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Changing Patterns of Household Expenditures on Energy

A Case Study of Indonesia and Pakistan

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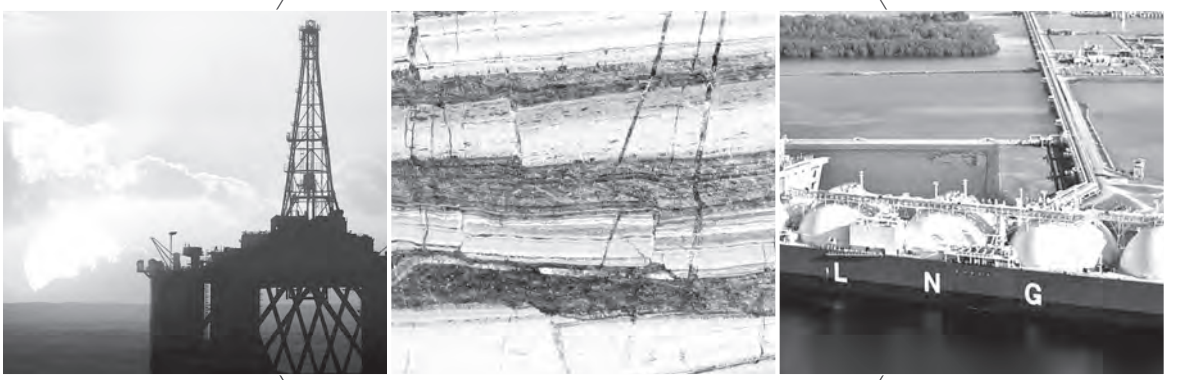

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Extractive Industries for Development Series

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Abbreviations

CPI	consumer price index
LPG	liquefied petroleum gas

Executive Summary

This paper applies a decomposition technique using a log mean Divisia index to two sets of household surveys taken several years apart in Indonesia and Pakistan. The methodology enables separation of changes in expenditure on different types of energy into changes in prices, quantities, the share of households using the given form of energy, and total household income (using total household expenditure as a proxy). The technique was applied to electricity, liquefied petroleum gas (LPG), kerosene, and gasoline in Indonesia, and to natural gas, kerosene, LPG, purchased firewood, collected firewood, dung cake, and other forms of biomass in Pakistan.

The recent history of petroleum product prices, which climbed over several years to a peak value in mid–2008 and then fell rapidly until early 2009, has drawn attention to the effects of energy prices on household expenditures and energy use. Although information on household expenditures in developing countries from 2007 and 2008 is not yet available, data from earlier household expenditure surveys conducted during periods of rising energy prices can be useful in this context. Using two sets of household surveys carried out during the first half of this decade, this paper investigates three questions:

- What proportion of household income is spent on petroleum products and on energy generally?
- How does the proportion vary across income levels, and does the effect of higher oil prices bear more heavily on low- or high-income groups?
- Are there important differences in the patterns of expenditure on energy between rural and urban households at similar income levels?

A further issue undertaken by this paper that has not been widely addressed relates to the changing patterns of household expenditure on energy over time. Changes in expenditure shares for an individual household can occur because of changes in quantities purchased, prices paid, or total expenditure. Separating these factors allows the relative importance of each to be pinpointed. The large changes in energy prices experienced over the last few years raise questions about the degree of

stability of household expenditure shares on energy, questions that this paper looks to address:

- Does the share of expenditure on energy remain constant over time when there are large price changes?
- How do household budget shares for different fuels change as quantities purchased respond to changed prices and incomes?
- Do households switch to or switch away from the use of certain fuels altogether?

The surveys of household expenditures confirmed the importance of energy in the household budget. In Indonesia, the share of expenditure on energy for all income group quintiles was about 7 percent in 2002 and 8 percent in 2005. In Pakistan, the share was about 9 percent in 2001–02 and 10 percent in 2004–05. These results suggest that large energy price increases would weigh heavily on all households.

The share of expenditure on electricity was high in both Indonesia and Pakistan, and higher than any other form of energy in every quintile in Pakistan. In Indonesia, the share of expenditure on electricity increased markedly between the two surveys, even though the access rate (defined here as the percentage of households reporting use) was already very high in urban areas at the time of the first survey. As expected, the share of expenditure on automotive fuels rose steeply with increasing income quintile in both countries. Firewood and other forms of biomass were widely consumed by low-income households, but their relative importance declined over time.

Comparing rural and urban households at the same quintile levels revealed large differences in patterns of energy use, even though the shares of expenditure on energy and the general level of household income were not very different. Urban households devoted more of their budget to modern forms of energy (petroleum products, electricity, and natural gas where available), while rural households devoted a larger share to biomass. A limited analysis of household groups at similar income levels showed that rural households as a group allocated a higher share of expenditure to automotive fuels than did urban households. In Indonesia, this is explained largely by a higher proportion of households owning automotive vehicles in rural areas, while in Pakistan the quantity consumed per user household is higher. At similar income levels, expenditure on electricity was higher in urban areas, while expenditure on firewood and other forms of biomass was higher in rural areas. Expenditure on kerosene differed between the two countries, being higher for Indonesia's urban quintiles and for Pakistan's rural quintiles.

The analysis of successive expenditure surveys for Indonesia and Pakistan indicates that, even in surveys taken three years apart, the patterns of expenditure on different sources of energy can change substantially. For example, the highest urban quintile in Pakistan increased the share of its expenditure on gasoline and diesel by nearly 2 percentage points, while in Indonesia all quintiles increased their share of expenditure on electricity by more than 1 percentage point. This suggests that it is important to work with up-to-date information for reliable analysis of the importance of energy in the total household budget.

For the bottom two quintiles nationally, the largest effect on the change in the percentage share of purchased energy was the electricity tariff increase in Indonesia and access to purchased firewood in Pakistan.[1] Among purchased fuels examined in Pakistan, the price effect was highest for kerosene, but was offset entirely by increasing income and decreasing access.

The decomposition analysis enables detailed disaggregation of various factors affecting the share of household expenditure on energy sources. Because they are additive, the relative effects of different factors can be readily expressed and compared. The impacts of the exogenous factors—real prices and real household total expenditure—are predictable in their direction. With no other changes, an increase in prices increases the share of expenditure on fuel; an increase in total household expenditure reduces the share. Changes in the quantity consumed by those with access, and in the numbers with access, depend on the economic reactions of the individual households to changing circumstances. There are four possible permutations of these changes, all of which are observed in this paper:

1. *Access increases and the quantity purchased by users increases.* This pattern was the case for purchased firewood in Pakistan. It suggests that the fuel was becoming more attractive to all households, and that if new users consumed less than existing users, the difference is made up by existing users increasing their consumption.
2. *Access increases and the quantity purchased by users decreases.* An example is natural gas in urban areas of Pakistan. It suggests that, although the fuel was more attractive, new users appeared to consume considerably less than existing users, thus bringing down average consumption.

[1] Information on unit prices paid for electricity in Pakistan was not available, and so the impact of tariff changes could not be assessed for that country.

3. *Access decreases and the quantity consumed by users decreases.* This pattern was found for LPG in Indonesia. Not only did some households stop consuming the fuel—probably those using lesser amounts—but those still using the fuel reduced consumption sufficiently to bring the average quantity down.
4. *Access decreases and the quantity consumed by users increases.* This pattern was exhibited by urban households using collected firewood in Pakistan; it suggests that those households using the least of this fuel stopped using it, increasing the average quantity for those still using it.

These results indicate that, in order to understand energy use patterns and their changes over time, insights regarding the decisions on whether and how much (if at all) to consume a fuel are needed. Where increases in demand are likely to be dominated by increasing access, rather than by increasing consumption by users, the challenge for energy suppliers will be to facilitate access.

The methods of analysis presented in this paper could be extended to other commodities or to changes in energy use patterns over longer periods of time, where suitable household expenditure surveys are available. In particular, when household surveys covering the period of high oil prices become available, the analysis of changing household patterns of fuel use will be valuable. The availability of evidence on the use of energy by various household groups will be important for considerations of providing targeted support to low-income households at times of unexpected shocks to energy prices.

Background and Methodology

Background

The recent history of petroleum product prices, which climbed over several years to a peak value in mid-2008 and then fell rapidly until early 2009, has drawn attention to the effects of energy prices on household expenditures and energy use. Although information on household expenditures in developing countries from 2007 and 2008 is not yet available, data from earlier household expenditure surveys conducted during periods of rising energy prices can be useful in this context. Using two sets of household surveys carried out during the first half of this decade, this paper investigates three questions:

- What proportion of household income is spent on petroleum products and on energy generally?
- How does the proportion vary across income levels, and does the effect of higher oil prices bear more heavily on low- or high-income groups?
- Are there important differences in the patterns of expenditure on energy between rural and urban households at similar income levels?

These aspects of household expenditure patterns have been addressed in a number of studies over the years. Bacon, Bhattacharya, and Kojima (forthcoming) review some studies for developing countries and provide new evidence from recent surveys carried out in Asian and African countries.

A further issue that has not been widely analyzed to date relates to the changing patterns of household expenditure on energy over time. Expenditure shares are an input to government policy, especially with respect to targeted assistance for low-income households in coping with large and unexpected energy price changes. Thus, understanding the nature of such changes can help inform the policy debate. Changes in expenditure shares for an individual household can occur because

of changes in quantities purchased, prices paid, or total expenditure. Separating these factors allows the relative importance of each to be pinpointed (Blow 2004). Increases in shares that have been largely caused by increases in quantities purchased may be of less policy concern than changes primarily resulting from increases in prices with quantities relatively unchanged. The large changes in energy prices experienced over the last few years raise questions about the degree of stability of household expenditure shares on energy:

- Does the share of expenditure on energy remain constant over time when there are large price changes?
- How do household budget shares for different fuels change as quantities purchased respond to changed prices and incomes?
- Do households switch in or switch away from the use of certain fuels altogether?

This paper is part of a larger study examining the impact of higher oil price levels and price volatility on the welfare of the poor. It follows *Coping with Higher Oil Prices* (Bacon and Kojima 2006), *Coping with Oil Price Volatility* (Bacon and Kojima 2008a), and *Vulnerability to Oil Price Increases: A Decomposition Analysis of 161 Countries* (Bacon and Kojima 2008b). Using successive household expenditure surveys, this paper applies a decomposition methodology to separate changes in shares of total expenditures on different types of energy into changes in prices, quantities, the share of households using a given form of energy, and total household expenditure.

The utility of decomposition, based on a Divisia index, is that the effects of the changes in the factors can be expressed in an additive form, and that, unlike a Laspeyres index, the total change in the expenditure share can be attributed to the changes in the factors without leaving a residual. In the absence of information on price and income elasticities that can directly link changes in quantities and access to changes in price and incomes, the method provides an ex post accounting of the change in the share of expenditure on energy into changes in its component parts.

Methodology

Household expenditure surveys are based on responses by a random sample of households to a questionnaire concerning their expenditures on all the items in their budget. Some questionnaires also ask for details on quantities purchased of certain items. Where both expenditures and quantities are given, the average price paid per unit can be derived. For

certain goods, there may be no quantity data recorded in the survey, but prices can be assumed to be the same for all consumers if there is pan-territorial pricing. In that case, quantities can be calculated from these prices and the expenditure data.

This paper groups responses to provide summary statistics of expenditure patterns. The population from which the survey is obtained is divided into quintile groups, with quintile 1 representing the lowest-income group and quintile 5 the highest, based on the total expenditure reported. Since expenditure of a household will be affected by the number of individuals in it, a common approach is to rank households according to their per capita income—or, in the absence of data on income, total expenditure per capita as a proxy—prior to separating households into quintiles. Households thus ranked are assigned to quintiles in order of increasing per capita expenditure so that each quintile contains an equal number of *people* rather than of *households*. Because poor families tend to be larger than rich, there are more households in upper quintiles using this approach. Where separate analysis for rural and urban households is conducted, households from the nationally based quintiles are allocated to a rural or urban group. Hence the lowest-income rural quintile consists of those rural households that are within the lowest national quintile, and the lowest-income urban households are similarly derived. This allocation method makes the per capita expenditure ranges at the same quintile for these two groups similar; however, the expenditures in the same quintile by urban and rural households are not identical and are almost always lower for the rural population.

