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Energy Pricing Policies and Consumers' Welfare: Evidence from Pakistan

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Abstract

This study analyzes the impact of energy pricing policies on consumers' welfare in rural and urban Pakistan. The study is based on pooled data from the Household Integrated Economic Survey for the period 1984/85 to 2011/12. We use the Almost Ideal Demand System to estimate parameters and price elasticities. The welfare analysis suggests that the rise in energy prices has been greater than the rise in the general consumer price index over this period. Therefore, consumers have incurred high expenditures in all years from 1984 to 2012, with a consistent welfare loss for all consumers with a decreasing trend. Additionally, the welfare loss to rural consumers is greater than that to urban consumers.

Keywords: energy pricing, welfare, almost ideal demand system, Pakistan.

JEL classification: Q41, D60, C1.

1. Introduction

Energy plays a vital role in a country's development and electricity and other energy resources are essential parts of a household's consumption basket. Modern governments have acknowledged energy as a basic need and a vital input for economic growth and this realization has led many countries, especially developing ones, to establish energy pricing policies that benefit consumers at large and make energy affordable for all income groups.[1] However, due to the rapid increase in oil prices internationally since 2003, large imbalances of payments and budget deficits have forced

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[1] There is a social motive behind the introduction of energy pricing policies by governments: to make energy affordable for low-income groups.

many governments to adjust their pricing policies, with a cut in energy subsidies occurring across the global level.

Since energy pricing policies directly and indirectly affect households' real income (del Granado et al., 2012),[2] governments tend to devise energy pricing policies – or may advance subsidies – that protect poor households from volatility in the energy cost of cooking, lighting and transportation. Nevertheless, subsidy-based energy pricing policies are often perceived as being inequitable and inefficient. In particular it is also presumed that subsidies crowd out high-priority government spending and encourage overconsumption (González, 2009; IEA et al., 2010).

Most of the benefit of subsidies is usually received by higher-income groups (Andriamihaja & Vecchi, 2007; del Granado et al. 2012; Vagliasindi, 2012). González (2009) and del Granado et al. (2012) find that the benefit of subsidies on energy prices reaches only 60 percent of the population, of which high-income groups capture six times the benefit accruing to lower-income groups. Additionally, the marginal social cost of subsidies on energy prices is higher than the benefit (Adagunodo, 2013). Consequently, the reduction or removal of subsidies saves public funds and can even improve the distribution of income in a society (Hartono & Resosudarmo, 2006; Mourougane, 2010).[3] Thus, it is necessary to apply effective and properly targeted price regulations, so that their proposed objectives are met (Frondel et al., 2010.

When these unfavorable attributes of subsidies on energy prices are accompanied by fiscal pressures, it leads to a change in energy pricing policies, mostly in the form of reduced or eliminated energy subsidies. However, even if empirical appraisals support the case for eliminating energy subsidies, there should be alternative policies that help limit the adverse impact on poor households (Gangopadhyay et al., 2005). Lower-income households show less flexibility in adjusting to energy prices and consumption because they use energy only to meet their basic needs. Therefore, they face a higher welfare loss when subsidies on energy prices are removed.

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[2] The increase in real disposable income due to payment of lower prices by households for the consumption of energy products is termed the direct effect. Indirect effects occur in the payment of lower prices by households for other goods and services, which is reflected in the lower cost of energy-based production inputs.

[3] Mourougane (2010) confirms that, if energy subsidies were reduced by a quarter, this could generate an estimated USD 2 billion in savings per year (0.2 percent of GDP).

The discussion above suggests that energy pricing policies and subsidies should be devised prudently. However, reforms to subsidies are usually difficult to implement due to rent seeking and the government's inability to convince citizens in this regard (Dansie et al., 2010; Albers & Peeters, 2011). Since the early 2000s, the Government of Pakistan's energy pricing policy has allocated generous subsidies to the energy sector to protect its citizens from rising fuel costs,[4] particularly for lower-income groups. Much of the lower-income population lives in rural areas and is close to the poverty line since it relies on farming and has no alternative resources or substitutes. Thus, a rise in energy prices is most likely to hurt rural consumers in Pakistan.

Despite the government's efforts to bring about changes in the energy pricing policy, wealthy and commercial consumers and some categories of industrial consumer enjoy the benefit of large subsidies. After entering into successive loan agreements with the IMF, the government has tried to reform its energy pricing policy and phase out energy subsidies gradually to create some fiscal space; however, it has had little success. In developing countries such as Pakistan, energy is considered a proximate factor in stimulating economic activity. Thus, any undesired change could affect people's wellbeing and economic growth. In this study, we assess the energy pricing policy in Pakistan and gauge whether potential reforms to energy subsidies would affect consumers' welfare.[5]

Our analysis is different from the existing literature on the association between economic growth and energy consumption in Pakistan (see Siddiqui, 2004), the causes of and solutions to the energy crisis (see Alahdad, 2012; Kessides, 2013), and energy demand and supply issues (see Hathaway et al., 2007; Burney & Akhtar, 1990; Khan & Ahmad, 2008). We focus on both the rural and urban regions, and check the robustness of our results with respect to differences in income. Using data from the Household Integrated Economic Survey (HIES), we employ the almost ideal demand system (AIDS), which is flexible enough to satisfy the axioms of choice and therefore produces reliable estimates.

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[4] In the period 2004 to 2010, the Government of Pakistan extended 1.12 percent of GDP in the form of subsidies to the energy sector (Vagliasindi, 2012). Currently, it allocates more than Rs200 billion a year in the form of subsidies to the energy sector, much of which goes to the power sector. The total amount in subsidies extended by the government to the energy sector in the last five years was Rs1,250 billion (Kessides, 2013).

[5] Recently, Aziz et al. (2016) have also probed the effect of higher energy prices on consumers' welfare in Pakistan.

