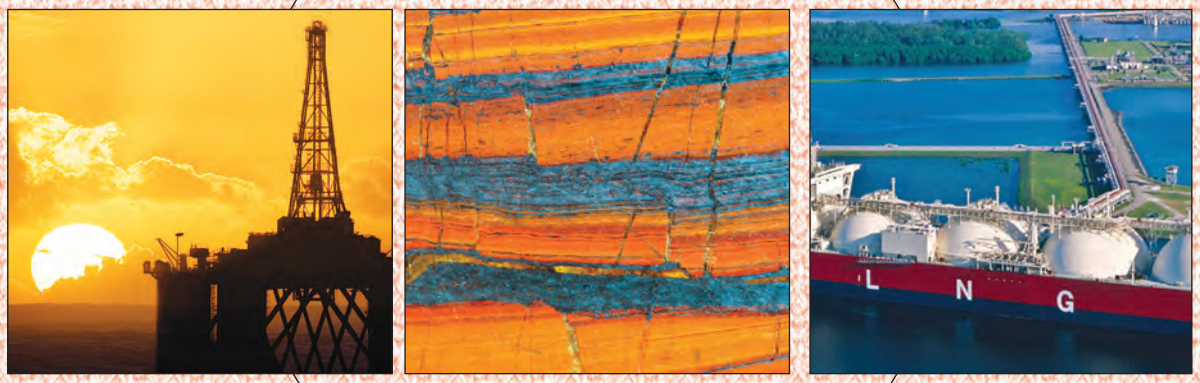
Extractive Industries for Development Series #16
June 2010

Expenditure of Low-Income Households on Energy



Evidence from

Africa and Asia

Robert Bacon
Soma Bhattacharya
Masami Kojima

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Cover photos: Oil rig, hematite-banded ironstone, LNG tanker

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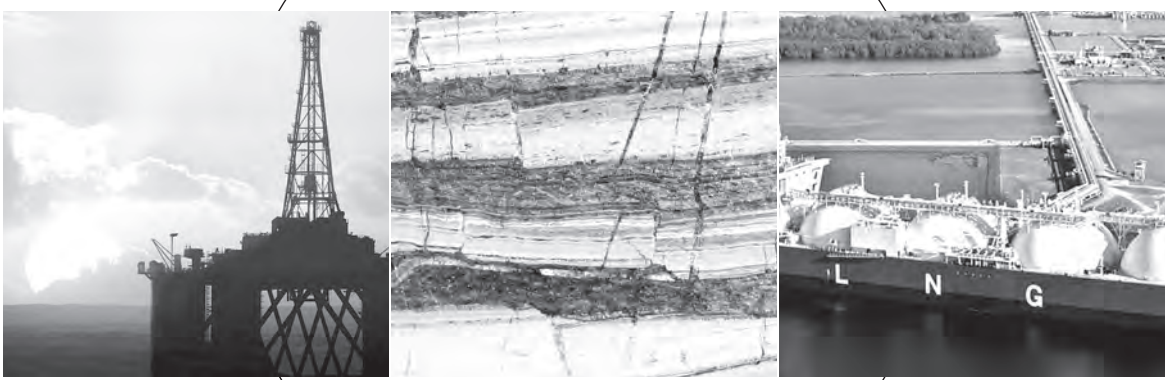

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World Bank | Oil, Gas, and Mining Policy Division Working Paper

Contents

Tables

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Abbreviations

HIES	Household Income and Expenditure Survey
IMF	International Monetary Fund
LPG	liquefied petroleum gas
PDS	public distribution system
PPP	purchasing power parity
SUSENAS	National Socio-Economic Survey

All dollar amounts are U.S. dollars.

Executive Summary

Patterns of household energy use and expenditure have been the subject of a large number of studies. Household expenditures on energy—particularly, how much the poor spend—have policy implications for several reasons. First, policies to mitigate or cope with energy price shocks are increasingly focusing on targeted support to low-income households as a way of limiting the fiscal cost of such policies while offering protection to the most vulnerable members of society. Second, for governments looking to reform energy price subsidies, the effects on household welfare—especially effects on poor households—of price increases resulting from subsidy reduction/removal is an important policy consideration. But subsidies for liquid fuels targeting the poor are difficult to design and implement effectively, because liquid fuels tend to be used more by the rich than by the poor, and are also easy to transport (and hence to divert to nonpoor users). For this reason, there is a growing recognition of the need to move away from price subsidies for liquid fuels to alternative forms of targeted assistance to compensate the poor for the adverse effects of higher fuel prices. Third, in areas where many households have not yet begun using modern commercial energy regularly, the amount they can afford to pay for such energy services is a relevant question. Quantifying expenditures on different types of energy at varying income levels provides a basis for addressing these questions.

A crucial aspect of this quantification is the ability to examine energy use patterns as a function of income and to identify the poor. Nationwide household expenditure surveys provide one of the best measures of poverty. These surveys assign a weight to each household so the results can be scaled up to the total population of the country. This, combined with detailed data on all important expenditures, enables a fairly accurate division of households into different expenditure groups. Where nationally administered household surveys collect disaggregated data on energy use, patterns of energy consumption and expenditure can be analyzed by income.

Using data obtained in nationally administered household expenditure surveys, this study investigates the shares of household expenditure

devoted to energy at different income levels for Bangladesh, Cambodia, India, Indonesia, Kenya, Pakistan, Thailand, Uganda, and Vietnam (table E.1). The paper also examines expenditures on motorized passenger transport and food, two items for which the price of oil is an important component of their cost structure and which are consequential in the budget of poor households. The income levels are based on per capita expenditure, with the country's population divided into five groups containing the same number of people in each. The study investigates the following questions:

- What proportion of households use various energy sources—electricity, petroleum products (kerosene, gasoline, diesel, and liquefied petroleum gas), natural gas, and biomass—and transport at different income levels and in rural and urban areas?
- What are the main energy sources used for cooking and lighting?
- What proportion of household income (using total household expenditure as a proxy) is spent on petroleum products, on modern sources of energy (petroleum products, electricity, and natural gas), and on energy generally? How does spending on energy compare to what households spend on food and motorized transport?
- How do the proportions vary across income levels and does the effect of higher energy prices bear more heavily on low- or high-income groups?

For all forms of modern energy except kerosene, this study found that the proportions of households using different sources of energy at

Table E.1 Survey Countries

Country	Survey year	Annual per capita expenditure[a]	Urbanization (% of population)
Bangladesh	2005	657	25
Cambodia	2003–04	1,013	15
India	2004–05	707	25
Indonesia	2005	801	45
Kenya	2005–06	1,295	20
Pakistan	2004–05	1,005	32
Thailand	2006	3,073	30
Uganda	2005–06	926	15
Vietnam	2006	1,071	27

Sources: National household expenditure surveys and authors' calculations.
a. Expenditures are in 2005 dollars at purchasing power parity.

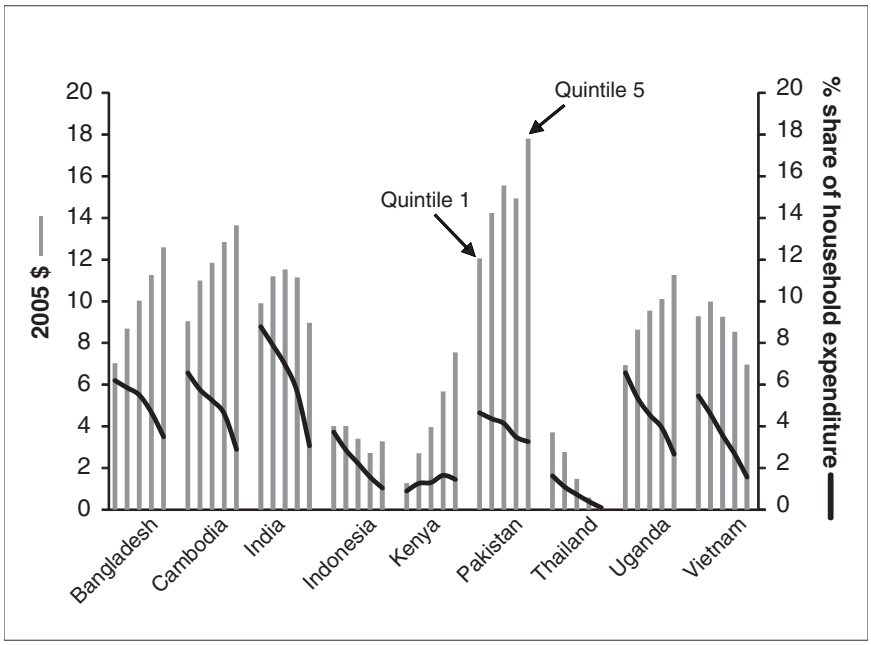
similar income levels were generally higher in urban than in rural areas.[1] There were notable exceptions. For every quintile in Thailand, a larger percentage of rural households used gasoline and diesel than their urban counterparts. The same pattern was observed in Bangladesh, India, and Kenya for three or more quintiles. Because of the availability of natural gas in urban areas, a greater proportion of rural households used liquefied petroleum gas (LPG) than their urban counterparts in every quintile in Pakistan. And while kerosene tended to be used more by rural households than urban in most countries, for all but one quintile in Indonesia—where kerosene was heavily subsidized and not rationed at the time—a larger percentage of urban households used kerosene. The uptake rate of biomass was nearly universal among rural households in many countries, as well as in urban Bangladesh, Cambodia, and Uganda. More than half the households in every quintile used motorized transport in Bangladesh and Pakistan, and more than half the households in four out of five urban quintiles used transport in India and Indonesia.

Six surveys asked about the household's main energy source for lighting. As expected, households that had access to electricity used it as the primary source of lighting. Access to electricity was very high in Vietnam and essentially universal in Thailand. It was very low in Kenya and Uganda, especially among rural households, and low in rural Bangladesh and Cambodia. Those households without access to electricity used mostly kerosene for lighting, but firewood was important for lower quintiles in Kenya, and batteries were an important third main energy source in Cambodia.

The expenditure shares of biomass and kerosene generally declined with rising quintile, but expenditures themselves rose for most countries among the bottom two to three quintiles. For kerosene, it would be reasonable to take expenditure levels as a first approximation of quantities consumed, particularly in countries with essentially pan-territorial pricing. For biomass, the relationship between quantity and value could be weak because of large geographic and temporal price variation as well as the difficulties of estimating equivalent market values of freely obtained biomass. Figures E.1 (rural) and E.2 (urban) show expenditures on biomass for quintiles converted to 2005 dollars at purchasing power parity.

[1]Rural areas in household surveys may include areas that are more peri-urban than rural. For example, "rural users" of natural gas in Pakistan were most likely peri-urban residents.

Figure E.1 Monthly Rural Household Expenditure on Biomass

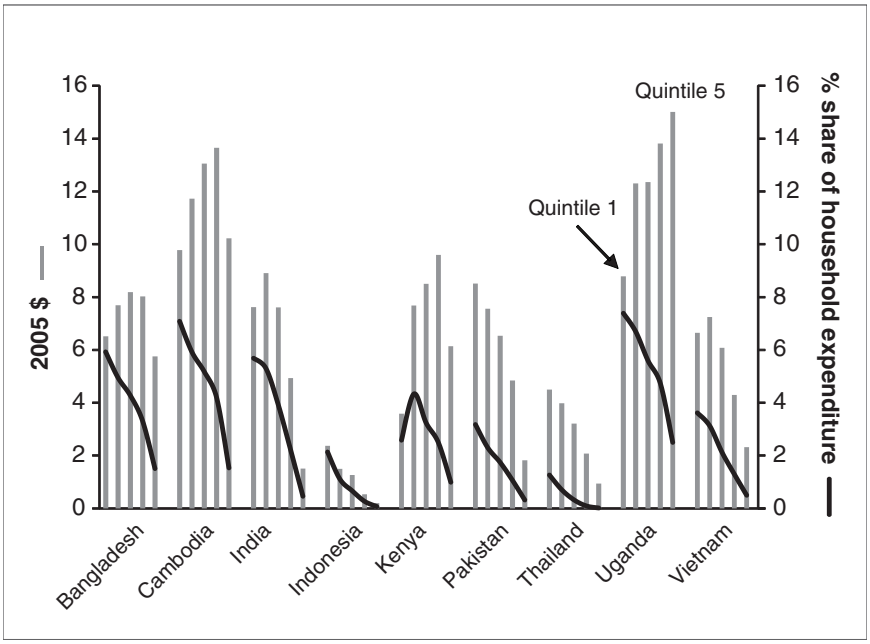


Source: Authors' calculations.
Note: In Kenya, 39 percent of rural households assigned an imputed value of zero to non-purchased biomass, including 68 percent of the bottom quintile, 48 percent of the second quintile, and 40 percent of the third quintile.