Once households in each quintile have been identified, it is possible to derive summary statistics for the group. For a variable such as total household expenditure per month, the calculation of average total expenditure for the group can be carried out unambiguously. However, for variables such as the ratio (or share) of expenditure on energy to total expenditure, there are two possible statistics. The first is the average for the group of each household's ratio of energy to total expenditure (the democratic budget share), while the second is the ratio of the average expenditure on energy of the group to its average total expenditure (the plutocratic budget share). The former measure is more frequently used, since the variable of interest is usually the share of expenditure for households rather than the share of the group as a whole.[1] However, as

[1] The ratio of averages is not generally equal to the average of ratios. Some results on the relationship between the two can be shown to hold. When the two component series are statistically independent, the average of the ratios can be shown to be equal to, or greater than, the ratio of averages, using Jensen's inequality. When the variables forming the ratio are all positive,

shown in appendix A, it is convenient to use the approach based on the ratio of averages to analyze shifts in behavior between surveys using a decomposition technique.

Three different types of surveys permit the analysis of household behavior at more than one period of time. A purely longitudinal survey follows one household over many time periods, obtaining information on the same concepts in each period. Such a survey might be used for econometric analysis of the reaction of households to changes in key variables, such as prices and incomes. Panel-based surveys interview some or all of the same households at two or more time periods. Special statistical models can be used to analyze the changing behavior of those households appearing in more than one survey. The third and most common type is random sample surveys carried out at successive intervals. Because these have no way of identifying whether any households were resampled from survey to survey, changes have to be analyzed at a group level. This was the case for the data analyzed in this paper.

The expenditure share of a particular commodity for a group of households, such as that of the lowest quintile, may change between two successive household surveys. Since several variables are embedded in the calculation of a budget share of a group, changes in each of these factors contribute to the overall change in budget share. Decomposition analysis provides a method of quantifying their relative importance in the overall change.

At the simplest level for an individual household i, a budget share identity can be written as

$$w_i \equiv e_i / y_i \equiv p_i \times q_i / y_i \qquad (1)$$

where w_i is budget share of the good,
e_i is household expenditure on the good,
y_i is total expenditure of the household,
p_i is unit price of the good paid by the household,
q_i is quantity purchased of the good by the household.

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then the ratio of averages is greater (smaller) than the average of the ratios if the individual ratio variable is positively (negatively) correlated with the denominator variable forming the ratio. In general, the plutocratic budget share gives greater weight to higher-income households than does the democratic share.

For an individual household, a change in the expenditure share of a good can be related to changes in price, quantity, and total household expenditure. These changes can be precisely linked in an additive form using decomposition analysis (Ang 2004, Bacon and Bhattacharya 2007, Bacon and Kojima 2008) as shown in appendix A.

For a group of households, the formula needs several adjustments. First, the relevant budget shares are those for the group as a whole. Second, prices as well as all other variables are household-specific, and an average price needs to be defined. Third, not all households in a group use the good in question. Since the proportion of households using a given good (referred to as having *access* to the good hereafter) may change over time, it is important to include a factor that allows for changes in access. A group identity suitable for decomposition analysis is given by

$$\Sigma e_i/\Sigma y_i \equiv (\Sigma q_i/HA) \times [(\Sigma p_i \times q_i)/\Sigma q_i] \times (HA/HT) \times (HT/\Sigma y_i) \quad (2)$$

where HA is the number of households with access to the good,
HT is the number of households in the group,
Σ is the sum over the variable for all households in the group.

In this identity, the statistics for the group expenditure share and group price paid are calculated as ratios of averages, rather than averages of the ratios. Accordingly, the price term is in effect the weighted average of individual prices paid rather than an unweighted average. Households not purchasing the good have zero entries for the price and quantity. The identity can be interpreted as follows:

> budget share of expenditure on the good for group as a whole
> = (average quantity purchased by households with access) ×
> (weighted average price paid by the households in the group
> using the good) × (proportion of households with access) /
> (average total expenditure for all households in the group)

Of particular interest is the impact of real—as opposed to nominal—price and income increases on household energy use patterns. To take the overall cost of living changes between the two survey dates into account, this paper adjusts energy prices and total expenditure by the cost of living index and measures changes in prices and in total expenditure in real terms. The identity based on real prices and expenditures becomes

$$\Sigma e_i/\Sigma y_i \equiv (\Sigma q_i/HA) \times [(\Sigma p_i \times q_i/p^*)/\Sigma q_i] \times (HA/HT) \times [HT/(\Sigma y_i/p^*)] \quad (3)$$

where p^* is the cost of living index at the time of the survey.

Changes in the group budget share measure can be linked through decomposition analysis to changes in the average quantity purchased, changes in the average real price paid, changes in the proportion of households with access to the good, and changes in the inverse of average total real expenditure of the group. Using the decomposition method, the price effect identifies what would have been the change in the budget share for a particular fuel if prices had changed but all other factors had remained constant. Other effects are calculated similarly, allowing a one-at-a-time identification of the impact of changes in each factor in identity 3. The particular form of decomposition used allows the effects to be added so as to equal the total change in the expenditure share of the good in question. In the absence of an additive decomposition, the relative importance of the different changes that contribute to the change in the expenditure share cannot be evaluated.

The set of variables from which identity 3 is constructed contains two factors that are largely outside the short-run control of the household—prices and total real expenditure—and two others that are under household control—quantities and access (provided that the fuel in question is available for purchase in the community). The analysis does not identify the total impact of changing prices (or household income) on the quantity purchased since this would require information on price elasticities, which are not available when there are not separate demand studies based on several years' worth of price and quantity data. Formal econometric modeling would be needed to establish the causal links between prices and incomes on the one hand, and the decisions on whether and how much energy to consume on the other. Without longitudinal data, such econometric modeling is not possible, but the decomposition analysis gives an ex post view of the importance of these two driving variables and two response variables in explaining changes in expenditure shares.

The Indonesia and Pakistan Household Surveys

The three key data requirements for the decomposition of changes of expenditure shares into the various components listed in the previous section are

- the availability of two (or more) relatively recent household expenditure surveys at dates separated by a sufficient length of time for prices to change,
- identical categories of energy components available for analysis from the two surveys,
- information on quantities purchased as well as expenditures on the energy categories.

These requirements reduce the number of readily available cases for investigation. For the analysis described here, surveys from selected Pakistan (2001–02 and 2004–05) and Indonesia (2002 and 2005) were selected as suitable. Details of the surveys are given in appendix B. For Indonesia, there also exist panel survey data for 2001 to 2003, with the panel being changed thereafter. In order to compare surveys at dates sufficiently far apart, and for which energy prices had changed substantially, the comparable surveys for 2002 and 2005 were considered more suitable, although these are not on a panel basis.

Conversion into real expenditure terms was based on the change in the national consumer price index (CPI). Separate urban and rural price indexes were not used, but for a longer period between surveys such an adjustment could be important.

Indonesia

The surveys in Indonesia were carried out in January to March in both 2002 and 2005. In 2002, the sample size was 63,189 representing 50 million households, of which 57 percent lived in rural areas. In 2005,

the sample size was 9,925 representing 52 million households, of which 56 percent lived in rural areas. The smaller sample size for the second survey means that small changes in variables between the surveys should be treated with caution as sampling error may have affected the results. The number of households in each quintile group is shown in appendix B.

Information was available on the basis required for electricity, kerosene, liquefied petroleum gas (LPG), coal, natural (city) gas, diesel for automotive use, and gasoline for automotive use. The expenditures on coal, city gas, and diesel are very small and are omitted from the decomposition, which is applied to the other four sources of energy. Data are also available for expenditure on firewood/charcoal and other biomass, but quantities are not available for this fuel type. The monthly average percentage expenditure shares for all fuels are given for national, urban, and rural quintiles for 2002 in table 1 and for 2005 in table 2. Total expenditure on fuels in 2002 also includes kerosene, gasoline, and diesel used for generators; these categories were not available for 2005.[1] Note that the shares for all households are affected not only by the shares for urban and rural households but also by the relative numbers of households in each area.[2]

In 2002, the share of household expenditure on all forms of energy ranged between 7 and 8 percent, with the lowest-income urban households having the highest shares. Averaged across the quintiles, the share of electricity was highest in urban areas, followed by kerosene and gasoline for automotive use. In rural areas, the combined expenditures on firewood, charcoal, and other fuels were highest, followed by kerosene and electricity. The share of total budget expenditure on petroleum products—LPG, kerosene, gasoline, and diesel (excluding use for generators)—was 4 percent in urban areas and 3 percent in rural areas. There were large differences in expenditure patterns among the quintiles. In urban areas, the share of kerosene fell at higher quintiles as did the share of firewood, charcoal, and other fuels. In rural areas, the share of firewood, charcoal, and other fuels also fell at higher quintiles. The shares of automotive gasoline and diesel and of LPG increased with the quintile level in both urban and rural areas, while the share of electricity rose by about 20 percent between the bottom and top

[1] The share of household expenditures on generator fuels in 2002 was less than 0.5 percent.

[2] It is possible that the expenditure share for a fuel could increase in both urban and rural areas but could decline nationally because of a relative increase in the number of households in the area where the share was lower.

Table 1 Percentage shares of household expenditures on electricity and fuels in Indonesia, 2002

Quintile	Electricity	LPG	City gas	Kerosene	Coal	Gasoline automotive	Diesel automotive	Firewood, charcoal & other fuels	All energy[a]
All households									
1	1.7	0.04	0.00	2.2	0.00	0.18	0.00	3.3	7.5
2	1.9	0.06	0.00	2.4	0.00	0.44	0.01	2.4	7.3
3	2.1	0.12	0.00	2.5	0.01	0.79	0.01	1.6	7.4
4	2.3	0.26	0.01	2.4	0.00	1.2	0.02	0.88	7.5
5	2.5	0.62	0.02	1.3	0.00	1.9	0.10	0.21	7.2
All	2.3	0.34	0.01	1.9	0.00	1.2	0.05	1.1	7.3
All urban households									
1	2.2	0.03	0.00	3.2	0.00	0.20	0.00	1.9	7.6
2	2.4	0.08	0.00	3.2	0.00	0.42	0.00	1.1	7.3
3	2.5	0.18	0.00	3.0	0.00	0.85	0.01	0.66	7.4
4	2.6	0.36	0.01	2.5	0.00	1.3	0.01	0.31	7.4
5	2.6	0.68	0.02	1.1	0.00	1.9	0.08	0.06	7.1
All	2.6	0.50	0.01	1.8	0.00	1.5	0.05	0.30	7.2
All rural households									
1	1.5	0.04	0.00	2.0	0.00	0.17	0.00	3.6	7.4
2	1.7	0.05	0.00	2.1	0.00	0.45	0.01	2.9	7.4
3	1.8	0.08	0.01	2.2	0.01	0.76	0.01	2.2	7.4
4	1.9	0.15	0.00	2.3	0.00	1.2	0.02	1.6	7.5
5	1.8	0.32	0.01	1.8	0.01	1.8	0.18	0.88	7.5
All	1.8	0.12	0.00	2.1	0.00	0.86	0.04	2.2	7.4

Source: Authors' calculations.

a. "All energy" includes lubricants and kerosene, gasoline, and diesel for power generation in addition to all other forms of energy shown in this table.

quintiles in urban areas and by less in rural areas. The share of city gas is negligibly small, reflecting its limited availability.

