmetric effects of oil prices on the manufacturing sectors for Turkey using a time series data for the period spanning from 1990-2007. The findings reveal that changes in oil product prices neither predict total industrial output nor manufacturing growth. Findings of the study reveal that increase in the prices of domestic oil product reduces the growth rate of some of the subsectors (wood & wood products, chemicals & chemical products, rubber and plastic products and furniture sectors). Results also show that a unit change in the oil price will lead to increase the manufacturing sector production by 0.06 units although not significant.

Nwosa & Ajibola, (2013) examined the impact of gasoline price on various sectors of the economy of Nigeria using time series data ranging from 1980-2010. The results showed that there exist two co-integrating relationship for the agricultural sector. The manufacturing sector model exist only one co-integrating equation indicating a long run relationship among the variables concerned. Findings of the study shows that a 1 percent increase in the gasoline

price will reduce the agricultural outputs by 22 percent and that of transportation sector by 20 percent. This increase in gasoline price will reduce the manufacturing output by 17.4 percent, whole sale by 23.1 percent and the communication output by 89.0 percent. The short run results showed that a 1 percent rise in the current gasoline price decline current agricultural output by 6.2 percent, while current manufacturing output decline by 7.3 percent.

Lee & Ni, (2002) employed a monthly time series data ranging from 1959:1-1997:9 to examine the dynamic impacts of the oil price shocks on USA. Findings of the study revealed that the contemporaneous elasticity of automobiles output with respect to the oil prices shock is -0.4 and for petroleum refinery is about 0.4. The standard deviation of oil price shock is 1.9 percent according to variance covariance matrix results. The peak automobile output response is about 1.7 percent. In most of the industries, there is similarity of output response to oil price shock.

Klinesen, (2006) employed a time series data ranging from 1979:1-2006:2 to investigate the impact of increase in natural gas price on economic activity of USA. Findings of the study show that changes in the prices of natural gas predict total manufacturing output insignificantly. The results show that a 1 percent increase in prices of natural gas and crude oil will reduced manufacturing output by 0.99 percent and 2.06 percent respectively. On the other hand, extending the Hamilton specification to 36 months (i-e three years), the associated coefficients are 1.86 and 4.4 percent respectively which are enough larger than the previous specification (one year).

Twimukye & Matovu, (2009) examined the impact of high energy prices on the macroeconomic indicators and welfare on the economy of Uganda using Social Accounting Matrix (SAM) 2007. The findings highlighted that rise in the oil prices will significantly

reduce the manufacturing, agricultural and transport sectors output. The combined effect of both the oil price shock and electricity generation will decrease the growth rate of manufacturing sector.

Mushtaq et al (2007) examined the causal relationship of the various sources of energy use with agricultural sector and per capita GDP of Pakistan using a time series data spanning from 1972-2005. The results revealed that there is unidirectional causality running from per capita real GDP to oil consumption. The results also revealed that increase in growth rate of agricultural sector will increase oil demand. The findings indicated that there is unidirectional causality running from electricity consumption to per capita real GDP and no causal relationship between gas consumption and per capita real GDP.

Bekhet & Abdullah, (2010) used a time series data ranging from 1991-2000 to examine the intensity of the various sources of energy in the agricultural sector for Malaysia. The findings of the study indicated that the use of energy in the agricultural sector increased 440 percent in 2000. This implies that the connectedness of agricultural sector with the energy sector has been increased during the study period (10 years). The use of energy input rises significantly in the agricultural sector in terms of direct and backward linkages over the study period.

Dar et al (2013) employed time series data ranging from 1980-2000 to quantify the impact of energy consumption on economic growth of Pakistan. The findings of the study revealed that as compare to emerging economies (China, India, Malaysia, Indonesia, Philippine and Bangladesh), the manufacturing market of Pakistan is relatively small and so rise in energy prices adversely affect the economy. The findings of the study indicated that rises in the energy prices lead to increase the production costs and so lead to reduction in production.

The results highlighted that the uninterrupted supply of electricity and sizable industrial sector of an economy are the key casual factors of economic growth.

Korsakiene et al (2013) examined the impact of energy prices on industrial sector and export of Lithuanian economy using a time series data spanning from 2003-2010. The findings of the study revealed that final energy consumption and GDP has strong and positive relationship, having correlation coefficient of 0.8 for Estonia, 0.8 for Latvia and 0.8 for Lithuania. The correlation coefficient for export and final energy consumption is 0.7 for Estonia, 0.8 for Latvia and 0.7 for Lithuania. The results showed that there is negative relationship among exports and energy prices but positive relationship between the oil prices and exports in Lithuania. The findings indicated a strong positive relationships between GDP and final energy consumption and export and final energy consumption for Estonia, Latvia and Lithuania.

Adjaye, (2000) employed a time series data ranging from 1971-1995 to examine the relationship between energy consumption, energy prices and economic growth for four Asian developing countries (India, Indonesia, Philippines and Thailand). The findings of the study revealed that for India there is unidirectional causality running from energy consumption to income in the short run. Energy price turned out to be neutral in case of energy and income. The results for Indonesia is similar to that of India, but in the long run the income and prices has no impact on energy consumption, whereas, the energy consumption and income granger causes price changes. For Thailand, the results shows that energy consumption granger causes income both in short and long run and both price and income granger cause energy consumption. In case of Philippines granger causality running from energy consumption and energy prices to income both in the short and long run but reverse causality that run from energy consumption to income.

Sultan & Waqas, (2014) examined the relationship between the oil price and real GDP growth for Pakistan using a time series data spanning from 1980-2012. The findings of the study show that both short and long run relationship exist between oil price and real GDP growth. The results also indicate that there is negative relationship between oil price and agricultural GDP in Pakistan. That is; a 1 percent increase in oil price will lead to decrease the agricultural GDP by 6.6 percent. The results also show that of trade balance and CPI have positive impact on agricultural GDP with the coefficients of trade balance is 0.56 and that of the CPI is 4.5.

Javed et al (2010) examined the impact of technology on agricultural sector growth of Pakistan using a time series data spanning from 1971-2007. The findings of the study indicated that fertilizer and tube wells have positive and significant impact agricultural growth. However, the use of tractors and pesticides have positive but insignificant impact on economic growth.

Soytas & Sari (2007) employed a time series data ranging from 1968-2002 to examine the relationship between energy and manufacturing output of Turkish economy. The findings of the study revealed a long run relationship between electricity consumption and manufacturing output. The results depicted a unidirectional causality that run from electricity consumption to the manufacturing value added in the long run. Fixed investment has bidirectional relation with the manufacturing output but unidirectional relationship between employment and manufacturing output in short run only. The findings of the study also revealed that the negative impact of fixed investment on the manufacturing value added is 50 percent for the first five years and that of the electricity is percent 26 percent.

Linn, (2006) investigated the impact of oil price shock on the manufacturing sector of USA using a time series data spanning from 1963-1982. The findings of the study revealed that

1 percent increase the oil prices will lead to decline in the value added of average industry by 0.024 percent, whereas, the materials supply and output demand remain same. The overall effect of oil prices on value added showed that 1 percent increase in the oil prices will reduce the value added by 0.07 percent.

Cobo-Reyes & Quirós, (2005) examined the impact of oil prices on industrial output and stock return using a monthly time series data spanning from 1963:1-2004:5. The findings of the study revealed that in case 1, oil prices has negative and insignificant effect on industrial output and stock return. Where as in case 2, results indicated a negative and statistically significant relation with industrial output and stock return. That is; 1 percent rise in the prices of oil will reduce industrial output and stock return by 0.0064 and 0.017 percent respectively. The overall results showed that the oil price has negative impact on industrial output and stock return but statistically significant.

Huang, Hwang & Peng, (2005) used monthly time series data ranging from 1970-2002 to examine the impact of oil price on industrial output and stock return of USA, Canada and Japan. The findings of the study showed that change in oil prices cause a 3.69% change in industrial output of Canada, where the US industrial output changes by 5.10% and there is no significant impact on industrial output of Japan.

Yusuf, (2015) employed quarterly time series data ranging from 1970-2011 to investigate the impact of oil price shock on economic growth of Nigeria. The findings of the study showed long run relationship share of crude oil price, unrest oil shocks and nominal exchange rate to agricultural output is less than that of real GDP. The results revealed that 1percent change in exchange rate will change agricultural output by 0.3 percent. The results also showed that 1 percent change in oil price and unrest oil shock will change agricultural

output by 0.07 percent and 0.2 percent respectively. Whereas the GDP explains 2.1 percent variation in agricultural output.

Farzanegan & Markwardt, (2009) employed a quarterly time series data ranging from 1988-2004 to examine the impact of the oil prices on Iranian economy. The findings of the study revealed that both positive and negative oil shock has inflationary effects on the economy. The positive oil shock effect industrial output positively, that is 8 percent in first quarter having little fluctuation about 11 percent at the end of the period. Where the negative oil price shock rise the share from 3 percent in first quarter to 22 percent in the 12th Quarter. The negative oil price shock change real effective exchange rate by 11 percent. Negative oil price shocks affect industrial output, real effective exchange rate and real import adversely but statistically significant.