It is striking that only in Thailand did the value of biomass consumed decline from the bottom to the second quintile in rural areas; the value in urban areas declined only in Indonesia, Pakistan, and Thailand. These findings might suggest that the quantity of biomass consumed in low-income countries tends to increase with rising income before falling.

A related interesting finding is the extent to which the rich in the survey countries were using biomass as their *primary* cooking fuel. These results should be interpreted with caution because households use a portfolio or fuel-stacking approach to cooking as income rises, and some households using two or more sources of energy might not have found it easy to name their primary cooking fuel. Only in high-income countries do households use a gas, electricity, or some combination of both for cooking; in developing countries, cooking with biomass is widespread. Using biomass may be time consuming, not only in terms of getting the fire started but also because, if not purchased, the fuel must be collected. Also, traditional use of biomass creates considerable indoor air pollution which is injurious to health. Despite these disadvantages, poor

Figure E.2 Monthly Urban Household Expenditure on Biomass



Source: Authors' calculations.
Note: In Kenya, 21 percent of the bottom urban quintile and 7 percent of the next two urban quintiles assigned an imputed value of zero to nonpurchased biomass.

households continue to use biomass if it carries low or zero monetary cost and they face cash constraints. What is surprising is that many rich households also use biomass—more than 90 percent of the fourth quintiles in several countries. Households do not abandon biomass use altogether for a variety of reasons, which include cost, the fact that modern fuel supplies are not always reliable or are time consuming to acquire where they live, and because of cooking practices and cultural preferences.

The persistent use of biomass even in urban areas and even as per capita expenditure reached upwards of $800, valued in 2005 dollars at purchasing power parity, shows that steps to move households away from biomass and toward modern energy sources will need to address a variety of concerns and problems. This is particularly the case for LPG, which, apart from electricity, is the cleanest modern fuel option in rural areas for cooking and heating. There are economies of scale in LPG delivery, which also requires good road infrastructure. If LPG is delivered only once every so many days, a backup cylinder (at $20–30 each) becomes

essential. Delivery may also not be regular and reliable in a low-volume market, particularly if it is remote. The cost of cylinder management rises with declining cylinder size, but large cylinders mean large refill payments, a problem for households with irregular cash income flow. These challenges all too often exist against the backdrop of more readily available and much cheaper biomass, which is also suited for cooking traditional meals.

For policy to shift household fuel use from traditional biomass to cleaner cooking fuels, it would make sense to examine first how the urban rich could be persuaded to make this shift, because they are most likely to be able to afford it and have ready access to the LPG service infrastructure. If there are distortions in the market—a lack of competition, an inadequate regulatory framework for the industry, poor enforcement of regulations, or any combination of these factors resulting in high prices, low quality of service, or both—the national energy ministry should take the lead in addressing them. The principal problems may, however, lie outside the energy sector: port congestion and slow customs clearance incurring high demurrage charges, bad road infrastructure, or the cost of doing business discouraging investment in bottling plants. Identifying and addressing these issues would require the involvement of other government ministries and agencies.

Expenditures on different forms of energy can be averaged across all households or across user households. From the policy perspective, the average across all households is more important because the question for the government is how a particular policy might affect the entire population or the poor as a whole. When averaged across all households in the country, the share of total household expenditures spent on modern energy varied between 2 percent and 10 percent. When biomass was included to make up total energy, the expenditure share rose considerably in several countries, ranging from 7 percent to 12 percent, demonstrating the importance of traditional use of biomass. The expenditure share of purchased food was markedly higher than that of modern energy, by 20-fold or greater in Bangladesh and Cambodia. The expenditure share of motorized transport was about the same order of magnitude as that of petroleum products, and was lowest in Cambodia and Vietnam at less than 1 percent of total household expenditures (table E.2).

The analysis of energy expenditures by quintile group gave useful information on the relative importance of energy to the poorest households in each country. In Bangladesh, Cambodia, India, and Uganda, the share of expenditure on energy was greatest for the bottom quintile;

Table E.2 Shares of Household Expenditure on Various Energy Sources, Food, and Transport: All Households (%)

Expenditure item	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Kerosene	1.0	1.0	1.5	2.3	2.1	0.3	0.0	1.5	0.3
LPG	ND	0.2	1.1	0.2	0.1	0.2	0.6	ND	2.6
Gasoline and diesel	0.1	ND	0.8	1.0	0.2	1.0	6.1	0.2	3.1
Petroleum products	**1.1**	**1.2**	**3.4**	**3.8**	**2.5**	**1.6**	**6.7**	**1.7**	**5.9**
Electricity	1.1	0.8	2.4	3.4	0.2	3.8	3.1	0.4	3.0
Natural gas	0.3	NA	NA	0.0	NA	0.6	0.0	NA	NA
Modern energy	**2.5**	**2.0**	**5.8**	**7.2**	**2.7**	**6.0**	**9.8**	**2.0**	**9.0**
Biomass	4.7	4.8	5.4	1.6	1.4	3.1	0.6	4.4	3.1
Total energy	**7.3**	**6.8**	**12**	**8.8**	**4.1**	**9.0**	**10**	**6.5**	**12**
Purchased food	49	52	47	54	36	42	35	29	39
Nonpurchased food	12	18	7.9	7.8	21	10	8.7	24	12
Total food	**61**	**70**	**55**	**62**	**57**	**52**	**44**	**53**	**51**
Transport	2.5	0.2	2.4	2.4	3.2	3.0	1.7	2.0	0.6

Source: Authors' calculations based on surveys described in appendix A.
Note: NA = fuel not available; ND = no question was asked concerning the fuel. Nonpurchased items, including cashfree biomass, are included.

this was also true of urban households in Indonesia and Thailand. Only Kenya, Pakistan, and Vietnam showed no such pattern, with the top quintile having the highest energy expenditure share in both rural and urban areas in Pakistan and Vietnam. The share of expenditure on modern energy rose with income in all the Asian countries (except the top quintiles in Indonesia). There was no evidence that the share of modern energy increased with quintile level in Kenya and Uganda, although Kenya could exhibit such a trend if nonzero values are assigned to nonpurchased biomass.

There was no consistent relationship between the share of petroleum products and income. In India, Indonesia, Pakistan, Thailand, and Vietnam, the share increased in both rural and urban areas with income. In Bangladesh and Cambodia, the share declined with the quintile group; this was also true in Uganda for all but the top quintile. For the bottom 40 percent, the spending on petroleum products was concentrated on kerosene, with the exception of Thailand, Vietnam, and urban Pakistan.

In those countries where the expenditure shares were already high in the middle of the last decade, subsequent oil price increases in 2007 and 2008 might have hit the poor hard.

Universal price subsidies for petroleum products are common, and a number of governments that had earlier eliminated price subsidies reintroduced them as oil prices soared to historic heights in 2008. A recent estimate suggests that global pretax petroleum product subsidies increased from about $60 billion in 2003 to $520 billion by mid-2008 (Coady and others 2010). Simulation of universal flat-rate price subsidies for petroleum products using the data in this study suggests that such subsidies would be regressive for LPG, gasoline, and diesel in all countries where data are available, and for kerosene in half the countries. The rate of excluding the poor is very high for LPG, gasoline, and diesel, but low for kerosene in six countries where that product is widely used. These findings would suggest that universal subsidies for LPG, gasoline, and diesel would not help the poor when considering direct effects on household expenditures, but that a kerosene price subsidy could be pro-poor under certain circumstances. However, because kerosene is a nearly perfect substitute for diesel, when the price of subsidized kerosene is lower than that of diesel, the former is almost universally diverted to the automotive sector, benefiting businesses and higher-income households and potentially making the kerosene subsidy regressive even in countries where an analysis of household energy use might suggest it would be progressive.

Combining the results of the above simulation with an examination of cash expenditures on food would further argue against price subsidies for petroleum products. The expenditure share of purchased food constituted one-third or more of total household expenditures for every urban quintile and as much as 60 percent for the bottom four urban quintiles in Cambodia and the bottom two in Bangladesh. In rural areas, cash expenditures on food in every quintile comprised 50 percent or more of total household expenditures in Cambodia and Indonesia and one-third or more in Bangladesh, India, Pakistan, and Vietnam. In India, Indonesia, Kenya, Pakistan, Thailand, and Vietnam, the ratio of expenditures on purchased food to those on petroleum products declined monotonically with income in both rural and urban areas. If a 10 percent increase in petroleum product prices were to lead to a 1 percent increase in food prices, the indirect effect on food prices would be larger than the direct effect of higher oil prices for all quintiles except in India, Thailand, Vietnam, and urban Kenya. Excluding Thailand, the bottom quintile in

both rural and urban areas in the remaining eight countries would be hit harder by higher food prices caused by higher oil prices than by the higher oil prices themselves. If that is the case, the policy response to help the poor cope with higher transportation fuel prices might more productively focus on assistance, ideally through targeted cash transfers, for food purchase—and more generally the basket of goods the poor consume—than on subsidizing fuel prices.

Chapter 1

Background

Many studies have examined patterns of energy use and expenditure on energy by households in developing countries. These studies have variously aimed to

- obtain a detailed picture on patterns of access to, and use of, modern forms of energy
- understand traditional use of biomass and its associated health effects
- evaluate technical and policy options that can facilitate the transition to cleaner use of household energy
- estimate the likely impact of higher energy prices on household welfare
- assess the progressiveness, or its lack, of energy subsidy schemes

Answering these questions entails examining households by their per capita income levels. Nationwide household expenditure surveys—such as the National Sample Survey of India and the Living Standards Measurement Study developed by the World Bank's Development Economics Research Group—provide one of the best measures of poverty in a given country. These surveys assign a weight to each household, so that the weighted households can be extrapolated to the total population of the country. This methodology, taken together with detailed data on all important household expenditures over one year, enables a fairly accurate separation of households into different groups based on per capita expenditures, which are taken as a proxy for per capita income. Where nationally administered household surveys collect disaggregated data on energy use, patterns of energy consumption and expenditure can be analyzed by expenditure group.

National household expenditure surveys do not provide the level of detail on energy use of specialized energy surveys. They do not, for example, normally ask how many units of electricity the household consumes, or the distance to the closest shop selling liquefied petroleum gas (LPG). In this sense, their utility in studying energy use is limited. However, the coverage of these surveys—in terms of both geography

and the breadth of expenditure categories—makes them uniquely valuable. Specialized energy surveys seldom cover the country in a way that enables their results to be scaled up to the entire population, nor do they collect detailed data on total household expenditures. Specialized surveys can study low-, middle-, and high-income households, but such classification tends to be more qualitative than that possible from nationally administered household expenditure surveys. For this reason, despite their limitations, household expenditure surveys have been used in many studies to understand the relationship between energy use and household poverty.

Household expenditures on energy—particularly, how much the poor spend—have policy implications for several reasons. First, policies to mitigate or cope with energy price shocks are increasingly focusing on targeted support to low-income households as a way of limiting the fiscal cost of such policies while offering protection to the most vulnerable members of society. Second, for governments looking to reform energy price subsidies, the effects on household welfare, especially poor households, of price increases resulting from subsidy reduction/removal is an important policy consideration. But subsidies for liquid fuels targeting the poor are difficult to design and implement effectively, because liquid fuels tend to be used more by the rich than by the poor, and are also easy to transport (and hence to divert to nonpoor users). For this reason, there is a growing recognition of the need to move away from price subsidies for liquid fuels to alternative forms of targeted assistance to compensate the poor for the adverse effects of higher fuel prices. Third, in areas where many households have not yet begun using modern commercial energy regularly, the amount they can afford to pay for such energy services is a relevant question. Quantifying expenditures on different types of energy at varying income levels provides a basis for addressing these questions.

This paper investigates the share of household expenditure devoted to energy at different income levels for a number of developing countries in Asia and Africa for which detailed data are available. It presents evidence relevant to the debate on the impact of higher energy prices—as a result of either higher world prices of fossil fuels or price subsidy reduction or removal—on the poor. By establishing the shares of household expenditure spent on different forms of energy, an estimate can be made of how changes in energy prices may affect household welfare directly. Further, by comparing shares of expenditure on energy at different income levels within a country, the extent to which the lowest-income households are

affected relative to higher-income households can be seen. This information can help inform the policy debate on the need to provide extra support to these lowest-income households.

The paper also examines expenditures on public transport and food, since the price of oil is an important component of their cost structure and both are significant items in the budget of poor households. Specifically, public transport may be used extensively by the urban poor, and food typically constitutes the largest share of total expenditure among the poor.