The expenditure share patterns for 2005 are similar to those for 2002, but with a higher share of total energy in every quintile group. Much of the overall increase came from the share of expenditure on electricity, with a smaller increase in the share of gasoline. The contribution of firewood, charcoal, and other fuels declined, and that of automotive gasoline rose, in both urban and rural areas. In rural areas, there was greater variation in the share of electricity across the quintiles than in

Table 2 Percentage Shares of Household Expenditures on Electricity and Fuels in Indonesia, 2005

Quintile	Electricity	LPG	City gas	Kerosene	Coal	Gasoline automotive	Diesel automotive	Firewood, charcoal & other fuels	All energy
All households									
1	2.6	0.01	0.01	2.3	0.01	0.27	0.01	3.0	8.3
2	3.2	0.01	0.01	2.5	0.00	0.67	0.01	2.1	8.6
3	3.5	0.09	0.01	2.5	0.00	0.96	0.02	1.3	8.7
4	3.7	0.22	0.01	2.4	0.01	1.4	0.03	0.63	8.8
5	3.6	0.65	0.03	1.3	0.00	2.0	0.09	0.22	8.4
All	3.5	0.33	0.02	1.9	0.00	1.5	0.05	0.95	8.5
All urban households									
1	3.8	0.05	0.04	3.3	0.00	0.18	0.00	1.7	9.1
2	4.0	0.00	0.02	3.3	0.00	0.54	0.00	0.86	8.9
3	3.8	0.11	0.01	3.0	0.00	0.94	0.01	0.58	8.7
4	4.0	0.25	0.01	2.5	0.00	1.3	0.01	0.19	8.7
5	3.9	0.72	0.03	1.2	0.00	2.1	0.08	0.04	8.5
All	3.9	0.48	0.02	1.9	0.00	1.6	0.05	0.23	8.6
All rural households									
1	2.4	0.00	0.00	2.1	0.01	0.29	0.01	3.2	8.1
2	2.8	0.02	0.00	2.2	0.01	0.72	0.01	2.5	8.5
3	3.2	0.07	0.01	2.2	0.00	0.99	0.03	1.9	8.7
4	3.3	0.16	0.01	2.2	0.01	1.5	0.06	1.2	8.9
5	2.6	0.36	0.00	1.5	0.01	1.7	0.10	0.93	7.8
All	2.9	0.12	0.01	2.0	0.01	1.1	0.04	1.9	8.4

Source: Authors' calculations.

2002. Unlike their urban counterparts, the fourth rural quintile had the highest share for both total energy and electricity.

A direct comparison between the behavior of urban and rural households requires examining income levels that are as close as possible. Table 3 shows the average total household expenditures by quintile for urban and rural households in the two survey years. In each survey, the average total expenditure for the third urban quintile is very close to that of the fourth rural quintile, so a comparison can be made between these groups. In both years, the total share of expenditure on energy is similar, but the proportions devoted to electricity and kerosene are higher in urban areas, while the proportion for firewood, charcoal, and

Table 3 Average Total Nominal Expenditure in Rupiah by Quintile in Indonesia, 2002 and 2005

	2002		2005	
Quintile	Urban	Rural	Urban	Rural
1	451,048	400,623	544,063	486,409
2	571,965	495,926	684,310	624,609
3	687,494	576,652	860,421	711,424
4	867,555	698,200	1,083,752	877,995
5	1,435,306	1,006,338	1,776,891	1,379,612
All	1,013,671	577,021	1,250,642	731,320

Source: Authors' calculations.

other fuels is markedly higher in rural areas. The shares for automotive gasoline and diesel are also higher in rural areas. Appendix tables C.1 and C.2 give access rates and quantities purchased by users for urban and rural quintile groups. For electricity, access rates are higher in urban areas—and in 2002 consumption per household is also higher—leading to the higher proportion of total group expenditure. In the case of kerosene, consumption is markedly higher among urban households, and the access rate is also higher in 2005. For gasoline, the quantities are essentially the same for the two groups; the higher rural expenditure is explained by the higher access rate, suggesting that rural households at the same income level as urban require more personal automotive transport. In 2005, this pattern is also clearly seen to hold at lower quintiles. For example, the average total household expenditure of urban quintile 1 is between those of rural quintiles 1 and 2, but the access rate (that is, the percentage of households owning gasoline-fueled vehicles) is much higher in rural areas, and similarly with urban quintile 2 versus rural quintiles 2 and 3.

To compare the two surveys through the decomposition analysis, prices and total expenditures are expressed in real terms in July 2002 rupiah. The CPI rose by 22 percent between 2002 and 2005. During this period, the total real expenditure of urban and rural households increased by 2.2 percent and 5.1 percent, respectively. Table 4 provides information from the two surveys on the average real energy prices paid, the average monthly quantities purchased by those households using the fuel, and the access rates for each form of energy analyzed by decomposition. An important distinction between the data presented in table 4 and those in tables 1 and 2 is that the quantities consumed shown in the former are averaged only over households using a given form of energy, while the expenditures shown in the latter are averaged over all households (regardless of whether they use the item).

TABLE 4 CHANGES IN DECOMPOSITION VARIABLES BETWEEN THE TWO SURVEYS IN INDONESIA

Parameter	Year	Electricity	LPG	Kerosene	Gasoline
		Urban households			
Real price	2002	262	1,886	954	1,556
	2005	416	3,127	1,003	1,589
	% increase	59	66	5.1	2.1
Quantity	2002	103	15	23	36
	2005	101	12	22	32
	% increase	–2.4	–17	–4.3	–9.7
Access	2002	97	18	85	28
	2005	96	13	88	33
	Increase in %	–0.6	–5.1	3.1	4.9
		Rural households			
Real price	2002	241	2,021	1,058	1,657
	2005	381	2,980	1,117	1,713
	% increase	58	48	5.6	3.4
Quantity	2002	54	13	13	24
	2005	58	11	13	21
	% increase	7.4	–12	–0.5	–10
Access	2002	78	2.7	91	13
	2005	80	2.2	89	18
	Increase in %	2.3	–0.5	–2.2	4.9

Source: Authors' calculations.

Note: Real prices are in July 2002 rupiah. Units for prices are rupiah per kilowatt-hour for electricity, per kilogram for LPG, and per liter for kerosene and gasoline. Quantities are per household purchasing a given form of energy and measured in kilowatt-hours, kilograms, and liters, as for the price data. Access rates are in percentages of all households. "Increase in %" is increase in percentage points.

Separate examination of the data by quintile group revealed that, for both urban and rural households, the average price paid for electricity was greater at higher quintile levels, reflecting the nature of the tariff structure. For other fuels, the price differences between quintiles within the urban and rural groups were small, but the average prices paid for kerosene, LPG, and gasoline were higher in rural than in urban areas in 2002; with the exception of LPG, the same pattern existed in 2005. These results held for each quintile group, suggesting that there is a general price differential depending on location. By contrast, the average price paid for electricity was lower in rural areas in both years, as were the quantities consumed. This suggests that this difference is largely a function of the quantity purchased rather than the location of the household and reflects a rising block tariff structure.

The real price increases were large in both areas for electricity and LPG, but were small for kerosene and gasoline. Table 5 compares the increase in the real prices in local currency paid for LPG, kerosene, and gasoline with the average real prices of these products on the international market expressed in local currency for the two three-month periods of the surveys. For LPG, the prices paid increased by a larger percentage than the international prices, but for kerosene and gasoline the local prices paid increased by a much smaller rate than the international prices. The pass-through coefficient (Kojima 2009) based on changes in nominal local prices[3] confirms that the increase in local prices paid for LPG was larger than the increase in the international price, while the increases in local kerosene and gasoline prices were much smaller. By 2005, the domestic kerosene price, which included transport costs and taxes, was far below the international price, providing a substantial stimulus to consumption.

TABLE 5 REAL PRICES PAID AND REAL INTERNATIONAL PRICES FOR PETROLEUM PRODUCTS IN INDONESIA, 2002 AND 2005

	LPG	Kerosene	Gasoline
	Rp/kg	**Rp/liter**	**Rp/liter**
Average real price paid in 2002	1,886	954	1,556
Real international price in 2002	1,955	1,410	1,455
Average real price paid in 2005	3,127	1,003	1,589
Real international price in 2005	3,033	2,935	2,765
Percentage increase in real prices paid	66	5.1	2.1
Percentage increase in real international price	55	108	90
Pass-through coefficient	1.11	0.12	0.20
	US$/kg	**US$/liter**	**US$/liter**
Nominal price paid in 2002	0.20	0.10	0.17
Nominal international price in 2002	0.21	0.15	0.15
Nominal price paid in 2005	0.32	0.10	0.16
Nominal international price in 2005	0.37	0.36	0.34

Sources: Various issues of the Platts *Oilgram Price Report* and authors' calculations.

Note: Real prices are in July 2002 rupiah. The international price for LPG is the average of Saudi Aramco contract prices for propane and butane, and the prices for kerosene and gasoline are free-on-board spot Singapore prices. The pass-through coefficients are as defined by Kojima (2009).

The changes between the two surveys in quantities purchased by households with access vary markedly among the different sources of

[3] For the pass-through coefficient, a coefficient of 1 represents passing through the increase in nominal prices on the international market, net of taxes and transport costs, fully to consumers on the domestic market.

energy. Electricity consumption by users fell in urban areas but rose in rural. In both the urban and rural areas, the average quantities purchased of all three petroleum products fell.

The access of urban households to electricity was almost universal; in rural areas, it was 80 percent. Access to LPG was much higher in urban than in rural areas, but fell in both areas in 2005, suggesting fuel switching between the periods. In both urban and rural areas, access to kerosene was high, suggesting its use as a fuel for cooking and heating water. Access to gasoline was higher in urban areas than in rural and increased in both during the period.[4]

The contributions of these different factors are brought together through the decomposition analysis. The results for each urban quintile are given in table 6 and for each rural quintile in table 7; the results for the aggregate of all households, combining the two groups, are shown in appendix table C.3. The interpretation of the decomposition analysis can be illustrated with the case of electricity for the highest urban quintile. The share of expenditure on electricity increased by 1.24 percentage points. Of this, with all other factors held constant,

- the increase in price would have resulted in an increase in share of 1.47 percentage points,
- the decrease in quantity purchased by those using electricity would have resulted in a fall in its share of 0.12 percentage points,
- the decline in the access rate would have resulted in a fall in the share of 0.03 percentage points,
- the increase in total household expenditure would have resulted in a fall in the share of 0.08 percentage points.[5]

The total effects were generally small, except for electricity, the share of which increased by more than 1 percentage point for all five urban and three rural quintiles. The expenditure effects for *all fuels* were mainly small and negative, reflecting the modest increase in real total expenditures. The lowest urban quintile did not experience any increase in total expenditure in real terms. Consistent with rising real prices, the

[4] Although more rural households at the same income as urban households tend to own automotive vehicles, the greater number of higher-income households in urban areas means that, for the group as a whole, more urban households consume gasoline.

[5] Even though the change in total expenditure is the same for all fuels, the formula for the decomposition implies that the larger the initial budget share, the larger will be the expenditure effect.

TABLE 6 DECOMPOSITION OF CHANGES IN THE SHARE OF URBAN QUINTILE EXPENDITURES ON ELECTRICITY AND FUELS BETWEEN 2002 AND 2005 IN INDONESIA

Quintile	Decomposition effect	Electricity	LPG	Kerosene	Gasoline
1	Total	1.57	0.02	0.11	–0.02
	Price	1.63	0.01	0.22	0.00
	Quantity	0.25	0.00	–0.21	0.02
	Access	–0.32	0.01	0.11	–0.03
	Expenditure	0.00	0.00	0.00	0.00
2	Total	1.61	n.a.	0.05	0.13
	Price	1.66	n.a.	0.16	0.02
	Quantity	–0.10	n.a.	–0.19	–0.05
	Access	0.02	n.a.	0.06	0.15
	Expenditure	0.03	n.a.	0.03	0.00
3	Total	1.27	–0.07	–0.03	0.09
	Price	1.53	0.05	0.19	0.02
	Quantity	–0.15	–0.02	–0.14	–0.08
	Access	0.01	–0.10	0.03	0.18
	Expenditure	–0.12	–0.01	–0.11	–0.03
4	Total	1.41	–0.10	–0.05	0.01
	Price	1.44	0.14	0.12	0.04
	Quantity	0.06	–0.06	–0.14	–0.25
	Access	0.02	–0.17	0.06	0.26
	Expenditure	–0.12	–0.01	–0.09	–0.05
5	Total	1.24	0.04	0.05	0.14
	Price	1.47	0.36	0.05	0.04
	Quantity	–0.12	–0.14	–0.04	–0.13
	Access	–0.03	–0.17	0.07	0.29
	Expenditure	–0.08	–0.02	–0.03	–0.05
All	Total	1.31	–0.02	0.03	0.09
	Price	1.48	0.25	0.09	0.03
	Quantity	–0.08	–0.09	–0.08	–0.16
	Access	–0.02	–0.16	0.07	0.26
	Expenditure	–0.07	–0.01	–0.04	–0.04

Source: Authors' calculations.