Our results confirm that there has been a consistent welfare loss to all consumers, with a decreasing trend due to the increase in energy prices. Additionally, the welfare loss to rural consumers is greater than the welfare loss to urban consumers. The rest of the study is organized as follows. Section 2 describes the data and methodological framework. Section 3 presents the empirical results of our analysis and Section 4 concludes the paper.

2. Data and Methodology

This section describes the data and the methodological framework.

2.1. Data

This study uses pooled data instead of cross-sectional or time series data. For assessing economic relationships, time series data is more suitable on theoretical grounds, but in practice it exhibits many problems, such as high correlation among the explanatory variables. Likewise, we are unable to estimate coefficients for prices using cross-sectional data because, for all consumers at any point in time, the price structure remains the same. To avoid these problems, we use pooled data which provides a large sample and yields sufficient degrees of freedom to obtain more reliable estimates.

The data is taken from multiple Household Integrated Economic Surveys (HIES) for rural and urban Pakistan for the period 1984/85 to 2011/12. The HIES is conducted by the Pakistan Bureau of Statistics and the dataset is not a panel since the same households are not re-surveyed in each wave. This dataset divides households into several income groups and provides information on their expenditure on various commodities. We use the data on nine goods: food and beverages; apparel, textiles and footwear; firewood; kerosene oil; gas; electricity, house rent and housing; transport and communications; and miscellaneous.[6] Goods such as food and beverages, apparel, textiles and footwear, housing and miscellaneous are included to compare their prices and price elasticities with those of the energy products (electricity, gas, firewood and kerosene oil), and to

[6] Out of a total of nine goods, the energy goods (firewood, kerosene oil, gas and electricity) are considered at disaggregate level, while all other goods (food and beverages, apparel, textiles and footwear, transport and communications, house rent and housing) are considered at aggregate level. The goods included in miscellaneous are furniture and household equipment, education and recreation. Expenditure trends for urban and rural households on energy goods are given in Table A4 in the Appendix. Over the years, urban households have spent more on electricity, followed by gas and firewood, while rural households have spent more on firewood, followed by electricity and gas.

determine their shares of the total expenditure of households in urban and rural Pakistan.

The data for rural and urban Pakistan is pooled for 14 time periods and 12 income groups for the years 1984/85, 1985/86, 1986/87, 1987/88, 1990/91, 1992/93, 1996/97 and 1998/99, and for five income groups for the years 2001/02, 2004/05, 2005/06, 2007/08, 2010/11 and 2011/12. These income groups have been constructed by the Pakistan Bureau of Statistics for the HIES, according to the incomes of urban and rural households in Pakistan. Data on the consumer price index (CPI) and the prices of the nine goods used in this study is obtained from various issues of the Pakistan Economic Survey published by the Ministry of Finance, and from the Pakistan Energy Yearbook published by the Ministry of Petroleum and Natural Resources. All price indices are converted to the base year 2000/01.[7]

2.2. *Methodology*

This section discusses the methodology we use to study the impact of energy prices on household welfare in Pakistan. First, we use the AIDS model and its linear approximation (LA/AIDS) to estimate the required parameters of the household demand model. Next, we estimate the uncompensated price elasticities to determine whether the data is consistent with economic theory. Finally, we estimate the effects of changes in energy prices on the welfare of households in the form of compensating income variations.

2.2.1. AIDS Model

The AIDS was proposed as a new demand system by Deaton and Muellbauer (1980), and is considered a breakthrough in demand system generation. Alston and Chalfant (1993) comment that, in the relatively short time since AIDS was introduced, economists have adopted it to the extent that it appears to be the most popular demand system. It is appealing because it satisfies almost all the properties of a theoretical demand system and has a high level of flexibility. AIDS gives an arbitrary first-order approximation of any demand system and satisfies the axioms of choice. Without invoking linear parallel Engel curves, it aggregates cleanly over consumers. It has a functional form that is consistent with household budget data and its estimation is simple. It satisfies the restrictions of homogeneity

[7] See Tables A1 to A4 in the Appendix for descriptive statistics of the data.

and symmetry through linear restrictions on the fixed parameters, and its linear approximated version avoids the need for nonlinear estimation.

The AIDS model has been used in the literature on the welfare impact of energy prices. Adagunodo (2013) employs an AIDS model to examine the effect of energy prices reform on consumer welfare in Nigeria. Aziz et al. (2016) use the same approach (LA/AIDS) while investigating the impact of energy prices on consumer welfare in Pakistan.

The system is based on an expenditure function of the form

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

where

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

$$\ln[b(p)] = \ln[a(p)] + \beta_{\circ}\prod_k [p_k]^{\beta_k} \tag{3}$$

Substituting equations 2 and 3 into equation 1 yields

$$\ln[M(p,u)] = a_{\circ} + \sum_k a_k[\ln(p_k)] + \frac{1}{2}\sum_k\sum_j \gamma_{kj} * [\ln(p_k)\ln(p_j)] + u\beta_{\circ}\prod_k [p_k]^{\beta} \tag{4}$$

The Marshallian demand function for any good i is obtained in two steps. By taking the derivative of the expenditure function above with respect to $ln(p_i)$ and applying Shepherd's lemma in the first step, the compensated demand function is obtained as an equation for the expenditure share of good i. We 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 is an expenditure share equation of the form

$$s_i = a_i + \sum_j \gamma_{ij}\ln p_j + \beta_i \ln\left(\frac{M}{P}\right) \tag{5}$$

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

In the above system, s_i is the budget share of good i, p_i is the price of good i, M denotes total expenditure and P is the price index. The parameters a_i are the intercepts of the share equations while γ_{ij} and β_i represent parameters indicating the sensitivity of the budget shares to changes in prices and real income, respectively.

The price index P is defined as:

$$\ln P = a_\circ + \sum_k a_k \ln p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \ln p_k \ln p_j \quad (6)$$

The demand functions given in equation (6) are nonlinear in parameters. The natural starting point for predictions using the AIDS model is that, in the absence of change in relative prices and real expenditure (M/P), the budget shares are constant; this is a simple interpretation of an AIDS. Changes in real expenditure work through the β_i coefficient; changes in relative prices operate through γ_{ij}. Further, the $\beta_i's$ add up to 0 and are positive for luxuries and negative for necessities.