Azam khan et al (2009) investigated energy input and output for agricultural sector of Pakistan using a time series data spanning from 1981-82 to 2005-06. The findings of the study showed that energy consumption in agricultural sector increases by 42 percent in 2005-06 than 1981-82. The human, animal and petroleum energy decline during the study period from 41 to 34 percent, from 27 to 9.6 percent and from 6 to 5.5 percent respectively. Whereas tractor energy and electricity consumption increase from 0.01 to 0.02 percent and from 26 to 51 percent respectively. The results also revealed that fertilizer consumption increased by 3.5 folds, which means that fertilizers consumption increase in the future.

Siddiqui, (2004) employed a time series data ranging from 1970-2003 to examine the relationship between energy and economic growth of Pakistan. The findings of the study revealed that increase in capital stock, electricity consumption and petroleum products has significant impact on economic growth. Whereas increase in the natural gas consumption has no effect on economic growth. Economic growth is not effected by total energy use but

it effect economic growth when energy is divided into its different parts. The results also indicated that output growth is affected positively due to rise in electricity and petroleum products consumptions. Gas consumption has no significant impact on economic growth. The findings of the study revealed that energy is key factor for determining economic growth. The results also showed that increase in level of energy may increase growth where energy shortfall slow down growth process.

Zaman et al (2012) investigated the relationship between energy demand and agricultural technology using a time series data spanning from 1975-2010. The findings of the study revealed that if total primary energy consumption increases by 1 percent than tractor use will increase by 0.43 percent per 100 sq.km of arable land, the agricultural irrigated land increase by 1.7 percent of total agricultural land and the agricultural value added will increase by 1.9 percent in GDP. Whereas there is negative relationship between primary energy consumption and industrial value added. The results also showed that there is positive and significant relationship between electricity consumption per capita and agricultural technology. That is; if there is 1 percent increase in electricity consumption per capita the use of tractors will increase by 0.89 percent, agricultural irrigated land will increase by 3.07 percent and that of agricultural value added will increase by 3.17 percent. The results showed bidirectional causal relationship between total primary energy consumption and tractors. Whereas there is unidirectional causal relationship run from electricity consumption to livestock production, agricultural value added and industrial value added.

Herrera, (2011) employed a monthly data spanning from 1947:1-2009:9 to examine the asymmetric and nonlinear relationship between oil prices and industrial production for USA. The findings of the study showed that the relationship between oil price and industrial production is nonlinear. The results also revealed that by using net oil price increase for last

12 months maximum specification there is some evidence of non-linearity in the industrial production. This study also checked the nonlinearity for 36 months but there is less statistical evidence of nonlinearity in 36 months specification than 12 months specification. The results also showed that the response to positive oil price shock is larger than the negative shock.

Narayan & Sharma, (2011) used daily data for the period spanning from 5 January 2000-31 December 2008 to examine the impact of oil prices on firms return for USA. The findings of the study revealed that the firm returns are affected differently by oil prices because it depends on the sector of firm to which it belong. The firm returns of 12 sectors falls due to rise in oil prices, whereas the return of energy and transport sector rises due to rise in oil prices. The results also showed that oil prices affect firm returns with a lag. That is oil prices affect firm returns negative and significant effect either on lag two or five. Finally the results revealed that for small size firm the oil prices and firm returns has positive and statistically significant relationship.

Naseem & Khan, (2015) employed annual data spanning from 1982-2011 to examine the impact of energy crisis on economic growth of Pakistan. The findings of the study showed that there is positive correlation between energy consumption and economic growth. That is increase in one variable value will lead to increase the value of another. The results also revealed that if energy consumption increase by 1 kilo ton of oil equivalent than GDP will rise by $2.517 million. Finally the results showed that there is strong correlation between energy consumption and economic growth for Pakistan.

Mahmud, (2000) examined the role of energy in the manufacturing sector of Pakistan by using annual data spanning from 1972-1993. The findings of the study revealed that the energy price shock may lead to a significant rise in the production cost of industries. The

results also showed that the investment in capital goods is not adversely affected by energy price shocks. Finally the results indicated that there is meaningful substitution possibilities between electricity and gas.

Chebbi & Boujelbene, (2008) examined the relationship between energy consumption and sectoral production of Tunisia for the time spanning from 1971-2003. The findings of the study showed that there is unidirectional causal relationship between various sectors (i.e. agricultural, manufacturing and services sector) and energy consumption in the long run. The results also showed that the relationship between Tunisian GDP and energy consumption is also unidirectional. The finding of the study also relied that the growth of Tunisian agricultural sector is not dependent on energy and higher use of energy does not mean greater extent of agricultural productivity in short term.

Ifeakachukwu & Temidayo, (2012) using annual time series data spanning from 1980-2010 examined the nexus between energy consumption and sectoral production of Nigeria. The findings of the study revealed that there is unidirectional causal relationship between energy consumption and agricultural production, while the results also found unidirectional causal relation between services sector and energy consumption. The results concluded that casual relation between energy consumption and production of different sectors may be dissimilar.

Akpan, (2009) investigated the impact of change in oil prices on Nigerian macro economy by using quarterly time series data spanning from 1970-2007. The results showed positive connectedness between positive change in oil prices and government expenditure. The results also revealed that change in oil prices marginally affect industrial production insignificantly. Which means, that oil price fluctuation affect industrial output by 2.5 percent and 6 percent in the fourth and tenth quarters.

2.2. Interlinkage between Agricultural and Industrial Sectors

Moyen Uddin, (2015) investigated the causal relationship between economic sectors for GDP growth in Bangladesh by using annual data spanning from1980-2013. The findings of the study revealed that the long run relationship exist between the variables. The results also showed that there is bidirectional causality between agricultural sector and GDP, whereas there is unidirectional causality run from industry sector to GDP and there is no causal relationship between services sector and GDP. The findings also revealed that there is unidirectional causality run from services sector to agricultural sector and industry sector to services sector. Finally the results showed that there is bidirectional causal relationship between agricultural and industrial sectors. The results showed that both agricultural and industrial sectors determine each other.

Saari et al (2013) examined inter sectoral linkages between agricultural and industrial sector of Malaysia by using input-output table 2005 published by the department of statistic Malaysia. The findings of the study for backwards linkages revealed that if agricultural sector is removed from economy the total output will decrease by 1.8% from original. That is 32% loss in agricultural sector, 32.4% and 35.6% loss in manufacturing and services sector respectively. The results of forward linkages showed that if agricultural sector production is removed total output would decrease by 5.6%. Due to which the output of other sectors decrease by 50% in which 37.1% decline in the manufacturing sector and 13% in the services sector.

Onakoya & Babatunde, (2013) employed annual data ranging from 1970-2010 to examine the sectoral relationship between agricultural, manufacturing and services sectors for Nigeria. The findings of the study revealed that the agricultural sector production is positively related to the production of manufacturing and services sectors. This means that

one percent increase in the manufacturing sector output will rise agricultural production by 0.44 percent, whereas one percent rise in services sector will increase agricultural sector output by 0.05 percent. The results also showed that oil sector has negative relation with agricultural sector production. This means that one percent increase in oil sector will reduce agricultural sector production by 0.41 percent. There is bidirectional causal relationship between agricultural output, manufacturing sector output and services sector.

Alhowaish et al (2012) examined the inter-sectoral relationship between agricultural, industrial, oil and services sector by using annual data spanning from 1970-2012 for Saudi Arabia. The findings of the study revealed that that there is bidirectional causality between agricultural, oil and services sectors in the short run. The results also showed that there is unidirectional causality between economic growth and industrial output. The results also confirmed unidirectional causal relationship running from industrial sector to agricultural sector. The industrial and services sectors growth has short run unidirectional causal relation with oil and gas sector growth. The findings of the study also revealed bidirectional causal relationship between industrial sector and services sector output.

Matahir, (2012) employed annual data ranging from 1970-2009 to examine the inter relationship between agricultural and industrial sector of Malaysia. The findings of the study revealed that both agricultural and industrial sectors are co-integrated in the long run. The results also show that unidirectional causal relationship run from agricultural to industrial sectors in both short and long run.

Subramaniam & Reed, (2009) employed annual data ranging from 1989-2007 to investigate agricultural inter-sectoral linkages and its contribution to economic growth of transition countries (i-e Poland and Romania). The findings of study showed that there is three long run co-integration relationships for Poland and One for Romania. All the three long run co-

integration relationships show positive sign of industries, which showed that the industrial and agricultural sector has strong positive relationship. Whereas the services sector seem to be detrimental to the growth of agricultural sector. The results also revealed that the Romanian agricultural is negatively affected by the industrial sector and positively by the services sector. In short run services sector play a key role in overall economic growth in Poland, while the results are not significant for Romania. That is; a 1 percent increase in growth of services sector leads to a more than 2 percent growth in agricultural and industrial sector holding all other variables constant. Growth of industrial sector affect the other two sectors negatively in Poland similar effect is observed in Romanian economy. The role of agricultural is not significant to other sectors in short run but there is a positive impact on the industrial sector of Romania.

