The Impacts of Energy Pricing Policies on Consumers' Welfare

By:

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11/M.Phil-ECO/PIDE/2012

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DEDICATION

My this effort is dedicated to my parents, who provided me with an opportunity to study in this prestigious institution with devoted teachers & supporting class fellows, without their support my this effort would have never been worth viewing.

ACKNOWLEDGEMENT

I am grateful to Almighty ALLAH, The most Merciful and Beneficent, Who gave me Knowledge, Strength and Energy and enabled me to work on and complete this Research.

Every Research work needs the guidance of qualified and cooperative teachers and without their continued assistance we may not be able to complete any sort of research. In this regard I owe a highest debt of gratitude to all my teachers for their persistent guidance and invaluable assistance. My special thanks go to my Supervisor, Prof. Dr. Eatzaz Ahmad who has a brilliant head and kind heart and has always given me patient hearing in all matters, guided and supervised my work in the best way possible.

I would also like to thank my parents especially my father who thoroughly showered his valuable advices on me and extended his moral support in the preparation of this research.

I am thankful too to all my class fellows and university friends for their unending moral support.

I do hope that the future students will find this research study interesting and useful.

Muhammad Atta ul Islam Abrar

ABSTRACT

The study attempts to analyze the impact of energy pricing policies on consumers' welfare in rural and urban Pakistan. The study is based on pooled data of Household Integrated Economic Survey (HIES) from year 1984-85 to 2011-12. The Almost Ideal demand system (AIDS) is employed for estimating the parameters and price elasticities. The welfare analysis shows that increase in prices of energy has been more than the increase in general consumer price index over the period. Therefore consumers have been incurring high expenditures in all the years from 1984 to 2011 and there has been a consistent welfare loss for all the consumers with a decreasing trend. Welfare loss to the consumers in rural Pakistan is more as compared to the welfare loss of consumers in urban Pakistan.

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LIST OF ACRONYMS

AIDS	Almost Ideal Demand System
CGE	Computable General Equilibrium
CNG	Compressed Natural Gas
CPI	Consumer Price Index
ECC	Economic Coordination Committee
ESAM	Energy Social Accounting Matrix
GDP	Gross Domestic Product
GFS	Government Finance Statistics
GNP	Gross National Product
GOP	Government of Pakistan
GST	General Sales Tax
HIES	Household Integrated Economic Survey
IEA	International Energy Agency
IMF	International Monetary Fund
IUF	Indirect Utility Function
LA / AIDS	Linear Approximation Almost Ideal Demand System
LPG	Liquefied Petroleum Gas
MOF	Ministry of Finance
NGO	Non-Governmental Organization
NSS	National Sample Survey
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
PBS	Pakistan Bureau of Statistics
SAM	Social Accounting Matrix
WB	World Bank
WEO	World Energy Outlook

Chapter 1

INTRODUCTION

1.1. Introduction

Energy plays a vital and important role in the developmental process of a country. It is not only electricity, but every other energy resource, which is a fundamental and important part of households' consumption basket. The literature on the inter-dependence of economic growth and energy consumption is widely known along with the realization that industrialization at large is an energy intensive process. According to Riaz (1984), commercial energy consumption increases by 1.23 percent with every one percent increase in the Gross Domestic product (GDP). Thus, the rise in energy consumption with the passage of time can be attributed to increase in capital plus rising per-capita income.

Governments in the modern era have acknowledged energy as one of the basic needs and have termed it as a vital input for economic growth. This realization led many countries, specifically the developing ones, to establish such energy pricing policies which would benefit the consumers at large and would make energy affordable for every income group. However, due to the rapid increase in oil prices internationally since 2003, huge balance of payments and budget deficits forced them to bring changes in these pricing policies and also re-visit policies regarding energy subsidies. Until quite recently, electricity and natural gas were available on highly subsidized rates in Pakistan. But subsidies on these items increased further due to the rapid rise in international oil prices. However taking into account the fiscal pressures and crowding out of high priority public

spending, which includes spending on infrastructure, health and education, these energy pricing policies have seen significant changes and subsidies on energy have been removed or reduced substantially in the recent years.

There are certain social motives behind the introduction of energy pricing policies by governments i.e. to make energy, which is a basic need affordable to low income groups. Energy pricing policies directly and indirectly affect households' real incomes. The increase in real disposable income due to payment of lower prices by households for consumption of energy products is termed as the direct effect. Indirect effects can be noticed in the payment of lower prices by households for other goods and services that are reflected in lower costs of energy based production inputs.

Usually governments establish such energy pricing policies that protect households, especially the poor ones from the fuel costs volatility of cooking, lighting and transportation. But energy pricing policies regarding subsidies are inequitable as well as inefficient and also encourage overconsumption (IMF, 2013). Another problem with the energy pricing policies regarding subsidies is that most of its benefits go to the groups who have higher incomes and consume more fuel (Arze and others, 2012). Recognition of these factors along with the others that are discussed above has led to changes in energy pricing policies mostly in the form of reduction or removal of energy subsidies.

Since the last decade the government of Pakistan in its energy pricing policy has allocated generous subsidies to the energy sector (electricity, kerosene, pipe lined gas and CNG) to shield its people from the rising fuel and capital costs. In the period from 2004

to 2010 the government of Pakistan has extended 1.12 percent of its gross domestic product (GDP) annually in the form of subsidies to the energy sector (Vagliasindi, 2013).

Currently the government of Pakistan has been allocating more than 200 billion rupees per year, in the form of subsidies to energy sector, much of which goes to the power sector (MOF). The total amount of subsidies extended by the government of Pakistan to energy sector in the last five years is Rs.1250 billion (IMF). But these subsidies are not limited to the lifeline consumers only. Despite the government's efforts to bring changes in the energy pricing policy and effectively target these energy subsidies to the most vulnerable groups of society; rich consumers, commercial consumers and some categories of industrial consumers are also enjoying these massive subsidies. In this regard, the International Monetary Fund (IMF) has advised the government of Pakistan several times to bring reforms in the energy pricing policy and cut down the energy subsidies as these subsidies are both inefficient and untargeted and much of its advantage goes to the large companies and wealthy segments of the society, leaving poor sections of the society no better off (Mills, 2012). After entering into a loan agreement with the IMF, the government of Pakistan is trying to bring reforms in the energy pricing policy and phase out these subsidies gradually in an estimated period of four years for creating some fiscal space. In this regard the Economic Coordination Committee (ECC) of Pakistan has given its approval to end subsidies for all categories of energy except those subsidies that benefit the lifeline consumers.

But what about the welfare of consumers? Bringing reforms in the energy pricing policy and phasing out energy subsidies will obviously have some impacts on the welfare of

consumers. The reduction in subsidies and rising domestic prices of energy products affect the welfare of households in two ways (Arze del Granado 2012). One is a *direct impact*, which households face when the prices of electricity and fuels consumed for lighting, heating, cooking and personal transportation rises. The other is the *indirect impact*, which the households face in the form of increased prices of other goods and services, reflected in increased costs of production. The weight of lighting, heating, cooking and personal transportation costs in total household consumption will define the magnitude of these impacts. These impacts will be different across different income groups depending on the importance of these factors in each income group. Consumption baskets of households with higher incomes are usually more fuel intensive than the households with lower incomes. So, changing energy pricing policy and reducing energy subsidies will have higher direct and indirect impacts on higher income groups and relatively less impacts on lower income groups.

Due to energy crisis in Pakistan, many researchers have taken into account the issue of energy pricing for finding out the causes of these crisis and for proposing some possible solutions. Most of the researchers have addressed the energy demand and energy supply issues (Burney and Akhtar, 1990; Hathaway, 2007; Khan and Ahmed, 2009). The issue of energy pricing policy, energy subsidies reforms and its consequences on welfare of consumer has not been addressed exclusively to the best of knowledge. So the main focus of the present study is to analyze the impacts of energy pricing policies (increase or decrease in energy prices) on consumer's welfare in Pakistan. The study will be conducted for both Rural and urban consumers and for different income groups. The findings of this study will guide us about the impacts of energy pricing policies on

households' welfare and will help us to elaborate that whether changes in energy pricing policies improve or create situations that is further worsening the welfare of the households.

1.2 Objectives of the study

- To analyze the energy consumption pattern of consumers in rural and urban areas of Pakistan.
- To analyze the impacts of energy pricing policies on consumers' welfare in Pakistan.

1.3 Hypotheses

The hypotheses of the study are as follow:

- Energy consumption patterns are different in rural and urban areas.
- There are negative impacts of energy pricing policy on consumers' welfare.