Note: n.a. = not applicable: no expenditure on fuel for quintile group in one of the survey years.

TABLE 7 DECOMPOSITION OF CHANGES IN THE SHARE OF RURAL QUINTILE EXPENDITURES ON ELECTRICITY AND FUELS BETWEEN 2002 AND 2005 IN INDONESIA

Quintile	Decomposition effect	Electricity	LPG	Kerosene	Gasoline
1	Total	0.84	–0.04	0.11	0.12
	Price	0.88	0.00	0.17	0.01
	Quantity	0.00	0.00	–0.02	–0.01
	Access	–0.04	–0.04	–0.02	0.12
	Expenditure	–0.01	0.00	–0.01	0.00
2	Total	1.14	–0.04	0.04	0.27
	Price	1.02	0.01	0.12	0.00
	Quantity	0.11	0.00	0.06	0.02
	Access	0.11	–0.04	–0.05	0.28
	Expenditure	–0.10	0.00	–0.09	–0.02
3	Total	1.43	–0.02	–0.04	0.23
	Price	1.11	0.03	0.13	0.03
	Quantity	0.21	–0.02	–0.09	–0.11
	Access	0.16	–0.02	–0.03	0.33
	Expenditure	–0.05	0.00	–0.05	–0.02
4	Total	1.44	0.01	–0.05	0.31
	Price	1.21	0.06	0.07	0.04
	Quantity	0.23	–0.02	0.02	–0.10
	Access	0.10	–0.02	–0.05	0.42
	Expenditure	–0.11	–0.01	–0.09	–0.05
5	Total	0.81	0.04	–0.26	–0.12
	Price	0.93	0.14	0.07	0.09
	Quantity	0.22	–0.05	0.02	–0.16
	Access	–0.05	–0.01	–0.13	0.18
	Expenditure	–0.28	–0.04	–0.21	–0.23
All	Total	1.16	0.00	–0.05	0.19
	Price	1.04	0.05	0.11	0.03
	Quantity	0.16	–0.02	–0.01	–0.10
	Access	0.07	–0.03	–0.05	0.31
	Expenditure	–0.11	–0.01	–0.10	–0.05

Source: Authors' calculations.

price effects in all cases were positive and were largest for electricity. For *electricity*, the access effect was generally small except for the lowest urban quintile where access declined from 91 to 82 percent. For *gasoline*, the real price of which increased only slightly, access increased in all quintiles except for the lowest urban quintile. The quantity of electricity consumed by users increased in the top four rural quintiles, and for the lowest and fourth urban quintiles.

For *LPG*, the access effect was negative in most cases, reflecting the decision of many households to stop using the fuel. Access to *kerosene* declined in rural areas despite experiencing only a small price increase; access increased in urban areas, possibly reflecting a switch away from LPG. Illustrative calculations of the costs of useful energy in table 8 explain such a shift. In 2002, the price difference between kerosene and LPG was in favor of kerosene but not by a large margin. By 2005, the price difference had widened to the point where kerosene might have been markedly cheaper (see the last column in the table). Nevertheless, LPG has distinct advantages over kerosene: it is much cleaner and considered by many to be more convenient.

TABLE 8 RELATIVE COSTS OF USING LPG AND KEROSENE

Fuel	Year	LHV	Efficiency (%)	Price	Price per unit of energy	Price per unit of usable energy
LPG	2002	46	50	1,886	41	82
Kerosene	2002	34	40	954	28	69
LPG	2005	46	50	3,127	68	136
Kerosene	2005	34	40	1,003	29	73

Source: Authors' calculations.

Note: LHV = lower heating value. Efficiency is the efficiency of cooking and heating water. Units are megajoules per kilogram (LPG) and liter (kerosene) for LHV, July 2002 rupiah per kilogram (LPG) and liter (kerosene) for price, July 2002 rupiah per megajoule for price per unit of energy and per unit of useful energy. Usable energy is LHV multiplied by the efficiency in this table.

PAKISTAN

The 2001–02 survey in Pakistan was carried out mostly in 2001 with some interviews conducted in the first months of 2002. The sample size was 15,962 representing 18 million households, of which 71 percent lived in rural areas. For the 2004–05 survey, the bulk of the interviews were carried out between September 2004 and May 2005. The sample size was 14,700 representing 19 million households, of which 68 percent lived in rural areas. The number of households in each quintile group is shown in appendix B. Although data from the 2005–06 survey are available, that survey lumped consumption of LPG and natural gas into

a single category. Given the importance of natural gas as a household fuel in urban areas, the 2005–06 survey consequently was not used.

Conversion of expenditures into real terms was carried out using the national CPI for both urban and rural households. The national CPI is based on price data from urban areas, and an analysis by the World Bank suggests that the CPI in rural areas may have risen faster than in urban areas. Taking urban- and rural-specific CPIs could reduce the price and income effects in rural areas relative to the information presented in this paper.

The monthly average percentage expenditure shares for different forms of energy for national, urban, and rural quintiles in 2001–02 and 2004–05 are given in tables 9 and 10, respectively. Coal and charcoal were combined in the tables because analysis showed that each had a very small share in total expenditure.

Table 9 shows that, in 2001–02, the share of household expenditure on energy was about 9 percent. In both urban and rural areas, the aggregate share of all energy sources first declined with rising quintile and then increased at higher incomes. The largest expenditure for energy was on electricity; for urban households, the shares of gasoline and diesel and of natural gas were also substantial. The share of expenditure on petroleum products (kerosene, LPG, gasoline, and diesel) was 2.1 percent in urban areas and 1.6 percent in rural areas. For rural households, the shares of purchased and collected firewood, dung cake, and other forms of biomass were important. As in virtually all other countries, natural gas is not available in rural areas in Pakistan; the "rural" households consuming natural gas are likely located in peri-urban areas classified as rural in the survey. Expenditure on coal and charcoal was negligible. Comparing urban and rural households, urban households spent much more on natural gas (reflecting mainly the much higher access rate of urban households due to the absence of a natural gas distribution infrastructure in rural areas) and less on kerosene and LPG than their rural counterparts. At higher total expenditure levels, the shares of most fuels declined in both urban and rural areas, with the exceptions of diesel and gasoline nationally and LPG in rural areas, all of which increased steadily with the quintile level. To a lesser extent, the shares of kerosene and electricity in rural areas also rose with rising quintile.

The same pattern was repeated in the 2004–05 survey, with the share of gasoline and diesel increasing steeply with rising quintile but to much higher levels than in 2001–02. The total share of petroleum products increased in both urban and rural areas, to 3.3 and1.9 percent, respectively. The shares of kerosene, natural gas, and all forms of

TABLE 9 PERCENTAGE SHARES OF HOUSEHOLD EXPENDITURES ON ELECTRICITY AND FUELS IN PAKISTAN, 2001–02

Quintile	Electricity	Natural gas	LPG	Kerosene	Diesel & gasoline	Firewood purchased	Firewood collected	Dung cake	Coal & charcoal	Other forms of biomass	All energy
All households											
1	3.3	0.27	0.05	0.42	0.08	0.67	1.8	1.1	0.02	1.5	9.4
2	3.4	0.42	0.08	0.42	0.14	0.77	1.8	0.79	0.01	0.88	8.9
3	3.5	0.53	0.21	0.37	0.29	0.75	1.7	0.66	0.01	0.64	8.8
4	3.8	0.83	0.30	0.36	0.69	0.74	1.3	0.51	0.01	0.42	9.1
5	4.1	0.99	0.43	0.28	2.3	0.34	0.63	0.22	0.01	0.21	9.7
All	3.8	0.74	0.28	0.34	1.1	0.58	1.2	0.52	0.01	0.54	9.3
Urban households											
1	5.2	1.2	0.12	0.23	0.07	1.4	0.50	0.65	0.01	0.77	10
2	5.0	1.8	0.13	0.34	0.15	1.2	0.51	0.37	0.02	0.15	9.9
3	5.1	1.7	0.31	0.23	0.35	0.84	0.30	0.21	0.01	0.15	9.4
4	5.0	2.2	0.27	0.24	0.61	0.51	0.15	0.11	0.01	0.05	9.2
5	4.6	1.6	0.27	0.11	2.5	0.12	0.07	0.03	0.01	0.01	9.4
All	4.8	1.7	0.26	0.16	1.7	0.38	0.16	0.11	0.01	0.07	9.4
Rural households											
1	2.9	0.11	0.04	0.45	0.08	0.54	2.0	1.2	0.02	1.6	9.2
2	3.0	0.11	0.07	0.44	0.14	0.67	2.1	0.89	0.01	1.0	8.7
3	2.9	0.13	0.18	0.42	0.27	0.72	2.2	0.82	0.01	0.81	8.6
4	3.2	0.12	0.31	0.41	0.74	0.86	1.9	0.72	0.01	0.62	9.0
5	3.5	0.19	0.64	0.52	2.1	0.64	1.4	0.49	0.02	0.50	10
All	3.2	0.14	0.30	0.45	0.82	0.70	1.9	0.77	0.01	0.83	9.2

Source: Authors' calculations.

biomass except purchased firewood were generally lower than three years earlier. In particular, there was a shift in both urban and rural areas toward purchased firewood and away from collected firewood. The share of LPG remained essentially constant between the surveys. The shares of dung cake and other forms of biomass, already low in urban areas, declined in rural areas. The inter-quintile patterns were also similar to those of 2001.

Table 11 gives the average total expenditures for the urban and rural quintile groups for the two survey years. In 2001–02, the total expenditures of urban quintile 3 and rural quintile 4 are essentially the

Table 10 Percentage Shares of Household Expenditures on Electricity and Fuels in Pakistan, 2004–05

Quintile	Electricity	Natural gas	LPG	Kerosene	Diesel & gasoline	Firewood purchased	Firewood collected	Dung cake	Coal & charcoal	Other forms of biomass	All energy
All households											
1	3.4	0.30	0.08	0.43	0.14	0.98	1.8	0.46	0.02	0.90	8.8
2	3.6	0.36	0.15	0.37	0.34	1.13	1.5	0.45	0.02	0.65	8.8
3	3.7	0.48	0.22	0.31	0.55	1.15	1.3	0.43	0.01	0.43	8.8
4	4.0	0.71	0.34	0.25	1.1	0.81	1.0	0.29	0.01	0.32	9.0
5	4.2	0.99	0.39	0.09	3.8	0.43	0.47	0.12	0.01	0.13	11
All	3.9	0.71	0.30	0.22	2.0	0.76	0.97	0.28	0.01	0.35	9.7
Urban households											
1	4.7	1.3	0.14	0.11	0.21	1.8	0.35	0.32	0.00	0.41	9.5
2	4.9	1.4	0.16	0.18	0.34	1.6	0.23	0.15	0.00	0.15	9.3
3	4.8	1.5	0.24	0.11	0.54	1.1	0.19	0.12	0.00	0.12	9.0
4	4.9	1.7	0.29	0.13	1.1	0.72	0.07	0.08	0.00	0.05	9.2
5	4.6	1.5	0.29	0.02	4.3	0.14	0.02	0.02	0.00	0.01	11
All	4.7	1.5	0.27	0.06	3.0	0.49	0.07	0.06	0.00	0.05	10
Rural households											
1	3.1	0.08	0.06	0.49	0.13	0.82	2.2	0.49	0.03	1.0	8.6
2	3.2	0.09	0.14	0.42	0.35	1.0	1.9	0.53	0.02	0.78	8.6
3	3.3	0.07	0.21	0.39	0.55	1.2	1.7	0.55	0.02	0.55	8.8
4	3.4	0.14	0.36	0.32	1.2	0.87	1.5	0.41	0.02	0.47	9.0
5	3.5	0.16	0.57	0.20	2.9	0.92	1.2	0.31	0.03	0.33	10
All	3.4	0.11	0.31	0.34	1.2	0.96	1.6	0.44	0.02	0.57	9.2

Source: Authors' calculations.

same, so a direct comparison can be made between these two groups. The share of electricity is substantially higher in the urban households, while the shares of collected firewood, dung cake, and other forms of biomass are markedly lower. The share of kerosene is higher in rural areas. Although rural households consumed on average only 2.6 liters of kerosene per month compared to 4.2 liters among urban households, the rural access rate was nearly triple the urban (appendix tables C.4 and C.5). The quantity of kerosene used for lighting is generally much smaller than that used for cooking, and the quantities consumed in Pakistan are more representative of kerosene used as a lighting source.