Rashid, (2004) examined the sectoral linkages among industrial, services and agricultural sector by using annual data for the period spanning from 1971-2002 to identify the key growth stimulating sectors of Pakistan economy. The Findings of the study indicated that the industrial sector plays an important role in determining the overall growth rate of economy. Industrial sector growth rate leads to increase growth rate of agricultural sector. That is 1 percent increase in industrial growth leads to 0.5 percent increase in growth rate of agricultural sector. Industrial growth rate is also positively related to service sector growth rate. That's 1percent increase in growth of industrial sector leads to 0.8 percent growth in services GDP1 and 1.5 percent growth in services GDP2. Agricultural GDP growth does not play any significant role in the growth of other sectors. The industry growth has significant influences and granger causes agricultural sector growth. Services sector growth influence agricultural growth rate but does not granger causes growth in industrial sector.

Gemmell, Lloyd, & Mathew, (1998) examined dynamic sectoral linkages and structural change in the developing economy for Malaysia by using annual data ranging from 1971-1991. The findings of the study revealed that in the long run agricultural sector only adjusts the sectoral disequilibrium. The results showed that growth in manufacturing and services sectors does not granger causes agricultural sector growth, whereas the growth in agricultural sector granger causes the growth of manufacturing and services sectors. That is 1 percent increase in manufacturing or services sector GDP leads to 0.6 percent rise and 0.4 percent fall in agricultural GDP. The underlying growth rate in agricultural is estimated at 2.8 percent per year, a little over half the actual growth rate. Indicating a substantial degree of inter sectoral interdependence. The short run impact is that 1 percent increase in growth rate in either manufacturing or services sector retards growth in agricultural by 0.4 percent and 0.7 percent respectively.

Koo & Lou, (1997) examined the interdependence of Agricultural and industrial sector by using panel data for the period spanning from 1988-1992 for China. The findings of the study revealed that the industrial growth contributes to agricultural growth, but agricultural growth does not contribute to industrial growth. Labor variable has positive sign and statistically significant at 5% level in both agricultural and industrial growth model. Investment variable is positively related to agricultural income growth but statistically insignificant at 5% level. However it is significant at 5% level for industrial sector. The trade variable has positive sign and statistically significant. Implies that foreign trade has a positive impact on growth of Agricultural and industrial sectors. Land was found to be positively and significantly related to the agricultural growth rate.

Kaur et al (2009) employed annual data for the period spanning from 1985-86 to 2007-08 to examine the inter-sectoral linkages for India. The findings of the study revealed that there is strong inter-sectoral linkage between services, agricultural and manufacturing sector in

the long run. The result of the study also showed that change in one sector influence the performance of other sectors over time. The findings of the study showed that all the three sectors show strong long run equilibrium.

Gaspar et al (2006) examined the inter-sectoral linkages between three sectors of Portugal for the period spanning from 1970-2006. The findings of the study revealed that in the long run agricultural sector does not influence the performance of other sectors. The services sector use less agricultural products than industrial sector, due to dominance of service reduce the importance of sectoral linkages. The results also showed that agricultural sector is not affected by the growth of other two sectors. The results also confirmed that in terms of productivity the growth in services and manufacturing sectors expand the growth of agricultural sector, whereas there is weak linkage in the case of industry.

Roland & Darvin, (2008) examined the long run and short run relationship between agricultural, industry and services sectors for two sub periods spanning from 1946-1969 and 1970-2003 for Barbados economy. The findings of the study revealed that the agricultural GDP is lower than industrial and services sectors GDP in the long run. Whereas in the short run change in industrial output raises the agricultural output. The results also showed that raise in services sector output influenced the output of industrial sector both in short run and long run. The results also revealed that there is no significant impact of agricultural sector output in either timeframe.

Houssem & Lassaad, (2007) employed annual data spanning from 1961-2005 to examine the interaction of agricultural sector with other sector in Tunisian economy. The findings of the study confirmed that in short run agricultural sector do not motivate the growth of other sectors significantly, whereas in the long run all economic sectors are moving unitedly. The

results also showed that the agricultural sector growth may not contribute directly on the industrial and services sectors growth in the short run.

Katircioglu, (2006) employed annual data spanning from 1977-2002 to examine the relationship between agricultural, services and industrial sectors of North Cyprus. The findings of the study revealed that agricultural sector is the main contributor in the growth of services and industrial sector in the long run. The results also showed that the agricultural sector contributes in overall growth of an economy.

Yao, (1996) examined the relationship between agricultural and non-agricultural sector by using annual data spanning from 1952-92 for China. The findings of the study revealed that all other sectors of china economy are stimulated by the agricultural sector, whereas the industrial and services sectors has small impact on the growth of agricultural sector. The results also showed that the agricultural sector has statistically positive and strong impact on the growth of all other sectors after 1979. The results also confirmed that industrial sector has negative relation with all other sectors.

Mamta & Khorshed, (1995) employed annual data spanning from 1968-1988 to examine the growth linkages between agricultural and industrial sectors for thirteen Asian countries. The data from 1968-92 is used for China, Malaysia and Sri Lanka. The findings of the study revealed that rise in the agricultural sector output will increase the industrial sector GDP. Whereas for Thailand, Pakistan, Austria and Bangladesh the sample period is used after separation of East Pakistan. The results showed that the growth in agricultural sector is caused due growth in the industrial sector.

Yao, (1994) examined the inter-sectoral linkages between the agricultural, industry, transportation, construction and services sectors by using annual data spanning from 1952-92 for China. The findings of the study revealed that the agricultural sector is the driving

force for all other sectors, which is weakly related to the other sectors. The results also showed that agricultural sector has little impact on the growth of various sectors of the economy. The results also confirmed weak exogenity problem which is due to biased policies of the government against agricultural sector.

Hye, (2009) employed annual data spanning from 1971-2007 to examine inter linkage between industrial and agricultural output of Pakistan. The findings of the study showed that industrial output affect agricultural output supportively, which means that if there is 1 percent rise in industrial output than agricultural output will increase by 0.52 percent. Whereas the agricultural output is adversely affected by industrial output in the short run. The results also showed that agricultural output affect industrial output positively both in the short and long run, which means that if there is 1 percent rise in agricultural output the industrial output will increase by 1.98 percent. The results show bidirectional relationship between agricultural and industrial output.

The above discussion concludes that there are many studies that have been conducted to examine the relationship between energy prices and the manufacturing and agricultural sectors. However, this discussion also highlighted that there is no studies that has simultaneously relied both on the agricultural and manufacturing sectors of Pakistan. The discussion also concluded that different researchers have concluded different opinions regarding the nature of the above said relationship. This is carried out in different fashion as it simultaneously rely both on the agricultural as well as the industrial sectors. The study also intends to investigate the interdependency of both the sectors as none of the above reported studies have examined.

2.3. Gap in the Literature and Rationale for the Study

As it is evident that Pakistan has been facing severe energy crises in the form of shortage in the sources. This shortage has led to a persistent rise in the energy prices particularly in the prices of petroleum products. These hikes in the prices of energy sources are considered to have serious impacts on the sectoral productivity, particularly the two major sectors: the agricultural and the industrial sectors. This study is therefore carried out to examine the sector-wise impacts of increase in energy prices on industrial and agricultural sector productivity. A number of studies have been carried out to investigate the impact of the energy crises on the economy of Pakistan.

The above analysis reveals that there is no study which has simultaneously relied on both agricultural and industrial sector productivity for Pakistan. It is evident that both the sectors are interdependent and each of them is believed to have significant impact on the performance of the other one. Therefore examining the performance of any one of the two sectors in isolation does not make any sense. The above discussion provides enough rationale to consider both the sectors simultaneously while examining the sectoral impacts of energy shocks. This study therefore relies on the specification of separate equation for each agricultural and industrial sector productivity. It also makes sense to investigate the inter-sectoral impacts of both the sectors. That is; to evaluate the impact of agricultural sector productivity on the industrial productivity and that of the industrial sector productivity on the agricultural sector productivity keeping in view the interdependence of both the sectors. That is; none of the studies has studied the impact of the agricultural sector productivity on industrial sector productivity so far, nor the impact of the industrial sector productivity on the agricultural sector productivity. This relationship can be tested and make sense if we properly handle the possible simultaneity problem in the model.

Chapter 3

Theoretical Framework

This chapter is supposed to show the theoretical linkage of variables to the problem. This shows the relevance of the key variables of the study that reader can easily understand theoretical relationship among the focus variables. This chapter determines the theoretical reason behind the study.

3.1 Energy Prices and Productivity in Agricultural and Industrial Sectors

Energy play key role for running the economic activities and thus energy crises directly affect all the economic sectors of a country. Agricultural and industrial sectors are also the victims of such crises and therefore affect all the macroeconomic indicators. Most of the developing countries are energy intensive economies Pakistan is also one of them. From last two decades Pakistan is facing worst energy crises and met its energy demand by imports of oil like other non-oil exporting countries. These energy crises badly affect the production, trade and industrial activities of Pakistan. Due to decrease in these activities the management of the industrial sector releasing labor continuously due to which unemployment rises. Whereas the other countries of the world are helping the industries by providing cheaper inputs. By facilitating the industries with many incentives and cheaper input cost increases the productivity, exports and competitiveness in the world market, which boost their economies. However, the Pakistani industries are facing many challenges like tax burden, costly energy supply with continuous disturbance which results loss in the production. Most of the Pakistani industries are not capable to generate their own power.