1.4 Organization of the Study

The study is organized in five chapters. Chapter 1 presents introduction of the study. The relevant literature is reviewed in chapter 2. Data sources, variables and methodology are discussed in chapter 3 of this study. The analyses of results are presented in chapter 4 and finally chapter 5 concludes the study with some policy recommendations.

Chapter 2

LITERATURE REVIEW

Literature on the specific subject of energy pricing is available in abundance. Many researchers in various countries round the globe have addressed this issue. Most of the researchers and policy makers criticise governments on the extension of universal energy subsidies to consumers, as their studies show that untargeted energy prices are both inefficient, inequitable and crowd out high priority government spending. They recommend governments to phase-out subsidies, as subsidizing energy sector encourages over consumption of energy products and much benefit of subsidized energy goes to rich consumers (Arze and others, 2012; Vagliasindi, 2013; Mills, 2012).

Some of the researchers favor the energy price regulation but also recommend its proper targeting, so that the proposed objectives from energy price regulation can be achieved (Frondel *et al*., 2006).

The main reason, due to which the energy pricing has become an issue in major public policy and have attracted many researchers and policy makers, is its cost. Subsidized energy has contributed to fiscal deficits that are hardly sustainable. Price controls once adopted are difficult to roll back and become persistent. Phasing-out of such controls later becomes a headache for the policy makers as they face a lot of opposition. Some of the studies relating to pricing policies are discussed in table 2.1. Researchers from many countries have contributed to this burning issue; some of them are presented in this table.

Table 2.1: Summary Table of Literature based on Energy Pricing policies

S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
1	Adagunodo (2013)	➢ Examines effects of energy prices reform on consumers' welfare in Nigeria. ➢ Uses marginal social cost approach for evaluation of implications after energy prices reform.	Annual data on Households expenditure surveys	Almost Ideal Demand system (AIDS)	➢ Removing of energy subsidy and price reforms will free large amount of funds for government expenditures. ➢ Results support price reforms and subsidies removal in energy sector. ➢ Marginal social and welfare costs of energy products are low which suggest reform of subsidies on all energy products in Nigeria.
2	Ahmadian *et al.* (2007)	➢ Estimates gasoline demand function for Iran. ➢ Examines the effect of gasoline pricing policy on social welfare in Iran.	Annual time series data 1968-2002	Structural time series model (STSM)	➢ Short run and long run price elasticities of demand are inelastic. ➢ Social welfare decreases due to higher gasoline prices. ➢ Social welfare increases due to changes in other variables, which decrease negative effects of rise in gasoline prices.
3	Andriamihaja and Vecchi (2007)	➢ Estimates effects on welfare due to rise in prices of petroleum products in Madagascar. ➢ Analyzes impacts of rise in petroleum prices on households, especially the poor. ➢ Identifies direct and indirect welfare effect of price rise.	Annual Households survey data (2005)	Price-shifting model	➢ On average households expenditures increase by 1.75 percent due to a 17 percent increase in price of oil. ➢ Sixty percent increase in households' expenditure is due to the indirect effects of price rise. ➢ In percentage terms the poor households are highly affected because of the price rise. ➢ Subsidies leakages to rich households are substantial. ➢ A more cost-effective policy should be identified for protection of the lower income households against the increases in energy prices.
4	Zhang (2011)	➢ Presents and analyzes welfare impacts of energy	Annual data on Household	Descriptive	➢ Lower and upper income households reduce electricity consumption by 1.6 percent 5.6 percent

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		prices reforms in Turkey. ➢ Analyzes energy demand of households.	Survey (2008)		respectively, due to a 10 percent rise in the price of electricity. ➢ Lower income households show less flexibility in adjustment to electricity prices and consumption as they use electricity only for basic needs. ➢ Due to rise in price of electricity, the poor households experience more welfare loss. ➢ Social protection policies should be carefully crafted for mitigating the affects of rise in prices of energy on poor households.
5	Gangopadhyay *et al.* (2004)	➢ Examines the impact of increase in energy prices due to reduction in subsidy on the welfare of poor in India.	Annual data on Households expenditure surveys (1993-94, 1999-00)	Descriptive	➢ The case for reducing LPG and kerosene oil subsidies is strong. ➢ These subsidies are an inefficient means of reducing fuel prices. ➢ The paper recommends that reduction in these subsidies must be accompanied by other policies that would limit the adverse impacts on poor household.
6	Hartono and resosudarmo (2006).	➢ Analyzes the implications of fuel, electricity and gas prices increase resulting from subsidies reduction policy on economic growth and income distribution in Indonesia. ➢ Identifies those groups of households who are affected the most by energy price increase.	Annual data from Indonesian Energy Social Accounting Matrix (ESAM) (1990-2003)	Dynamic Computable General Equilibrium (CGE) Model	➢ As a result of subsidies reduction GDP will increase about 0.48% - 0.51% and income distribution will be more even. ➢ Without income transfer program to the poor most of the poor households' incomes will be lower than the base scenario. ➢ If fuel subsidy reform is followed by compensation program, this will increase GDP and poor households' incomes with the highest percentages (0.06% to 1.33%). ➢ Miss-management in compensation program will

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S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
		➢ Examines the economic impacts of direct cash transfer policy to compensate for the reduction in fuel subsidy on poor households.			decrease poor household incomes about (34.23% to 36.60%). ➢ Efficient utilization of energy after reform will make energy trade balance better.
7	Coady *et al*. (2006)	➢ Evaluates the magnitude and distribution of fuel subsidies in Bolivia, Ghana, Jordan, Mali and Sri Lanka. ➢ Emphasizes on the likely impacts of energy price increase on the poorest households. ➢ Examines alternative approaches for mitigating these adverse effects.	Annual Households expenditure surveys (2005) and Industries input-output tables (2005)	Price shifting model	➢ Energy subsidies are badly targeted. ➢ Households with lower incomes do suffer from sizable real income decreases due to subsidy removal. ➢ Government should allocate savings for the promotion of access of poor households to health services, quality education and electricity.
8	Komives *et al.* (2006)	➢ Examines whether poor households are disproportionately benefited from water and electricity subsidies in developing countries. ➢ Evaluates whether subsidies are well-targeted to the poor households.	Annual Households expenditure survey and utility data	Descriptive	➢ Poor households are not effectively targeted by quantity-targeted subsidies. ➢ The non-poor benefit disproportionately from subsidies and many poor households are excluded. ➢ Many poor households do not receive any subsidy as the leakage cost of the subsidies is very high.
9	González (2009)	➢ Presents evidences and consequences of an energy	Annual data on energy	Descriptive	➢ Due to high subsidies for natural gas, users are discouraged to choose for efficiency in

Table 2.1: Summary Table of Literature based on Energy Pricing policies

S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
		policy which is based on heavy subsidies for natural gas in Argentina. ➢ Demonstrates social and environmental injustices that are derived from subsidies. ➢ Examines whether natural gas subsidies have contributed to low thermal efficiency.	subsidies from International Energy Agency (IEA) (2008)		Argentina. ➢ Natural gas Subsidies led to spread of unawareness on the advantages of efficiency. ➢ It brought up injustices as not all the households enjoy the same benefits. ➢ Subsidy on natural gas reaches only to 60% of the population leaving out most of the poor sectors. ➢ Natural gas subsidy has lowered the economic efficiency because high consumption by households prevents the use of energy in production activities. ➢ It has negative consequences on environment.
10	Mourougane (2010)	➢ Studies the main features of energy subsidy policy in Indonesia. ➢ Subsequently details the costs that are associated with this subsidy policy. ➢ Reviews fiscal, economic and social burdens. ➢ Studies benefits of reforms in subsidy with related aspects of political economy.	Annual data from Organization for Economic Cooperation and Development (2000-09).	Descriptive	➢ Both the economy and environment are likely to improve by removing energy subsidies. ➢ Removal of energy subsidies is predicted to have good general-equilibrium effects. ➢ If the energy subsidies are reduced by one-fourth it is estimated to generate savings of USD 2 billion per year (0.2% of GDP). ➢ Removal of energy subsidies without any compensation policy increases the chances of an increase in poverty. ➢ Compensating measures must be introduced by the authorities that support the poor households in a more effective and direct way, as reduction in energy subsidies will reduce purchasing power of the poor.