Table 11 Average Total Nominal Expenditure in Rupees by Quintile in Pakistan, 2001–02 and 2004–05

	2001–02		2004–05	
Quintile	Urban	Rural	Urban	Rural
1	4,010	3,766	5,617	5,044
2	5,199	4,775	6,715	6,360
3	6,155	5,340	7,971	7,257
4	7,176	6,153	9,875	8,476
5	11,723	7,911	17,239	11,877
All	8,611	5,581	12,126	7,716

Source: Authors' calculations.

Indeed, appendix table C.6 shows that 81 percent of urban kerosene-users in the third quintile and 86 percent of rural users in the fourth quintile did not have access to electricity. The share of LPG is the same for the two groups, despite the much higher share of natural gas in the urban quintiles. This is because rural households, even in the fourth quintile, do not generally use LPG—their access rate, at 10 percent, was not much higher than the urban access rate of 8 percent in the third quintile, and the monthly urban consumption was higher (7.9 kilograms) than rural (5.9 kilograms). As in Indonesia, the share of gasoline and diesel is higher in the rural quintile at the same total expenditure level. Further insight into these figures can be obtained from looking at the access rates and average expenditure by users on electricity and on gasoline and diesel, as given in appendix tables C.7 and C.8. At similar income levels, the access rate for electricity is higher in urban quintile 3 than in rural quintile 4, and the expenditure per user household is also higher. By contrast, the access rate for gasoline and diesel is the same for the two groups, but the expenditure per rural user household is double that of the urban quintiles. This suggests that, at similar incomes, rural households that own a motorcycle or a car travel longer distances than their urban counterparts.

In 2004–05, direct comparisons between quintile groups are not exact. For example, the urban quintile 3 total expenditure falls between those of rural quintiles 3 and 4. Access and expenditure by users on electricity for urban quintile 3 are higher than for rural quintile 4, confirming that urban households at the same income tend to spend more on electricity. Similarly, although the access rate for gasoline and diesel for urban quintile 3 lies between those for rural quintiles 3 and 4, the expenditure per user household is actually lower for urban quintile 3 than for rural quintile 3, which supports the finding that rural households with similar income spend more on gasoline and diesel than urban households.

Quantity and price information (computed for purchased energy or imputed for freely available energy) was collected on the basis required for decomposition analysis for kerosene, LPG, coal, firewood (both purchased and collected), dung cake, charcoal, other forms of biomass, and natural gas. For collected firewood, dung cake, and other biomass, the survey imputed prices to arrive at an equivalent expenditure on these fuels. Questions about quantities purchased were not asked about natural gas and electricity. For natural gas, the tariff structure during each survey period was used to estimate the quantities consumed. For electricity, a previous study showed that there was considerable diversion of electricity to those not formally connected to grid power (Kojima 2006). Because there are complications with prices paid when there is a rising block tariff structure and several households are jointly paying for electricity, no attempt was made to estimate the quantities consumed. While expenditures on gasoline and diesel were obtained, the surveys combined the two fuels. Because their price differences were large, these fuels were not included in the decomposition analysis.

The decomposition variables, then, are kerosene, LPG, purchased firewood, collected firewood, dung cake, other forms of biomass, and natural gas. As with the Indonesian data, the weighted prices and total expenditures were converted into constant prices using the CPI deflator and expressed in January 2001 rupees. Between the two survey periods, the CPI increased by 20 percent. Total real expenditure by urban and rural households increased by 17 and 15 percent, respectively.[6] For the fuels used in the decomposition analysis, table 12 provides information from the two surveys on the average real energy price, the monthly quantity purchased by those using the fuel, and the access rate for all urban and rural households. Examination of the data did not reveal large differences for the average price paid among the quintiles. However, the quantities purchased and access rates did vary among the quintiles (see appendix tables C.4 and C.5).

The price changes for commercial fuels (kerosene, LPG, purchased firewood, and natural gas) were similar between the urban and rural groups, but the imputed price of collected firewood increased in rural areas while it fell in urban areas. The real price of kerosene rose the most followed by that of LPG; the price of natural gas fell slightly. The price of other forms of biomass fell more in rural areas than in urban. Given that rural inflation may have been higher, the actual price decline in rural areas could be even greater.

[6] Because rural inflation may have been higher than urban inflation, which forms the basis for the national CPI, the rural income increase may be overestimated.

TABLE 12 CHANGES IN DECOMPOSITION VARIABLES BETWEEN THE TWO SURVEYS IN PAKISTAN

Parameter	Year	Kerosene	LPG	Purchased firewood	Collected firewood	Dung cake	Other forms of biomass	Natural gas
Urban households								
Real price	2001	18	30	1.5	1.4	1.1	1.0	85
	2004	22	33	1.4	1.3	1.1	0.9	83
	% increase	22	11	–7.3	–8.7	1.5	–11	–2.0
Quantity	2001	5.6	9.2	110	133	94	115	2.8
	2004	3.2	11.3	152	151	90	130	2.7
	% increase	–43	23	39	14	–4.9	13	–1.1
Access	2001	14	8.0	20	6.9	8.8	5.2	62
	2004	8.7	7.0	22	3.7	5.8	4.7	66
	Increase in %	–4.9	–0.9	3.1	–3.2	–2.9	–0.4	4.4
Rural households								
Real price	2001	19	31	1.5	1.3	1.0	0.9	84
	2004	23	34	1.4	1.3	1.0	0.7	82
	% increase	22	12	–6.5	5.2	–0.6	–21	–2.7
Quantity	2001	2.7	6.7	114	154	102	147	2.7
	2004	2.3	6.8	148	166	84	166	2.6
	% increase	–14	2.1	30	7.9	–18	13	–4.3
Access	2001	49	8.0	22	52	40	34	3.4
	2004	41	8.5	29	46	32	30	3.4
	Increase in %	–8.6	0.5	6.6	–5.7	–7.9	–3.9	0.0

Source: Authors' calculations.

Note: Real prices are in January 2001 rupees. Units for prices are rupees per kilogram, except for kerosene (rupees per liter) and natural gas (rupees per million British thermal units). Quantities are per household purchasing the fuel and measured in kilograms, liters, or million British thermal units as for the price data. Access rates are in percentages of all households. "Increase in %" is increase in percentage points.

Table 13 compares the increases in the real prices in local currency paid for LPG and kerosene with the average real prices of these products on the international market expressed in local currency between the periods of the surveys. For LPG, the price paid in local currency rose by more than the international price, meaning that the pass-through was greater than unity; for kerosene, the local price increased by less than the international price. For both fuels, the price paid was markedly above the international price, reflecting transport costs and taxes. Unlike in Indonesia, the costs of using LPG or kerosene for cooking and heating

Table 13 Real Prices Paid and Real International Prices for Petroleum Products in Pakistan, 2001–02 and 2004–05

Parameter	LPG	Kerosene
	PRs/kg	**PRs/liter**
Average real price paid in 2001–02	30.3	18.4
International real price in 2001–02	15.9	10.2
Average real price paid in 2004–05	33.5	22.5
International real price in 2004–05	19.5	17.4
Percentage increase in real prices paid	10.6	22.3
Percentage increase in real international price	22.4	70.8
Pass-through coefficient	1.3	0.81
	US$/kg	**US$/liter**
Nominal price paid in 2001–02	0.50	0.30
International price in 2001–02	0.26	0.17
Nominal price paid in 2004–05	0.69	0.47
International price in 2004–05	0.40	0.36

Source: Authors calculations.

Note: The international price for LPG is the average of Saudi Aramco contract prices for propane and butane, and the price for kerosene is the Persian Gulf price, both on a free-on-board basis net of tax and transport costs. The pass-through coefficients are as defined by Kojima (2009).

water, when normalized for usable energy, were broadly comparable in Pakistan in both survey years—that is, there would have been little, if any, operating cost advantage in using kerosene for cooking, whereas LPG has the advantage of being clean. One cost disadvantage that LPG has is the upfront cost of uptake, namely the purchase of a gas cook stove, which can be more expensive than a kerosene stove, and of a cylinder for which there is no kerosene equivalent. The prices paid in 2004–05 in Pakistan for LPG and for kerosene were substantially higher than those paid in Indonesia during 2005; this may partly explain why consumption by users was so much larger in Indonesia.

The quantities purchased by those using the various fuels showed declines for kerosene, natural gas, and dung cake in both urban and rural areas. The quantity purchased of LPG, firewood (both purchased and collected), and other forms of biomass increased in both areas. An interesting contrast is between LPG, where consumption per user household rose in the fourth and fifth quintiles in both urban and rural areas despite rising prices, and natural gas, where consumption per user household declined in urban quintiles 2 to 4 despite falling prices. This finding should be interpreted in light of the fact that access to natural gas increased in every urban quintile, while access to LPG declined in the top quintile—the highest consumption group—in both urban and rural

areas. Many of those households that continued to consume LPG appear to be using it as their primary cooking fuel, which would explain their relatively high consumption. Analysis of the top quintiles showed that 57 and 19 percent, respectively, of urban and rural LPG-using households did not use any other type of cooking fuel in 2004–05.

The access rates indicate a sharp divergence between urban and rural households. For urban households, the access rate for natural gas was high and increased slightly during the period. The access rate was low and remained static in rural areas; but with essentially no natural gas infrastructure available in rural areas, no informative conclusions can be drawn from this observation. The access rate of kerosene was high in rural areas and much lower in urban areas, but declined in both. In both survey years, the proportion of households using kerosene that did not have access to electricity was very high in rural areas (between 80 and 90 percent in all quintiles); in urban areas, the proportion was substantially lower, especially in the top two quintiles (appendix table C.6). The access rate for purchased firewood was about 20 percent in urban areas, slightly higher in rural areas, and increased in both. Predictably, collected firewood had a much higher access rate in rural areas than in urban, as did dung cake and other forms of biomass, but access to all three declined in both areas. The access rate for LPG was low in both urban and rural areas—but for quite different reasons—and did not change markedly between the two surveys. The low access rate in urban areas is primarily due to the fact that those who use natural gas would typically not use LPG. Among urban households, 45 percent of those that used LPG used no other fuel. In rural areas, about 85 percent of households that used LPG also used some form of biomass.

The contributions of these different factors are brought together through the decomposition analysis. The results for each urban (table 14) and rural (table 15) quintile are given. The results for the aggregate of all households, combining the two groups, are shown in appendix table C.9.

For *all fuels*, in both urban and rural areas, the expenditure effect was negative, since total real expenditure rose in every quintile, reducing the magnitude of the share of expenditure on the fuel had prices, quantities, and access remained constant. In virtually every quintile, the direction of the access effect largely explained the direction of the change in the expenditure share: where there were substantial changes in the expenditure share the change in the access share was also large, and—with the notable exception of natural gas in urban areas—where access rose, the expenditure share rose, and where access fell, the expenditure share fell.