Because of the above reasons most of the industries are shutting down or shifting to neighbor countries (Imran Naseem & Jawad Khan 2015).

Energy shortages lead to stagnation of the industry, raising the cost of production, which consequently leads to increase in the prices of finished goods. As a result in the local market, consumers have to bear it and as well as in the international market price competitiveness reduces exports. These persistent hikes in the energy prices lead to destruction of the economy.

This rise in oil price began in the last decade, due to which the prices of other energy sources also increased in Pakistan. Over the last few years, the world in general and Pakistan in particular, is facing severe energy crisis. These crisis have multiple adverse effects on various sectors, particularly agricultural and industrial sectors. This shortage in the energy prices has led to increase in energy prices, thereby adversely affecting both the agricultural and industrial sectors of Pakistan as energy is the most critical input to the production of both the sectors. Agricultural sector makes use different kinds energy, i-e electricity is used in the irrigation process, mainly for running tube wells. Light speed diesel is used for running tractors and croppers that work in agricultural farms. It is used in running motor engines installed in tube wells. Industrial sector is relatively highly exposed to energy as it depends on the extensive use various kinds of energy in the production process. All this means that the two main sectors are critically exposed to energy and so any shock to energy is expected to yield high loss to both the sectors which further leads to economy-wide adverse impacts.

In addition globalization has also lead world-wide energy crisis. Increase in supply of energy resources could not follow increase in global demand and so the gap between demand and supply has been increasing continuously. This has led to a massive increase in

energy price and so increase in price of inputs to industries. Energy issue has been much severe and so therefore received significant attention of researchers.

3.2 Interrelationship between Agricultural and Industrial Sector

The inter-relationship between agricultural and industrial sector has been a long debated issue in literature of development. The sectoral economic performance and growth linkages are very important for designing development policies. Understanding of sectoral linkage is very important to design long-run policies to achieve sustainable growth rate in real GDP. Agricultural and industrial sectors are considered as back bone of an economy as both the sectors play an important role in the economic activity of a country and also play a very key role in general life of the people. Agricultural sector provides food to the general public which meets their food demand, while industrial sector provides other goods like shelter, shoes, clothes, electricity, automobiles, etc. to meet their non-food demands. Agricultural and industrial are complementary as both are jointly important for growth. So both the sectors are need to be developed simultaneously as both the sectors are dependent on each other in respect of demand and supply.

3.2.1 Agricultural Sector Dependence on Industrial Sector

The agricultural production needs the industrial goods like machinery, fertilizers, pesticides, croppers and other mechanical tools used in agricultural. The rich farmer's quickly adopt the improved seeds and fertilizers and then moved to mechanization. Seeds is an important input in the agricultural sector which is processed in industry. There is continuous attempt by researchers to introduce better quality seeds with high yield, resistant to pets and disease and suited for local condition. These research requires laboratories with sophisticated instruments, air condition facilities and many other things. It is the industrial sector which

develops new technologies and design equipment's and instruments necessary to carry out research.

Industrial sector also provides chemical fertilizers to agricultural production. The use of these fertilizers enhances the productivity and increase production. Chemical industry provides these fertilizers to agricultural sector. One of the key determinant of agricultural production is the irrigation system. There is need to build dams, wells, canals, storage reservoirs, tube wells to provide enough irrigation to the crop. The basic materials require for construction of such facilities are bricks, iron cement, that are manufactured in the industrial sector. The machines such as motors, pump set etc. are also produced by industrial sector.

The industrial sector also provides pesticides to save crops from pets and diseases and so are helpful in raising agricultural production. The industrial sector also provides mechanical tools and equipment, for cultivation such as Tractor, Harvester, and Machines etc. Industry also helps to build storage and warehousing facilities so that farmers can store their products till they get fair market price.

3.2.2 Industrial Sector Dependence on Agricultural Sector

The growth of agricultural sector is equally dependent on growth of industrial sector. On the other side industrial sector is also dependent on agricultural. The agricultural sector is main source of labor supply to the industrial sector. The main reason of supply of surplus labor from agricultural sector to industrial sector is farm mechanization. The use of advance technologies like tractors, harvesters and many others in agricultural sector reduce labor demand and the surplus labor engage in other sectors of economy. The agricultural sector also provides raw materials to the industrial sector for further processing to produce finished goods. These raw materials are provided to various small and large scale industries. That is;

raw cotton is provided to the cotton textile or textile industry, sugar cane is provided to the sugar industry, wood to sports industry. The agricultural sector provides some crops to flour mills, rice mills and many others. The agricultural sector development improve living standard of farmers and rise their income due to which they build better houses and demanding luxurious goods such as auto mobile, computer, television etc., which causes growth in the particular industries.

The above discussion implies that the progress of both agricultural and industrial sectors are dependent on each other, so the growth of industrial sector is linked with growth of agricultural sector. Underdeveloped countries are primarily agro-based economies and as development take place then labor is gradually replaced by machines in the agricultural sector. It is due to two reason; first as income increases demand for food items increases at slow rate. Second the productivity in agricultural sector increases due to use of better quality seeds, fertilizers, machinery and proper irrigation facility. So less people are required to produce same amount of crop. As an economy developed the demand for industrial goods increases so they require more labors, so the industrial sector needs large number of labors which is fulfilled by surplus labor of the agricultural sector. Hence the agricultural sector is source of labor for industrial sector.

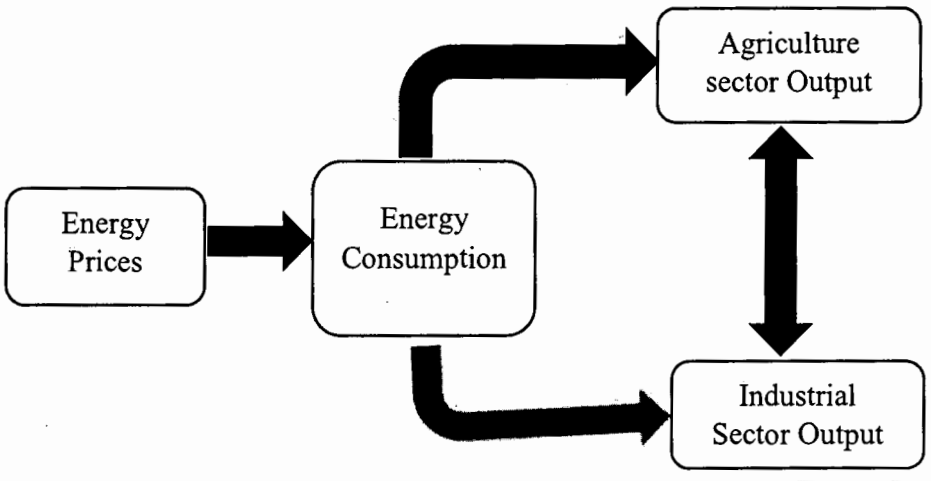
The discussion provided point towards the interlinkages between agricultural and industrial sector. These linkages are categorized in to demand side and supply side linkages. The supply side linkage basically arises from the interdependence of the sectors for meeting the needs of their productive inputs, whereas the demand side linkage fulfil the final consumption. The linkages may be further categorized in to two groups based on the direction of their interdependence Hirschman (1958). One is the backward linkage, which identifies the dependence of the sector on others for their input supplies. Agriculture sector uses industrial inputs like fertilizers, pesticides, machine tools. This is the backward linkage

of agricultural sector with industrial sector. The other is the forward linkage, which identifies how the sector distributes its output to the remaining economy. Agricultural sector supplies raw materials to agro-based industries which is the forward linkage of agricultural sector.

3.3 Concluding Remarks

The above discussion revealed that both the sectors are interdependent and none can be developed without the development of other. However, the development of each one of the two sectors is also constrained to some other factors. For example, labor employed to agricultural and capital stock to industrial sector. On the other hand, energy resources also play a very crucial role in the development of both the sectors and so the recent world-wide energy crises are believed to have adversely affected both the sectors.

Figure 3.1: The Impact of Energy Prices on Agricultural and Industrial Sector Productivity through Energy Consumption Channel.



The above figure shows the impact of energy prices on both the agricultural and industrial sector productivity through energy consumption channel. As the arrow showing the effect of rise in energy prices (electricity, oil and gas) affect the energy consumption which show

direct relationship between change in energy prices and energy consumption. This shows the impact of energy prices on key sectors of the economy through energy consumption channel.

The Figure 3.1 show the direct relationship between agricultural and industrial sectors. Both the sectors are interdependent on each other, which means that both agricultural and industrial sectors effect each other. The change in the productivity of one sector may affect the productivity of the other sector. To examine the impact of change in energy prices on agricultural and industrial sector productivity and their interdependence on each other, the empirical model is being discuss in next chapter.

Chapter 4

Model, Methodology and Data Consideration

This chapter discusses, the model specification, followed by a brief discussion of the variables definition and construction. This chapter also provides an overview of the estimation technique and data sources.