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					➢ Among the available social policy tools, more advantages are presented by cash transfers, which can be easily targeted and their cost is commonly known with certainty.
11	Dansie *et al.* (2010)	➢ Examines and compares efforts to reduce energy subsidies in China, India and Russia. ➢ Examines the main obstacles to reducing energy subsidies in China, India and Russia.	Annual Data on Subsidies from World Energy Outlook (WEO)	Descriptive	➢ Subsidy reform cannot be implemented straight forwardly, it will take time and will keep advancing in fits and starts. ➢ Obstacle in the way of subsidy reform is: rent-seeking by entrenched interests that prevent the implementation of subsidy reforms. ➢ Implementation of subsidy reform also depends on whether governments can convince their populations about the fact that reducing subsidies will benefit them directly. ➢ This also depends on the capability of the government to turn the savings which are received from reduced subsidies into other welfare goods.
12	IEA, OPEC, OECD, World Bank Joint report (2010)	➢ Analyzes the scope of energy subsidies. ➢ Evaluates phase-out of inefficient subsidies which lead to wasteful consumption.	Annual data on fuel prices IEA 2008 & 2010	Descriptive	➢ Availability and transparency of data on energy subsidies is essential to overcome challenges that are related to the subsidy reform. ➢ Financial support for poverty alleviation and economic restructuring is essential for smoothing the path for subsidy reform. ➢ For a successful subsidy reform an important condition is the credibility of government's commitment to compensate vulnerable groups from increased energy prices. ➢ For protection of the poor the governments must

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S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
					consider alternative policy tools such as cash and non-cash transfers, lifeline rates and other policies that usually perform better than universal subsidies. ➢ After subsidy reform the governments must give priority to those structural expenditures that benefit the poor which include road and rural-electrification schemes along with social expenditure i.e. health and education.
13	World Bank (2010)	➢ Provides an overview of the concept of a subsidy, where they arise, how they are financed, and who are affected. ➢ Review those channels by which subsidy reforms affect an economy.	Annual data on subsidies IMF 2008 & 2010	Descriptive	➢ Subsidies do benefit in supporting the poor in job creation, industry protection, or energy security. ➢ Energy subsidies also carry costs which include fiscal costs, effects on the balance of payments along with other growth and global externalities. ➢ Economies based on large energy consumption face the problem of working against the energy security as subsidizing energy induces more demand due to lower consumer prices. ➢ Subsidizing energy has global effects due to rising prices in the international market with increasing demand. ➢ Subsidies on gasoline, diesel, and LPG are very weakly targeted to the poor, particularly in less-developed countries. ➢ Transparency and proper accounting about the cost of subsidies is important for proper evaluation of government policies.

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14	Granado *et al.* (2010)	➢ Reviews evidences on the impact of fuel price rise due to subsidy reform on household welfare in developing countries.	Annual Household survey	Descriptive	➢ The burden of subsidy reform is evenly distributed among income groups. ➢ A 6 percent decrease in real income of all groups occur due to a $0.25 decrease in the per liter subsidy. ➢ More than 50 percent of this impact occurs due to the indirect impact on prices of goods and services consumed by households. ➢ Due to large benefit leakage to better off households, fuel subsidies is a costly mechanism for protecting the poor. ➢ Quantitatively, people from high income groups capture six times more benefits from energy subsidies than the people who are from lower income groups.
15	Breisinger *et al.* (2011)	➢ Contributes to the ongoing debate on energy subsidy reform in Yemen. ➢ Assesses the economic and social impacts of reform. ➢ Forwards several methods for allocation of the freed resources. ➢ Considers the positive impacts the freed resources, when utilized for reduction in budget deficit, direct transfers to the poor and investments.	Annual data Households Budget Survey 2005/06	Computable General Equilibrium (CGE) model	➢ Lessons from other countries have suggested that efficiency gains from petroleum subsidies reform are likely to accelerate economic growth from 0.1 to 0.8 percentage points annually. ➢ Petroleum subsidies reform also leads 2 to 6 percentage points increase in poverty. ➢ If other measures along with reform are not taken, poverty will increase in both urban and rural areas. ➢ The poorest groups can be saved for the direct negative effects of subsidy reform through social transfers and the proper investment of saved resources.

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S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
16	Albers and Peeters (2011)	➢ Focuses on fuel and food prices. ➢ Analyzes recent changes in fuel and food inflation in Mediterranean countries. ➢ Quantifies subsidies on fuel and food per country for the period of 2002-2010. ➢ Provides a comparative analysis of fuel and food pricing across Mediterranean countries.	Annual data Government Finance Statistics (GFS) from the IMF	Descriptive	➢ Increasing subsidies results in an estimated deterioration of the government's budget balances for more than 2% of the total GDP. ➢ There is need for creation of more fiscal space by reducing subsidies, which will provide more room for spending on growth-enhancing measures. ➢ Safety-nets must be designed to improve targeting in such a way that leakages are phased out. ➢ Short-term compensation measures for protecting the poorer households should preferably be focused on income transfers for reducing the loss in real income due to reform. ➢ Reforms in subsidy must be accompanied by improved administration capabilities for more effectiveness.
17	Guillaume *et al*. (2011)	➢ Reviews the technical issues which arise in the implementation of subsidy reform. ➢ Evaluates actions taken by Iranian policy-makers and administrative bodies for implementation of subsidy reform.	Annual data on subsidies Central Bank of the Islamic Republic of Iran	Descriptive	➢ Due to the successful implementation of the subsidy reform unique opportunity has arose for Iran to develop its economy and accelerate economic growth. ➢ For ensuring long-term success of the subsidy reform, Iran's corporate sector must adjust itself to higher energy prices and reduced energy intensity. ➢ Change in production technologies and product mix is required to cope with rising prices of energy. ➢ Iranian companies will be in need to

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					manufacture more energy efficient products and to produce them with more energy efficient technologies.
18	Dartanto (2012)	➢ Studies the relationship between fiscal balance and fuel subsidies. ➢ Evaluates the impact on poverty of fuel prices. ➢ Examines that how effective are the reallocation policies in protection of low income groups.	Annual data (National Socio-Economic Survey of Indonesia) (2005)	CGE Microsimulation approach (CGE-MS)	➢ Fuel subsidies lead to reduction of fiscal space used to promote economic growth which is a prerequisite for poverty reduction. ➢ Since 2004, the expenditure share of fuel and energy subsidies is greater than the share of development expenditures. ➢ Subsidies mostly benefit the middle and upper class who consumed 68.4 per cent of the total subsidies. ➢ Transfers of subsidies from upper income households to poor households will accelerate economic growth and will improve income distribution. ➢ Poverty is increased by 0.25 percent if one-fourth of subsidy is phased out. ➢ If the freed money is allocated to government spending and transfers, the adverse impact can be reduced.
19	Glomm and Jung (2012)	➢ Analyzes the affects of energy subsidy reforms in Egypt. ➢ Examines welfare and growth of a small open economy having large energy sector.	Annual data World Bank 2009	Dynamic General Equilibrium model	➢ Cuts in energy subsidies without the efficient usage of energy in production will have adverse impacts on growth but not on welfare. ➢ An increase of 3 percent occurs in GDP with a 15 percent reduction in energy subsidies to households and firms. ➢ Government policy determines the expansionary or contractionary effects of cuts in subsidy cut.

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					➢ Growth effects can be realized by increasing infrastructure investments after the cut in subsidy. ➢ If government compensates the households by lowering other taxes after cuts in the energy subsidy, no growth effects will result.
20	Hamid And Rashid (2012)	➢ Examines the economic impacts due to the removal and re-allocation of energy subsidy on Malaysian economy. ➢ Analyzes economy-wide impacts on different sectors and welfare. ➢ Suggests policies for redistribution of energy subsidy.	Annual fuel subsidy data from Economic Report 2010-11. Input-Output Table 2005. Social Accounting Matrix (SAM) data Of 2010-11	Computable General Equilibrium (CGE) model	➢ Subsidies phase-out affects the structure, sectors performance and welfare. ➢ Delay in the removal of subsidies will reduce Malaysia's competitiveness and will lead to more economic problems. ➢ Gradual rationalization is suggested for gradual reaping of more efficient fuel utilization and efficiency. ➢ Malaysia should not only continue policies of subsidy rationalization, but should also consider the adoption of a goods and services tax (GST).
21	Hosseini and Kaneko (2012)	➢ Studies the reform in energy subsidies and its inflationary impact in Iran. ➢ Examines its affects on non-energy sectors along with the positive and negative impacts on rural and urban households.	Quarterly data Consumer Price Index 2006-2012 Iran's national input-output table 2001	Input-output price model	➢ If the entire energy subsidies are removed, an increase of 45.7 percent in consumption prices will occur. ➢ Rural families will suffer more inflation than the urban families if the energy subsidies are removed. ➢ When the consumption price in urban areas increases by 42.8 percent, it increases by 55.5 percent in the rural areas. ➢ Gradual phase out of the energy subsidies is