Links between Oil and Energy Prices Paid by Households

Energy prices are location specific, some more than others. The cost and availability of electricity from hydropower depend largely on hydrology. Oil, in contrast, is the most internationally traded energy commodity and prices depend primarily on the cost of transport from oilfields or major refining centers. World oil prices are the most transparent and the most publicized: information on oil prices is readily available daily. Retail prices of petroleum products closely track those on the world market in some developing countries. Others, however, do not have completely liberalized markets, and international prices are not fully passed onto consumers, as documented by Bacon and Kojima (2006) and Kojima (2009a and b). Instead, subsidies, either implicit or explicit, keep domestic prices below the international equivalents.

Households are affected by a change in oil prices through a variety of mechanisms, some direct and some indirect:

- Households purchase a number of petroleum products directly, and petroleum product prices rise in step with crude oil prices. The impact of these price increases on a household depends on the importance of various fuels in the household budget and on the extent to which international prices have been passed through to domestic.
- Households purchase other sources of energy besides petroleum products, including electricity. The international prices of natural gas and coal have also risen in recent years, in part because oil, gas, and coal are substitutes over the medium to long run in many applications. The prices of electricity generated by fossil fuel combustion are determined in part by fuel costs—which are directly affected by higher oil prices if the fuel is a petroleum product, and indirectly affected in terms of higher coal and gas prices. If price increases of other fuels are passed through to households, they pay more for electricity, coal, and gas.

Where petroleum products such as kerosene compete with biomass—typically in urban markets—prices of biomass may also rise in tandem.

- Petroleum products are an input to the production of other goods, many of which are purchased by households. In particular, the costs of transportation are directly affected by the price of diesel and gasoline. Higher domestic petroleum product prices lead to higher transportation costs. These in turn are both a direct cost to households that use public transport, and an indirect one affecting the prices of goods transported. For example, food prices are affected by higher oil prices not only because food needs to be transported to markets, but also because diesel fuel is used to operate irrigation pumps and tractors, and fossil fuels are used in fertilizer manufacture.

These direct and indirect links mean that an increase in international oil prices can have a series of effects on the prices faced by households. For a complete quantification of the changes of all prices faced by households due to oil price changes, a detailed breakdown of the direct and indirect cost components of every item of household expenditure would be needed. To carry out such a calculation, an input-output table is required. Such information is available for relatively few countries, and where it is available, the table is sometimes based on data that are several years out of date. Partial equilibrium analysis using an input-output table provides upper bounds on the impact of higher energy prices on households, because coefficients in the model are fixed and substitution is not modeled. A general equilibrium model considers market interactions and allows for relative changes in prices and resource flows, which affect macroeconomic and distributional outcomes.

Partial and general equilibrium analyses are resource intensive, particularly the latter. Although limited in scope, useful information can still be gathered from analyzing household surveys alone: namely, current energy use patterns and expenditures, and first-order estimates of direct (and some indirect) effects of changing energy prices. Importantly, as mentioned above, household expenditure surveys enable separation of households into different income groups, so energy use can be analyzed as a function of per capita expenditure level, a common measure of poverty. This paper focuses on studies that report results by expenditure quintile or decile.

Measuring Household Expenditure on Energy

Household expenditure surveys enable calculation of the shares of household expenditure spent on different forms of energy. These shares

can also be calculated for groups of households, allowing comparisons between households with high or low total expenditures per capita, or between rural and urban households. Because very few countries carry out such surveys every year, the information from the most recent available survey may be a few years out of date.

Depending on the country, expenditures are provided for a number of energy sources. This paper defines petroleum energy products as *kerosene*, *LPG*, *gasoline*, and *diesel*.

Other sources of energy are *electricity*, *natural gas*, *coal*, and *firewood and other forms of biomass*. Low-income households in some countries also use candles for lighting and car batteries as a source of power for electric appliances.

Firewood and other forms of biomass may include charcoal, wood, straw, and dung. With the exception of charcoal, households often collect, rather than purchase, biomass, especially in rural areas. Surveys reporting these as expenditures have imputed a value to each freely obtained fuel. In some cases, such as in the National Sample Survey of India, the values are solicited from respondents by enumerators, injecting a large element of subjective judgment. Where there is a well-established market for firewood, as in many peri-urban and urban areas, the imputed values are more likely to reflect the market value of firewood in the community.

Household expenditures on energy can usefully be aggregated into three categories:

- Expenditure on petroleum products (sum of expenditures on kerosene, LPG, gasoline, and diesel)
- Expenditure on modern forms of energy (sum of expenditures on kerosene, LPG, gasoline, diesel, electricity, and natural gas)
- Expenditure on energy (sum of expenditures on kerosene, LPG, gasoline, diesel, electricity, natural gas, coal, and firewood and other forms of biomass)

Shares of total expenditure on different energy sources can be computed for each household. The shares can be averaged across all households—whether they use the energy source or not—or across only those households that use the particular energy source. For the purpose of policy formulation, averaging across all households is more important than focusing only on users of a particular form of energy. This paper thus focuses primarily on shares averaged across all households in each income group under consideration.

Energy Ladder and the Energy Portfolio

Many authors have analyzed the use and choice of energy sources at the household level. Early studies on the use of fuels for the basic needs of lighting, cooking, and heating centered on the concept of an energy "ladder." Later studies suggested that a portfolio, or fuel-stacking, approach is more realistic. The differences between the two approaches were well described in a study by ESMAP (2003c, pp. 11–12):

> The energy ladder model envisions a three-stage fuel switching process. The first stage is marked by universal reliance on biomass. In the second stage households move to "transition" fuels such as kerosene, coal and charcoal in response to higher incomes and factors such as deforestation and urbanization. In the third phase households switch to LPG, natural gas, or electricity…
>
> Yet the ladder image is perhaps unfortunate because it appears to imply that a move up to a new fuel is simultaneously a *move away* from fuels used hitherto…
>
> Evidence from a growing number of countries is showing multiple fuel use to be fairly common…
>
> The new perspective on household energy choice sees it as a portfolio choice more than as a ladder.

A striking example of multiple fuel use was seen in a study conducted in rural Mexico. Households were found to move to multiple-fuel cooking with rising income in a bidirectional process—meaning that separate, coexisting factors simultaneously pushed households away from biomass and pulled them back. Even when households had been using LPG for many years, they rarely abandoned fuelwood use. Fuelwood savings from using LPG ranged from 35 percent on average in one village to as little as zero percent. Expenditures on fuelwood were higher in some cases in households using both fuelwood and LPG than in fuelwood-only households (Masera, Saatkamp, and Kammen 2000).

Energy Prices

The budget share allocated to a particular form of energy depends on a number of factors that underpin the energy portfolio or energy ladder explanations of household behavior. For a given household, the four important determinants of energy use are *availability*, *income*, the *price of energy*, and the *prices of possible substitutes*. These together influence the

quantity purchased and the expenditure on an energy source. Changes in expenditure share over time for a group can be related to 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). For those countries where household expenditure surveys are available for more than one date, changes in expenditure shares can be related to changes in these four factors through a decomposition analysis (Bacon, Bhattacharya, and Kojima 2009).

For those surveys that provide information on quantities purchased as well as expenditure on each energy source, it is possible to derive measures of the prices (unit values) paid for each form of energy. Where such information is available, it is almost always for a fuel and not for electricity. Calculating prices paid allows examination of the hypotheses that (1) poor households tend to pay more per unit for a given fuel than do rich households, and (2) with the exception of biomass, rural households pay more than urban because of higher energy delivery costs.

The first hypothesis is based on the possibility that there are economies of scale in purchasing that credit-constrained low-income households are unable to exploit. In addition, where fuels require transport from the retailer to the home, lower-income households may not be able to visit the lowest-cost suppliers because of the associated costs of transportation. The second hypothesis rests on the possibility that rural households may face higher retail prices because of the extra transport costs of supplying fuels to more remote areas. However, for firewood, where the main source of supply is the countryside, urban households are likely to face higher prices than rural.

Where grid electricity is available, whether and how much to use depends in part on the pricing scheme in effect. For countries using rising block tariffs with lower prices charged for the first block(s) of purchases, the average price paid will be lower the smaller the amount purchased. However, where there is a fixed charge for access (such as a meter fee), or where connection charges have been recorded for households connected during the survey period, the average prices paid rise with decreasing amount of electricity purchased. It is possible that the average price paid by households is U-shaped—initially declining with volume and then increasing.

Chapter 2

Previous Studies

The World Bank and the International Monetary Fund (IMF), among other institutions, have published a number of studies that include detailed information on household energy consumption in developing countries. The purposes of these studies differ considerably; consequently, close comparisons of the countries covered by these are not possible. Some studies focused on the choice of fuel for cooking, thus excluding consideration of the use of petroleum products for transportation. Other studies looked primarily at the implications of subsidies given for petroleum products, excluding electricity and biomass from the analysis. Their inconsistencies notwithstanding, these studies can inform the present investigation.

This chapter considers only those studies that analyze expenditures on energy by income group. In nearly all household survey analyses, expenditures are used as a proxy for income. Limiting the comparability of the results is that not all of the studies provide full details on how the quintile or decile groups are calculated—that is, whether they are based on per household expenditure or per capita expenditure rankings, and whether the groups contain equal numbers of people or of households. Where the method used in the study was indicated, this is noted here. Virtually none of the reports clarify what total household expenditures include, nor how the purchase of large durables is treated. As explained in chapter 1 and appendix A, their inclusion could change results significantly. A brief review of key studies is provided below; space constraints prevent presentation of all potentially relevant results. In the following discussion, the lowest quintile or decile represents the poorest households, and the highest quintile or decile the richest.

Islamic Republic of Iran (1999)

The World Bank's study on the Islamic Republic of Iran (2003) provided information on household expenditures on the principal sources of energy for rural and urban quintiles. The country's population was first

divided into rural and urban areas before calculating quintiles separately for each area. The study used a household expenditure survey conducted in 1999 when world oil prices were at a historic low. Even at that time, the government of the Islamic Republic of Iran was heavily subsidizing petroleum products, natural gas, and electricity; the study was a contribution to the analysis of the effects of reducing or removing these subsidies. The expenditure shares reflect the very low prices charged for energy, but still provide information on the patterns of expenditure of higher- and lower-income, as well as rural and urban, households (table 2.1).

Table 2.1 Shares of Total Household Expenditure on Various Energy Sources in the Islamic Republic of Iran, 1999 (%)

		Petroleum products				Electricity	Natural gas	Total
	Quintile	Kerosene	Gasoline	Diesel	Total			
Rural	1	1.6	0.2	0.1	1.9	1.1	0.4	3.3
	2	1.3	0.2	0.0	1.5	1.1	0.3	2.9
	3	1.0	0.3	0.1	1.4	0.9	0.4	2.7
	4	0.9	0.3	0.1	1.3	0.9	0.4	2.6
	5	0.4	0.2	0.1	0.7	0.4	0.2	1.3
	All	**0.7**	**0.2**	**0.1**	**1.0**	**0.7**	**0.3**	**2.0**
Urban	1	0.7	0.2	0.0	0.9	1.2	0.2	2.3
	2	0.6	0.2	0.0	0.8	1.2	0.2	2.1
	3	0.5	0.3	0.0	0.8	1.2	0.2	2.2
	4	0.4	0.3	0.1	0.8	1.2	0.2	2.1
	5	0.1	0.3	0.1	0.5	0.8	0.1	1.2
	All	**0.3**	**0.3**	**0.0**	**0.6**	**1.0**	**0.1**	**1.7**

Source: World Bank 2003.

There is little difference among quintiles in terms of expenditure shares for a given energy source, with the exception of kerosene, which declined steadily as the quintile level increased. The top quintile also spent a much lower expenditure share on electricity. Expenditure on diesel was low for all groups, while the share for gasoline was similar across groups and between areas. The share of total spending on energy was higher for each rural quintile compared to the corresponding urban quintile; this difference was largely accounted for by the much greater share of expenditure on kerosene.

Ghana (1999)

Coady and Newhouse (2006) analyzed the potential effects of removing fuel price subsidies in Ghana. Their study was based on a household expenditure survey for 1999 and presented information on expenditure shares by quintile for petroleum products (kerosene, LPG, and gasoline). The quintiles were based on national expenditures per equivalent adult (table 2.2). Rural and urban households were not disaggregated, and information on other forms of energy was not given in the study. The share of expenditure on petroleum products fell as income rose, but increased for the highest quintile. This pattern was explained largely by a steadily falling share for kerosene and rising shares for LPG and gasoline. In particular, the expenditure on gasoline increased markedly at the top quintile. Expenditure on LPG remained small throughout the income range.