Abstracting from the theoretical properties of the expenditure functions, this model has no restrictions on the structural parameters. The restricted model can be used to examine some of the conclusions of demand theory by imposing special conditions on the parameters successively. Some restrictions are imposed on the parameters of equations 5 and 6 to enforce consistency with theory. These restrictions are summarized below:

$$\sum_i a_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0 \quad (7)$$

$$\sum_j \gamma_{ij} = 0 \quad (8)$$

$$\gamma_{ij} = \gamma_{ji} \quad (9)$$

Provided equations (7), (8) and (9) hold, equation (5) represents a system of demand functions that add up to total expenditure ($\sum s_i = 1$), and which satisfy Slutsky symmetry and are homogenous of degree zero in prices and total expenditure taken together. Equation (7) is the set of adding-up restrictions, equation (8) is the restriction of homogeneity in prices, and equation (9) is the Slutsky symmetry condition. Simply put, equation (7) means that the budget shares should add up to unity.

Since the budget shares add up to unity, in equation (5) the parameters a_i must also add up to unity, while the γ_{ij} matrix and β_i vector must add up to 0 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, while total expenditure and the budget shares remain unchanged. This will happen only when the γ_{ij} rows add up to 0 in dimension j. The demand system is complete, as the adding-up and homogeneity restrictions enable us to add another commodity defined as 'all other goods' as well as by deriving its own and cross-elasticities from these restrictions. When $\gamma_{ij} = \gamma_{ji}$, then the substitution matrix of the demand system is symmetric. Symmetry restriction is commonly used in demand analysis to maintain theoretical consistency of the parameter estimates.

Equation (5) is very close to being linear, which is convenient from an econometric point of view. The system will become linear in parameters if P is estimated separately. Equation (6) defines P as a homogenous linear function of individual prices ensured by the restrictions on a and γ. P is defined as the approximate price index due to the relative collinearity of prices in practical situations.

As used by Stone:

$$\ln P^* = \sum_k (s_k \ln p_k) \tag{10}$$

This index is calculated directly before estimation so that equation (5) becomes

$$s_i = a_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \left(\frac{M}{P^*}\right) \tag{11}$$

Equation (11) can be estimated easily and is known as an LA/AIDS model. In general, the relationship between AIDS parameters and LA/AIDS parameters in this form is not known; these are non-nested models. Stone's price index is a good proxy for the price index in equation (5). The estimates of the LA/AIDS model approach the estimates of the AIDS model except for the intercept term, when changes in price are proportional to one another. It is not known whether the theoretical properties of consumer theory are satisfied by the LA/AIDS model.

2.2.2. Price Elasticities

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

$$\eta_{ij} = \frac{d \ln Q_i}{d \ln P_i} = -\delta_{ij} + \frac{d \ln s_i}{d \ln P_j} = -\delta_{ij} + \left\{\gamma_{ij} - \beta_i \frac{d \ln P}{d \ln P_j}\right\} / s_i \tag{12}$$

Holding total group expenditure and all other prices constant, these elasticities relate to allocations within the group. The term δ_{ij} is known as the Kronecker delta: it is equal to 1 if and only if $i = j$ and is equal to 0 if $i \neq j$. For the correct expression of elasticity in the AIDS model, the term in equation (12), $\frac{d \ln P}{d \ln P_j}$, can be elaborated as $\frac{d \ln P}{d \ln P_j} = a_i \sum_k \gamma_{kj} \ln P_k$. Plugging this expression into equation 12, the formula for elasticity becomes

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{s_i} - \frac{\beta_i a_i}{s_i} - \frac{\beta_i}{s_i} \sum_k \gamma_{kj} \ln P_k \tag{13}$$

This formula does not work for LA/AIDS as we use a different price index instead of the price index given in equation (6). The price index used in LA/AIDS is:

$$\ln P^* = \sum_k s_k \ln P_k \tag{14}$$

Stone's price index is differentiated with respect to the *j*th commodity price to obtain the formula for price elasticity in the LA/AIDS model. The final expression obtained is:

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{s_j} - \frac{\beta_i s_j}{s_i} - \beta_i / s_i \left[\sum_k s_k \ln P_k \left(\eta_{kj} + \delta_{kj} \right) \right] \tag{15}$$

which can be expressed in matrix form as

$$E = A - (BC)(E + I) \tag{16}$$

Its 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 x n matrix); $b_i = (\beta_i / s_i)$ in B (an n x 1 vector); $c_j = s_j \ln P_j$ in C (an n x 1 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 x n matrix). Solving for elasticities $[\eta_{ij}]$ yields, after some simplifications,

$$E = [BC + 1]^{-1} [A + I] - I \tag{17}$$

where *I* is the identity matrix.

The formula used to calculate income elasticities is

$$N = (I + BC)^{-1} B + i \tag{18}$$

where *N* (n x 1) is the expenditure/income elasticities vector and i is an n unit vector.

2.2.3. Welfare Effects of Energy Price Changes

The welfare effects of energy price changes can be analyzed using a specific measure of welfare for consumers, and the actual and hypothetically specified energy prices. One approach to setting these hypothetical energy prices, which is often adopted in the literature, is to consider the existing energy subsidies and then gauge what impact their removal will have on consumers. This approach is appropriate when analyzing the effect of removing one specific structure of energy subsidies. However, in using this approach, it becomes 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 approach, which we follow here, is to set 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 consider the compound inflation rate of each energy category over a given period and then replace this rate with the CPI inflation rate for the same period. The benchmark energy prices for the current period are then computed by applying the CPI inflation rate over the period under consideration. The period for the present analysis is the latest year of data, 2011/12. To compute the benchmark energy prices, we consider the following periods: 1992/93 to 2011/12, 1996/97 to 2011/12, 2001/02 to 2011/12, and 2007/08 to 2011/12

The next question is how to measure welfare. Since consumers' utility itself is not measurable, the effect of price changes on the welfare of a consumer can only be measured in monetary terms. A simple way to measure the welfare effect of price changes is to compute the effect of price changes on the total expenditure incurred when purchasing a given basket. The advantage of this measure is that it is simple to calculate, but it is a poor measure of the true welfare effect as it assumes that consumers' choices do not respond to price changes at all. The alternative approach, which involves the concept of consumer surplus and allows for changes in demand in response to price changes, is obviously preferable.