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					suggested for avoidance of devastating shocks which will affect households, especially the poor ones. ➢ A gradual subsidy reform poses less inflation to producers and households and provides room for alleviation of the negative effects.
22	Commander (2012)	➢ Examines reasons for failure in reform. ➢ Forwards possible ways of overcoming the obstacles to reforms. ➢ Looks at the characteristics of the countries using energy subsidies.	IEA Annual dataset for 2007-2009 IMF dataset which contains annual observations between 2002 and 2008	Descriptive	➢ The main reasons for failure in subsidy are roles of interested parties or lobbies. ➢ Countries with weak institutions are linked with higher subsidies. ➢ Energy subsidies reforms face significant hurdles. ➢ Considering these hurdles, government should have adequate preparation before reforming subsidies. ➢ Governments interested in reform should implement policies that are consistent with fiscal, institutional and other capacities. ➢ Subsidy reforms face acute opposition in non-democracies.
23	Vagliasindi (2012)	➢ Provides evidence about the role of reforms in reducing fiscal burden. ➢ Addresses implementation and challenges of reform. ➢ Discusses instruments for compensation of vulnerable groups from energy-price increases.	Annual data on budgetary subsidies, fuel and electricity tariffs, and household survey data	Descriptive	➢ Compensating vulnerable groups is an important condition for successful reforms. ➢ Subsidy reforms also depend on the credibility of the government commitment. ➢ Subsidy reforms meet success when the funds freed from reforms are used for more pro-welfare activities. ➢ Instruments for protecting the poor from adverse impacts of subsidy reform include lifeline rates

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S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
					and direct cash transfers which perform better than universal subsidies. ➢ Public should be informed about the benefits of subsidy reform and also about the compensating measures.
24	Widodo *et al.* (2012)	➢ Aims at analyzing the impacts after removal of fuel subsidy on Indonesian economy.	Annual data from Social Accounting Matrix (SAM) 2010.	General Equilibrium model	➢ Removal of energy subsidies affects governments, firms and households. ➢ By reallocation of freed funds to agriculture, trade, food and beverages sectors, adverse impacts of subsidy reform can be reduced. ➢ The government should design a clear long term scheduled and gradual program for energy subsidy reforms. ➢ All of a sudden a total removal of fuel subsidy will be a shock for the economy. ➢ Government should not consider policies such as "targeted fuel subsidy" for correcting the misallocation.
25	Energy Subsidies in the Middle East and North Africa: Lessons for Reform IMF (2013)	➢ Studies energy Subsidies in the Middle East and North Africa. ➢ Examines methods of Reforms.	IMF staff estimates	Descriptive	➢ Subsidies do provide support to poor households but their benefits go mainly to the better-off households. ➢ Subsidies also weigh on government budgets at the cost of investment in other important areas such as health care, education, and infrastructure. ➢ Careful planning of reform is crucial for its success. ➢ Compensatory measures like better-targeted cash transfers for those who are hit hard by the subsidies reform are also helpful in its success.

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S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
					➢ Communications campaign is another important key to success of reform, as it raises awareness in public about the cost of subsidies and the benefits of subsidies reform.
26	Nugumanova (2013)	➢ Examines the issues and the extent of fuel subsidies in Kazakhstan. ➢ Analyzes implications of the subsidies. ➢ Provides policy suggestions about subsidy.	Annual data IMF	Computable General Equilibrium model (CGE)	➢ Due to Subsidy reform slight decrease in welfare and GDP are possible. ➢ Energy prices are expected to increase with subsidy reform. ➢ Energy demand will decrease; therefore there could be slight increase in the export of fuels. ➢ For achieving goals of reform, such policies and institutions are necessary that provide incentives towards investments.
27	Charap *et al.* (2013)	➢ Analyzes a panel of cross-country data for exploring the changes in energy consumption due to changes in its prices. ➢ Examines the implications of energy subsidy reform.	Annual Cross country data, Review of Energy Statistics (2011)	Regression Analysis	➢ Long-term energy demand price elasticity is lying between -0.3 and -0.5, suggesting significant long-term benefits from the energy subsidy reform. ➢ Short-term benefits from subsidy reform are smaller, suggesting the need of a gradual reform. ➢ There is loss of consumer welfare resulting from subsidy reform. ➢ Loss of consumer welfare is larger in short term than in the long term, ➢ Gradual approach for reforming subsidy is suggested along with generous safety nets for poor households in short term.
28	Strand (2013)	➢ Discusses numerous aspects of political economy regarding fuel	Annual data on subsidies	Descriptive	➢ Less ability of government to provide other public goods lead to more gasoline subsidies. ➢ A non-democratic government fails in providing

Table 2.1: Summary Table of Literature based on Energy Pricing policies

S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
		pricing. ➢ Focuses on gasoline and kerosene subsidy reforms. ➢ Political and economic aspects are considered for explaining differences in subsidies.			public goods and relies greatly on gasoline subsidies. ➢ Bribing politician by owners of motor vehicles lead to increase in gasoline subsidies. ➢ Government ignored other potential and important issues such as influence of other groups like NGOs, on gasoline pricing. ➢ Problems arise due to non availability of data on various energy related variables. ➢ Government should establish institutions for collecting data and for making policies.
29	Umar and Umar (2013)	➢ Measures the direct welfare impact of increase in fuel prices on different groups in Nigeria.	Annual data Household Expenditures Survey of 2010	Regression Analysis	➢ Subsidies in fuel are costly in protecting the poor households as there is a substantial leakage of benefits to the households with higher incomes. ➢ Welfare loss for the poor households due to subsidy reform is greater due to their small income. ➢ Subsidy reform is necessary but it must be phased out with caution. ➢ Programs for mitigating welfare loss are necessary as subsidy cut is, for protecting the lower income and the middle income groups from the adverse impacts of subsidy reform. ➢ The highest percentage of benefits from fuel subsidies goes to the highest 20% income group. ➢ Highest income group receives four times more benefit from fuel subsidy than the lowest income group due to their higher share in the average monthly fuel consumption.

Table 2.1: Summary Table of Literature based on Energy Pricing policies

S No.	Author/ study	Focus of the Study	Data Type	Methodology	Results/Conclusions
30	Anand *et al.* (2013)	➢ Evaluates the welfare and fiscal implications of fuel subsidy reform in India. ➢ Identifies issues that need to be addressed while designing a subsidy reform.	Annual National sample survey (NSS) 1950 to 2009/10	Descriptive	➢ Fuel subsidies are badly targeted. ➢ Richest 10% percent households are receiving 7 times more benefits than the poorest 10%. ➢ Subsidy reform will generate large fiscal savings. ➢ Real incomes of households will be lowered due to increases in fuel and other prices. ➢ Better targeted fuel subsidies will protect lower income groups and will still generate large fiscal savings.

Chapter 3

DATA AND METHODOLOGY

3.1 Data

This study uses pooled data instead of cross-section or time series alone. For estimation of economic relationships time series data is more suitable on theoretical backgrounds. But, in practice time series data exhibit many problems i.e. intercorrelation among explanatory variables, which vary over time. Due to this the coefficients of the relationship tends towards instability and therefore accuracy of the estimates cannot be assessed. On the other hand we are unable to obtain a price coefficient estimate using cross-sectional data, because for all consumers at any point of time the price structure remains the same. Therefore, to avoid the problems associated with time series or cross-section we use pooled data. One other advantage of pooled data is that it relatively provides us a large sample and yields sufficient degrees of freedom.

Due the combination of cross-section and time series data our estimates will be more reliable than the estimates obtained by using the time series or cross-section sample alone. In the estimation of demand functions, use of time series data in combination with cross-section data avoids the problems of identification, simultaneous equation bias and multicollinearity.