Table 2.2 Shares of Total Household Expenditure on Petroleum Products in Ghana, 1999 (%)

Quintile	Kerosene	LPG	Gasoline	Total
1	5.9	0.0	0.1	6.0
2	4.1	0.0	0.1	4.2
3	3.4	0.0	0.2	3.6
4	2.4	0.1	0.2	2.7
5	1.6	0.2	2.1	3.9
All	**3.5**	**0.1**	**0.6**	**4.2**

Source: Coady and Newhouse 2006.

India (1999–2000)

ESMAP (2003a) reported on household energy consumption in India, focusing on those fuels used primarily for cooking—in particular, on the choice between biomass in its various forms and cleaner sources such as kerosene, LPG, or electricity. Deciles were based on per capita total expenditures, each containing the same number of households, and were calculated separately for the samples of rural and urban households. Shares of total expenditure allocated to clean energy sources are shown in table 2.3.

The total share of expenditure on the three sources of energy rose throughout the expenditure range for rural households, and for urban households up to the sixth decile. Both rural and urban households allocated declining shares of total expenditure to kerosene and increasing

Table 2.3 Shares of Total Household Expenditure on Cooking Fuels in India, 1999–2000 (%)

Rural decile	Kero-sene	LPG	Elec-tricity	Urban decile	Kero-sene	LPG	Elec-tricity
1	1.3	0.0	0.5	1	2.0	0.5	2.2
2	1.2	0.0	0.7	2	2.3	1.1	2.7
3	1.1	0.0	0.8	3	2.1	1.5	3.1
4	1.1	0.1	0.9	4	2.2	1.8	3.3
5	1.1	0.1	1.0	5	2.0	2.2	3.4
6	1.1	0.1	1.2	6	1.8	2.4	3.5
7	1.1	0.2	1.3	7	1.5	2.5	3.5
8	1.1	0.3	1.5	8	1.4	2.3	3.4
9	1.0	0.5	1.6	9	0.9	2.2	3.5
10	0.9	0.8	1.8	10	0.4	1.7	3.5

Source: ESMAP 2003a.

shares to electricity as incomes rose. Rural households increased the share of expenditure on LPG, but urban households increased the share only up to the seventh decile, above which this energy source's share declined. The share of expenditure on each fuel was higher in urban deciles throughout the income range.

ESMAP Multicountry Study (Various Survey Dates)

ESMAP (2003c) brought together results from several household surveys taken at different dates, including the India survey mentioned above. Because its focus was the choice and use of energy sources for nontransportation household activities, gasoline and diesel were not included. The countries and survey dates were South Africa (1993–94), Nepal (1995–96), Brazil (1996–97), Vietnam (1997–98), Nicaragua (1998), Ghana (1998–99), India (1999–2000), and Guatemala (2000). In each country, quintiles were based on per capita expenditure rankings with equal numbers of people in each quintile. Rural and urban quintiles were calculated separately rather than from aggregated countrywide household ranked data, as this latter method would result in large differences between rural and urban households in total expenditure at the same quintile level. Information was analyzed for expenditures and use of kerosene, LPG, electricity, coal and charcoal, and firewood. Histograms, but not numerical information, were given for rural and urban quintiles for

shares of total household expenditure on each energy source. These indicate that, except in Brazil where the use of kerosene was negligible, the share of expenditure on kerosene declined with total expenditure level for rural households in all countries. Among urban households in India and Vietnam, the share initially increased before decreasing at the higher quintiles. The shares of expenditure on electricity and LPG increased with total expenditure in all countries and areas except urban Brazil and urban Guatemala, where they declined. The share of expenditure on purchased firewood declined in all urban areas but increased at low incomes for rural households before declining at the highest quintiles.

An indication of the overall importance of energy in household budgets is given by the aggregate shares of expenditure on purchased energy for cooking and lighting (table 2.4). In all cases, the share of expenditure on energy is higher for urban households than for rural, except in South Africa and in India when collected firewood is taken into account. In several countries, urban households allocated more than 5 percent of total expenditure to energy. This is notable, given that all the surveys were conducted before 2001, when energy prices were much lower than they have been since 2004. In addition, if expenditures on gasoline and diesel were included, the shares would be higher, especially in urban areas.

Table 2.4 Shares of Total Household Expenditure on Energy for Cooking and Lighting in Various Countries (%)

Country	Rural	Urban
	Purchased energy	
Brazil (1996–97)	3.2	3.4
Ghana (1998–99)	3.1	5.0
Guatemala (2000)	6.2	6.7
India (1999–2000)	4.1	7.5
Nepal (1995–96)	2.1	6.0
Nicaragua (1998)	2.5	4.8
South Africa (1993–94)	5.9	3.7
Vietnam (1997–98)	2.9	5.6
	All energy including collected firewood	
India	8.3	8.0
Nepal	2.4	6.2
Vietnam	4.8	5.9

Source: ESMAP 2003c.

Guatemala (2000)

ESMAP (2003b) analyzed the choice of household fuel for cooking and lighting in 2000 in Guatemala, especially the potential for switching from biomass to cleaner fuels. Accordingly, it did not cover expenditure on transportation fuels (gasoline and diesel) but did include information on purchased and collected firewood (evaluated at imputed prices). Rural and urban quintiles were based on national population quintile per capita expenditure groupings, thus standardizing differences in the total expenditures between the two areas. Average expenditures for kerosene, LPG, electricity, charcoal, and firewood were given for rural and urban quintiles for those households using a fuel, but shares of total expenditure were not given (table 2.5).

Table 2.5 Shares of Total Household Expenditure on All Energy Sources in Guatemala, 2000 (%)

Rural quintile	Expenditures for energy		Urban quintile	Expenditures for energy	
	All	Cash[a]		All	Cash[a]
1	10	3.6	1	9.8	5.2
2	8.9	3.5	2	11	8.1
3	7.9	4.4	3	9.2	7.8
4	7.4	5.1	4	6.9	6.4
5	5.4	4.5	5	4.3	4.2
All	**8.2**	**4.0**	**All**	**5.7**	**5.1**

Source: ESMAP 2003b.
a. Cash expenditures exclude imputed expenditures on freely acquired forms of energy such as firewood.

Rural energy expenditures, including for collected firewood, declined with total expenditure but increased when only cash outlays were included. For urban households, both total energy expenditures and cash expenditures declined from the second quintile. Urban households spent more on energy (cash-only basis) than rural households at the same expenditure quintile. The study's detailed expenditure tables indicated that LPG and firewood were the most important sources of energy at low income levels for both rural and urban households, and that electricity expenditure increased more rapidly at higher income levels. Kerosene was relatively unimportant at all income levels for both rural and urban households.

Mali (2000–01)

Energy expenditure patterns in Mali were examined by Kpodar (2006) as part of an analysis of the distributional effects of oil price changes. The study, based on a household survey carried out in 2000–01, constructed national quintiles based on total expenditures per equivalent adult. The study provided information on energy expenditures (including for electricity and charcoal) but did not distinguish between rural and urban expenditure patterns. Firewood is an important source of energy, but information was not available on its use; expenditure on LPG was unimportant and not recorded.

Table 2.6 indicates that the share of expenditure on energy rose with income level and that the shares of expenditure on all energy sources, except kerosene, also increased with income level. Diesel was unimportant throughout the income range, while the shares of spending on gasoline, electricity, and charcoal all rose strongly at the highest quintile.

Table 2.6 Shares of Total Household Expenditure on Various Energy Sources in Mali, 2000–01 (%)

	Petroleum products				Elec-	Char-	
Quintile	Kerosene	Gasoline	Diesel	Total	tricity	coal	Total
1	2.0	0.6	0.0	2.7	0.0	0.1	2.8
2	1.5	0.7	0.0	2.2	0.1	0.1	2.4
3	1.5	0.7	0.0	2.2	0.2	0.3	2.6
4	1.3	1.1	0.1	2.4	0.5	0.5	3.4
5	0.9	2.0	0.1	3.0	1.5	0.9	5.3
All	**1.5**	**1.0**	**0.0**	**2.5**	**0.4**	**0.4**	**3.3**

Source: Kpodar 2006.
Note: Details may not sum to totals because of rounding.

IMF Multicountry Study (Various Dates)

Coady and others (2006), in an IMF study, brought together information on patterns of household expenditure on petroleum products and energy for quintile groups in five countries to analyze the magnitude and distribution of fuel subsidies. Information on Ghana and Mali, two of the countries included, was taken from the sources described above. The other countries studied were Bolivia, Jordan, and Sri Lanka. For the latter two countries, information on expenditure on electricity as well as on petroleum products was included. None of the reported results

distinguished between rural and urban households, nor were data on firewood or biomass included.

Tables 2.7–2.9 present the results for the additional countries. In all three, the share of expenditure on total energy (petroleum fuels only in

Table 2.7 Shares of Total Household Expenditure on Petroleum Products in Bolivia, 2000 (%)

Quintile	LPG	Transportation fuels	Total
1	2.6	0.0	2.6
2	2.3	0.0	2.4
3	2.1	0.3	2.4
4	1.7	0.5	2.2
5	1.1	2.5	3.6
All	**1.5**	**1.6**	**3.1**

Source: Coady and others 2006.
Note: Details may not sum to totals because of rounding.

Table 2.8 Shares of Total Household Expenditure on Various Energy Sources in Jordan, 2002–03 (%)

	Petroleum products					Elec-	
Quintile	Kerosene	LPG	Gasoline	Diesel	Total	tricity	Total
1	1.0	1.8	0.9	0.3	4.0	3.1	7.1
2	0.7	1.3	1.5	0.4	3.9	2.3	6.1
3	0.6	1.2	2.1	0.4	4.3	2.1	6.3
4	0.3	0.7	3.4	0.9	5.3	1.8	7.1
5	0.3	0.7	3.4	0.9	5.3	1.8	7.1
All	**0.6**	**1.2**	**2.0**	**0.5**	**4.3**	**2.3**	**6.6**

Source: Coady and others 2006.

Table 2.9 Shares of Total Household Expenditure on Various Energy Sources in Sri Lanka, 1999 (%)

	Petroleum products				Elec-	
Quintile	Kerosene	LPG	Transportation fuels	Total	tricity	Total
1	1.8	0.1	0.0	1.9	0.8	2.7
2	1.2	0.2	0.2	1.6	1.1	2.6
3	0.9	0.2	0.3	1.4	1.1	2.6
4	0.8	0.6	0.5	1.9	1.5	3.4
5	0.4	1.4	1.6	3.4	2.1	5.4
All	**1.0**	**0.5**	**0.5**	**2.0**	**1.3**	**3.3**

Source: Coady and others 2006.

Bolivia) first declined but then rose with the level of total per capita expenditure. Kerosene was not recorded in Bolivia, but in Jordan and Sri Lanka the share of expenditure on this fuel declined with increasing quintile. In all three countries, the share of total expenditure on transportation fuels (gasoline and diesel) increased at higher income levels. The shares of expenditure for LPG and electricity fell in Jordan but rose in Sri Lanka.

Republic of Yemen (2003)

ESMAP (2005), to examine household use of energy in the Republic of Yemen, collected survey information in 2003 on the expenditure and use of all sources of energy except gasoline. Expenditure shares were calculated for each energy source for both rural and urban deciles as defined in national household income ranges; as a result, equivalent rural and urban deciles have similar average total household expenditure levels.

When the survey data were collected, the government of the Republic of Yemen was following a policy of heavy price subsidization for petroleum products, especially for LPG. This subsidization was in part meant to encourage a shift away from the use of firewood, which was widely used by households across all income levels. Data were collected for purchased firewood and charcoal as well as for other forms of biomass. Diesel was widely used, particularly in rural areas for agricultural purposes and for captive power generation where there was no grid electricity or the electricity supply was unreliable. The expenditure shares based on all households in the deciles are shown in table 2.10.

In both rural and urban households, the share of expenditure on all forms of energy (excluding gasoline) declined by income level. For rural households, the shares of expenditure on kerosene, LPG, and biomass all declined with income, while the shares of expenditure on diesel and electricity increased. In urban households, the shares of expenditure on all sources of energy except diesel decreased at higher income levels. At lower deciles in both rural and urban areas, the total expenditure on energy accounted for very large shares of all household expenditure; urban households dedicated a larger share to energy than did the equivalent rural decile even though average total household expenditures were similar.