The typical measure of consumer surplus is based on the assumptions that utility is measurable cardinally and that the marginal utility of money is constant (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: compensating variation (CV), equivalent variation, compensating surplus and equivalent surplus. Although any one of these can be used to estimate the effects of energy price changes on the welfare of consumers, the most suitable one, as will become obvious in the following analysis, is CV, which measures the increase in income that compensates for the price increase, or the decrease in income that compensates for the price decrease, as may be the case. Studies such as Niimi (2005), Nicita (2004), and Friedman and Levinsohn (2002) have also used the CV technique to measure changes in consumer welfare.

Consider the level of utility at the initially given prices. Inverting the expenditure function (IUF) under AIDS (equation 1) for utility, we obtain the following indirect utility function:

$$U = \frac{\log(M) - \log[a(P)]}{\log[b(P)] - \log[a(P)]} \tag{19}$$

Substituting for the functions log[a(P)] and log[b(P)] from equations (2) and (3), respectively, we obtain:

$$U = \frac{\log(M) - a_0 - \sum_k a_k \log(p_k) - \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k)\log(p_j)}{\beta_0 \prod_k (p_k)^{\beta_k}} \tag{20}$$

Let observed prices be denoted by P_k^0 and proposed prices by P_k^1. Initial income or total expenditure is denoted by M^0. The first step is to compute the value of utility using the IUF (19), that is:

$$U^0 = \frac{\log(M^0) - a_0 - \sum_k a_k \log(p_k^0) - \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^0)\log(p_j^0)}{\beta_0 \prod_k (p_k^0)^{\beta_k}} \tag{21}$$

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 (1) as follows:

$$\log(M^1) = a_0 + \sum_k a_k \log(p_k^1) + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log(p_k^1)\log(p_j^1) + U^0 \ \beta_0 \prod_k (p_k^1)^{\beta_k} \tag{22}$$

Substituting for U^0, we obtain:

$$\log\left(M^1\right)=a_0+\sum_k a_k\log\left(p_k^1\right)+\tfrac{1}{2}\sum_k\sum_j\gamma_{kj}^*\log\left(p_k^1\right)\log\left(p_j^1\right)$$
$$+\left[\log\left(M^0\right)-a_0-\sum_k a_k\log\left(p_k^0\right)-\tfrac{1}{2}\sum_k\sum_j\gamma_{kj}^*\log\left(p_k^0\right)\log\left(p_j^0\right)\right]\prod_k\left(\frac{p_k^1}{p_k^0}\right)^{\beta_k} \tag{23}$$

Note, that in the AIDS estimation, we estimate only the share equations but we cannot estimate the expenditure function or the IUF. This means that all the parameters of the system except β^0 are estimated. However, as we can see from equation (23), this parameter drops out when computing the expenditure at new prices but at an 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 obtain the percentage CV when moving from old prices to new prices as follows:

$$CV = \frac{M^1 - M^0}{M^0} 100 \tag{24}$$

In applying this procedure, we consider a representative consumer whose total expenditure (representing 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. If the benchmark prices of energy categories are less than the observed prices as expected, then the CV given above will be negative, indicating that the representative consumer would have incurred lower expenditure to maintain his or her existing level of wellbeing had the energy prices increased at the rate of CPI inflation rather than the observed inflation rate.

3. Empirical Results

We have estimated both the linear and nonlinear versions of the AIDS for rural and urban Pakistan separately. However, we rely on the results of the NL/AIDS model, which are more promising and significant than those of the linear AIDS model in terms of direction and magnitude. Similar to our analysis, Zhou (2015) estimates both the linear and nonlinear versions of the AIDS model. The author compares the results of the NL/AIDS model with those of the linear AIDS model and concludes that the former are more reasonable and in line with economic theory. Hence, the

NL/AIDS model is preferable to the linear one. Therefore, we focus on the results of the NL/ AIDS. The results of the linear AIDS are given in Tables A5–A8 in the Appendix.

The NL/AIDS for both rural and urban Pakistan is estimated using a seemingly unrelated regression procedure by imposing certain conditions on the parameters, such as adding up, homogeneity and symmetry. Tables 1 and 2 give estimates of the NL/AIDS model for rural and urban Pakistan, respectively. In the case of rural Pakistan, the intercept terms for food and beverages, apparel, textiles and footwear, firewood, kerosene oil, and house rent and housing are positive with reasonable magnitudes and are highly statistically significant, which indicates that significant proportions of expenditure on these commodities are independent of changes in price and incomes.

Table 1: Parameter estimates of nonlinear AIDS for rural Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
αs	18.45939*	2.499461*	2.758553*	1.134486*	-0.34603	-0.32563	1.205026**	-5.1736*	-19.2117
βs	-0.06808*	-0.00932*	-0.01034*	-0.00433*	0.0012***	0.00123**	-0.00399**	0.019916*	0.073633
γs									
Food and beverages	-1.06734*	-0.22698*	-0.20862*	-0.07891*	0.000569	0.03182**	-0.01443	0.354752*	1.209152
Apparel, textiles and 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 and housing	-0.01443	-0.01783	-0.0131	0.0097***	-0.0140**	-0.04204*	-0.05246**	0.065525*	0.078573
Transport and 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%.
Source: Authors' calculations.