This study uses the data of *Household Integrated Economic Survey (HIES)* for rural and urban Pakistan from the year 1984-85 to 2011-12, conducted by Pakistan Bureau of Statistics (PBS). This data set divides households into several income groups and

provides information about the expenditures made by households on various commodities such as Food and Beverages, Apparel, Textile & Footwear, Firewood, Kerosene Oil, Gas, Electricity, House Rent & Housing, Transport & Communications etc. The data on nine goods is used for this study. The goods are

1. Food and Beverages

2. Apparel, Textile & Footwear

3. Firewood

4. Kerosene Oil

5. Gas

6. Electricity

7. House Rent & Housing

8. Transport & Communications

9. Miscellaneous

Out of the total nine goods the energy goods (Firewood, Kerosene Oil, Gas and Electricity) are considered at disaggregate level, while all others goods (Food and Beverages, Apparel, Textile & Footwear, Transport & Communications, House Rent & Housing) are considered at aggregate level. The goods included in miscellaneous are Furniture & Household equipments, Education and Recreation.

The data for each of the rural and urban Pakistan is pooled for fourteen years and twelve income groups for the years 1984-85, 1985-86, 1986-87, 1987-88, 1990-91, 1992-93, 1996-97, 1998-99 and five income groups for the years 2001-02, 2004-05, 2005-06, 2007-08, 2010-11 and 2011-12. The total number of observations for rural and urban Pakistan is 122 each.

3.2 Data on Prices

Data on Consumer Price Index (CPI) and prices of the nine goods used by this study are obtained from various issues of *Economic Survey of Pakistan* published by Ministry of Finance (MOF) and *Pakistan Energy Yearbook* published by Ministry of Petroleum and Natural Resources, Government of Pakistan. All price indices are converted to the base year 2000-01.

3.3 Methodology

This chapter discusses the methodology that we used for studying the impacts of energy prices on households' welfare in Pakistan. First, we used the Almost Ideal Demand System (AIDS) and Linear Approximation of Almost Ideal Demand System (LA / AIDS) models for the estimation of required parameters of the households' demand model. Then we estimated the uncompensated price elasticities to determine whether the data is consistent with the economic theory. Finally, we estimated the effects of changes in energy prices on the welfare of households in the form of compensating income variation Winch (1971).

3.4 Almost Ideal Demand System

Almost Ideal Demand System was proposed as a new demand system by Angus Deaton and John Meulbauer in 1980, which is considered as a major breakthrough in demand system generations. Alston and Chalfant (1993) commented that, in a relatively short time since the introduction of AIDS, economists had adopted it to the extent that it appeared to be the most popular of all demand systems. This is an ideal demand system because this system satisfies almost all the properties of a theoretical demand system in spite of its high level of flexibility. An arbitrary first order approximation is given by AIDS to any demand system. Axioms of choice are satisfied by AIDS. Without invoking linear parallel Engel curves, it aggregates perfectly over consumers. It has a functional form, which is consistent with household budget data. Its estimation is simple. It satisfies the restrictions of homogeneity and symmetry through linear restrictions on the fixed parameters and also its linear approximated version avoids the need for non-linear estimation.

The system is based on an expenditure function of the form:

$$\ln n[M(p,u)] = (1-u)\ln[a(p)] + u\ln[b(p)], \tag{3.1}$$

where

$$\ln[a(p)] = a_{\circ} + \sum_k a_k [\ln(p_k)] + \frac{1}{2}\sum_k \sum_j \gamma_{kj} * \left[\ln(p_k)\ln(p_j)\right] \tag{3.2}$$

$$\ln[b(p)] = \ln[a(p)] + \beta_{\circ} \prod_k [p_k]^{\beta_k} \quad (3.3)$$

Substituting equations 3.2 and 3.3 into equation 3.1 yields

$$\ln[M(p,u)] = a_{\circ} + \sum_k a_k [\ln(p_k)] + \frac{1}{2}\sum_k \sum_j \gamma_{kj} * \left[\ln(p_k)\ln(p_j)\right] + u\beta_{\circ} \prod_k [p_k]^{\beta} \quad (3.4)$$

The Marshallian demand function for any good i is obtained in two steps. By taking derivative of the above expenditure function with respect to $ln(pi)$ and applying Shepherd's lemma in the first step, the compensated demand function is obtained as an equation for expenditure share on good 'i'. One can substitute in the resulting equation the indirect utility function in the second step, which can also be obtained by inverting the above expenditure function. The result would be an expenditure share equation of the form:

$$s_i = a_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{M}{P}\right), \quad (3.5)$$

Where

$$\gamma_{ij} = \frac{1}{2}\left(\gamma_{ij} * + \gamma_{ji} *\right)$$

In the above system 's_i' is the budget share of good i, P_i is the price of good i, M is the total expenditure and P is the price index. The parameters $a_i s$ are the intercepts of the

share equations while $\gamma_{ij}s$ and $\beta_i s$ represent the parameters indicating sensitivity of budget shares to changes in prices and real income respectively.

The price index '*P*' is defined as:

$$\ln P = a_\circ + \sum_k a_k \ln p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \ln p_k \ln p_j \qquad (3.6)$$

The demand functions given in equation 3.5 are non linear in parameters**.** The natural starting point for predictions using AIDS model is that in the absence of changes in the relative prices and real expenditure (*M/P*), the budget shares are constant and this is the simple interpretation if AIDS. The changes in real expenditure works through the term β_i coefficient and the changes in relative prices operate through the terms γ_{ij}. Further note that $\beta_i^{'}s$ add up to zero and are positive for luxuries and negative for necessities. Abstracting from the theoretical properties of the expenditure functions, this model has no restriction on the structural parameters. This restricted model can be used as a basis for examining some of the conclusions of the demand theory by imposing some special conditions on the parameters successively. Some restrictions are imposed on the parameters of equations 3.5 and 3.6 for enforcing consistency with the theory. Those restrictions are summarized as below

$$\sum_i a_i = 1\ , \qquad \sum_i \gamma_{ij} = 0\ , \qquad \sum_i \beta_i = 0 \qquad (3.7)$$

$$\sum_j \gamma_{ij} = 0 \qquad (3.8)$$

$$\gamma_{ij} = \gamma_{ji} \quad (3.9)$$

Provided that equations 3.7, 3.8 and 3.9 hold, equation 3.5 represent a system of demand functions which add up to total expenditure ($\sum s_i = 1$), which satisfy Slutsky symmetry and are homogenous of degree zero in prices and total expenditure taken together. Equation 3.7 is the set of adding up restrictions, equation 3.8 is the restriction of homogeneity in prices and equation 3.9 is the Slutsky's symmetry condition. Simply equation 3.7 means that the budget shares should add up to unity.

As the budget shares add to unity, in equation 3.5 the parameters $a_i's$ must also add up to unity, while $\gamma_{ij}'s$ matrix and the $\beta_i s$ vector must add to zero in dimension i. The system must also be homogenous of degree zero in prices and total expenditure, which means that the unit values should double with the doubling of prices and total expenditure and the budget shares remain unchanged. And this will happen only when the γ_{ij} rows will add to zero in the dimension j. The demand system is complete as the adding up and homogeneity restrictions make us able to add another commodity defined as 'all other goods' and also by deriving its own and cross elasticities from these restrictions.

When $\gamma_{ij} = \gamma_{ji}$ then the substitution matrix of demand system is symmetric. For theoretical consistency of the parameter estimates symmetry restriction is commonly used in demand analysis.

Equation 3.5 is very close to being linear and that is the most interesting aspect of equation 3.5 from the econometric point of view. The system will become linear in parameters if "*P*" is estimated separately. Equation 3.6 defines P as homogenous linear function of individual prices ensured by the restrictions on a and γ. P is defined as approximate price index due the relative collinearity of prices in practical situations.

As used by Stone

$$\ln P^* = \sum_k (s_k \ln p_k) \tag{3.10}$$

direct calculation of this index can be done before estimation so that equation 3.5 becomes,

$$s_i = a_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \left(\frac{M}{P^*}\right) \tag{3.11}$$

Equation 3.11 can be easily estimated and is known as Linear Approximate Almost Ideal Demand System (LA/AIDS). In general, the relationship of parameters of Almost Ideal Demand System (AIDS) with the parameters of Linear Approximate Almost Ideal Demand System (LA/AIDS) in this form is not known. These are actually non nested models. The Stone's price index is a good proxy for the price index in equation 3.5. Estimates of LA/AIDS approach the estimates of AIDS except the intercept term, when the changes in prices are proportional to one another. It is not known whether or not the theoretical properties of consumer theory are satisfied by LA / AIDS.