Luanda, Angola (2005)

A poverty and social impact analysis was carried out by the World Bank (2005) in the Luanda province of Angola. This analysis concerned the effects of phasing out fuel and electricity price subsidies on households at different income levels. A relatively small household survey collected

Table 2.10 Shares of Total Household Expenditure on Various Energy Sources in the Republic of Yemen, 2003 (%)

	Decile	Kerosene	LPG	Diesel	Electricity	Biomass	All energy[a]
Rural	1	4.4	3.8	0.2	0.6	3.1	15
	2	2.6	3.1	0.2	0.4	2.1	10
	3	2.0	3.2	0.8	0.7	1.5	12
	4	2.3	3.2	0.9	1.0	1.7	12
	5	1.4	3.0	0.9	0.8	0.9	9.7
	6	1.1	2.7	0.4	1.2	1.4	8.1
	7	1.0	2.7	1.1	1.3	0.9	10
	8	0.9	2.2	1.1	0.9	1.1	9.2
	9	0.5	2.0	1.6	1.4	0.7	10
	10	0.3	1.3	1.9	1.1	0.7	7.1
	All	**1.1**	**2.3**	**1.2**	**1.0**	**1.1**	**9.4**
Urban	1	2.1	4.6	0.1	5.0	2.4	18
	2	1.3	2.8	0.0	5.9	1.6	13
	3	0.8	3.4	0.0	4.6	1.8	12
	4	0.4	1.9	0.1	4.0	0.6	7.8
	5	0.6	2.8	0.0	4.1	1.2	10
	6	0.4	2.5	0.4	4.8	1.2	10
	7	0.6	2.0	0.1	4.7	1.1	9.0
	8	0.3	1.9	0.3	3.8	1.0	8.6
	9	0.1	1.4	0.3	3.3	0.5	6.2
	10	0.1	1.0	0.4	2.2	0.4	4.5
	All	**0.3**	**1.7**	**0.3**	**3.4**	**0.8**	**7.1**

Source: ESMAP 2005.
a. "All energy" consists of kerosene, LPG, diesel, electricity, biomass, candles, batteries, and maintenance and repair of self-generating units.

expenditure information on the main commercial sources of energy but excluded biomass. The survey was carried out for rural and urban households in Luanda and therefore did not represent expenditure patterns for the whole country. Quintiles were based on per capita expenditure, but results for the expenditure analysis did not separate rural and urban household expenditure patterns. The results for aggregate quintiles are shown in table 2.11.

The share of total expenditure allocated to energy was very high for the lowest quintile but declined markedly at higher quintiles. LPG was the most important item of energy expenditure at all income levels. The shares of total expenditure for LPG, kerosene, electricity, and coal/charcoal all

Table 2.11 Shares of Total Household Expenditure on Various Energy Sources and Public Transport in Luanda, Angola, 2005 (%)

Quintile	Petroleum products					Electricity	Coal/charcoal	Total energy	Public transport
	Kerosene	LPG	Gasoline	Diesel	Total				
1	2.3	13	1.9	0.2	17	4.3	0.9	23	3.8
2	1.7	5.8	1.5	0.2	9.2	2.8	0.9	13	6.0
3	1.1	4.3	1.3	0.2	6.9	2.9	0.5	10	6.1
4	1.1	3.5	1.5	0.3	6.3	3.1	0.5	10	5.5
5	0.4	2.9	2.0	0.5	5.8	2.2	0.6	8.6	4.3
All	**1.3**	**5.7**	**1.6**	**0.3**	**9.0**	**3.0**	**0.7**	**13**	**5.1**

Source: World Bank 2005.

declined at higher quintiles, while the shares for gasoline and diesel rose from the third quintile onwards. The share of expenditure for public transport was also substantial, although it was lowest for the top quintile.

Gabon (2005)

El Said and Leigh (2006) looked at the magnitude of fuel price subsidies in Gabon using evidence drawn from a 2005 household survey. Shares of per capita expenditures allocated to kerosene, LPG, and transportation fuels (gasoline and diesel), were given for national decile groups. No separate information on other forms of energy expenditure or rural versus urban patterns were reported. Table 2.12 gives the results of these calculations.

Table 2.12 Shares of Total Per Capita Expenditure on Petroleum Products in Gabon, 2005 (%)

Decile	Kerosene	LPG	Transportation fuels	Total
1	1.3	1.2	0.0	2.6
2	0.8	1.6	0.1	2.5
3	0.6	1.6	0.1	2.3
4	0.5	1.8	0.3	2.5
5	0.4	1.6	0.2	2.2
6	0.4	1.8	0.3	2.4
7	0.3	1.7	0.5	2.5
8	0.2	1.6	1.1	2.9
9	0.2	1.5	1.4	3.0
10	0.1	1.1	2.5	3.7
All	**0.5**	**1.5**	**0.6**	**2.7**

Source: El Said and Leigh 2006.

The share of expenditure on transportation fuels rose, and that on kerosene declined, with expenditure level. The share of expenditure on LPG initially increased but then declined over the top four deciles. The total share of expenditure on petroleum products remained fairly constant up to the eighth decile, above which it increased. The total share of petroleum products is much lower than in some other countries.

Madagascar (2005)

Andriamihaja and Vecchi (2007) analyzed the potential impact of an increase in petroleum prices on household living standards in Madagascar, using information from a 2005 household expenditure survey. The quintiles were based on national per capita annual expenditures for kerosene, gasoline, diesel, and electricity. Information on differences between rural and urban households was presented only in diagrammatic form.

Table 2.13 presents the results. The share of total expenditure on energy declined with quintile group until the highest quintile was reached. This effect was dominated by a falling share for kerosene and a rising share for electricity. The share for diesel was negligible at all income levels, while that for gasoline was negligible for all quintiles except the top level.

Table 2.13 Shares of Total Household Expenditure on Various Energy Sources in Madagascar, 2005 (%)

	Petroleum products					
Quintile	Kerosene	Gasoline	Diesel	Total	Electricity	Total
1	3.2	0.0	0.2	3.4	0.1	3.5
2	2.3	0.0	0.1	2.4	0.1	2.5
3	2.0	0.0	0.1	2.0	0.2	2.3
4	1.6	0.0	0.1	1.7	0.5	2.2
5	1.0	0.3	0.1	1.4	1.2	2.6
All	**1.9**	**0.1**	**0.1**	**2.1**	**0.5**	**2.6**

Source: Andriamihaja and Vecchi 2007.

Common Findings

The surveys reviewed above were carried out in different years—corresponding to different international energy prices—and in countries with different energy pricing policies and varying levels of energy subsidies. Despite these differences, certain common features emerge. Classifying

countries around a series of stylized facts helps highlight these similarities and differences. These simple criteria are used as a starting point for description of patterns of energy use; where fuller information is available, as in chapter 3, more nuanced patterns of use may be discerned.

The main variables considered are described below.

- Was the share of total expenditure on energy greater than 5 percent for the lowest quintile?[1]
- Was the share of expenditure on energy generally greater for urban households than for rural households at the same quintile level?
- Did the share of expenditure on kerosene tend to fall with rising income?
- Did the share of expenditure on electricity tend to rise with income?
- Did the share of expenditure on LPG tend to rise with income?
- Did the share of expenditure on gasoline tend to rise with income?
- Was the share of diesel less than 0.5 percent at all income levels?
- Did the share of expenditure on petroleum products first decline and then rise with income (U-shaped response)?

The tabulation of findings is given in table 2.14.

The table indicates considerable variation among the countries surveyed. In about half the countries, the share allocated to energy was more than 5 percent for the lowest-income groups, indicating its direct importance in household budgets. In the majority of countries where information was available, the share of expenditure on energy was higher for urban households in the same quintiles, but this finding should be interpreted in light of the fact that quintiles were defined separately for the rural and urban groups in some countries and hence were not necessarily at similar per capita income levels. A common finding in all countries for which information was available is that the share of expenditure on kerosene declined at higher income levels. The share of electricity at different income levels did not show a common tendency to increase or decrease, but was country specific. The share of expenditure on LPG decreased in more countries than those in which it increased, but information on LPG consumption was not available for many countries. The share of gasoline rose in all countries for which information was available, while the share of expenditure on diesel tended to be less than 0.5 percent at all income levels. The combination of a falling share of kerosene and a rising share

[1]In all surveys, except for that in the Republic of Yemen, the figure for total energy excludes any imputed expenditure for firewood or other forms of biomass.

Table 2.14 Patterns of Energy Use Based on Selected Surveys

Country and survey year	Share > 5%	Urban > rural	Kerosene falls	Electricity rises	LPG rises	Gasoline rises	Diesel < 0.5%	U-shaped response
Angola, 2005	Y	—	Y	N	N	Y	Y	Y
Bolivia (petroleum products only), 2000	N	—	—	—	N	Y*	—	Y
Gabon (petroleum products only), 2005	—	—	Y	—	—	Y*	—	Y
Ghana (petroleum products only), 1999	Y	—	Y	—	Y	Y	—	Y
Guatemala, 2000	Y	Y	—	—	—	—	—	—
Iran, Islamic Rep., 1999	N	N	Y	N	—	Y	Y	N
India (cooking and lighting), 1999–2000	—	Y	Y	Y	Y	—	—	—
Jordan, 2002–03	Y	—	Y	N	N	Y	N	Y
Madagascar, 2005	N	—	Y	Y	—	Y	Y	N
Mali, 2000–01	N	—	Y	Y	—	Y	Y	Y
Sri Lanka, 1999	N	—	Y	Y	Y	Y*	—	Y
Yemen, Rep., 2003	Y	N	Y	N	N	—	N	Y

Source: Authors' calculations.
Note: Y = yes; N = no; — = not available; * = information provided relates to both gasoline and diesel, which were not separated. Studies that did not provide sufficient information to complete at least two columns of the table were excluded.

for gasoline did produce a U-shaped pattern of expenditure on petroleum products in most countries for which data were available.

Chapter 3

Methodology and Findings

This study aimed to answer the following questions concerning the use of, and expenditures on, energy sources by households, and their importance relative to household expenditures on food and transport, two items that are affected by higher energy prices:

- What proportion of household income is spent on petroleum products, on modern sources of energy, and on energy generally? How does spending on energy compare to what households spend on food and transport?
- How do proportions vary across income levels, and is the effect of higher energy prices expected to weigh more heavily on low- or high-income groups?
- Are there important differences in the patterns of expenditure on energy, food, and transport between rural and urban households at similar income levels?
- What proportion of households use various energy sources at different income levels and in rural and urban areas?
- What are the main energy sources used for cooking and lighting?

To answer these questions, the study analyzed a number of household expenditure surveys that provide similar coverage on the pattern of expenditures on energy sources, food, and transport. Production-related expenditures—such as diesel used to power irrigation pumps and the cost of transporting produce to markets—were excluded from the analysis.

The proportion of household income spent on energy can be used to quantify the potential vulnerability of households to higher energy prices. Because households purchase energy items directly, their effects on household welfare are called *direct effects*. The proportion of household income spent on food and transport can give an indication of *indirect effects* of higher energy prices. An input-output table may suggest, for example, that a 10 percent rise in oil prices will lead to a 3 percent rise in transport costs and a 2 percent rise in food prices. Potential increases

in the prices of these items can then be calculated for a given increase in oil prices and the impact on households in different income groups estimated. Such estimations based on an input-output table give an upper bound on the effects of higher oil prices. To take substitution and other effects into account, a general equilibrium model needs to be used. This study, however, stops at the question given in the first bullet above.

To allow comparisons across surveys conducted in different countries, this study used the same methodology to move from original household expenditure data to an analysis of energy and other expenditure patterns. Notably, as described in the following sections, the study created a standardized procedure for

- defining the measure of total household expenditure to be used;
- arranging the data in expenditure groups;
- calculating average household expenditures on various energy sources by all households and average uptake rates (the percentage of households using the energy source), and on food and transport.

Measuring Total Household Expenditure

To determine the potential vulnerability of households to higher energy prices, expenditures on different sources of energy are compared to total household expenditure. The use of household expenditure rather than household income was determined by data availability, since many surveys provide evidence only on the former.

The use of total household expenditure as a reference against which expenditure on fuels and electricity can be compared raises two further measurement problems. First, some recorded expenditure is actually based on consumption of nonpurchased goods and services. Households acquire certain goods without payment (for example, food and biomass), but household surveys generally collect such data and impute prices to the quantities acquired, thus increasing measured expenditure. In most cases, the dominant categories of imputed expenditure are food and housing. For biomass sources of energy, which can be collected rather than purchased, most surveys impute a value to the collected product. All these imputed expenditures are included in the present study in total household expenditure for those countries where the surveys have provided such information unless indicated otherwise. It is common for imputed values to be entered by the enumerators on the raw survey data sheets. The imputed values are intended to approximate local market values, but it is difficult to know how accurately the respondents and

enumerators estimated the market values of nonpurchased goods and services. In the extreme case, no local market may exist—for example, all firewood in a community may be collected and not purchased. For this reason, the values of nonpurchased energy are expected to have the greatest uncertainties.