Table 14 Decomposition of Changes in the Share of Urban Quintile Expenditures on Fuels between 2001–02 and 2004–05 in Pakistan

Quintile	Decomposition effect	Kerosene	LPG	Firewood purchased	Firewood collected	Dung cake	Other forms of biomass	Natural gas
1	Total	–0.12	0.02	0.40	–0.15	–0.33	–0.36	0.16
	Price	0.03	0.02	–0.15	–0.03	0.03	0.02	–0.06
	Quantity	–0.08	–0.07	0.50	0.06	–0.03	–0.05	0.12
	Access	–0.05	0.09	0.29	–0.11	–0.26	–0.24	0.29
	Expenditure	–0.02	–0.02	–0.24	–0.06	–0.07	–0.09	–0.19
2	Total	–0.16	0.03	0.38	–0.28	–0.23	0.00	–0.44
	Price	0.05	0.02	–0.04	–0.01	–0.01	–0.06	–0.12
	Quantity	–0.08	0.01	0.34	–0.01	–0.09	0.04	–0.38
	Access	–0.11	0.01	0.18	–0.24	–0.11	0.03	0.18
	Expenditure	–0.02	–0.01	–0.10	–0.03	–0.02	–0.01	–0.11
3	Total	–0.12	–0.07	0.26	–0.11	–0.08	–0.03	–0.20
	Price	0.03	0.03	–0.08	–0.03	0.00	–0.02	–0.07
	Quantity	–0.08	–0.05	0.28	0.08	0.00	0.03	–0.13
	Access	–0.05	–0.03	0.14	–0.14	–0.08	–0.03	0.11
	Expenditure	–0.01	–0.02	–0.07	–0.02	–0.01	–0.01	–0.12
4	Total	–0.11	0.02	0.21	–0.08	–0.03	0.00	–0.47
	Price	0.04	0.03	–0.05	–0.01	0.00	–0.01	–0.10
	Quantity	–0.08	0.02	0.20	0.02	0.00	0.01	–0.15
	Access	–0.05	0.02	0.15	–0.07	–0.01	0.00	0.03
	Expenditure	–0.02	–0.04	–0.08	–0.01	–0.01	–0.01	–0.26
5	Total	–0.09	0.01	0.02	–0.05	–0.01	0.01	–0.10
	Price	0.01	0.03	–0.01	0.00	0.00	0.00	0.00
	Quantity	–0.04	0.11	0.06	0.00	0.00	0.01	0.08
	Access	–0.04	–0.07	–0.01	–0.04	–0.01	0.00	0.13
	Expenditure	–0.01	–0.06	–0.03	–0.01	0.00	0.00	–0.31
All	Total	–0.10	0.01	0.10	–0.08	–0.05	–0.01	–0.20
	Price	0.02	0.03	–0.03	–0.01	0.00	–0.01	–0.03
	Quantity	–0.06	0.06	0.14	0.01	0.00	0.01	–0.02
	Access	–0.05	–0.03	0.06	–0.07	–0.03	–0.01	0.11
	Expenditure	–0.02	–0.04	–0.07	–0.02	–0.01	–0.01	–0.26

Source: Authors' calculations.

Table 15 Decomposition of Changes in the Share of Rural Quintile Expenditures on Fuels between 2001–02 and 2004–05 in Pakistan

Quintile	Decomposition effect	Kerosene	LPG	Firewood purchased	Firewood collected	Dung cake	Other forms of biomass	Natural gas
1	Total	0.05	0.03	0.28	0.18	–0.73	–0.65	–0.03
	Price	0.09	0.01	0.00	0.39	0.03	–0.35	–0.01
	Quantity	0.04	–0.01	0.06	0.00	–0.25	0.09	–0.04
	Access	–0.03	0.04	0.29	0.02	–0.43	–0.25	0.02
	Expenditure	–0.05	–0.01	–0.07	–0.22	–0.09	–0.14	–0.01
2	Total	–0.01	0.07	0.35	–0.24	–0.36	–0.26	–0.02
	Price	0.08	0.02	–0.08	0.15	0.01	–0.20	–0.01
	Quantity	0.00	0.00	0.24	0.00	–0.13	0.16	–0.02
	Access	–0.05	0.07	0.27	–0.20	–0.17	–0.13	0.01
	Expenditure	–0.04	–0.01	–0.08	–0.20	–0.07	–0.09	–0.01
3	Total	–0.03	0.03	0.44	–0.41	–0.26	–0.26	–0.07
	Price	0.07	0.02	–0.07	0.11	–0.04	–0.12	0.00
	Quantity	0.00	0.00	0.28	0.03	–0.07	0.03	0.00
	Access	–0.05	0.03	0.34	–0.32	–0.07	–0.09	–0.05
	Expenditure	–0.05	–0.02	–0.11	–0.23	–0.08	–0.08	–0.01
4	Total	–0.09	0.05	0.01	–0.32	–0.31	–0.15	0.01
	Price	0.07	0.03	–0.09	–0.05	0.01	–0.20	0.00
	Quantity	0.00	0.06	0.15	0.17	–0.13	0.18	0.01
	Access	–0.11	0.01	0.07	–0.21	–0.12	–0.06	0.03
	Expenditure	–0.05	–0.04	–0.12	–0.23	–0.07	–0.07	–0.02
5	Total	–0.32	–0.07	0.28	–0.17	–0.18	–0.17	–0.03
	Price	0.08	0.07	–0.02	0.00	–0.02	–0.05	0.00
	Quantity	–0.19	0.07	0.33	0.39	–0.07	–0.03	0.00
	Access	–0.14	–0.06	0.15	–0.27	–0.01	0.01	0.00
	Expenditure	–0.07	–0.13	–0.17	–0.29	–0.09	–0.09	–0.04
All	Total	–0.11	0.02	0.26	–0.22	–0.33	–0.26	–0.03
	Price	0.08	0.03	–0.06	0.09	0.00	–0.16	0.00
	Quantity	–0.06	0.01	0.22	0.13	–0.11	0.08	–0.01
	Access	–0.08	0.02	0.21	–0.20	–0.13	–0.08	0.00
	Expenditure	–0.05	–0.04	–0.11	–0.24	–0.08	–0.09	–0.02

Source: Authors' calculations.

The price effect is related to the change in the average prices paid; for *kerosene* and *LPG*, these increased in both urban and rural areas, resulting in positive price effects. The price of *firewood*, both purchased and collected, fell in urban areas; that of purchased firewood fell in rural areas. However, the price of collected firewood actually rose for the lowest rural quintiles. For *dung cake*, there was no significant change in prices, but for *other forms biomass*, the price fell, producing a substantial negative effect on rural expenditures.

The direction and magnitude of the quantity effect is of considerable interest in understanding household expenditure patterns. In general, it would be expected that the quantity effect would be in the opposite direction of the price effect, and this was found to be the case for the majority of fuels for most quintiles and in both urban and rural areas. The most striking exception to this was the case of *natural gas* for urban households: with the exception of the lowest quintile, the share fell even though prices also fell. At the same time, the access effect indicated that in every quintile more households were using gas at the time of the second survey. A possible reconciliation of these findings is that the lower price of gas induced more households to use it, but that the average usage of these new users was lower than that of earlier users, thus bringing down the group average for all.

In the case of *kerosene*, where expenditure share fell in all groups, not only did the quantity purchased by users fall, but the proportion of users also fell, indicating a switch away from this source of energy in both urban and rural areas. At the same time, the proportion of users for purchased firewood increased and the quantity purchased per user also increased, indicating a switch toward this source of energy. For collected firewood, the proportion of users fell, but the average quantity consumed per user increased, suggesting that those who had been marginal users were the ones who switched away, resulting in higher average consumption for those who continued to use this source.

Conclusions

The surveys of household expenditures confirmed the importance of energy in the household budget. In Indonesia, the share of expenditure on energy for all income groups was about 7 percent in 2002 and 8 percent in 2005. In Pakistan, the shares were about 9 percent in 2001–02 and 10 percent in 2004–05. These results suggest that large energy price increases would bear heavily on all households.

The share of electricity was high in both Indonesia and Pakistan, and higher than any other form of energy in every quintile in Pakistan. In Indonesia, the share of electricity increased markedly between the two surveys, even though the access rate was already very high in urban areas at the time of the first survey. As expected, the share of automotive fuels rose steeply with increasing quintile in both countries. Firewood and other forms of biomass were widely consumed by low-income households, but their relative importance generally declined over time.

Comparing rural and urban households at the same quintile level revealed large differences in the pattern of energy use, even though the shares of expenditure on energy and the general level of household income were not very different. Urban households devoted more of their budget to modern forms of energy (petroleum products, electricity, and natural gas where available), while rural households devoted a larger share to biomass. A limited analysis of household groups at similar income levels showed that rural households as a group allocated a higher share of expenditure to automotive fuels. In Indonesia, this is explained largely by a higher access rate in rural areas; in Pakistan, the quantity per user household is higher. At similar income levels, expenditure on electricity was higher in urban areas, while expenditure on firewood and other forms of biomass was higher in rural areas. Kerosene had different expenditure shares in Indonesia and Pakistan—in the former, the share was higher in the urban quintile; in the latter, it was higher in the corresponding rural quintile.

The analysis of successive expenditure surveys for Indonesia and Pakistan indicates that, even within a three-year gap between the surveys, the patterns of expenditure on different sources of energy can change substantially. For example, the highest urban quintile in Pakistan increased the share of its expenditure on gasoline and diesel

by nearly 2 percentage points. In Indonesia, all quintiles increased their share of expenditure on electricity by more than 1 percentage point. This suggests that, for reliable analysis of the importance of energy in the total household budget, up-to-date information is vital.

For the bottom two quintiles nationally, the largest effect on the change in the percentage share of purchased energy was the electricity tariff increase in Indonesia (price effect in appendix table C.3) and access to purchased firewood in Pakistan (access effect in appendix table C.9). Among purchased fuels examined in Pakistan, the price effect was highest for kerosene, but was offset entirely by increasing income and decreasing access.

The decomposition analysis enables detailed disaggregation of various factors affecting the share of household expenditure on energy sources. Because they are additive, the relative effects of different factors can be readily expressed and compared. The impacts of the exogenous factors—real prices and real household total expenditure—are predictable in their direction. With no other changes, an increase in prices increases the expenditure share on the fuel, while an increase in total household expenditure reduces the share of expenditure on a fuel. Changes in the quantity consumed by those with access, and in the numbers with access, depend on the economic reactions of the individual households to changing circumstances. There are four possible permutations of these changes, all of which are observed in this paper.

1. *Access increases and the quantity purchased by users increases.* This pattern was the case for purchased firewood in Pakistan. It suggests that the fuel was becoming more attractive to all households, and that if new users consumed less than existing users, the difference is made up by existing users increasing their consumption.
2. *Access increases and the quantity purchased by users decreases.* An example is natural gas in urban areas of Pakistan. It suggests that, although the fuel was more attractive, new users appeared to consume considerably less than existing users, thus bringing down average consumption.
3. *Access decreases and the quantity consumed by users decreases.* This pattern was found for LPG in Indonesia. Not only did some households stop consuming the fuel—probably those using lesser amounts—but those still using the fuel reduced consumption sufficiently to bring the average quantity down.
4. *Access decreases and the quantity consumed by users increases.* This pattern was exhibited by urban households using collected firewood in Pakistan; it suggests that those households using the least of this

fuel stopped using it, increasing the average quantity for those still using it.

These results indicate that, in order to understand energy use patterns and their changes over time, insights regarding the decisions on whether and how much (if at all) to consume a fuel are needed. Where increases in demand are likely to be dominated by increasing access, rather than by increasing consumption by users, the challenge for energy suppliers will be to facilitate access.

Changes in access and quantity can be linked, although not in a formal statistical fashion, to changes in real prices and real expenditure. For example, the share of urban expenditure on gasoline in Indonesia increased for all but the lowest quintile, despite a rise in real total expenditure, because the access effect outweighed the negative effect on quantities that could have been brought about in part by the higher real price of gasoline.[1] It is likely that the increasing access was driven by the higher level of income (reflected in the increased real total expenditure effect), since it was unlikely to have been stimulated by the higher real price. Increasing access could also be encouraged by an increase in the real prices of alternative activities (such as public transport).