3.5 Price Elasticities

A measure of the relationship between a change in the quantity demanded of a good due to a change in its own price or price of another good is the general definition of price elasticity. The uncompensated elasticities in terms of AIDS and LA/AIDS models can be defined as

$$\eta_{ij} = \frac{d \ln Q_i}{d \ln P_i} = -\delta_{ij} + \frac{d \ln s_i}{d \ln P_j} = -\delta_{ij} + \left\{ \gamma_{ij} - \beta_i \frac{d \ln P}{d \ln P_j} \right\} / s_i \quad (3.12)$$

Holding total group expenditure and all other prices constant, these elasticities relate to allocations within the group. The term δ_{ij} is equal to one if and only if $i = j$ and it is equal to zero if $i \neq j$ and is known as Kronecker delta. For the correct expression of elasticity in AIDS, the term in equation 3.12 that is $\frac{d \ln P}{d \ln P_j}$ can be further elaborated as $\frac{d \ln P}{d \ln P_j} = a_i \sum_k \gamma_{kj} \ln P_k$. By plugging this expression in equation 3.12, the formula of elasticity becomes:

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{s_i} - \frac{\beta_i a_i}{s_i} - \frac{\beta_i}{s_i} \sum_k \gamma_{kj} \ln P_k \quad (3.13)$$

This formula does not work for LA/AIDS as we use a different price index in LA/AIDS instead of the price index discussed in equation 3.6. The price index that we use in LA/AIDS is

$$\ln P^* = \sum_k s_k \ln P_k \quad (3.14)$$

Stone's price index is differentiated with respect to the *j*th commodity price for obtaining the formula for the price elasticity in LA/AIDS model. We get the final expression as

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{s_j} - \frac{\beta_i s_j}{s_i} - \beta_i / s_i \left[\sum_k s_k \ln P_k \left(\eta_{kj} + \delta_{kj}\right)\right] \quad (3.15)$$

which can be expressed in the matrix form as

$$E = A - (BC)(E + I) \quad (3.16)$$

The typical elements are $a_{ij} = -\delta_{ij}\left(\frac{\gamma_{ij}}{s_j}\right) - \beta_i\left(\frac{s_j}{s_i}\right)$ in A (an n × n matrix); $b_i = (\beta_i / s_i)$ in B (an n × 1 vector); $c_j = s_j \ln P_j$ in C (a 1 × n vector); and $\eta_{ij} = -\delta_{ij} + \gamma_{ij}/s_j - \beta_i s_j / s_i - \frac{\beta_i}{s_i}[\sum_k s_k \ln P_k(\eta_{kj} + \delta_{kj})]$ in E (an n × n matrix). Solving for elasticities $[\eta_{ij}]$ yields, after some simplifications;

$$E = [BC + 1]^{-1}[A + I] - I \quad (3.17)$$

where I is the identity matrix.

The formula that is used for calculation of income elasticities is

$$N = (I + BC)^{-1}B + i \quad (3.18)$$

Where $N_{(nx1)}$ is the expenditure/income elasticities vector, *i* is an n unit vector.

3.6 Welfare Effects of Energy Price Changes

The welfare effects of energy price changes can be analyzed using a specific measure of welfare on the consumers and employing the actual and hypothetically specified energy prices. One approach for setting the hypothetical energy prices, which is quite often adopted in the literature, is to consider the existing energy subsidies and then see what impact the removal of these subsidies will have on consumers (see Literature review). This approach is appropriate when analyzing the effect of removing one specific structure of energy subsidies. But, by using this approach it becomes quite difficult to analyze the cumulative effect of removing all distortions that exist due to the introduction of taxes and subsidies applied in the past.

An alternative easier approach that we followed here is to set the energy prices at some benchmark level and then compare the effect of changing the prices from the actual to the benchmark levels. To apply this approach we considered the compound inflation rate of each energy category over some period of time and then replaced this rate by the CPI inflation rate for the same period. The benchmark energy prices for the current period were then computed by applying the CPI inflation rate over the period under consideration. The period for the present analysis was the latest year of data 2011-12. For the computation of the benchmark energy prices we considered the following periods.

1992-93 to 2011-12

1996-97 to 2011-12

2001-02 to 2011-12

2007-08 to 2011-12

The next question is how to measure welfare. Since utility is not measureable, the effects of price changes on welfare of a consumer can only be measured in monetary terms. A simple way to measure the welfare effects of price changes is to compute the effects of price changes on total expenditure incurred in purchasing a given basket. The only advantage of this measure is this it allows the easiest calculation for welfare effects of price changes but it does not capture the true welfare effects as it assumes that consumers do not at all respond to price changes. The alternative approach of involving the concept of consumer surplus that allows for changes in demands in response to price changes is obviously preferable.

The typical measure of consumer surplus as presented in basic textbooks of microeconomics is based on the assumptions that utility is measurable cardinally and that the marginal utility of money is constant [See Winch (1971)]. Alternative measures of consumer surplus have been proposed that do not require these two assumptions. Winch (1971) explains four alternative measures of consumer surplus, known as compensating variation, equivalent variation, compensating surplus and equivalent surplus.

Although any one of these measures can be used to estimate the effects of energy price changes on welfare of consumers, the most suitable one, as will become obvious in the following analysis is compensating variation, which measures the increase in income that compensates for the price increase or the decrease in income that compensates for the price decreases as may be the case. Thus, consider the level of utility at the initially given prices. Inverting the expenditure function (IUF) under AIDS (equation 3.1) for utility, we obtained the following indirect utility function.

$$U = \frac{\log(M) - \log[a(P)]}{\log[b(P)] - \log[a(P)]} \tag{3.19}$$

Substituting for the functions $\log[a(P)]$ and $\log[b(P)]$ from equations (3.2) and (3.3) respectively, we obtained:

$$U = \frac{\log(M) - a_0 - \sum_k a_k \log(p_k) - \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k)\log(p_j)}{\beta_0 \prod_k (p_k)^{\beta_k}} \tag{3.20}$$

Let the actually observed prices be denoted by P_k^0 and the proposed prices by P_k^1. Also denoted the initial income or total expenditure by M^0, the first step is to compute the value of utility using the IUF (3.19), that is;

$$U^0 = \frac{\log(M^0) - a_0 - \sum_k a_k \log(p_k^0) - \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^0)\log(p_j^0)}{\beta_0 \prod_k (p_k^0)^{\beta_k}} \tag{3.21}$$

The value of utility obtained above is used to compute the value of the log of expenditure at the new prices using the expenditure function (equation 3.1) as follows.

$$\log(M^1) = a_0 + \sum_k a_k \log(p_k^1) + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^1)\log(p_j^1) + U^0 \ \beta_0 \prod_k (p_k^1)^{\beta_k} \tag{3.22}$$

Substituting for U^0, we obtain:

$$\begin{aligned} \log(M^1) = {} & a_0 + \sum_k a_k \log(p_k^1) + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^1)\log(p_j^1) \\ & + \left[\log(M^0) - a_0 - \sum_k a_k \log(p_k^0) - \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^0)\log(p_j^0)\right] \prod_k \left(\frac{p_k^1}{p_k^0}\right)^{\beta_k} \end{aligned} \tag{3.23}$$

Note that in the estimation of AIDS, we estimate only the share equations but we cannot estimate the expenditure function or the IUF. This means that all parameters of the system except β^0 are estimated. However, as we can see from equation (3.23) this parameter drops out in the computation of the expenditure at new prices but old level of utility. This means that despite not being able to estimate β^0 we are able to make all the necessary computations for our welfare analysis.

Finally, given the initial total expenditure M^0 and the computed new expenditure to retain the initial level of expenditure M^1, we obtained the percentage compensating variation while moving from old prices to new prices as follows.

$$CV = \frac{M^1 - M^0}{M^0} 100 \tag{3.24}$$

In applying the above procedure we considered a representative consumer whose total expenditure (representing the income) is equal to the mean per capita total expenditure obtained from the entire sample. The actual prices are set equal to the prices prevailing in the current year 2011-12 and the benchmark prices are obtained by applying the CPI inflation rate to the prices of energy categories over some period of time as explained earlier in this section. If the benchmark prices of energy categories are less than actually observed prices, as expected then the compensating variation given above will be negative, indicating that the representative consumer would have incurred lower expenditure to maintain the existing level of well being had the energy prices increased at the rate of CPI inflation rather than the actually observed inflation rate.

Chapter 4

EMPIRICAL RESULTS

We have estimated both the linear and non-linear versions of the Almost Ideal Demand System (AIDS) for rural and urban Pakistan separately. But the results of non-linear AIDS are more significant than those of the linear AIDS. Therefore we are presenting here the results for non-linear AIDS only. The non-linear AIDS for both rural and urban Pakistan is estimated using seeming unrelated regression procedure. The data for each of the rural and urban Pakistan are pooled for fourteen years and twelve income groups for the years 1984-85, 1985-86, 1986-87, 1987-88, 1990-91, 1992-93, 1996-97, 1998-99 and five income groups for the years 2001-02, 2004-05, 2005-06, 2007-08, 2010-11 and 2011-12. The total number of observations for rural and urban Pakistan is 122 each.