The second issue in using total household expenditure as a proxy for disposable income is the purchase of high-cost durables in the year of the survey. Expensive durables that have a life of many years are likely to be financed out of savings. Including them in total household expenditure—to represent the income level that determines the purchases of goods regularly acquired—may misrepresent household income. Households that purchase such a durable good in the year of the survey will appear to have a higher income than is normally the case and can be placed in a higher-income group than their long-term behavior would merit. They would be seen to be allocating a smaller share of total expenditure on energy and other nondurable items than would have occurred had the survey been taken in a different year. To deal with this problem, expenditure on major durables is excluded from total household expenditures in this study. However, the classification used by household surveys in different countries does not permit a standardized definition of major durables; such items thus vary from country to country (see appendix A).

Constructing Expenditure Groups

Because the primary purpose of this study is to quantify differences in expenditure patterns on energy, food, and transport across income levels, the method of grouping households by expenditure is critical. Poverty levels are conventionally analyzed by per capita income rather than household income, because the same household income with different household sizes clearly does not correspond to the same welfare level. Accordingly, households are divided into expenditure groups on a per capita basis, even though expenditure patterns are analyzed at a household level. Expenditure surveys are carried out using households as the basic data unit with information included about the number of household members, and these are used to construct such a distribution.

The method of grouping used in this study is to rank households by their associated per capita total expenditure. The ranked households are then assigned to quintiles in order of increasing per capita expenditure so that each quintile contains an equal number of *people* rather than of

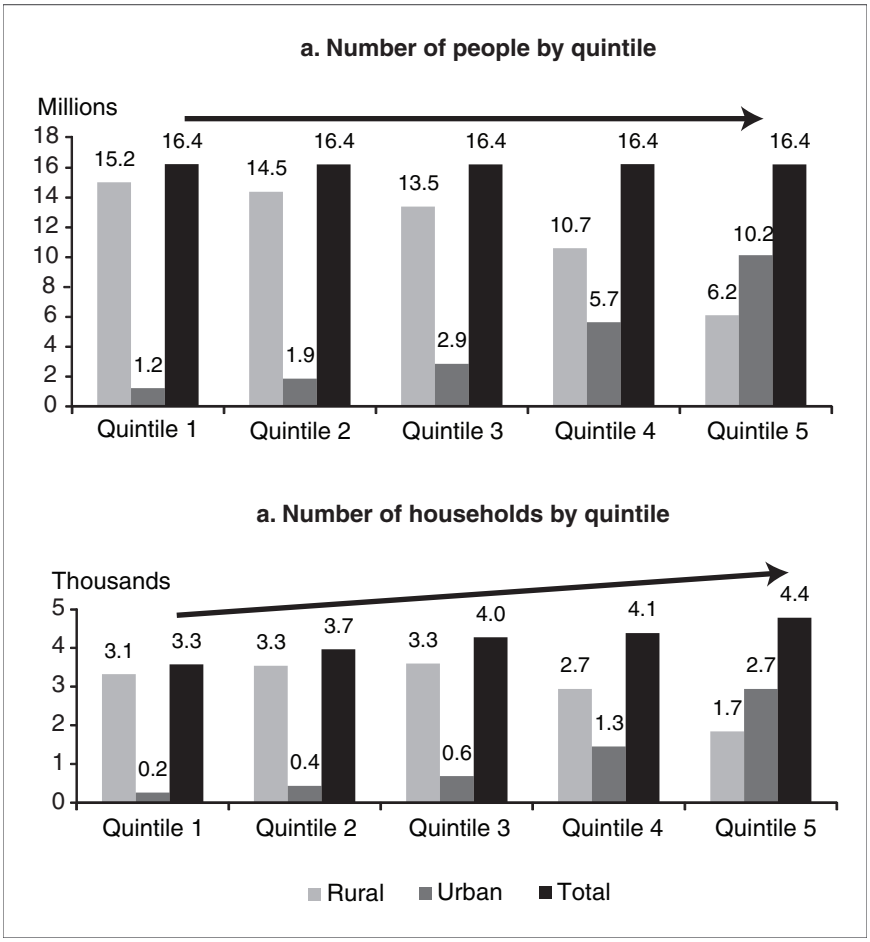
households, corresponding to 20 percent of the total surveyed population (figure 3.1a). Where this paper discusses consumption patterns for energy and other items at different income levels, the income levels refer to the quintiles computed on the basis of average per capita expenditures. In assigning households to quintiles, they are weighted by factors that ensure the sample represents the characteristics of the population as identified in a national census. These weights are coded in the responses of the household surveys. Since household size varies across the income distribution, the number of households per quintile will not be constant. More specifically, 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 reported, households from the nationally based quintiles were 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; the lowest-income urban households are similarly derived (figure 3.1b). Note that rural areas in household surveys might have included areas more precisely considered peri-urban than rural. For example, rural users of natural gas in Pakistan were most likely peri-urban residents.

This allocation method makes the per capita expenditure ranges at the same quintile for rural and urban groups similar, although not identical. In contrast, the alternative method of dividing the population into rural and urban areas first and then creating quintiles in each region can make per capita expenditure in the same quintile group markedly different between rural and urban, introducing an additional complication in interpreting the results.

Calculating Average Expenditure Shares and Uptake Rates

To calculate the average expenditure share of a particular item, this study averages the expenditure share for each household in the quintile by number of households—weighted for this purpose—in the quintile. This average is more important for policy purposes than an average taken across only those households that consume the particular good. When considering the impact of higher or lower prices, the government's first concern is the welfare of *all* households in a given group; a particularly important question is how the poor as a whole may be affected. For this reason, unless indicated otherwise, group averages are obtained by aver-

Figure 3.1 Creating Quintiles: Example from Ghana



Source: Authors' calculations.

aging across all households, regardless of whether they consumed the good in question.

There are two ways of computing the average share of total expenditure on an item. The first is the average for the group of each household's ratio of expenditure on the item to total expenditure (the *democratic budget share*); the second is the ratio of the average expenditure on the item of the group to its average total expenditure (the *plutocratic budget share*). This study uses the former method, because the variable of interest is usually the share of expenditure for households rather than the share of the group as a whole.

By identifying which households report zero expenditure on a particular energy source, it is possible to define an uptake rate. Taking the ratio of the number of households using an energy source to the total number of households in that same group, the degree of uptake can be derived. This procedure was used to compute uptake rates for all forms of energy except biomass and electricity in Kenya, LPG in Thailand, and electricity in Uganda, as explained below and in appendix A. Taking the average expenditure on an energy source only for the subset of users within a group, a different share of expenditure on the energy source can be derived. The average share of expenditure by users will be higher than the average share for all households, and this difference will be larger the lower the uptake rate for the group.

Countries Analyzed and Total Household Expenditures

The study focuses on a group of recent household expenditure surveys that provide extensive information on expenditures for various forms of energy. These surveys are for Bangladesh (2005), Cambodia (2003–04), India (2004–05), Indonesia (2005), Kenya (2005–06), Pakistan (2004–05), Thailand (2006), Uganda (2005–06), and Vietnam (2006). Details on the surveys are given in appendix A. These surveys, all conducted in 2003–06 and, with the exception of Thailand, for countries at fairly similar levels of per capita income, provide a basis for analyzing energy expenditure patterns under reasonably comparable external environments. The surveys are mainly from Asian countries, where the wealth of material available permitted selection for almost identical time periods. The two African countries were included to provide a wider comparison from among readily available and comparable surveys.

The original survey data were reported in current local currency prices. To provide a comparative evaluation of the results, average per capita expenditures are given in 2005 dollars valued at purchasing power parity (PPP), as shown in table 3.1. The table also provides comparative information on levels of average annual per capita expenditure from national accounts and the rate of urbanization in each country. The countries surveyed had fairly similar consumption levels valued at PPP, except Thailand, where the level was more than double that in Kenya, the next highest case. The expenditure surveys in some countries yield a different value for average consumer expenditure than that based on the national accounts because of the inclusion or omission of certain items in

Table 3.1 Average Annual Per Capita Expenditure and Urbanization in Sample Countries

Country	Survey year	Annual per capita expenditure		% of households living in urban areas
		From national accounts	From survey	
Bangladesh	2005	706	657	25
Cambodia[a]	2003–04	849	1,013	15
Cambodia[b]	2003–04	849	900	15
India	2004–05	1,170	707	27
Indonesia	2005	1,931	801	44
Kenya[a]	2005–06	938	1,295	25
Kenya[b]	2005–06	938	1,127	25
Pakistan	2004–05	1,479	1,005	32
Thailand	2006	3,773	3,073	32
Uganda[a]	2005–06	572	926	17
Uganda[b]	2005–06	572	764	17
Vietnam[a]	2006	1,160	1,071	27
Vietnam[b]	2006	1,160	986	27

Source: National accounts data and exchange rates from World Bank 2009.
Note: Expenditures are in 2005 dollars at PPP.
a. Including nonpurchased food.
b. Excluding nonpurchased food.

the surveys; Bascand, Cope, and Ramsay (2006) note that such a disparity is not unusual. Household expenditure surveys showed that urban households comprised less than half of all households in every country. They constituted 30 percent of households when averaged across all households in the study countries, ranging from 15 percent in Cambodia to 44 percent in Indonesia.

The grouping of households into quintiles based on per capita expenditures, and the subsequent separation into rural and urban quintiles drawn from these national quintiles, also produces a distribution of total household expenditure by quintile. Mean monthly household expenditure, converted to 2005 dollars at PPP, for the different quintile groups are given in table 3.2. For Cambodia, Kenya, Uganda, and Vietnam, the value of nonpurchased food at imputed prices was sufficiently large to shift households from one quintile to another if it were excluded. For consistency, the tables in the main text are based on the *inclusion* of imputed food expenditure. The differences in total expenditure by quintile for these countries excluding the value of nonpurchased food

Table 3.2 Average Monthly Total Household Expenditure by Quintile (2005 $ at PPP)

	Quintile	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Rural	1	120	140	115	124	139	265	316	118	179
	2	160	187	149	159	229	334	430	181	239
	3	197	228	178	181	295	381	565	240	288
	4	266	291	215	223	391	445	755	311	377
	5	449	757	335	351	675	623	1,406	558	568
	All	**223**	**310**	**184**	**186**	**343**	**405**	**637**	**280**	**304**
Urban	1	119	140	122	138	126	295	351	127	199
	2	165	199	172	174	202	352	489	201	260
	3	199	256	202	219	276	418	644	245	325
	4	261	337	252	275	395	518	853	331	422
	5	567	993	471	452	993	904	1,588	784	749
	All	**355**	**650**	**372**	**318**	**729**	**636**	**1,142**	**586**	**556**

Source: Authors' calculations.

are given in tables B.1–B.4 in appendix B. The survey in Vietnam did not include a question on imputed rent, so total household expenditures for that country are lower relative to the measure used in the other countries.

Table 3.2 indicates that the households surveyed had an average urban monthly household expenditure (including nonpurchased food) of $550 or higher in Cambodia, Kenya, Pakistan, Thailand, Uganda, and Vietnam; the average urban expenditure was lower than $400 in Bangladesh, India, and Indonesia. Thailand had the highest average rural expenditure (including nonpurchased food), followed by Pakistan, Kenya, Cambodia, and Vietnam. Excluding nonpurchased food reduced the average rural expenditure in Cambodia, Kenya, Uganda, and Vietnam by a substantial fraction, leaving Thailand and Pakistan distinctly higher than the other countries surveyed.

In every country, the average expenditure for all urban households was higher than for rural. In Cambodia, India, Indonesia, Pakistan, Thailand, Uganda, and Vietnam, the average expenditure of a given urban quintile was higher than that of its corresponding rural quintile. In Bangladesh, the first four rural and urban quintiles were similar to each other, with only the top urban quintile being well above the top rural

quintile. Excluding the value of nonpurchased food reduced the average urban expenditure in Cambodia, Kenya, Uganda, and Vietnam by a small fraction. In Kenya, when the value of nonpurchased food was included, the bottom three rural quintiles had a higher average household expenditure than the corresponding urban quintiles; this trend could not be discerned when nonpurchased food was excluded.