The methods of analysis presented in this paper could be extended to other commodities or to changes in energy use patterns over longer periods of time, when suitable household expenditure surveys are available. In particular, where household surveys covering the period of high oil prices become available, the analysis of household patterns of fuel use and responses to changes in energy prices will be valuable. The availability of evidence on the use of energy by various household groups will be important for considerations of providing targeted support to low-income households at times of unexpected shocks to energy prices.

[1] It is also possible that the income elasticity of demand was greater than unity so the rise in real total expenditure itself helped generate a rising expenditure share.

Appendix A: The Decomposition of Changes in Expenditure Shares

Group expenditure shares (defined as the ratio of mean expenditure on a good to mean total expenditure for the group) can be written according to identity 1 (see p. 8). Consider two time periods, 0 and 1, with index j. The identity at time 0 can be written in the compact form

$$W(0) \equiv Q(0) \times P(0) \times N(0) / Y(0)$$

while at time 1 it can be written as

$$W(1) \equiv Q(1) \times P(1) \times N(1) / Y(1)$$

where $W(j)$ is the group budget share at time j,

$Q(j)$ is the group average quantity purchased at time j by those with access,

$P(j)$ is the group average price paid per unit at time j,

$N(j)$ is the proportion of the group with access at time j,

$Y(j)$ is the group average total expenditure at time j.

The change in budget share between the two periods can be related to the sum of effects linked to changes in each of the factors, labeled as Q_{eff}, and so on.

$$W(1) - W(0) \equiv Q_{eff} + P_{eff} + N_{eff} + Y_{eff}$$

The effects can be calculated using the logarithmic mean Divisia index:

$$Q_{eff} = [W(1) - W(0)] \times \{\log[Q(1)/Q(0)]/\log[W(1)/W(0)]\}$$

Other effects are calculated using similar formulas. For small percentage changes in the variables, each of the four effects can be approximated by the initial budget share multiplied by the fractional change in the variable.

If the democratic budget share $[\Sigma(e_i/y_i)]$, rather than the plutocratic budget share $[(\Sigma e_i)/(\Sigma y_i)]$, is used for analysis, a similar decomposition cannot be carried out.

Appendix B: Survey Descriptions

Indonesia Household Expenditure Surveys

The data for this paper are from the National Socioeconomic Survey conducted by BPS-Statistics Indonesia, a government institution responsible for collecting and disseminating public statistics. These large-scale multimodule surveys were initiated in the 1960s and are conducted annually.

This paper uses data from the consumption module surveys for 2002 and 2005. While the (larger) full consumption module survey for 2002 was used, only the (smaller) panel consumption module for 2005 was used since the full module was not available. The sample size for the 2002 survey was 63,189 households, 55 percent of which were in rural areas. The 2005 survey comprised a sample of 9,925 households, of which 57 percent were in rural areas. The total population of Indonesia in 2002 and 2005 was 212 million and 220 million, respectively. The proportion of the population living in rural areas in these years was 56 and 52 percent, respectively (World Bank 2009). Tables B.1 and B.2 show the number of households in the survey and in the population by quintile (quintile 1 representing the lowest-income group and quintile 5 the highest) for the two survey years. In the analysis used here, the sample households were weighted to match the population distribution.

The two surveys provided data on household-level consumption (quantity as well as amount paid) of LPG, kerosene, city (natural) gas, motor vehicle diesel, motor vehicle gasoline, coal/briquette, and electricity. The quantity of household consumption for firewood was not specified; firewood includes fuels not included in other categories and contains imputed values when the wood was collected or received in kind. Expenditure and quantity data for kerosene, gasoline, and diesel used for generators were reported in 2002, but not in 2005.

Total household expenditure as provided by the data set included high-cost durables and the value of food consumed in kind. The analysis in this paper excludes large expenditure items such as furniture;

TABLE B.1 NUMBER OF HOUSEHOLDS IN POPULATION AND IN SURVEY SAMPLE IN INDONESIA, 2002

	Population			Sample size		
Quintile	Rural	Urban	Total	Rural	Urban	Total
1	7,135,842	1,292,831	8,428,673	8,763	1,459	10,222
2	6,971,171	2,435,727	9,406,898	8,309	2,764	11,073
3	6,490,606	3,618,920	10,109,526	7,786	4,197	11,983
4	5,226,542	5,419,356	10,645,898	6,458	6,791	13,249
5	2,779,136	8,954,454	11,733,590	3,541	13,121	16,662
All	28,603,297	21,721,288	50,324,585	34,857	28,332	63,189

Sources: National Socioeconomic Survey and authors' calculations.

TABLE B.2 NUMBER OF HOUSEHOLDS IN POPULATION AND IN SURVEY SAMPLE IN INDONESIA, 2005

	Population			Sample size		
Quintile	Rural	Urban	Total	Rural	Urban	Total
1	7,226,540	1,286,827	8,513,367	1,437	239	1,676
2	7,201,263	2,450,041	9,651,304	1,348	418	1,766
3	6,376,747	4,095,174	10,471,921	1,205	739	1,944
4	5,205,461	5,799,124	11,004,585	1,043	1,096	2,139
5	2,933,365	9,240,124	12,173,489	596	1,804	2,400
All	28,943,376	22,871,290	51,814,666	5,629	4,296	9,925

Sources: National Socioeconomic Survey and authors' calculations.

household appliances including refrigerators, air-conditioning units, washing machines, televisions, and DVD players; expensive jewelry; vehicles and their major repairs; and major ceremonies such as weddings and funerals. These large expenditure items—which comprised about 3 percent of total household expenditure on average—were removed to avoid misrepresentation of households in the respective income quintiles at times when they had just purchased a large durable item. However, the value of in-kind food was included in the total expenditure estimate since it comprised a sizeable proportion in the budgets of rural households (12.4 percent in 2002 and 11.1 percent in 2005) compared to urban households (3.6 percent in 2002 and 3.1 percent in 2005).

For the survey outliers in energy consumption, data were removed in two steps. The first step involved removal of households whose LPG, kerosene, gasoline, or electricity consumption levels were very different from what could be considered reasonable based on the level of consumption of other households in the survey. The next step involved

removing those households that seem to have paid prices that were far from the average price paid. Overall, this procedure removed a total of 1,216 households from the 2002 survey and 650 households from the 2005 survey.

The household weights provided in the original data set reflected the entire population of Indonesia including conflict zones such as East Papua/East Timor. Therefore, an alternative set of weights, provided by the World Bank Jakarta office, was used that reflected the population of the area in which the survey was conducted.

To convert current values to real values, prices were deflated using the CPI. The value of the CPI in July 2002 was 100. It rose 22 percent between the two survey periods, averaging 97.8 and 119.1 for the three months of the survey (January through March) in 2002 and 2005, respectively.

Pakistan Household Expenditure Surveys

The first set of data for Pakistan was taken from the 2001–02 Household Integrated Economic Survey, conducted by the Federal Bureau of Statistics of the government of Pakistan. Most of the fieldwork for this survey was conducted in the 2001 calendar year, with a few interviews held in January and April 2002. The sample size was 15,692 households,[1] out of which about 63 percent were in rural areas. The total population of Pakistan in 2001 and 2002 was 141 million and 145 million, respectively; the proportion of the population living in rural areas in these years was 65 percent (World Bank 2009).

The second set of data for Pakistan was taken from the 2004–05 Household Integrated Economic Survey, also conducted by the Federal Bureau of Statistics. The fieldwork for this survey was conducted between July 2004 and June 2005, with the bulk carried out between September and May. The sample size was 14,700 households,[2] of which about 61 percent were in rural areas. The actual population of Pakistan in 2004 and 2005 was 152 million and 156 million, respectively, while the proportion of

[1] Overall, 16,238 households were interviewed. The cleaned data set used here contained observations from 15,692 households, since it was necessary to drop 546 households from the analysis for which there was no information on fuel expenditures, food expenditures, other nonfood expenditures, or household size.

[2] Overall, 14,744 households were interviewed; 44 households were removed from the analysis because data were missing for these on either food expenditures, fuel expenditures, or other non-food expenditures or household size.

the population living in rural areas in these years was 65 percent (World Bank 2009). Tables B.3 and B.4 show the number of households in the survey and in the population, by quintile, for the two survey years. In the analysis used here, the sample households were weighted to match the population distribution. The surveys cover Pakistan's four provinces and three federally administered territories.

Data on household-level consumption (quantity as well as amount paid) of LPG, kerosene, coal, firewood, dung cake, charcoal, and other forms of biomass were available. The quantities of firewood, dung cake, and other forms of biomass that were either collected or received in kind were also available, as were the imputed values of all these fuels that were collected or received in kind. For electricity, diesel and gasoline, and natural gas, the quantity consumed was not specified. The quantity of natural gas consumed was imputed from the expenditure data using the tariff structure in effect during the period of each survey.

TABLE B.3 NUMBER OF HOUSEHOLDS IN POPULATION AND IN SURVEY SAMPLE IN PAKISTAN, 2001–02

	Population			Sample size		
Quintile	Rural	Urban	Total	Rural	Urban	Total
1	2,524,637	411,507	2,936,144	1,702	439	2,141
2	2,663,392	544,140	3,207,532	2,031	638	2,669
3	2,745,815	784,834	3,530,649	2,167	912	3,079
4	2,696,901	1,196,229	3,893,130	2,061	1,235	3,296
5	2,507,858	2,375,705	4,883,563	1,890	2,617	4,507
All	13,138,603	5,312,415	18,451,018	9,851	5,841	15,692

Sources: Household Integrated Economic Survey and authors' calculations.

TABLE B.4 NUMBER OF HOUSEHOLDS IN POPULATION AND IN SURVEY SAMPLE IN PAKISTAN, 2004–05

	Population			Sample size		
Quintile	Rural	Urban	Total	Rural	Urban	Total
1	2,517,639	473,981	2,991,620	1,665	523	2,188
2	2,720,450	676,981	3,397,431	1,919	727	2,646
3	2,743,280	980,918	3,724,198	1,951	993	2,944
4	2,750,563	1,362,342	4,112,905	1,885	1,285	3,170
5	2,304,704	2,717,310	5,022,014	1,474	2,278	3,752
All	13,036,636	6,211,532	19,248,168	8,894	5,806	14,700

Sources: Household Integrated Economic Survey and authors' calculations.

Total household expenditure as provided by the original data set included large expenditure items. As with the Indonesia surveys, these items—which accounted for a little less than 4 percent of total household expenditure on an average—were removed to avoid misrepresentation of households in the respective income quintiles. Again, it was decided to retain the value of in-kind food in the total expenditure estimate, since it made up a sizeable proportion of the budgets of rural households (15.8 percent) compared to urban (3.7 percent).

The data sets were examined for the presence of any outliers in energy consumption data, using the same procedure as for the Indonesia data. A total of 103 households from the 2001–02 data set because they had reported implicit prices greater than 60 rupees per kilogram for LPG or greater than 25 rupees per liter for kerosene; no outliers were identified in the 2004–05 data set.

To calculate real energy prices and real household expenditure, the CPI set at 100 as of January 2000 was used to scale household data depending on the month in which they were collected. The first survey started in January 2001, when the index was 100.2, and finished in April 2002, when the index had reached 105.1. The second survey started in July 2004, when the index was at 117.6, and finished in June 2005, when the index was 126.1. The price index therefore increased by about 20 percent between the two periods. As noted in the main text of this paper, because rural inflation may have been higher than urban, the results presented here may overestimate real prices and expenditures in rural areas.

Appendix C: Additional Data

Table C.1 Quantities and Access of Urban Households in Indonesia

Quintile	Electricity	LPG	Kerosene	Gasoline
	Quantities 2002			
	kWh	kg	Liter	Liter
1	49	13	17	17
2	63	14	21	18
3	76	13	23	23
4	93	14	25	27
5	138	15	23	43
	Quantities 2005			
	kWh	kg	Liter	Liter
1	54	12	16	19
2	61	n.a.	20	16
3	72	12	22	21
4	94	11	23	22
5	133	12	22	40
	Access 2002 (%)			
1	91	0	90	3
2	95	2	93	9
3	96	5	94	16
4	98	12	92	27
5	98	35	74	42
	Access 2005 (%)			
1	82	1	93	3
2	95	0	95	12
3	96	2	95	19
4	99	7	95	33
5	97	27	78	49

Source: Authors' calculations.