We have estimated the non-linear AIDS model using seemingly unrelated regression procedure by imposing certain conditions on the parameters. The imposed conditions are adding-up, homogeneity and symmetry. Parameters estimates of the non-linear AIDS model are shown in tables 4.1 and 4.2 for rural Pakistan and urban Pakistan respectively.

In case of rural Pakistan the intercept terms for Food & Beverages, Apparel Textile & Footwear, Firewood, Kerosene oil and House rent & Housing are positive with reasonable magnitudes and are highly statistically significant, which indicates that significant portions of expenditures on these commodities are independent of the changes in prices and incomes. The intercept term for Transport & Communications is significant but negative, which indicates that the share of Transport & Communications will be negative if price and income effects are ignored. In case of urban Pakistan the intercept

terms are positive for Food & Beverages, Apparel Textile & Footwear, Firewood, Kerosene oil and Electricity and negative for Gas, House rent & Housing and Transport & Communications.

The nature of a good *i* as luxury or necessity is determined by the parameter β_i. If $\beta_i > 0$, the good *i* is luxury meaning that the expenditure on good *i* will increase with increase in income. If $\beta_i < 0$, the good *i* is a necessity meaning that the expenditure on good *i* will decrease with increase in income. The results in case of rural Pakistan show that $\beta_i s$ for Food & Beverages, Apparel Textile & Footwear, Firewood, Kerosene oil and House rent & Housing are negative and statistically significant indicating that these are necessities in rural Pakistan. The $\beta_i s$ for Gas, Electricity and Transport & Communications are positive and statistically significant indicating that these are luxuries in rural Pakistan.

In urban Pakistan, Food & Beverages, Apparel Textile & Footwear, Firewood, Kerosene oil and Electricity are classified as necessities as indicated by the negative sign of the corresponding $\beta_i s$ while Gas, House rent & Housing and Transport & Communications are luxuries. The change in the share of *i*th good due to one percent change in its own price or the price of any other good with constant expenditure is measured by $\gamma_{ij.}$

The price elasticities for rural and urban Pakistan are shown in tables 4.3 and 4.4 respectively. All the own-price elasticities are negative both in case of rural and urban Pakistan. In rural Pakistan own-price elasticities of Firewood, Kerosene oil, Gas and Electricity are -0.12, -2.06, -4.56 and -0.68 respectively, which means that there will be 0.12%, 2.06%, 4.56% and 0.68% decrease in the consumption of these commodities in rural Pakistan if there is a one percent increase in their prices.

The own-price elasticities of Firewood, Kerosene oil, Gas and Electricity in urban Pakistan are -0.87, -2.22, -1.19 and -0.05, which means that with a one percent increase in the prices of these commodities, the decrease in their quantity demand will be 0.87%, 2.22%, 1.19% and 0.05% respectively.

Using non-linear AIDS the cross-price elasticities are reporting mixed results. The cross-price elasticities with positive sign show that these goods are substitutes while the negative sign of cross-price elasticities shows that these goods are complements. The cross-price elasticities show that Firewood and Gas, Gas and Electricity are the substitutes and Kerosene Oil and Firewood are complements.

Table 4.1 Parameter Estimates of Non-linear AIDS for Rural Pakistan

	Food & beverages	Apparel, Textile & Footwear	Firewood	Kerosene Oil	Gas	Electricity	House rent & Housing	Transport & Communications	Misc.
α_s	18.45939*	2.499461*	2.758553*	1.134486*	-0.34603	-0.32563	1.205026**	-5.1736*	-19.2117
β_s	-0.06808*	-0.00932*	-0.01034*	-0.00433*	0.0012***	0.00123**	-0.00399**	0.019916*	0.073633
γ_s									
Food & beverages	-1.06734*	-0.22698*	-0.20862*	-0.07891*	0.000569	0.03182**	-0.01443	0.354752*	1.209152
Apparel, Textile & Footwear	-0.22698*	0.177307*	-0.00251	-0.01129*	-0.0181**	0.01698*	-0.01783	-0.0439**	0.126366
Firewood	-0.20862*	-0.00251	-0.00317	-0.01464*	0.02804*	-0.009***	-0.0131	0.0286***	0.194794
Kerosene Oil	-0.07891*	-0.01129*	-0.01464*	-0.01082*	0.001335	-0.00021	0.0097***	0.034023*	0.070736
Gas	0.000569	-0.0181**	0.02804*	0.001335	-0.00739	0.016322*	-0.0140**	0.007699	-0.01443
Electricity	0.03182**	0.01698*	-0.009***	-0.00021	0.016322*	0.026512*	-0.04204*	-0.021*	-0.019
House rent & Housing	-0.01443	-0.01783	-0.0131	0.0097***	-0.0140**	-0.04204*	-0.05246**	0.065525*	0.078573
Transport & Communications	0.354752*	-0.0439**	0.0286***	0.034023*	0.007699	-0.021*	0.065525*	-0.07716**	-0.34853
Miscellaneous	1.209152	0.126366	0.194794	0.070736	-0.01443	-0.019	0.078573	-0.34853	-1.29767

*: Significant at 1%, **: Significant at 5%, ***: Significant at 10%

Table 4.2 Parameter Estimates of Non-linear AIDS for Urban Pakistan

	Food & beverages	Apparel, Textile & Footwear	Firewood	Kerosene Oil	Gas	Electricity	House rent & Housing	Transport & Communications	Misc.
α_s	1.476164	0.167573	0.17508	0.034248	-0.02358	0.017552	-0.17236	-0.25735	-0.41733
β_s	-0.08616*	-0.00671*	-0.01358*	-0.00366*	0.003446*	-0.00023	0.030954*	0.025*	0.050937
γ_s									
Food & beverages	-0.06064	0.02393	-0.04575	-0.00372	0.00428	0.00506	0.10873	-0.03622	0.00433
Apparel, Textile & Footwear	0.02393	0.025961	-0.01161	0.00234	-0.011***	-0.00587	-0.04789*	0.01188	0.01297
Firewood	-0.04575	-0.01161	0.0239***	-0.00176	-0.00127	-0.00405	0.00023	0.03088	0.00941
Kerosene Oil	-0.00372	0.002337	-0.00176	-0.00708*	0.00466*	0.00022	-0.00032	0.0052	0.00045
Gas	0.004279	-0.011***	-0.00127	0.00466*	-0.00229	0.01097*	-0.00773	-0.00368	0.00677
Electricity	0.005057	-0.00587	-0.00405	0.00022	0.01097*	0.03093*	-0.03465*	-0.009***	0.0065
House rent & Housing	0.108733	-0.04789*	0.000226	-0.00032	-0.00773	-0.03465*	-0.05555	0.04067	-0.00348
Transport & Communications	-0.03622	0.011876	0.030876	0.0052	-0.00368	-0.009***	0.04067	-0.00793	-0.03169
Miscellaneous	0.004327	0.012969	0.009405	0.00045	0.00677	0.0065	-0.00348	-0.03169	-0.00524

*: Significant at 1%, **: Significant at 5%, ***: Significant at 10%

Table 4.3. Price Elasticities of Non-linear AIDS for Rural Pakistan

	Food & beverages	Apparel, Textile & Footwear	Firewood	Kerosene Oil	Gas	Electricity	House rent & Housing	Transport & Communications	Misc.
Food & beverages	**-0.67122**	-0.11072	-0.04676	-0.00393	-0.04234	0.02144	0.11987	0.01092	-0.14534
Apparel, Textile & Footwear	-0.73519	**-1.55659**	0.28988	-0.00981	-0.27023	0.18024	-0.09418	-1.16881	-0.62969
Firewood	-0.73116	0.82168	**-0.12316**	-0.10461	0.86923	-0.44239	-0.0533	-0.86203	-0.00935
Kerosene Oil	-0.03031	-0.08656	-0.52124	**-2.06559**	-0.01663	-0.27514	2.63254	2.12111	-1.97907
Gas	-11.5795	-10.902	12.5698	-0.05528	**-4.56306**	8.54668	-7.90225	7.28786	4.94446
Electricity	0.58628	0.87206	-0.79946	-0.10083	1.05003	**-0.6877**	-2.72569	-0.92015	0.2724
House rent & Housing	0.66628	-0.09061	-0.0264	0.16417	-0.17615	-0.49696	**-1.5514**	0.51797	0.03889
Transport & Communications	-0.19662	-2.58968	-0.70197	0.31909	0.39452	-0.4132	1.19558	**-0.30926**	0.75044
Miscellaneous	-0.55835	-0.24868	-0.02054	-0.05387	0.0426	0.01498	-0.0171	0.12603	**-0.6045**