4.1. Model Specification

This study aims to examine the impact of change in energy prices on the agricultural and industrial sector productivity. As energy is considered to be the most critical input, therefore shortage in energy supplies and the resulting hikes in their prices have sector-wide serious concern. There are many studies that have been carried out to examine the impact of energy prices on various sectors of the economy. For example Binuomote and Odeniyi, (2013) and Ikram and Waqas, (2014) examined the impact of crude oil prices on the agricultural productivity for Nigeria and Pakistan respectively. Wang and McPhail, (2012) investigated the impact of energy shocks on US agricultural productivity growth and food prices. Bolaji and Bolaji, (2010) has checked the impact of increase in oil prices on manufacturing companies in Nigeria. Eksi et al (2011) has examined the relationship between oil prices and industrial production in some OECD countries. Mehrara and Sarmen (2009) examined the impact of oil price shock on industrial production for the oil exporting countries. This discussion shows that different researchers have estimated different models to investigate the sector-wide impacts energy related crises in terms of variables included in the model and the nature of problems that they have addressed. In addition most of the researchers either relied on agricultural sector productivity or on the industrial sector productivity to evaluate the sectoral (agricultural and industrial) impacts.

This study is different from the existing studies as it uses the simultaneous equations model to estimate the sectoral impacts of energy crises. That is; the study simultaneously examines the impact of energy crises on the agricultural and industrial sector productivities. In addition the study also intends to examine the interdependence between the agricultural and industrial sectors keeping in view the importance of each one for the other. So the specification of the empirical model for this study is based on the complete specification and estimation of a separate equation for each sector. Keeping in view the nature of the model discussed above a separate equation is specified for each sector. Following this, the agricultural sector is shown as the function of energy consumption, industrial sectors productivity, and fertilizer consumption. The equation for the industrial sector productivity is also specified in the similar fashion in which the industrial sectors productivity is shown as dependent on the energy consumption, agricultural sectors productivity and other variables. The equations are specified as follows:

$$TPA_t = \alpha_0 + \alpha_1 TPI_t + \alpha_2 ECA_t + \alpha_3 FC_t + e_t \quad \ldots\ldots (1)$$

$$TPI_t = \beta_0 + \beta_1 TPA_t + \beta_2 ECI_t + \beta_3 OP_t + u_t \quad \ldots\ldots (2)$$

$$ECA_t = \gamma_0 + \gamma_1 TPA_t + \gamma_2 EP_t + v_t \quad \ldots\ldots (3)$$

$$ECI_t = \delta_0 + \delta_1 TPI_t + \delta_2 EP_t + z_t \quad \ldots\ldots (4)$$

Where TPA_t stands for total factor productivity of Agricultural sector, 'ECA_t' is the Energy Consumption in Agricultural sector, 'FC_t' stands for fertilizer consumption, 'TPI' stands for total factor productivity of Industrial sector, ECI_t is Energy Consumption in Industrial sector,'OP_t' represents Openess of the economy, 'EP' represent energy price index.

Equations (1) is the equation for the agricultural productivity in which the agricultural sector productivity is shown as dependent on the industrial sector productivity, energy

consumption in agricultural sector, fertilizer consumption. Equation (2) is the industrial sector productivity equation in which the industrial sector productivity is shown as dependent on the agricultural sector productivity, energy consumption in industrial sector, and openness. Equation (3) is the energy consumption equation in which the energy consumption in agricultural sector is shown as dependent on agricultural sector productivity and energy price index. Similarly equation (4) is the energy consumption equation in which energy consumption in industrial sector is dependent on industrial sector productivity and energy price index. These equations are interdependent and therefore it is a simultaneous equations model which will be estimated in a simultaneous equation framework.

By substituting equation (3) in Equation (1) we get

$$TPA_t = \left(\frac{\alpha_o+\alpha_2\gamma_o}{1-\alpha_2\gamma_1}\right) + \left(\frac{\alpha_1}{1-\alpha_2\gamma_1}\right)TPI_t + \left(\frac{\alpha_2\gamma_2}{1-\alpha_2\gamma_1}\right)EP_t + \left(\frac{\alpha_3}{1-\alpha_2\gamma_1}\right)FC_t + \left(\frac{1}{1-\alpha_2\gamma_1}\right)e_t \quad \ldots\ldots (5)$$

Similarly substituting equation (4) in Equation (2) we get

$$TPI_t = \left(\frac{\beta_o + \beta_2\delta_o}{1-\beta_2\delta_1}\right) + \left(\frac{\beta_1}{1-\beta_2\delta_1}\right)TPA_t + \left(\frac{\beta_2\delta_2}{1-\beta_2\delta_1}\right)EP_t + \left(\frac{\beta_3}{1-\beta_2\delta_1}\right)OP_t + \left(\frac{1}{1-\beta_2\delta_1}\right)u_t \quad \ldots\ldots (6)$$

By substituting equation (5) in Equation (6) we get

$$TPI_t = \rho_o + \rho_1 EP_t + \rho_2 FC_t + \rho_3 OP_t + \mu_t \quad \ldots\ldots (7)$$

4.2. Definition of the Variables

This section define and explain the variables used in this study

4.2.1. Agricultural and Industrial sector Productivity

Researchers have used various methods to calculate agricultural and industrial sector productivity. To calculate agricultural sector productivity, some researchers have used the arithmetic index like Khan et al (1994) and average productivity index like Dharmasiri, (2012). Likewise, the researchers have used different indicators to measure industrial sector productivity. For example Chaudhry, (2009) has used value added, average daily employment and value fixed assets in large Scale Manufacturing. Some people use Craig-Harris productivity model for the calculation of total productivity measurement of manufacturing sector like Ali et al (2012). Total factor productivity is the ratio of total output to the inputs. Chaffai & Plane (2011) measure total factor productivity (TFP) by using growth accounting technique. The total factor productivity (TFP) is the relationship between output and input, traditionally it is define as the ratio of output and input. For both agricultural and industrial sector output we consider value added at constant price, where the production technology is assumed at constant return to scale for both labor and capital: the number of workers in Million (L) and capital stock (K) in million rupees. The data for labor cost and number of hours is not easily available. Thus, we use the number of labors in million. Capital stock is measured by arranging it for depreciation and adding particular arrangement of fixed capital yearly. Mahmood and Siddiqui (2000) and Ali and Hamid (1996) used this variable in their studies. Some of the researcher use perpetual inventory method in their studies to calculate the capital stock like Hamid and Pichler (2009). To calculate capital stock we use perpetual inventory method. For the calculation of capital

stock we use constant prices and depreciation rate is consider 5%. The capital stock is calculated as

$$K_t = (1 - \delta) * K_{t-1} + I_t \quad \ldots\ldots\ldots (4.A)$$

Where 'K denotes capital stock','t' represents year', 'δ is rate of depreciation' and I is the investment. We use equation (4.A) to calculate the capital stock. Where Total Factor Productivity is computed from the Cobb-Douglas production function.

4.2.2. Energy consumption in Agricultural and Industrial sectors

(Siddiqui 2004) have divided the energy sector into three components comprising electricity (Gigawatt Hour (GWH)), natural gas (million cubic feet (MMCFT)) and petroleum products (in tons). We use the same method by converting the consumption of the sources in to common unit i-e in 'tons of oil equivalent (TOE)'. As petroleum consumption is already in tons, we convert electricity consumption from GWH to TOE and gas consumption from MMCFT to TOE as follow

$$TOE = 1\ Gwh * 86.04 \quad \ldots\ldots\ldots (4.B)$$

Where1 Gwh is equivalent to 86.04 TOE[1]

$$TOE = 1\ MMCFT * 25.1996 \quad \ldots\ldots\ldots (4.C)$$

Where 1mmcf is equivalent to 25.1996 TOE[2]

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1 http://www.traditionaloven.com/tutorials/energy/convert giga watt hour gwh to ton oil equivalent toe.html

2 http://www.kylesconverter.com/energy, work, and heat/cubic feet of natural gas to tons of oil equivalent

Both the electricity and gas consumptions are converted in to tons of oil equivalent using conversion factor table. We use this method of conversion following Hydro Carbon Development Institute of Pakistan (HDIP).

After converting all energy sources in to same unit we simply add them for both the sectors which give us sector specific consumption of energy as follow

Energy consumption of agricultural sector= Electricity consumption + Oil/petroleum consumption

Energy consumption of industrial sector= Electricity consumption + Oil/petroleum consumption + Gas consumption

After getting sector specific energy consumption for agricultural and manufacturing sector.

4.2.3. Fertilizer Consumption

Fertilizers are the agrochemical products which are used in the agricultural. This is an input for agricultural which is purchased by the farmers. The consumption of fertilizer is measured in thousands of tons. Many of researchers use it as input in their studies and they measure it in thousands of tons like (Javeed et al 2010). Fertilizer consumption in agricultural is also used by (Nadeem et al 2010). In our study we convert thousands of tons in to millions kilogram as

$$\text{Million kilograms} = \text{Thousands of tons} * 1000 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.D)$$

After converting fertilizer consumption into million kilograms we compute fertilizer consumption as below.

Where 'FC' fertilizer consumption (In Million Kilograms), 'YA' agricultural sector output (In Million Rupees) and 'LA' labor force employed in agricultural sector (In Million persons).