Table 2: Parameter estimates of nonlinear AIDS for urban Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
αs	1.476164	0.167573	0.17508	0.034248	-0.02358	0.017552	-0.17236	-0.25735	-0.41733
βs	-0.08616*	-0.00671*	-0.01358*	-0.00366*	0.003446*	-0.00023	0.030954*	0.025*	0.050937
γs									
Food and beverages	-0.06064	0.02393	-0.04575	-0.00372	0.00428	0.00506	0.10873	-0.03622	0.00433
Apparel, textiles and 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 and housing	0.108733	-0.04789*	0.000226	-0.00032	-0.00773	-0.03465*	-0.05555	0.04067	-0.00348
Transport and 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%.
Source: Authors' calculations.

The intercept term for transport and communications is significant but negative for rural Pakistan, which indicates that the share of transport and communications will be negative if price and income effects are ignored. In the case of urban Pakistan, the intercept terms are positive for food and beverages, apparel, textiles and footwear, firewood, kerosene oil, and electricity, and negative for gas, house rent and housing, and transport and communications.

The nature of a good i as a luxury or necessity is determined by the parameter β_i.[8] The results for rural Pakistan show that the $\beta_i s$ for food and beverages, apparel, textiles and footwear, firewood, kerosene oil and house rent and housing are negative and statistically significant, indicating that these are necessities in rural Pakistan. The $\beta_i s$ for gas, electricity and transport and communications are positive and statistically significant, indicating that these are luxuries in rural Pakistan. For urban Pakistan, food and beverages, apparel, textiles and 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 and housing, and transport and communications are luxuries.

The change in the share of the *i*th good due to a 1 percent change in its own price or the price of any other good, with constant expenditure, is measured by γ_{ij}. The price elasticities for rural and urban Pakistan are shown in Tables 3 and 4, respectively. All the own-price elasticities are negative both for rural and urban Pakistan. For rural Pakistan, the 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 a 0.12, 2.06, 4.56 and 0.68 percent decrease in the consumption of these commodities in rural Pakistan if there is a 1 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 1 percent increase in the prices of these commodities, the decrease in their quantity demanded will be 0.87, 2.22, 1.19 and 0.05 percent, respectively.

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[8] If $\beta_i > 0$, good *i* is a luxury, meaning that the expenditure on good *i* will increase with an increase in income. If $\beta_i < 0$, good *i* is a necessity, meaning that the expenditure on good *i* will decrease with an increase in income.

Table 3: Price elasticities of nonlinear AIDS for rural Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
Food and beverages	-0.67122	-0.11072	-0.04676	-0.00393	-0.04234	0.02144	0.11987	0.01092	-0.14534
Apparel, textiles and 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 and housing	0.66628	-0.09061	-0.0264	0.16417	-0.17615	-0.49696	-1.5514	0.51797	0.03889
Transport and 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

* Significant at 1%, ** significant at 5%, *** significant at 10%.
Source: Authors' calculations.

Table 4: Price elasticities of nonlinear AIDS for urban Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
Food and beverages	-0.85481	0.0795	-0.06608	0.0011	0.00375	0.01684	0.19765	-0.12557	-0.06674
Apparel, textiles and 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 and housing	0.3694	-0.3094	-0.03056	-0.01081	-0.04017	-0.20986	-1.29115	0.28612	0.05417
Transport and 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

* Significant at 1%, ** significant at 5%, *** significant at 10%.
Source: Authors' calculations.

The estimates of cross-price elasticities yield mixed results. The cross-price elasticities with a positive sign show that these goods are substitutes, while a negative sign shows that these goods are complements. The cross-price elasticities show that firewood and gas in the rural areas, and gas and electricity are substitutes, while kerosene oil and firewood are complements.

The increase in price of energy products (electricity, gas, kerosene oil and firewood) in the last three decades is more than the increase in the general CPI, as shown in Table 5. Using the 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 the sample period.

Table 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

Source: Authors' calculations.

If the benchmark prices of fuel categories are less than the observed prices, then the CV will be negative, indicating that the representative consumer will have incurred less expenditure to maintain the existing level of wellbeing had the fuel prices increased at the rate of CPI inflation rather than the observed inflation rate. Since energy prices have increased at a higher rate than the CPI inflation rate and consumers are incurring more expenditure, representing a welfare loss for consumers.

Table 6 shows the welfare gain or loss for consumers in rural and urban Pakistan due to energy pricing policies. Our results show that both rural and urban consumers have been paying higher prices for 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. This represents a consistent welfare loss for all consumers. Rural consumers have been paying far higher prices than the benchmark level of prices in the past: their welfare loss was very high in 1984 (13.17 percent), which gradually decreased over time to 11.01 percent in 1999 and to 2.58 percent in 2011.

Table 6: Welfare gain and loss for 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 1984/85	-13.1769	-3.31152
New 1985/86	-13.2692	-3.38778
New 1986/87	-13.4739	-3.36409
New 1987/88	-13.7403	-3.35116
New 1990/91	-13.322	-2.84972
New 1992/93	-9.87021	-3.27489
New 1996/97	-10.5028	-3.0106
New 1998/99	-11.0103	-2.36629
New 2001/02	-10.4125	-1.76838
New 2004/05	-8.25478	-0.54071
New 2005/06	-5.82269	-0.42829
New 2007/08	-4.11864	-0.96624
New 2010/11	-2.58153	-0.36017

Source: Authors' calculations.

Consumers in urban Pakistan have also been paying higher prices than the benchmark level of prices in the past, but their welfare loss is smaller than that of rural consumers. The welfare loss for urban consumers was 3.31 percent in 1984, which gradually decreased over time to 2.36 percent in 1999 and to 0.36 percent in 2011. The welfare loss for both rural and urban consumers has decreased over time from 1984 to 2011, since the observed prices have approached the benchmark level of prices in all these years. For this reason, consumers' expenditure on energy products (electricity, gas, kerosene oil and firewood) has gradually decreased, leading to a reduction in the welfare loss for both rural and urban consumers. These results are consistent with Aziz et al. (2016), who conclude that CV is positive (and consumer welfare falls) due to a rise in energy prices, especially in inflationary conditions.