Note: kWh = kilowatt-hour; n.a. = not applicable. Quantities are monthly consumption per household averaged across those using electricity or the fuel in question in each expenditure category.

TABLE C.2 QUANTITIES AND ACCESS OF RURAL HOUSEHOLDS IN INDONESIA

Quintile	Electricity	LPG	Kerosene	Gasoline
	Quantities 2002			
	kWh	kg	Liter	Liter
1	39	11	8	13
2	47	11	11	17
3	53	13	13	20
4	64	12	16	24
5	81	14	18	33
	Quantities 2005			
	kWh	kg	Liter	Liter
1	39	15	8	13
2	49	10	11	18
3	58	10	13	18
4	70	11	16	22
5	89	12	18	30
	Access 2002 (%)			
1	68	1	89	3
2	76	1	91	8
3	81	2	92	13
4	85	4	93	20
5	88	11	91	34
	Access 2005 (%)			
1	67	0	88	5
2	80	0	89	13
3	87	1	91	19
4	88	4	91	28
5	86	11	84	38

Source: Authors' calculations.

Note: kWh = kilowatt-hour. Quantities are monthly consumption per household averaged across those using electricity or the fuel in question in each expenditure category.

Table C.3 Decomposition of Changes in the Share of All Quintile Expenditures on Electricity and Fuels between 2002 and 2005 in Indonesia

Quintile	Decomposition effect	Electricity	LPG	Kerosene	Gasoline
1	Total	0.95	–0.03	0.11	0.10
	Price	1.01	0.00	0.18	0.01
	Quantity	0.03	0.00	–0.05	–0.01
	Access	–0.08	–0.03	–0.01	0.10
	Expenditure	–0.01	0.00	–0.01	0.00
2	Total	1.26	–0.05	0.03	0.23
	Price	1.20	0.01	0.14	0.00
	Quantity	0.04	0.00	–0.01	0.00
	Access	0.09	–0.05	–0.03	0.24
	Expenditure	–0.07	0.00	–0.07	–0.02
3	Total	1.39	–0.04	–0.01	0.17
	Price	1.28	0.04	0.14	0.03
	Quantity	0.08	–0.02	–0.05	–0.10
	Access	0.12	–0.05	–0.01	0.28
	Expenditure	–0.09	0.00	–0.09	–0.03
4	Total	1.43	–0.05	–0.04	0.14
	Price	1.34	0.11	0.10	0.04
	Quantity	0.14	–0.05	–0.05	–0.18
	Access	0.07	–0.10	0.01	0.33
	Expenditure	–0.12	–0.01	–0.10	–0.05
5	Total	1.14	0.03	0.00	0.08
	Price	1.37	0.32	0.05	0.04
	Quantity	–0.05	–0.12	–0.02	–0.13
	Access	–0.04	–0.14	0.03	0.26
	Expenditure	–0.13	–0.03	–0.06	–0.09
All	Total	1.25	–0.01	0.00	0.14
	Price	1.29	0.16	0.10	0.03
	Quantity	0.03	–0.06	–0.03	–0.15
	Access	0.04	–0.10	0.00	0.31
	Expenditure	–0.11	–0.01	–0.08	–0.05

Source: Authors' calculations.

TABLE C.4 QUANTITIES AND ACCESS OF URBAN HOUSEHOLDS IN PAKISTAN

Quintile	Kerosene	LPG	Firewood purchased	Firewood collected	Dung cake	Other forms of biomass	Natural gas
	Quantities 2001–02						
	Liter	**kg**	**kg**	**kg**	**kg**	**kg**	**MMBTU**
1	2.2	9.1	94	113	86	145	2.0
2	4.4	5.1	116	140	112	121	2.7
3	4.2	7.9	114	137	89	111	2.5
4	7.1	8.4	120	119	93	87	2.8
5	7.3	10	98	146	95	72	2.8
	Quantities 2004–05						
	Liter	**kg**	**kg**	**kg**	**kg**	**kg**	**MMBTU**
1	1.4	5.3	130	130	80	132	2.2
2	3.2	5.5	149	138	76	159	2.1
3	2.5	6.5	151	187	91	139	2.3
4	4.7	8.9	166	141	94	107	2.6
5	3.3	15	158	154	111	112	3.0
	Access 2001–02 (%)						
1	22	2	36	13	28	23	28
2	21	4	35	13	16	6	41
3	18	8	29	10	13	8	50
4	13	7	20	6	7	4	63
5	9	10	9	4	3	1	75
	Access 2004–05 (%)						
1	16	4	44	10	0	15	35
2	13	5	40	7	0	8	46
3	13	7	34	6	0	6	53
4	10	8	26	3	0	4	64
5	4	8	9	2	0	2	82

Source: Authors' calculations.

Note: MMBTU = million British thermal units.

TABLE C.5 QUANTITIES AND ACCESS OF RURAL HOUSEHOLDS IN PAKISTAN

Quintile	Kerosene	LPG	Firewood purchased	Firewood collected	Dung cake	Other forms of biomass	Natural gas
	Quantities 2001–02						
	Liter	**kg**	**kg**	**kg**	**kg**	**kg**	**MMBTU**
1	1.8	3.8	100	147	105	148	2.7
2	2.2	4.2	103	160	99	147	2.5
3	2.3	4.8	114	160	104	144	2.4
4	2.6	5.9	122	153	101	142	2.6
5	4.7	8.4	120	150	102	158	3.1
	Quantities 2004–05						
	Liter	**kg**	**kg**	**kg**	**kg**	**kg**	**MMBTU**
1	2.0	2.9	110	147	77	159	1.8
2	2.2	4.1	138	160	83	176	2.0
3	2.3	4.7	153	163	94	150	2.4
4	2.6	7.0	144	169	80	198	2.8
5	2.7	9.3	183	201	86	146	3.1
	Access 2001–02 (%)						
1	48	1	14	45	43	47	2
2	49	3	20	52	41	37	2
3	50	7	22	55	38	33	4
4	51	10	27	54	41	29	3
5	47	20	28	51	35	26	6
	Access 2004–05 (%)						
1	45	3	22	46	25	39	2
2	44	5	28	47	32	32	3
3	44	8	32	47	34	29	2
4	38	10	30	47	33	27	4
5	31	18	34	41	34	26	6

Source: Authors' calculations.

Note: MMBTU = million British thermal units.

TABLE C.6 ACCESS TO KEROSENE BY HOUSEHOLDS THAT DO NOT HAVE ELECTRICITY IN 2001–02 AND 2004–05 IN PAKISTAN (PERCENTAGES)

Quintile	Urban	Rural	Total	Urban	Rural	Total
	2001–02			2004–05		
1	68	78	78	77	92	91
2	63	86	85	81	89	89
3	81	83	83	62	93	92
4	48	86	84	50	89	87
5	28	82	75	15	87	78
All	53	83	81	56	90	88

Source: Authors' calculations.

TABLE C.7 ACCESS TO ELECTRICITY AND TO GASOLINE AND DIESEL IN 2001–02 AND 2004–05 IN PAKISTAN (PERCENTAGES)

Quintile	Electricity			Gasoline and diesel		
	Urban	Rural	Total	Urban	Rural	Total
	2001–02					
1	85	57	61	11	6.3	7.0
2	92	67	71	10	7.1	7.6
3	97	69	75	12	9.0	9.7
4	97	73	80	16	12	13
5	97	81	89	32	21	27
All	96	69	77	22	11	14
	2004–05					
1	90	66	70	8.1	7.5	7.6
2	96	71	76	11	11	11
3	96	76	81	12	11	12
4	97	81	86	20	20	20
5	99	87	93	48	29	39
All	97	76	83	29	15	20

Source: Authors' calculations.

TABLE C.8 AVERAGE MONTHLY EXPENDITURE IN RUPEES BY USERS ON ELECTRICITY AND ON GASOLINE AND DIESEL IN 2001–02 AND 2004–05 IN PAKISTAN

Quintile	Electricity			Gasoline and diesel		
	Urban	Rural	Total	Urban	Rural	Total
			2001–02			
1	243	193	202	25	45	41
2	281	214	229	79	94	91
3	326	227	255	175	161	165
4	368	269	306	279	367	335
5	556	343	456	901	775	850
All	430	254	317	667	411	523
			2004–05			
1	291	239	249	146	85	95
2	345	288	302	208	199	201
3	401	315	342	346	351	349
4	496	362	413	547	509	522
5	806	483	668	1,550	1,211	1,437
All	588	341	435	1,236	629	918

Source: Authors' calculations.

TABLE C.9 DECOMPOSITION OF CHANGES IN THE SHARE OF ALL QUINTILE EXPENDITURES ON FUELS BETWEEN 2001–02 AND 2004–05 IN PAKISTAN

Quintile	Decomposition effect	Kerosene	LPG	Firewood purchased	Firewood collected	Dung cake	Other forms of biomass	Natural gas
1	Total	0.01	0.03	0.32	0.09	–0.68	–0.62	0.03
	Price	0.08	0.01	–0.02	0.32	0.03	–0.29	–0.01
	Quantity	0.02	–0.02	0.13	0.01	–0.22	0.07	–0.01
	Access	–0.04	0.05	0.31	–0.03	–0.41	–0.26	0.09
	Expenditure	–0.05	–0.01	–0.09	–0.21	–0.09	–0.14	–0.03
2	Total	–0.05	0.06	0.37	–0.29	–0.35	–0.23	–0.07
	Price	0.07	0.02	–0.07	0.12	0.00	–0.17	–0.03
	Quantity	–0.02	0.00	0.26	0.01	–0.12	0.14	–0.09
	Access	–0.06	0.06	0.27	–0.25	–0.17	–0.12	0.09
	Expenditure	–0.04	–0.01	–0.09	–0.16	–0.06	–0.07	–0.04
3	Total	–0.06	0.00	0.40	–0.39	–0.23	–0.21	–0.05
	Price	0.06	0.03	–0.07	0.07	–0.03	–0.09	–0.02
	Quantity	–0.02	–0.02	0.28	0.04	–0.05	0.03	–0.03
	Access	–0.06	0.02	0.29	–0.34	–0.10	–0.09	0.06
	Expenditure	–0.04	–0.02	–0.11	–0.17	–0.06	–0.06	–0.06
4	Total	–0.10	0.04	0.08	–0.28	–0.22	–0.11	–0.11
	Price	0.06	0.03	–0.08	–0.04	0.01	–0.13	–0.04
	Quantity	–0.02	0.05	0.17	0.12	–0.08	0.12	–0.05
	Access	–0.10	0.01	0.09	–0.20	–0.09	–0.05	0.08
	Expenditure	–0.04	–0.04	–0.11	–0.16	–0.05	–0.05	–0.11
5	Total	–0.19	–0.03	0.09	–0.16	–0.10	–0.08	–0.01
	Price	0.04	0.04	–0.02	0.00	–0.01	–0.02	0.00
	Quantity	–0.10	0.10	0.17	0.16	–0.02	–0.01	0.05
	Access	–0.09	–0.08	0.03	–0.19	–0.03	–0.01	0.17
	Expenditure	–0.04	–0.09	–0.09	–0.13	–0.04	–0.04	–0.23
All	Total	–0.12	0.01	0.18	–0.24	–0.24	–0.19	–0.03
	Price	0.06	0.03	–0.05	0.05	0.00	–0.10	–0.01
	Quantity	–0.06	0.03	0.19	0.09	–0.07	0.05	–0.01
	Access	–0.07	0.00	0.15	–0.20	–0.10	–0.07	0.11
	Expenditure	–0.05	–0.05	–0.11	–0.18	–0.06	–0.07	–0.12

Source: Authors' calculations.

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