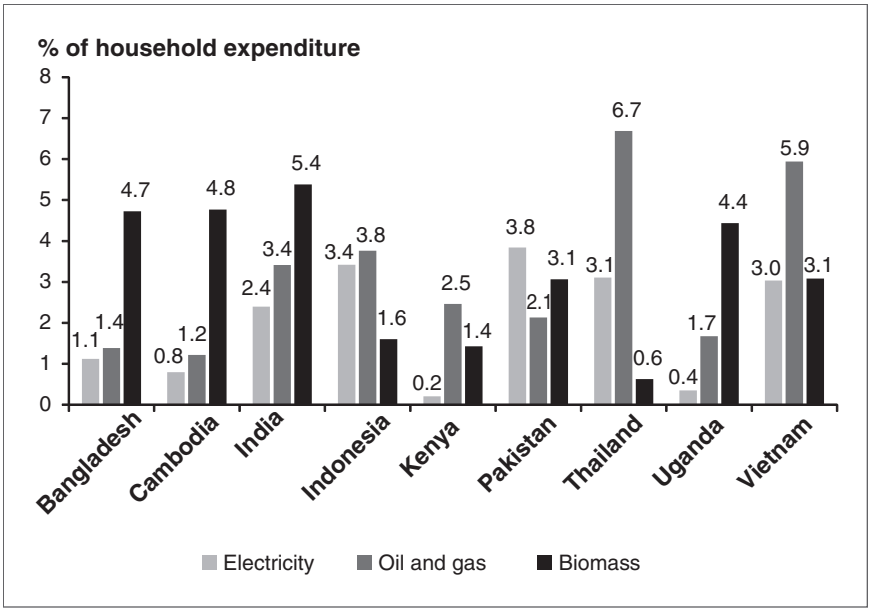
Shares of Expenditure on Energy, Food, and Transport

Shares of total energy and of the individual sources of energy in the household budget are the starting point of this analysis. A detailed description of the fuels covered in the different questionnaires is given in appendix A, which also explains the grouping of fuels into the categories used here. Coverage varies from country to country; notably, questions were not asked about expenditure on LPG in Bangladesh and Uganda, and on gasoline and diesel in Cambodia. These omissions are likely to result in underestimation of expenditure on energy by higher-income households in those countries.

Figure 3.2 shows expenditure shares for electricity, oil and gas (petroleum products and natural gas), and biomass averaged across all households. The expenditure share, inclusive of imputed values of nonpurchased fuels, was highest for biomass in India, Cambodia, Bangladesh, and Uganda. As mentioned earlier, values of nonpurchased biomass fuels are likely to contain large uncertainties, and these findings should be interpreted with caution. In particular, 30 percent of all Kenyan households surveyed assigned a value of zero to nonpurchased biomass, thereby reducing expenditures on biomass and increasing the share of modern energy in total energy. The share for oil and gas was highest in Thailand, Vietnam, Indonesia, and India; because natural gas is not available to households in these countries, the share represents that for petroleum products. The expenditure share for electricity was highest only in Pakistan.

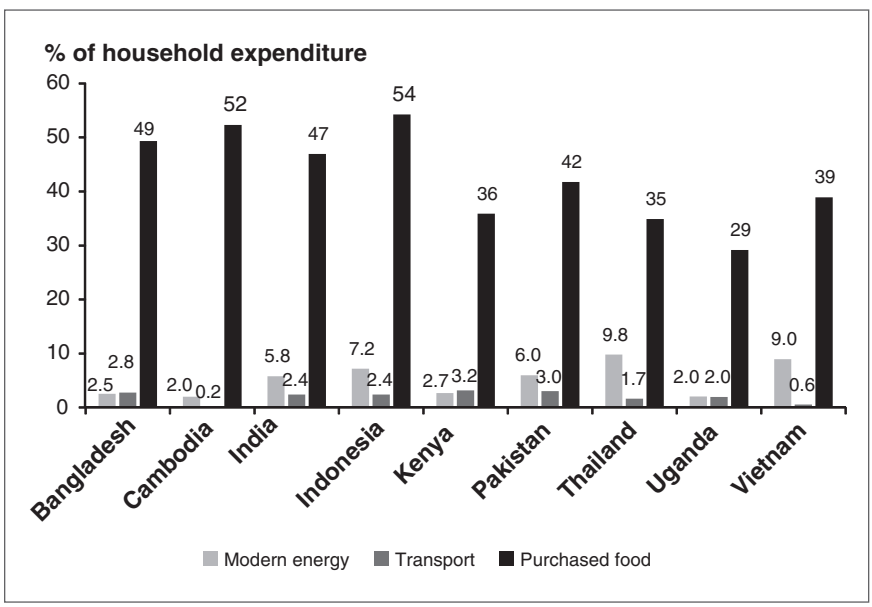
Expenditures on transport were comparable to or lower than those in modern energy; as expected, expenditures on food were markedly higher (figure 3.3). Even in Thailand, which had the smallest difference between expenditures on modern energy and food, households on average spent 3.5 times more on food than on modern energy. The difference widens to a factor of 4.4 when the imputed value of nonpurchased food is included.

Figure 3.2 Shares of Total Household Expenditure on Various Energy Sources



Source: Authors' calculations.

Figure 3.3 Shares of Total Household Expenditure on Modern Energy, Food, and Transport



Source: Authors' calculations

The shares of total expenditure devoted to the individual sources of energy, to subgroups of energy sources, and to total energy are presented for rural households in table 3.3 and for urban households in table 3.4. The tables also show the shares of total household expenditure spent on food (purchased and nonpurchased) and transport. They indicate that, in all countries and in both rural and urban areas, energy accounted for 4 percent to 14 percent of total household expenditure, ranging from 6 percent in urban Uganda and Kenya to 14 percent in urban Vietnam, and from 4 percent in rural Kenya to 12 percent in rural India. The Cambodian survey did not ask for information on expenditure on gasoline or diesel; thus, the extent to which households actually purchased these fuels as a total share of spending on energy was understated. In Kenya, 30 percent of households assigned an imputed value of zero to nonpurchased biomass, again understating total energy spending. Since all

Table 3.3 Shares of Rural Household Expenditure on Various Energy Sources, Food, and Transport: All Households (%)

Expenditure item	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Kerosene	1.1	1.1	1.7	2.2	1.9	0.4	0.0	1.5	0.3
LPG	ND	0.1	0.5	0.1	0.1	0.2	0.6	ND	1.9
Gasoline and diesel	0.1	ND	0.5	0.8	0.1	0.7	6.3	0.2	2.6
Petroleum products	**1.2**	**1.2**	**2.7**	**3.3**	**2.1**	**1.3**	**7.0**	**1.7**	**4.7**
Electricity	0.7	0.5	2.0	3.0	0.0	3.4	2.9	0.2	2.7
Natural gas	0.0	NA	NA	0.0	NA	0.1	0.0	NA	NA
Modern energy	**2.0**	**1.7**	**4.7**	**6.3**	**2.2**	**4.8**	**9.9**	**1.9**	**7.4**
Biomass	5.3	5.0	6.8	2.5	1.3	4.0	0.8	4.6	3.8
Total energy	**7.3**	**6.8**	**12**	**8.8**	**3.5**	**8.8**	**11**	**6.5**	**11**
Purchased food	49	52	49	55	35	42	35	27	38
Nonpurchased food	15	20	11	11	25	14	11	29	16
Total food	**64**	**72**	**60**	**67**	**60**	**56**	**46**	**56**	**54**
Transport	2.4	0.2	2.4	1.8	2.6	3.0	1.3	1.8	0.6

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel. Nonpurchased items, including cashfree biomass, are included. In Vietnam, "gasoline and diesel" included only gasoline and lubricants; biomass included coal, as well as charcoal, firewood, and other forms of biomass. In Thailand, "natural gas" refers to compressed natural gas used as an automotive fuel. In Kenya, 39 percent of all rural households and 4 percent of urban households surveyed assigned an imputed value of zero to nonpurchased biomass.

Table 3.4 Shares of Urban Household Expenditure on Various Energy Sources, Food, and Transport: All Households (%)

Expenditure item	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Kerosene	0.6	0.5	1.2	2.4	2.7	0.1	0.0	1.1	0.3
LPG	ND	0.8	2.5	0.3	0.4	0.3	0.5	ND	4.6
Gasoline and diesel	0.1	ND	1.5	1.3	0.5	1.7	5.6	0.4	4.3
Petroleum products	**0.7**	**1.3**	**5.2**	**4.3**	**3.5**	**2.1**	**6.1**	**1.5**	**9.1**
Electricity	2.2	2.8	3.6	4.0	0.7	4.8	3.5	1.1	4.0
Natural gas	1.0	NA	NA	0.0	NA	1.6	0.0	NA	NA
Modern energy	**4.0**	**4.1**	**8.8**	**8.3**	**4.2**	**8.4**	**9.6**	**2.7**	**13**
Biomass	3.1	3.2	1.6	0.5	1.8	1.1	0.2	3.6	1.2
Total energy	**7.1**	**7.3**	**11**	**8.8**	**6.0**	**9.6**	**9.8**	**6.3**	**14**
Purchased food	51	53	41	53	39	42	35	37	41
Nonpurchased food	3.9	6.6	0.8	3.2	6.9	2.0	4.5	6.5	2.6
Total food	**55**	**60**	**42**	**56**	**46**	**44**	**39**	**44**	**44**
Transport	2.8	0.1	2.5	3.1	4.9	3.1	2.5	2.5	0.5

Source: Authors' calculations.
Note: See notes for table 3.3.

surveys were carried out prior to 2007, these shares do not reflect high international oil prices in 2007–08. Results averaged across all households are shown in table B.5.

In Bangladesh, Cambodia, India, Indonesia, Pakistan, Thailand, and Uganda, the shares of expenditure on energy were similar between the rural and urban groups as a whole. In Kenya and Vietnam, the shares were substantially higher for urban households. Tables B.6–B.9 show that, when the value of nonpurchased food was excluded in Cambodia, Kenya, Uganda, and Vietnam, the share of expenditure on energy increased for both rural and urban households—substantially in the case of the former, indicating the importance of nonpurchased food.

Modern energy—electricity, petroleum products, and natural gas—is more convenient and generates less indoor air pollution than firewood or other solid fuels. However, because modern energy is typically more expensive, it tends to be used less by lower-income households as well as by those in rural areas where biomass is more likely to be free or much cheaper. The household surveys analyzed in this study indicate that, with

the exception of Uganda, modern energy comprised at least 50 percent of total energy expenditure for urban households on average. The share of modern energy in total energy consumed was substantially smaller in rural areas, and was less than 30 percent on average in Bangladesh and Cambodia. In Thailand, which had the highest household income level in the sample, modern energy's share of total energy was 98 percent in urban areas and 90 percent in rural.

The share of petroleum products in total energy expenditure was smaller, but still greater than 50 percent in urban areas in India, Indonesia, Kenya, Thailand, and Vietnam. The proportion of total energy accounted for by petroleum fuels in rural areas was notably lower than in urban areas for India and Vietnam.

The share of total household expenditure on electricity was higher in urban than in rural areas in all countries; with the exceptions of Bangladesh and Uganda, the share of petroleum products was also greater in urban areas. Particularly in Thailand, but also in India, Indonesia, and Vietnam, the share of petroleum products in urban areas was significant, indicating the potential vulnerability of these households to large oil price increases.

Among fuels, biomass was the most important in rural areas, with the exception of Kenya where kerosene's share of total was greater. This finding, which does not reflect the relative amounts of kerosene and biomass used by Kenyan households, is primarily due to nonpurchased biomass being given zero imputed values by many households. In Thailand, biomass was unimportant as an energy source in both rural and urban areas. LPG was not important for rural households except in Vietnam, but its consumption was substantial in urban areas in India and Vietnam. Kerosene was more important in rural than urban areas except in Kenya and was essentially not consumed by households in Thailand. Gasoline and diesel were more important in urban than in rural areas in all countries and were of very considerable importance in Thailand, where they accounted for more than 5 percent of total expenditure in both rural and urban areas. The greater use of natural gas (where available) in urban areas reflects the fact that natural gas is usually not supplied to rural households. In Thailand, natural gas refers to compressed natural gas for use in vehicles, and its use at the time of the survey was limited.

The expenditure share on all food, both purchased and nonpurchased, varied from 46 percent in Thailand to 72 percent in Cambodia for rural households, and from 39 percent in Thailand to 60 percent in Cambodia for urban households. The smallest expenditure share on purchased

food was 27 percent in rural Uganda; the highest share was 55 percent in rural Indonesia. The expenditure shares on purchased food were identical across rural and urban households in Pakistan and Thailand, and very close in Bangladesh, Cambodia, and Indonesia. Purchased food comprised at least 90 percent of the total value of food consumed by urban households in all countries except Cambodia and Uganda. In rural areas, purchased food comprised as little as 48 percent of total food consumption in Uganda, followed by 58 percent in Kenya, and 70 percent in Vietnam. The highest share was 82 percent in India and Indonesia.