4.2.4. Trade Openness

Trade openness is the ratio of trade to gross domestic product (GDP). Different researchers used various techniques to measure the openness, but the basic and most frequently use measure is the simple shares of trade. It is simply measure as addition of exports and imports fraction to GDP. Some of the researchers used this measure for trade openness like Harrison (1996) and Ilyas et al (2010). Shahbaz et al (2008) also use trade openness variables and measure it as [(exports plus imports)/GDP]. We also used the same measurement technique for trade openness given below.

$$TO = \frac{(\text{exports} + \text{Imports})}{\text{Gross Domestic Product}} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (4.E)$$

All the three factors exports, imports and GDP is measured in Million Dollars US.

4.2.5. Energy Prices

The energy price data is not easily available in developing countries. Therefore researchers argued to use different proxies for energy prices. Some of the researchers use Consumer Price Index (CPI) as proxy either for energy price or electricity price in different countries like [Tang &Tan, (2013), Lean & smyth, (2010) and Mahadevan & adjaye, (2007) and Qazi & Yulin (2013)]. Wang & Mcphail, (2014) used gasoline price index as measure of energy prices. Some of the researchers measured real energy prices by producer price index: fuels and related products and powers divided by GDP Deflator this is used by Yoon and Ratti, (2011). This study will use energy price index. The energy price index is taken from Statistical Year Book published by Pakistan Bureau of Statistics.

4.3. Estimation Strategy and Data Consideration

4.3.1. Methodology of Estimation

To examine economic system empirically researchers used different models. For estimation of simultaneous equation number of models has been used. Nickel (1981) suggested that Ordinary Least Square (OLS) method became biased and inconsistent in the presence of autoregressive nature. Some of the researchers suggested static Ordinary Least Square (OLS) for estimating simultaneous equation frame work like Engel and Granger (1987). Whereas, Benergy (1989) showed that two problems occur in this procedure, i.e.: biasness of small sample and the endogeneity problem in regressors. To overcome on both problems Modified ordinary leas square (OLS) was justified by Phillips and Hansen (1990). However, it does not describe the simultaneity problem because this is method of single equation in which each equation is estimated separately in the proper order. Some of the researchers have used Two Stage Least Square (TSLS) for estimating the system of equation for example Sinha Roy (2007). The Two stage Least Square (TSLS) is also a single equation technique and the equations are estimated separately but provides information of the other equations used in the system through the instruments used. This method facing some problems regardless its validity still the variables are not stationary or co-integrated in the system. The preferred methods for estimating the system of equations are Three Stage Least Square (3SLS), Full Information Maximum Likelihood (FIML) and Generalized Method of Moments (GMM).

This study is carried out on the basis of two fold objectives. The first is to examine the impact of energy prices on the agricultural and manufacturing sectors productivity and the second is the interdependence of both the sectors. To investigate the relationship between energy price, agricultural and manufacturing sectors productivity and the interdependence

time series data is employed spanning from 1972-2014. As we have mentioned above that the equations are interdependent. That is; they have across the equation correlation and they are said to be the system of interdependent equations. So this is a simultaneous equation model estimated through the simultaneous equation method keeping in view the possible simultaneity problem. The procedure which agree to economic models to be specified and escape unnecessary assumption is Generalized Method of Moments (GMM). So, to estimate our model the Generalized Method of Moment (GMM) technique suggested by Arellano-Bond (1991) is used for estimation. The GMM technique eliminate the endogeneity problem by using instrumental variables, which give us consistent results. So, the Generalized Method of Moment (GMM) technique handle the endogeneity problem by means of some exogenous instruments as well as lags of independent variables as instruments

4.3.2. Data Consideration

We consider annual time series data spanning from 1972 to 2014 for Pakistan. Our data mainly consist of three variables namely agricultural sector productivity, industrial sector productivity and energy prices. We took data from GOP, Pakistan Economic Survey (various issues), Labor Force Survey (various issues), Statistical Year Book and World Development Indicator (WDI).

Chapter 5

Results and Analysis

This chapter discusses the GMM results of our empirical model. The chapter also compares the results of this study with the results of other studies.

As this study uses time series data for the analysis, so it is necessary to check, the time series properties of the data before estimating the model. The study uses the Augmented Dickey Fuller (ADF) test to check the data for stationarity both with trend and intercept. The results obtained are given in appendix A which show that all the variables are integrated of order 1, that is I(1).

5.1 Analysis and Discussion of the GMM Results

As this study aims to examine the impact of energy prices on the agricultural and industrial sector productivity, for this purpose the study uses a simultaneous equation model involving four interdependent equations which have to be estimated simultaneously. Keeping in view, the interdependency of the equations, the study employs the Generalized Method of Moments (GMM) which is considered to be the most efficient technique of all the classical simultaneous equation methods. This is due to the fact the variances of the GMM estimates are lower than the variances of all other classical estimators. The software used for estimation is E-Views 9. The data is ranging from 1972-2014 for Pakistan. The study uses the system GMM to overcome the endogeneity problem. The results of system GMM is given in table 5.1, 5.2, 5.3 and 5.4.

Table 5.1 show the impact of explanatory variables on agricultural sector productivity, table 5.2 shows the impact of explanatory variables on industrial sector productivity, table 5.3

show the impact of explanatory variables on energy consumption of agricultural sector and table 5.4 shows the impact of explanatory variables on energy consumption of industrial sector. All the variables are taken in the log form.

5.1.1 Analysis of Agricultural Sector Productivity

The results of agricultural sector productivity are shown in Table 5.1. The dependent variable is log of agricultural sector productivity (lnTPA), whereas the independent variables include log of manufacturing sector productivity (lnTPI), log of energy consumption in agricultural sector (lnECA), log of fertilizer consumption (lnFC) and lag of agricultural sector productivity (lnTPA).

Table 5.1 Agricultural sector productivity

Empirical Findings (1972-2014)

Dependent Variable= Total Factor productivity of Agricultural Sector

Number of Observations=42

Variable	Coefficient	Standard Error	t-Statistics	Probability
Intercept	0.041853	0.154611	0.270696	0.7870
$lnTPM_t$	0.88761*	0.051932	1.709180	0.0896
$lnECA_t$	0.256782*	0.137004	1.874271	0.0629
$lnFC_t$	-0.055357	0.038084	-1.453520	0.1483
$lnTPA_{t-1}$	0.613977***	0.123743	4.961720	0.0000
R^2= 0.979044		Adjusted R^2= 0.976715		D.W=1.975520

*** 1% level of significance, **5% level of significance and *10% level of significance

The value of intercept in table 5.1 is 0.0418, which means that if all the variables remain the same than change in agricultural sector production will be 4.18 percent. The results show that the industrial sector productivity carries out a significant coefficient with reasonable magnitude which is 0.88. The coefficient is however, significant at the 10 percent level of significance and it shows that that a 10 percent increase in industrial sector productivity causes the agricultural sector production to increase by 8.8 percent. The results showed positive and significant impact of industrial sector productivity on agricultural sector productivity, which is reliable with the argument of the neo-classical theory that agriculture welfares from spillover effect of higher productivity techniques in the industrial sector with important convergent trends across all sectoral productivity levels. Theoretically the importance of industrial development play significant role in making agricultural sector more efficient through advance technologies and the benefits of large economies of scale is also substantiated. The energy consumption in agricultural sector variable has also positive and significant impact on the agricultural sector productivity as shown in Table 5.1 above. The coefficient is 0.26 which is significant at 10 percent level of significance which show that if the energy consumption of agricultural sector increases by 10 percent the agricultural sector productivity rises by 2.5 percent. The results of energy consumption variable show that if energy use increases it leads to rise agricultural sector production. In agricultural sector the energy is use in different machineries like tractors, tube wells etc. The use of modern machineries has been increased which rises the consumption of petroleum products, electricity etc. which in turn increase agricultural sector production. Fertilizer variable carries out an unexpected coefficient with negatively signed and insignificant coefficient. One of the possible reason is that the excess use of fertilizers effect agricultural sector productivity negatively, which is in line with Ikram and Waqas (2014).

5.1.2 Analysis of Industrial Sector Productivity

The results of industrial sector productivity are reported in Table 5.2 (a) and 5.2 (b). The dependent variable in this model is the log of industrial sector productivity (lnTPM), whereas the explanatory variables include log of agricultural sector productivity (lnTPA), log of energy consumption in industrial sector (lnECI) and log of trade openness (lnTO) and lag of industrial sector productivity ($LTPI_{t-1}$). We replace trade openness (lnTO) by share of industrial raw materials (lnSIR) the results are shown in table 5.2 (b).