In both urban and rural Pakistan, firewood has a negative and inelastic own-price elasticity. The findings suggest that its demand is less responsive to changes in its own price in both areas. This result is consistent (in direction and almost in magnitude) with Kidane (1991), who finds an inelastic demand for firewood in Ethiopia. Additionally, electricity and gas are essential energy sources in Pakistan. According to our results, electricity and gas are necessities in Pakistan, echoing the results of Akmal (2002) and Khan and Ahmad (2008).

That the price elasticity of demand for electricity is relatively less responsive to own price is in line with Siddiqui (1999) and Khan and Ahmad (2008), but different from Chaudhry et al. (2012). We find that the demand for gas responds considerably to changes in its own price, which is not consistent with Siddiqui (1999) and Khan and Ahmad (2008). It is important to note that the responsiveness of demand for energy products is, in most cases similar to Siddiqui (1999). Our results are also consistent with Davoodi and Salem (2007), Asghar et al. (2010), Nikban and Nakhaie (2011), Araghi and Barkhordari (2012), Ahmadian et al. (2007), and Huang and Huang (2012).

4. Conclusion

This study has analyzed the welfare of households corresponding to changes in energy prices. The study uses data from the HIES for the period 1984/85 to 2011/12 and employs an AIDS model. The welfare analysis shows that the increase in prices of energy has been greater than the increase in the general CPI over this period. Therefore, consumers have been paying more for energy products, incurring a higher expenditure in all the years from 1984 to 2011, with a consistent welfare loss for all consumers. However, over time from 1984 to 2011, the welfare loss of consumers has decreased because of the decreasing gap between energy price rises and the CPI. Furthermore, the welfare loss to rural consumers is higher than that of urban consumers, due to the rapid and intensive increase in the prices of firewood and kerosene oil compared to the increase in prices of electricity and gas. In terms of policy implications, if an energy policy leads to an increase in the price of energy which is greater than the CPI, consumers will incur greater energy expenditure and suffer from higher welfare losses.

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Appendix

Table A1: Expenditure shares, by commodity group in urban Pakistan

Year	Total average expenditure	Food items	Textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
1984/85	2305.66	0.432042	0.066814	0.009643	0.005951	0.009091	0.016845	0.172801	0.060542	0.22626
1985/86	2292.46	0.420420	0.068933	0.010602	0.006179	0.009977	0.017624	0.178550	0.059756	0.22795
1986/87	2354.61	0.415853	0.068166	0.010372	0.006074	0.008768	0.018266	0.181563	0.058254	0.23268
1987/88	2390.12	0.415902	0.068722	0.010247	0.005989	0.009482	0.020279	0.194371	0.041105	0.23389
1990/91	3978.09	0.409995	0.068922	0.012187	0.006334	0.009191	0.021991	0.183779	0.047012	0.24058
1992/93	3978.09	0.443405	0.078406	0.008867	0.005420	0.012150	0.025016	0.183779	0.047012	0.19594
1996/97	4452.18	0.463572	0.081022	0.011076	0.004648	0.014434	0.031571	0.176685	0.037529	0.17945
1998/99	4773	0.480010	0.078357	0.010518	0.004125	0.016244	0.037669	0.171266	0.027705	0.17410
2001/02	7378.2	0.443170	0.072104	0.007548	0.001910	0.019386	0.047039	0.191699	0.037264	0.17987
2004/05	9448	0.438378	0.056710	0.009537	0.000924	0.017547	0.047635	0.179487	0.050833	0.19894
2005/06	11004	0.390393	0.052540	0.008048	0.000713	0.017633	0.046303	0.193788	0.061680	0.22889
2007/08	12771	0.418750	0.051514	0.007590	0.000292	0.016739	0.044215	0.197037	0.057019	0.20684
2010/11	16603.77	0.452817	0.049650	0.005858	0.000143	0.014121	0.049403	0.186198	0.059790	0.18201
2011/12	23041	0.422557	0.054277	0.004895	7.2261E-05	0.014006	0.049465	0.177045	0.062106	0.21557

Table A2: Expenditure shares, by commodity group in rural Pakistan

Year	Total average expenditure	Food items	Textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
1984/85	2156.76	0.460434	0.072497	0.025750	0.005698	0.000580	0.005006	0.083533	0.049673	0.296828
1985/86	2091.61	0.481964	0.075430	0.026746	0.006286	0.000425	0.005247	0.078319	0.049927	0.275656
1986/87	2231.01	0.469619	0.073456	0.026673	0.005358	0.000628	0.007244	0.081872	0.045297	0.289854
1987/88	2332.24	0.472918	0.077288	0.026249	0.005471	0.000881	0.006978	0.081758	0.041321	0.287136
1990/91	3611.72	0.438219	0.069622	0.020666	0.005079	0.001194	0.010207	0.086486	0.033391	0.335137
1992/93	3611.73	0.508621	0.088021	0.026660	0.006730	0.001371	0.011388	0.111078	0.033391	0.212741
1996/97	3792	0.537112	0.083861	0.032674	0.005085	0.001702	0.020019	0.091269	0.036634	0.191644
1998/99	4469.54	0.560785	0.102451	0.026924	0.003937	0.002770	0.023821	0.083881	0.021377	0.174055
2001/02	5730.6	0.577287	0.084633	0.023104	0.004321	0.003927	0.030476	0.078596	0.035487	0.162169
2004/05	7781.8	0.539130	0.064664	0.025831	0.003361	0.004372	0.033679	0.077334	0.044930	0.206698
2005/06	9120.6	0.475714	0.061816	0.024196	0.002020	0.006396	0.032765	0.087889	0.054925	0.254278
2007/08	11260.93	0.484886	0.060303	0.023761	0.001368	0.007889	0.033121	0.100423	0.059942	0.228308
2010/11	17113.08	0.544260	0.054292	0.023008	0.001288	0.005585	0.033248	0.087239	0.055815	0.195265
2011/12	19138.88	0.502741	0.061771	0.023180	0.000744	0.007632	0.036727	0.079618	0.062461	0.225127