Table 4.4 Price Elasticities of Non-linear AIDS for Urban Pakistan

	Food & beverages	Apparel, Textile & Footwear	Firewood	Kerosene Oil	Gas	Electricity	House rent & Housing	Transport & Communications	Misc.
Food & beverages	**-0.85481**	0.0795	-0.06608	0.0011	0.00375	0.01684	0.19765	-0.12557	-0.06674
Apparel, Textile & Footwear	0.47813	**-0.61965**	-0.14718	0.03759	-0.16791	-0.07969	-0.69399	0.14324	0.14411
Firewood	-1.82739	-0.6836	**-0.87954**	-0.07799	-0.11909	-0.25852	-0.17517	1.95764	0.27455
Kerosene Oil	0.30653	0.51315	-0.19844	**-2.22548**	0.80835	0.06002	-0.18479	0.75802	-0.18672
Gas	-0.07378	-1.07126	-0.16383	0.39319	**-1.19155**	0.95118	-0.61807	-0.24477	0.71696
Electricity	0.18389	-0.19881	-0.13681	0.0079	0.37364	**-0.05462**	-1.18271	-0.31222	0.21825
House rent & Housing	0.3694	-0.3094	-0.03056	-0.01081	-0.04017	-0.20986	**-1.29115**	0.28612	0.05417
Transport & Communications	-1.81565	0.20078	0.65581	0.09842	-0.07275	-0.24502	1.12839	**-1.03791**	-0.53073
Miscellaneous	-0.36724	0.02729	0.00253	-0.01054	0.04257	0.02503	0.03378	-0.09596	**-0.91959**

The increase in the prices of energy products (Electricity, Gas, Kerosene oil and Firewood) in the last three decades is more than the increase in general CPI (Consumer Price Index) as shown in table 4.5.

Table 4.5 Percentage Inflation rates of CPI and Price Indices of Energy Products

Year	CPI	Price of Firewood	Price of Kerosene Oil	Price of Gas	Price of Electricity
1984-85	8.652953	10.104751	16.318860	12.504619	11.235044
1985-86	8.821785	10.447674	16.585162	13.015612	11.449170
1986-87	9.036121	10.683708	17.577179	13.536617	11.754812
1987-88	9.151905	10.852841	18.400168	13.721335	12.076501
1990-91	9.079234	10.924647	19.314973	13.733739	11.867736
1992-93	9.039529	10.858473	16.289658	14.491710	12.357463
1996-97	8.336276	11.281809	16.462110	15.057746	11.611556
1998-99	8.579637	12.311093	18.358637	16.957451	10.337948
2001-02	10.425225	15.557101	20.065572	17.809887	11.951588
2004-05	11.995142	18.333562	20.087507	17.060139	10.599570
2005-06	12.689255	17.714517	19.395989	16.976079	11.802355
2007-08	14.127356	18.938217	24.640533	24.616021	16.868148
2010-11	10.364797	24.683169	23.515551	20.069929	13.587100

Using CPI and prices of energy products (Electricity, Gas, Kerosene oil and Firewood) from 1984-85 to 2011-12, the actual prices of energy products are set equal to the prices prevailing in the current year 2011-12 and the benchmark prices are obtained by applying

the CPI inflation rate to the prices of fuel categories over some period of time. If the benchmark prices of fuel categories are less than actually observed prices, then the compensating variation will be negative, indicating that the representative consumer would have incurred lower expenditure to maintain the existing level of well being had the fuel prices increased at the rate of CPI inflation rather than the actually observed inflation rate. But as the energy prices have increased at a higher rate than the CPI inflation rate and consumers are making more expenditure. That is why this is a welfare loss for the consumers.

Table 4.5 shows welfare gain or welfare loss by consumers in rural and urban Pakistan due to energy pricing policies. Our results show that both rural and urban consumers have been paying more prices for the energy products (Electricity, Gas, Kerosene Oil and Firewood) than the benchmark level of prices, incurring high expenditures in all the years from 1984 to 2011 and there has been a consistent welfare loss for all the consumers.

Consumers in rural Pakistan have been paying much higher prices than the benchmark level of prices in the past and therefore, welfare loss for rural consumers was very high in 1984 (13.17%) which gradually decreased over time to 11.01 percent in 1999 and to 2.58 percent in 2011.

Consumers in urban Pakistan have also been paying higher prices than the benchmark level of prices in the past but welfare loss for urban consumers is relatively much lesser than the welfare loss for the rural consumers. Welfare loss for urban consumers was 3.31 percent in 1984 which gradually decreased over time in 1999 to 2.36 percent and to 0.36 percent in 2011.

Welfare loss for both rural and urban consumers has decreased over time from 1984 to 2011, as the actually observed prices have approached the benchmark level of prices in all these years. Due to this the consumers' expenditure on energy products (Electricity, Gas, Kerosene Oil and Firewood) has gradually decreased leading to reduction in welfare loss for both the rural and urban consumers.

Our results show that there is more welfare loss to the consumers in rural Pakistan as compared to the consumers in urban Pakistan. The reason for which is the more rapid and intensive increase in the prices of Firewood and Kerosene oil in the years from 1984 to 2011 as compared to the increase in prices of Electricity and Gas. The consumers in rural Pakistan consume more of Firewood and Kerosene oil and less of Electricity and Gas as compared to their urban counterparts.

Table 4.6 Welfare Rural and Urban Pakistan

Energy Inflation set equal to CPI Inflation till 2011-12 from the year:	Percentage Change in Expenditure in Rural Pakistan	Percentage Change in Expenditure in Urban Pakistan
New 84-85	-13.1769	-3.31152
New 85-86	-13.2692	-3.38778
New 86-87	-13.4739	-3.36409
New 87-88	-13.7403	-3.35116
New 90-91	-13.322	-2.84972
New 92-93	-9.87021	-3.27489
New 96-97	-10.5028	-3.0106
New 98-99	-11.0103	-2.36629
New 01-02	-10.4125	-1.76838
New 04-05	-8.25478	-0.54071
New 05-06	-5.82269	-0.42829
New 07-08	-4.11864	-0.96624
New 10-11	-2.58153	-0.36017

Chapter 5

CONCLUSION

This study has been an attempt to analyze the welfare of households in correspondence to the changes in the energy pricing policies. The study is based on pooled data of *Household Integrated Economic Survey (HIES)* from year 1984-85 to 2011-12, conducted by Pakistan Bureau of Statistics (PBS). The E-Views package is used for the estimation purposes. The Almost Ideal demand system (AIDS) proposed by Deaton and Meulbauer (1980) is employed for estimating the parameters and especially the price elasticities.

The empirical results reported here are reliable in terms of economic theory and statistical fitness. Firewood and Kerosene Oil are necessities while Gas and Electricity are luxuries for households of Rural Pakistan. In case of households in Urban Pakistan Electricity is also a necessity along with Firewood and Kerosene Oil while Gas is a luxury. The own and cross-price elasticities are estimated using parameter estimates of AIDS. All own-price elasticities have correct negative signs. While the cross-price elasticities are reporting mixed results.

The welfare analysis shows that the increase in the prices of energy has been more than the increase in general consumer price index over the period. Therefore consumers have been paying more prices for the energy products (Electricity, Gas, Kerosene Oil and Firewood), incurring high expenditures in all the years from 1984 to 2011 and there has been a consistent welfare loss for all the consumers.

Over the time from 1984 to 2011, welfare loss of consumers has decreased, because of the decreasing gap between energy price rise and consumer price index. Due to this the consumers' expenditure on energy has gradually decreased leading to reduction in welfare loss of consumers.

Welfare loss to the consumers in rural Pakistan is more as compared to the welfare loss of consumers in urban Pakistan and that is due to more rapid and intensive increase in prices of Firewood and Kerosene oil as compared to the increase in prices of Electricity and Gas. The consumers in rural Pakistan consume more of Firewood and Kerosene oil and less of Electricity and Gas as compared to their urban counterparts.

The study concludes that if such energy policy is adopted in which increase in the price of energy is more than the increase in consumer price index, consumers will be incurring more expenditure on energy and will suffer from higher welfare loss.

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