Table 5.2 (a) Industrial Sector Productivity

Empirical Findings (1972-2014)

Dependent Variable= Total Factor productivity of Industrial Sector

Number of Observations=42

Variable	Coefficient	Standard Error	t-Statistics	Probability
Intercept	-0.503828***	0.134203	-3.754240	0.0003
$lnTPA_t$	0.125701*	0.066734	1.883618	0.0616
$lnECI_t$	0.329315***	0.073950	4.453177	0.0000
$lnTO_t$	-0.033785	0.100579	-0.335908	0.7374
$lnTPI_{t-1}$	0.529976***	0.079599	6.658096	0.0000
R^2= 0.993690		Adjusted R^2= 0.992989		D.W=1.646102

*** 1% level of significance, **5% level of significance and *10% level of significance

The results given in the above Table indicate that the value of intercept is -0.5038 which is highly significant. The findings of the study identified that agricultural sector productivity has positive and significant effect on industrial sector productivity with the value of coefficient is 0.125. The positive relation between agricultural sector productivity and

manufacturing sector productivity implies that a 10 percent increase in the agricultural sector production leads to 1.3 percent increase in the industrial sector production. As the agricultural sector coefficient is responsive to industrial sector productivity is due to two reasons. Firstly, the great innovations in the production and managerial technology initiate from industrial sector before being diffused to agricultural sector. Secondly, there is usually lag in time before spill over and externality effects filled through the economy. The significance of the findings that the inter-sectoral relationship are complex. The externalities and spillover effects caused by relation and connection between different sectors show the force full nature of an economy. The economic role of agricultural sector productivity is that the flow of capital towards the industrial sector. The energy consumption in industrial sector variable also show positive relation with industrial sector productivity and highly significant with the value of the coefficient is 0.329 which is significant at 1 percent level of significance. This shows that if energy consumption in industrial sector increases by 10 percent, the industrial sector output will rise by 3.29 percent. Different type of energies are used in the industrial sector like petroleum products, natural gas and electricity. The rise in energy consumption increases industrial sector productivity. The down turn in the industrial sector of Pakistan is due to shortage of energy sources. If budgetary and adequate supply of energy is provided to the industrial sector will rise industrial sector production. The energy consumption variable shows that higher use of energy sources rises the industrial sector production, if there is timely and sufficient amount of energy sources are provided to this sector. The trade openness variable show negative relation with the industrial sector productivity, however, the coefficient is statistically insignificant. One of the possible reasons for the insignificant impact of the trade openness is that Pakistan is developing country, where in competitive markets Pakistan is unable to produce such type of goods to compete with emerging markets like China and India.

Table 5.2 (b) Industrial Sector Productivity

Empirical Findings (1972-2014)

Dependent Variable= Total Factor productivity of Industrial Sector

Number of Observations=42

Variable	Coefficient	Standard Error	t-Statistics	Probability
Intercept	-0.363720***	0.139682	-2.603923	0.0102
$lnTPA_t$	0.072909	0.066879	1.090160	0.2775
$lnECI_t$	0.385604***	0.072476	5.320406	0.0000
$lnSIR_t$	-0.118835*	0.067555	1.759009	0.0807
$lnTPI_{t-1}$	0.469616***	0.088130	5.328652	0.0000

R^2= 0.993690 Adjusted R^2= 0.992989 D.W=1.646102

*** 1% level of significance, **5% level of significance and *10% level of significance

The results given in Table 5.2 (b) indicate that the value of intercept is -0.3637 which is significant at 5 percent level. The findings identified that agricultural sector productivity has no significant effect on industrial sector productivity. This equation shows that the industrial sector is not dependent on the agricultural sector, means that the agricultural sector production has no significant role to determine the industrial sector productivity. The energy consumption in industrial sector variable also show positive relation with industrial sector productivity and highly significant with the value of the coefficient is 0.385 which is significant at 1 percent level of significance. This shows that if energy consumption in industrial sector increases by 10 percent, the industrial sector output will rise by 3.85 percent. The share of industrial raw material variable show positive relation with the industrial sector productivity, the coefficient is statistically significant at 10 percent level. This shows that if raw materials share in industrial sector increases by 10 percent, the

industrial sector output will rise by 1.18 percent. The share of raw materials variable showed that if there is increase in the share of raw materials the industrial sector productivity will increase.

5.1.3 Analysis of Energy Consumption in Agricultural Sector

The results of energy consumption in agricultural sector are shown in Table 5.3. The dependent variable in this equation is the log of energy consumption in the agricultural sector (lnECA) whereas the independent variables are the log of Agricultural sector productivity (lnTPA) and log of energy prices (lnEP).

The impact of energy prices on energy consumption of agricultural sector is reported in table 5.3. The intuition behind this equation is that this equation captures the indirect impact of energy prices on the agricultural sector productivity. That is; the energy prices affect the energy consumption in the agricultural sector and then this shock to the energy consumption in the agricultural sector affect the agricultural sector production.

Table 5.3 Energy Consumption in Agricultural Sector

Empirical Findings (1972-2014)

Dependent Variable= Energy Consumption in Agricultural sector

Number of Observations=42

Variable	Coefficient	Standard Error	t-Statistics	Probability
Intercept	-0.578299**	0.274292	-2.108339	0.0367
$lmnTPA_t$	0.565115***	0.143556	3.936539	0.0001
$lnEP_t$	-0.025656**	0.010904	-2.352853	0.0200
$lnECA_{t-1}$	0.529976***	0.075978	9.585265	0.0000

R^2= 0.984149 Adjusted R^2= 0.982828 D.W=1.835888

*** 1% level of significance, **5% level of significance and *10% level of significance

The results given in Table 5.3 reveal that all the variables carry significant coefficients with reasonable magnitudes. That agricultural sector productivity has positive and significant impact on the energy consumption in agricultural sector which is statistically significant at one 1 percent level of significance. The coefficient of agricultural sector productivity is 0.56 which means that if there is a 10 percent increase in the agricultural sector production, it will lead to a 5.5 percent increase the energy consumption in agricultural sector. The results also identified a negative relationship between energy consumption in agricultural sector and energy prices. The results showed that the energy prices has negative and statistically significant impact on energy consumption of agricultural sector, with the coefficient -0.0256 which is significant at the 5 percent level of significance. This means that a 10 percent increase in the energy prices causes 0.2 percent decrease in the energy consumption of agricultural sector. However, it is reported in Table 5.1 that energy consumption in agricultural sector and agricultural sector productivity has positive relation, which means that if one increases the other will rise and if one decrease the other will reduce. Where the energy consumption in agricultural sector and energy prices has negative relation that is if energy price increases the energy consumption will decrease which effect agricultural sector productivity. As it is reported that energy consumption in agricultural sector and agricultural sector productivity has positive relation so energy prices effect energy consumption adversely which reduces agricultural sector productivity. The results also show that the lag of energy consumption significantly affect the agricultural sector, which implies that past shock to energy also affect the current agricultural production.

5.1.4 Analysis of Energy Consumption in Industrial Sector

The results of energy consumption in the industrial sector are shown in Table 5.4 below. The dependent variable is log of energy consumption in industrial sector (lnECI) and the

independent variables are log of industrial sector productivity (lnTPI) and log of energy prices (lnEP).

Table 5.4 Energy Consumption in Industrial Sector

Empirical Findings (1972-2014)

Dependent Variable= Energy Consumption in Industrial sector

Number of Observations=42

Variable	Coefficient	Standard Error	t-Statistics	Probability
Intercept	-0.095917	0.162101	-0.591711	0.5550
$lnTPI_t$	0.570075***	0.169030	3.372622	0.0010
$lnEP_t$	-0.040259***	0.013733	-2.931504	0.0039
$lmECI_{t-1}$	0.635823***	0.097125	6.546446	0.0000

R^2= 0.979044 Adjusted R^2= 0.976715 D.W=1.975520

*** 1% level of significance, **5% level of significance and *10% level of significance

The results reported in Table 5.4 shows the impact of industrial sector productivity and energy prices on energy consumption in the industrial sector, where log of energy consumption in industrial sector (lnECI) is dependent variable and log of industrial sector productivity (lnTPI) and log of energy prices (lnEP) are the explanatory variables. The results given in the above Table show that industrial sector productivity has positive and statistically significant impact on energy consumption in industrial sector. The coefficient of industrial sector productivity is 0.57 which is significant at the 1 percent level of significance. This shows that if there is a 10 percent increase in industrial sector productivity leads to 5.7 percent increase in in the energy consumption in industrial sector percent. The results also showed that energy price and energy consumption in industrial sector variables have negative relationship. The energy price coefficient is however, low by highly

significant which is -0.040 implying that a 10 percent rise in energy prices leads to 0.4 percent decrease in the energy consumption.

As reported in Table 5.2, that energy consumption in industrial sector and industrial sector productivity has positive relation. That is; energy consumption has positive impact on the industrial sector productivity. Where in the results it is reported that energy prices effect energy consumption in industrial sector adversely. This show that if there is increase in energy prices it will decrease energy consumption in industrial sector. Therefore increase in energy prices decrease energy consumption which further effect industrial sector productivity. So increase in energy prices will decrease industrial sector production.

5.2 Concluding Remarks

The objectives of this study are two folds. That is; the first is to determine the inter-relationship between agricultural and industrial sectors productivity and the second is to examine the impact of energy prices on the productivity of the two key sectors namely agricultural and industrial. The results show that both the agricultural and industrial sectors affect each other which implies that both the sectors are important for each other performance. The impact of the agricultural sector on the industrial sector is higher than the impact of the industrial sector on the agricultural sector which implies that in Pakistan, the industrial sector is highly exposed to the growth in the agricultural sector. The findings of the study reveal that the energy prices play crucial role in determining the production of both the agricultural and industrial sectors of Pakistan which is evident from the significant coefficient of the 'energy price' variable in all the equation with reasonable magnitudes. Both the agricultural and industrial sectors productivity are adversely affected due to shock in the energy prices as shown through indirect channel of energy consumption in the key sectors.