Table A3: Average income, by group in urban and rural Pakistan

	1984/85		1985/86		1986/87		1987/88	
Income group	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
Up to 600	477.21	462.53	495.56	475.71	483.8	479.08	491.39	488.65
601-700	661.93	656.07	666.29	655.85	670.99	658.59	663.71	655.62
701-800	765.61	754.62	767.06	754.23	761.51	759.16	766.81	757.09
801-1000	924.74	904.37	922.12	906.75	926.45	905.92	928.05	905.69
1001-1500	1255.4	1236.64	1273.94	1238.52	1280.29	1249.23	1283.46	1253.62
1501-2000	1756.85	1721.22	1756.99	1727.2	1773.53	1722.48	1759.62	1739.03
2001-2500	2260.06	2214.12	2272.49	2228.6	2269.02	2220.99	2271.85	2223.48
2501-3000	2759.11	2706.77	2771.38	2714.73	2763.12	2722.45	2787.39	2719.8
3001-3500	3273.45	3207.14	3263.31	3218.79	3277.37	3230.54	3265.79	3231.17
3501-4000	3762.77	3751.16	3749.44	3741.97	3773.71	3747.43	3758.64	3714.37
4001-4500	4270.72	4210.36	4257.48	4226.93	4243.96	4224.36	4273.34	4213.83
4501 and above	8037.39	7808.96	7056.31	7216.56	7456.72	7412.58	8206.97	7084.31

	1990/91		1992/93		1996/97		1998/99	
Income group	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
Up to 1000	491.39	488.65	665	658	569	746	643	693
1001-1500	663.71	655.62	1299	1283	1309	1287	1289	1282
1501-2000	766.81	757.09	1788	1766	1794	1783	1786	1784
2001-2500	928.05	905.69	2288	2243	2279	2274	2262	2275
2501-3000	1283.46	1253.62	2763	2746	2793	2759	2780	2749
3001-3500	1759.62	1739.03	3278	3245	3282	3257	3275	3257
3501-4000	2271.85	2223.48	3750	3751	3783	3752	3778	3759
4001-5000	2787.39	2719.8	4479	4424	4538	4485	4538	4473
5001-6000	3265.79	3231.17	5495	5456	5505	5494	5522	5471
6001-7000	3758.64	3714.37	6504	6466	6497	6473	6520	6499
7001 & above	4273.34	4213.83	12912	11537	12382	11277	15050	12419

	2001/02		2004/05		2005/06	
Income group	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
1st	5006.1	4258.9	6203	5446	6497	6768
2nd	6307.3	4966.9	7239	6588	8571	8339
3rd	7067.9	5582.2	8549	7104	10108	9670
4th	7786.2	6268.8	10462	8273	10747	11924
5th	14202.5	8913.7	19233	12658	21954	19277

	2006/07		2010/11		2011/12	
Income group	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
1st	8744.19	7639.08	11970.1	11265.2	13844.8	13221
2nd	11018.6	9576.5	16481.93	13613.4	17673.6	16578
3rd	11872.3	10900.7	17382.76	16617.6	21306.5	19342
4th	13238.9	13219.4	22295.92	19921.5	26755	23203
5th	26163.8	22807.5	40876.22	33932.5	51484	33977

Table A4: Energy expenditure trends in urban and rural Pakistan

Year	Urban Pakistan			
	Expenditure on firewood	Expenditure on kerosene oil	Expenditure on gas	Expenditure on electricity
1984/85	22.23427	13.72124	20.96172	38.83903
1985/86	24.14653	14.13139	22.72637	40.28394
1986/87	24.42215	14.30326	20.64720	43.01023
1987/88	24.49183	14.31586	22.66483	48.47045
1990/91	30.48453	25.20105	36.56515	87.48478
1992/93	35.27509	21.56377	48.33485	99.51616
1996/97	49.31645	20.69429	64.26718	140.5628
1998/99	50.20477	19.69146	77.53706	197.7952
2001/02	55.96096	14.09478	143.0376	347.0682
2004/05	90.11383	8.730361	165.7926	450.0597
2005/06	88.57702	7.856282	194.0576	509.5561
2007/08	96.93830	3.730800	213.8770	564. 6958
2010/11	114.8556	2.822764	276.8318	968.4899

Year	Rural Pakistan			
	Expenditure on firewood	Expenditure on kerosene oil	Expenditure on gas	Expenditure on electricity
1984/85	55.53736	12.28910	1.251229	10.79753
1985/86	55.94176	13.14764	0.889215	10.97507
1986/87	59.50694	11.95411	1.400984	16.16127
1987/88	58.36189	12.16361	1.958828	15.51600
1990/91	74.63838	18.34280	4.313951	36.86466
1992/93	96.28753	24.30594	4.953338	41.12906
1996/97	123.8983	19.28417	6.455390	75.91335
1998/99	120.3364	17.59563	12.37843	106.4694
2001/02	132.3970	24.76356	22.50374	174.6481
2004/05	201.0148	26.15832	34.0197	262.0854
2005/06	220.6841	18.42712	85.33484	298.8354
2007/08	267.56605	15.40365	88.83529	372.9693
2010/11	393.7394	22.03615	95.57117	386.2669

Table A5: Parameter estimates of linear AIDS for rural Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
αs	2.113311**	0.321561**	0.12043	0.010287*	0.007801*	0.07562**	0.360399*	0.14586**	0.86129*
βs	-0.14308***	-0.11197	-0.34119**	-0.64074**	0.70488	0.113815*	-0.04039*	0.574411	0.327202*
γs									
Food and beverages	0.035386**	-0.0787	-0.00057	-0.0185***	-0.00268	0.033**	0.046**	0.025**	-0.04074
Apparel, textiles and footwear	-0.0787*	0.2652***	-0.00949***	0.0066182	-0.00651	-0.0058*	0.00993	-0.12072	-0.060**
Firewood	-0.00057**	-0.00949	-0.004**	0.0072765	0.00864	-0.0209*	0.02112	-0.00656	0.00502
Kerosene oil	-0.01851	0.006618	0.007276	-0.000429	-0.00208	-0.001**	0.00458	0.00580	-0.002**
Gas	-0.0026**	-0.00652	0.00864***	-0.002089	-0.003**	0.01083	-0.005**	0.0005*	0.00037
Electricity	0.033747	-0.00586	-0.020***	-0.00101***	0.01083	0.021**	-0.03784	-0.00426	0.0033*
House rent and housing	0.04691***	0.009933	0.021122	0.0045894	-0.00584	-0.03784	-0.07647	0.03161	0.00599
Transport and communications	0.025164	-0.12***	-0.00656	0.0058031	0.00054	-0.004**	0.03161	0.048**	0.02008
Miscellaneous	-0.040***	-0.06052	0.005022	-0.0022***	0.00037	-0.00338	0.00599	0.02008	0.06864

Note: * Significant at 5%, ** significant at 10%, *** significant at 15%.

Table A6: Parameter estimates of linear AIDS for urban Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
αs	1.90064**	0.29067*	0.059476	0.01040***	0.045***	0.139232	0.703223	0.1631***	0.726***
βs	-0.17392*	-0.11494**	-0.82977	-0.62071*	0.216***	0.038511*	0.084***	0.56957	0.324413**
γs									
Food and beverages	0.0344*	-0.02060	-0.01***	-0.01088	0.00167	0.02228	0.04***	-0.01447	-0.04006
Apparel, textiles and footwear	-0.02060	0.149**	-0.007**	0.00352	-0.00624	-0.006**	-0.02146	-0.064**	-0.02529
Firewood	-0.014**	-0.00797	0.00312	0.00557	0.00294	-0.01203	0.01026	0.00782	0.004**
Kerosene oil	-0.01088	0.0035*	0.005**	-0.001**	-0.0009	-0.00216	0.00150	0.00578	-0.00091
Gas	0.001**	-0.0062*	0.00294	-0.00090	0.00106	0.009**	-0.00597	-0.00543	0.00338
Electricity	0.02228	-0.00666	-0.0120*	-0.00216	0.00948	0.02680	-0.036**	-0.00382	0.0026*
House rent and housing	0.04***	-0.02***	0.010**	0.00150	-0.00597	-0.03654	-0.03641	0.0428*	0.00401
Transport and communications	-0.014**	-0.06468	0.0078*	0.0057*	-0.00543	-0.00382	0.04281	0.02965	0.00233
Miscellaneous	-0.0400	-0.025**	0.0044*	-0.00091	0.00338	0.0026*	0.00401	0.00233	0.049**

Note: * Significant at 5%, ** significant at 10%, *** significant at 15%.

Table A7: Price elasticities of linear AIDS for rural Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
Food and beverages	-0.845475	-1.26879	0.00831	-4.26372	-1.94755	2.64595	0.69318	0.89993	-0.16875
Apparel, textiles and footwear	-0.08522	-2.17356	-0.31249	0.45758	-3.78169	0.04499	0.23475	-3.18121	-0.25628
Firewood	0.203870	-0.75433	-1.09009	-0.92297	3.05315	-0.05635	0.61027	0.30395	0.04086
Kerosene oil	0.349077	-1.10508	0.38463	-5.267	-3.63423	2.29996	0.74307	1.07249	0.02612
Gas	-0.42869	1.22543	0.16423	4.23374	-0.16140	-1.92034	-0.82665	-0.98818	-0.03780
Electricity	-0.00298	0.13653	-0.76199	0.56150	5.99691	-0.03993	-0.55747	-0.28005	0.0083003
House rent and housing	0.11517	0.051635	0.75335	0.56090	-3.15322	-2.22657	-1.83508	0.93227	0.028270
Transport and communications	-0.29634	-0.47262	-0.34625	4.79935	2.57787	-2.38689	-0.25567	-0.47967	0.05500
Miscellaneous	-0.27552	-0.16404	0.11190	1.73707	1.50114	-0.99490	-0.28365	0.090051	-0.72049

Table A8: Price elasticities of linear AIDS for urban Pakistan

	Food and beverages	Apparel, textiles and footwear	Firewood	Kerosene oil	Gas	Electricity	House rent and housing	Transport and communications	Misc.
Food and beverages	-0.82089	0.0565	-0.07608	0.1011	0.00475	0.034684	0.28765	-0.21557	-0.07674
Apparel, textiles and footwear	0.56813	-1.047168	-0.23718	0.03659	-0.21791	-0.09869	-0.79399	0.24324	0.23411
Firewood	-1.75739	-0.5836	-1.90264	-0.08799	-0.12909	-0.52852	-0.18517	1.89764	0.30455
Kerosene oil	0.28653	0.61315	-0.23844	-3.23675	0.81835	0.07002	-0.19879	0.81802	-0.20672
Gas	-0.08378	-1.05426	-0.20383	0.49319	-0.91462	0.89118	-0.76807	-0.31477	0.69696
Electricity	0.38389	-0.1871	-0.14681	0.0179	0.38364	-0.11347	-1.20271	-0.29222	0.19825
House rent and housing	0.1694	-0.3456	-0.04056	-0.02081	-0.05017	-0.40986	-1.25564	0.30612	0.06717
Transport and communications	-1.51565	0.31078	0.55581	0.08842	-0.06275	-0.43502	1.21839	-0.14735	-0.60073
Miscellaneous	-0.26724	0.90729	0.01253	-0.02054	0.043447	0.02403	0.05378	-0.08596	-0.73576