Besides the energy prices, there are a number of factors that also significantly affect the agricultural and industrial sector productivity. The energy consumption is measured separately for both the agricultural and industrial sector productivity. The energy consumption variable in agricultural and industrial sector carries positive and significant effect on the productivity of both the sectors, which implies that the energy consumption in both the sectors is also important for the productivity of these key sectors. However, the fertilizers consumption has negative impact on agricultural sector productivity but insignificant. Likewise, the trade openness coefficient has negative and insignificant impact on industrial sector production. The agricultural sector productivity coefficient has positive and significant impact on energy consumption in agricultural sector. However, the industrial sector productivity has also positive and significant impact on the energy consumption in the industrial sector. The overall results confirm that both the agricultural and industrial sector productivity are highly important for each other. The results also show that the energy prices has much important in the determination of the agricultural and industrial sector productivity.

The findings of our study are in line with the findings of Moyen Uddin (2015) which show that agricultural and industrial sectors are dependent on each other for Bangladesh. Onakoya and Babatunde (2013) shows that agricultural sector production has positive relationship with the manufacturing sector production in Nigeria. Similarly Subramanian and Reed (2009) find a strong positive relationship between industrial sector growth and agricultural sector growth for Poland and Romania. Hye. A (2009) also suggests the same kind of relationship between industrial sector output and agricultural sector output in case of Pakistan. As suggested by Ahmar Qasim Qazi and Z Hao Yulin (2013) for Pakistan that energy consumption (oil, coal, gas and electricity) has positive and significant impact on industrial output. Similarly Faisal Mehmood Mirza, Olvar Bergland and Naila Afzal (2014)

and Jamil and Ahmad (2010) showed that electricity consumption effect industrial output positively. Zaman et.al (2012) showed that there is positive relationship between electricity consumption and agricultural and industrial sector value added. The result for fertilizers consumption shows negative impact on agricultural sector productivity are in line with Hafsa Ikram and Muhammad Waqas (2014) they suggested that excess intake of fertilizer effect agricultural sector negatively, but in our study it is insignificant. The coefficient of trade openness shows negative impact on industrial sector productivity but it is insignificant. (Ilyas et al, 2010) also showed the same result for trade openness variable. The energy price variable shows negative and significant impact on both the agricultural and industrial sector productivity as suggested by Nwosa and Ajibola (2013) in case of Nigeria and Twimukye & Matovu (2009) for Uganda. Some other studies also show this negative effect of different energies price namely oil price, world crude oil price, electricity price and gas prices on the key sectors. Some of the studies indicated negative impact of energy prices on agricultural sector productivity, such as Ikram and Waqas (2014) and Sultan and Waqas (2014) obtained the negative impact of oil prices on agricultural sector productivity in case of Pakistan. Similarly, Binuomote and Odeniyi (2013) obtained that world crude oil price effect agricultural sector productivity negatively in Nigeria. As suggested by Rebeca and Rodriguez (2008) in case of OECD Countries, Rodriguez and Sanchez (2005) for UK and Bolaji and Bolaji (2010) for Nigeria that oil prices has negative impact on manufacturing sector output. Similarly Joshua Linn (2006) identified negative relation between oil prices and industrial value added in case of the United State. Kliesen (2006) reported that natural gas and crude oil price has negative impact on manufacturing output of the United State. In case of Pakistan Mirza, Bergland and Afzal (2014) found that electricity prices effect industrial output negatively.

Chapter 6

Conclusion and Policy Recommendation

6.1 Summary and Conclusion

This study is carried out to examine the impact of energy prices on agricultural and industrial sector productivity of Pakistan, using annual time series data spanning from 1972 to 2014. This study is based on two fold objectives, firs is to check the impact of energy prices on agricultural and industrial sector productivity and to examine the interlinkages between the key sectors namely agricultural and industrial sectors. The impact of energy prices on an economy is a long debated issue in the literature. Many of the researchers studied the impact of high energy prices on different sector of the economy. The researchers focused on the impact of energy prices on agricultural and industrial sectors productivity suggested that there is negative relation between high energy prices and the productivity of key sectors. This study also signified the connection of the variables used in the study. Theoretically energy prices significantly affect the performance of the agricultural and industrial sectors. There are some other determinants of both the agricultural and industrial sectors like energy consumption in agricultural and industrial sector, fertilizer consumption and trade openness. This study used a simultaneous equation model. The agricultural sector productivity equation was used in order to examine the impact of energy consumption of agricultural sector productivity, while, the industrial sector productivity equation is used to examine the impact of energy consumption on the industrial sector. The study used the Generalized Method of Moment technique to estimate the system of equations.

Findings of the study obtained from the system of equations concluded that the energy consumption in agricultural and industrial sectors has positive and significant impact on the agricultural and industrial sector productivities. Likewise the industrial sector productivity has also positive and significant impact on the agricultural sector productivity. Similarly the agricultural sector productivity affect industrial sector productivity positively and significantly. The fertilizer consumption coefficient turned out be insignificant in determining the agricultural sector productivity. Also the trade openness has no significant impact on the industrial sector productivity. The energy price variable affect the energy consumption in agricultural and industrial sectors negatively and significantly, which has indirect impact on the agricultural and industrial sector productivities. This showed us that energy prices has negative and statistically significant impact on the agricultural and industrial sector productivities. Where the agricultural sector productivity affect the energy consumption in agricultural significantly with correct sign. Similarly the industrial sector productivity affect the energy consumption in industrial sector significantly with correct sign.

Finally our study concluded by answering the question that increase in the energy prices affect the agricultural as well the industrial sector productivity. The results obtained from our analysis indicate that the energy prices affect both the agricultural and industrial sector productivity adversely which is consistent with the theory. Both the agricultural and industrial sectors are sensitive to shocks to energy prices. To answer the second question of our study, that which sector is greatly affected by energy prices. As we have seen the impact of energy prices indirectly through energy consumption channel, where the energy prices affect the energy consumption in both the sectors which alternatively affect the productivity of both the agricultural and industrial sector. So the magnitude of energy price coefficient is greater in the equation of energy consumption in industrial sector than energy

consumption in the agricultural sectors, therefore the rise in energy prices greatly affect the industrial sector productivity. Finally we have to answer the last question that as there any inter dependence between agricultural and industrial sector. Our analysis revealed that there is positive and significant relationship between the agricultural and industrial sector, which showed that both the agricultural and industrial sectors are interdependent on each other, both the sectors determine each other.

6.2 Policy Recommendation

This study intended to examine the impact of energy prices on the agricultural and industrial sector productivity. Most of the findings of the study are consistent with the theory. This yielded some interesting findings from which a number of useful policy recommendation could be drawn.

For example, the findings showed that energy prices affect both the agricultural and industrial sector negatively. So keeping this finding and the significance of agricultural and industrial sectors in the economic development in view, this study suggests the need to ensure smooth and consistent supply of energy to these sectors with stable prices.

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Appendix

The Augmented Dickey-Fuller Test Results:

Variables	Level								1st Difference								Order Of Integration
	Intercept				Trend and Intercept				Intercept				Trend and Intercept				
	T	1%	5%	10%	T	1%	5%	10%	T	1%	5%	10%	T	1%	5%	10%	
TFP[3] of Agricultural	-0.534	-3.596	-2.933	-2.604	-2.201	-4.192	-3.520	-3.191	-5.692	-3.610	-2.938	-2.607	-5.612	-4.211	-3.529	-3.196	I(1)
TFP Manufacturing	-1.138	-3.596	-2.933	-2.604	-1.007	-4.192	-3.520	-3.191	-5.778	-3.600	-2.935	-2.605	-5.821	-4.198	-3.523	-3.192	I(1)
EC[4] in Agricultural	-0.908	-3.596	-2.933	-2.604	-0.158	-4.211	-3.529	-3.196	-2.884	-3.615	-2.941	-2.609	-5.961	-4.211	-3.529	-3.196	I(1)
EC in Manufacturing	-1.277	-3.596	-2.933	-2.604	-0.518	-4.192	-3.520	-3.191	-5.425	-3.600	-2.935	-2.605	-5.561	-4.198	-3.523	-3.192	I(1)
Fertilizer Consumption	-2.781	-3.596	-2.933	-2.604	-1.352	-4.192	-3.520	-3.191	-5.976	-3.600	-2.935	-2.605	-6.132	-4.211	-3.529	-3.196	I(1)
Water Availability	-1.128	-3.596	-2.933	-2.604	-1.775	-4.192	-3.520	-3.191	-7.512	-3.600	-2.935	-2.605	-7.722	-4.198	-3.523	-3.192	I(1)
Trade Openness	-2.912	-3.596	-2.933	-2.604	-3.648	-4.192	-3.520	-3.191	-6.979	-3.600	-2.935	-2.605	-6.871	-4.198	-3.523	-3.192	I(1)
Energy Prices	3.699	-3.626	-2.945	-2.611	4.456	-4.243	-3.544	-3.204	3.416	-3.646	-2.954	-2.615	1.031	-4.211	-3.529	-3.196	

[3] TFP is Total Factor Productivity
[4] EC is Energy Consumption