Further insights into variations in the consumption of fuel, food, and transport can be obtained by examining expenditures by quintile. Expenditure shares for rural quintiles are shown in table 3.5 and for urban quintiles in table 3.6; shares for all households are shown in table B.10. In rural areas, the total energy share fell with rising quintile in Bangladesh, Cambodia, India, and Uganda; increased in Kenya, Pakistan, Thailand, and Vietnam; and increased through the bottom four quintiles in Indonesia. In urban areas, the share of spending on total energy decreased with rising quintile in Bangladesh, Cambodia, India, Indonesia, and Uganda. It fell from the second to the fifth quintile in Kenya. In

Table 3.5 Shares of Rural Household Expenditure on Various Energy Sources, Food, and Transport by Quintile: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Bangladesh	1	1.5	ND	0.0	0.3	0.0	6.2	**1.5**	**1.8**	**8.0**	56	13	**70**	1.8
	2	1.3	ND	0.0	0.4	0.0	5.8	**1.3**	**1.8**	**7.6**	51	17	**68**	2.2
	3	1.1	ND	0.0	0.8	0.0	5.5	**1.2**	**2.0**	**7.5**	49	16	**65**	2.5
	4	0.9	ND	0.1	1.1	0.1	4.7	**1.0**	**2.2**	**6.9**	45	15	**60**	2.9
	5	0.6	ND	0.4	1.2	0.1	3.5	**1.0**	**2.4**	**5.9**	39	12	**51**	2.9
Cambodia	1	1.6	0.0	ND	0.1	NA	6.6	**1.6**	**1.7**	**8.4**	49	28	**77**	0.2
	2	1.3	0.0	ND	0.1	NA	5.8	**1.3**	**1.5**	**7.3**	51	25	**76**	0.2
	3	1.1	0.0	ND	0.3	NA	5.2	**1.2**	**1.5**	**6.8**	54	21	**75**	0.2
	4	0.9	0.1	ND	0.6	NA	4.6	**1.0**	**1.6**	**6.2**	56	16	**72**	0.2
	5	0.5	0.4	ND	1.3	NA	2.9	**0.8**	**2.1**	**5.0**	50	9.4	**59**	0.1
India	1	2.1	0.0	0.0	1.2	NA	8.8	**2.2**	**3.4**	**13**	55	8.8	**63**	1.5
	2	1.9	0.1	0.1	1.7	NA	7.9	**2.1**	**3.8**	**12**	52	10	**63**	1.9
	3	1.7	0.4	0.3	2.1	NA	6.9	**2.4**	**4.4**	**12**	49	12	**61**	2.4
	4	1.4	0.9	0.7	2.4	NA	5.6	**3.1**	**5.5**	**11**	45	12	**58**	2.9
	5	0.9	1.9	2.1	2.8	NA	3.1	**4.9**	**7.8**	**11**	41	8.9	**50**	3.8

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Indonesia	1	2.1	0.0	0.2	2.4	0.0	3.7	**2.4**	**4.8**	**8.5**	55	15	**70**	1.2
	2	2.3	0.0	0.6	2.9	0.0	2.9	**3.1**	**5.9**	**8.8**	56	11	**68**	1.7
	3	2.3	0.1	0.9	3.4	0.0	2.2	**3.5**	**6.9**	**9.1**	56	11	**66**	2.2
	4	2.4	0.1	1.3	3.5	0.0	1.6	**4.1**	**7.6**	**9.2**	56	8.4	**64**	2.2
	5	1.8	0.3	1.6	3.0	0.0	1.0	**4.3**	**7.3**	**8.3**	52	8.7	**61**	2.2
Kenya[a]	1	2.1	0.0	0.0	0.0	NA	0.9	**2.1**	**2.1**	**3.0**	39	31	**70**	1.5
	2	2.1	0.0	0.0	0.0	NA	1.3	**2.1**	**2.1**	**3.4**	37	29	**66**	2.2
	3	2.0	0.0	0.0	0.0	NA	1.3	**2.1**	**2.1**	**3.4**	35	27	**61**	2.5
	4	1.8	0.0	0.2	0.1	NA	1.6	**2.0**	**2.0**	**3.7**	33	23	**56**	3.0
	5	1.5	0.3	0.5	0.1	NA	1.5	**2.3**	**2.4**	**3.9**	30	16	**46**	3.8
Pakistan	1	0.5	0.1	0.1	3.2	0.1	4.6	**0.7**	**4.0**	**8.6**	48	12	**59**	2.7
	2	0.5	0.1	0.3	3.2	0.1	4.4	**0.9**	**4.2**	**8.6**	44	14	**58**	2.9
	3	0.4	0.2	0.4	3.3	0.1	4.1	**1.0**	**4.4**	**8.6**	42	15	**57**	3.0
	4	0.4	0.3	0.9	3.5	0.1	3.5	**1.6**	**5.3**	**8.8**	39	16	**55**	3.1
	5	0.3	0.5	1.7	3.6	0.1	3.3	**2.5**	**6.3**	**9.6**	35	15	**50**	3.4
Thailand	1	0.0	0.3	4.6	3.2	0.0	1.6	**5.0**	**8.1**	**9.8**	37	17	**55**	0.8
	2	0.0	0.7	5.8	3.1	0.0	1.1	**6.4**	**9.6**	**11**	37	13	**50**	1.0
	3	0.0	0.8	6.5	2.9	0.0	0.7	**7.3**	**10**	**11**	36	10	**46**	1.4
	4	0.0	0.8	7.2	2.8	0.0	0.4	**8.0**	**11**	**11**	34	7	**41**	1.6
	5	0.0	0.5	8.3	2.4	0.0	0.1	**8.8**	**11**	**11**	27	4	**32**	1.6
Uganda	1	1.8	ND	0.0	0.1	NA	6.6	**1.8**	**1.9**	**8.4**	25	35	**61**	0.9
	2	1.7	ND	0.0	0.1	NA	5.4	**1.7**	**1.8**	**7.2**	25	35	**60**	1.4
	3	1.5	ND	0.1	0.1	NA	4.5	**1.6**	**1.8**	**6.3**	26	33	**59**	1.7
	4	1.4	ND	0.3	0.1	NA	3.9	**1.6**	**1.8**	**5.7**	27	29	**56**	2.2
	5	1.2	ND	0.6	0.5	NA	2.7	**1.8**	**2.2**	**4.9**	30	17	**47**	2.5
Vietnam	1	0.4	0.2	1.1	2.4	NA	5.5	**1.8**	**4.2**	**9.6**	37	26	**63**	0.6
	2	0.3	0.8	2.0	2.7	NA	4.6	**3.0**	**5.7**	**10**	38	20	**58**	0.6
	3	0.3	1.8	2.8	2.7	NA	3.6	**4.9**	**7.6**	**11**	40	14	**54**	0.7
	4	0.2	3.5	3.6	2.8	NA	2.6	**7.4**	**10**	**13**	39	9.8	**49**	0.6
	5	0.2	4.3	4.4	2.8	NA	1.6	**8.8**	**12**	**13**	37	5.1	**42**	0.5

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.
a. Nearly 40 percent of all rural households, and as much as 68 percent of the bottom quintile, assigned a value of zero to nonpurchased biomass (see appendix A).

Table 3.6 Shares of Urban Household Expenditure on Various Energy Sources, Food, and Transport by Quintile: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Bangladesh	1	1.1	ND	0.0	1.1	0.1	5.9	**1.1**	**2.3**	**8.3**	62	6.5	**68**	1.7
	2	0.9	ND	0.0	1.6	0.3	5.0	**0.9**	**2.8**	**7.7**	60	6.6	**66**	2.0
	3	0.7	ND	0.0	2.0	0.6	4.3	**0.8**	**3.4**	**7.8**	57	5.3	**62**	2.4
	4	0.6	ND	0.0	2.6	0.9	3.3	**0.6**	**4.2**	**7.5**	55	4.0	**59**	2.8
	5	0.3	ND	0.3	2.5	1.6	1.5	**0.6**	**4.8**	**6.3**	42	2.0	**44**	3.3
Cambodia	1	1.9	0.0	ND	0.3	NA	7.1	**1.9**	**2.1**	**9.2**	61	16	**77**	0.0
	2	1.3	0.0	ND	1.1	NA	5.9	**1.4**	**2.5**	**8.4**	58	17	**75**	0.0
	3	0.9	0.2	ND	1.4	NA	5.2	**1.1**	**2.5**	**7.7**	60	12	**72**	0.1
	4	0.6	0.4	ND	2.3	NA	4.2	**1.0**	**3.3**	**7.5**	60	7.7	**68**	0.2
	5	0.1	1.3	ND	3.9	NA	1.5	**1.3**	**5.2**	**6.8**	47	2.0	**49**	0.1
India	1	2.1	0.2	0.0	2.3	NA	5.7	**2.3**	**4.6**	**11**	51	0.9	**52**	1.6
	2	1.9	0.7	0.1	2.6	NA	5.3	**2.6**	**5.2**	**11**	53	1.2	**54**	1.3
	3	1.8	1.5	0.1	3.0	NA	3.9	**3.5**	**6.5**	**11**	50	1.3	**51**	1.8
	4	1.8	2.6	0.5	3.4	NA	2.2	**4.9**	**8.3**	**11**	47	1.0	**48**	2.3
	5	0.8	2.9	2.2	3.8	NA	0.5	**6.0**	**9.8**	**10**	37	0.5	**37**	2.9
Indonesia	1	3.5	0.0	0.1	3.5	0.0	2.1	**3.6**	**7.2**	**9.4**	59	5.1	**64**	1.2
	2	3.4	0.0	0.5	4.0	0.0	1.1	**4.1**	**8.1**	**9.2**	58	4.0	**62**	2.0
	3	3.1	0.1	0.8	3.9	0.0	0.7	**4.3**	**8.2**	**8.9**	56	5.0	**61**	2.8
	4	2.7	0.2	1.2	4.1	0.0	0.3	**4.5**	**8.7**	**8.9**	55	3.1	**58**	3.4
	5	1.6	0.6	1.8	3.9	0.0	0.1	**4.4**	**8.4**	**8.5**	48	2.0	**50**	3.7
Kenya[a]	1	3.1	0.0	0.0	0.0	NA	2.6	**3.1**	**3.1**	**5.8**	54	12	**66**	1.2
	2	3.4	0.0	0.0	0.6	NA	4.3	**3.4**	**4.0**	**8.3**	48	10	**58**	2.0
	3	3.7	0.0	0.0	0.3	NA	3.2	**3.8**	**4.1**	**7.3**	48	7.6	**56**	3.3
	4	3.1	0.0	0.0	0.6	NA	2.5	**3.2**	**3.8**	**6.3**	45	7.0	**52**	4.3
	5	2.2	0.6	0.8	0.8	NA	1.0	**3.6**	**4.4**	**5.4**	35	6.2	**41**	5.7
Pakistan	1	0.1	0.1	0.2	4.7	1.2	3.2	**0.4**	**6.4**	**9.6**	51	3.0	**54**	2.3
	2	0.2	0.2	0.3	5.0	1.4	2.3	**0.6**	**7.0**	**9.3**	49	2.8	**52**	2.6
	3	0.1	0.3	0.4	4.9	1.5	1.7	**0.8**	**7.2**	**8.9**	46	2.6	**49**	2.8
	4	0.1	0.3	0.8	5.0	1.7	1.1	**1.3**	**8.0**	**9.1**	44	2.1	**46**	3.4
	5	0.0	0.3	3.2	4.7	1.6	0.3	**3.5**	**9.8**	**10**	36	1.4	**38**	3.2
Thailand	1	0.0	0.5	4.7	3.8	0.0	1.3	**5.2**	**9.0**	**10**	41	12	**53**	0.8
	2	0.0	0.8	5.2	3.8	0.0	0.7	**5.9**	**9.7**	**10**	41	8.6	**49**	1.3
	3	0.0	0.8	5.1	3.8	0.0	0.3	**5.9**	**9.7**	**10**	39	6.6	**46**	1.8
	4	0.0	0.6	5.0	3.6	0.0	0.1	**5.6**	**9.2**	**9.3**	38	4.7	**43**	2.8
	5	0.0	0.3	6.2	3.3	0.0	0.0	**6.5**	**9.8**	**9.8**	31	2.6	**33**	2.9

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Uganda	1	2.5	ND	0.0	0.0	NA	7.4	**2.5**	**2.5**	**9.8**	40	17	**57**	1.0
	2	1.7	ND	0.0	0.2	NA	6.7	**1.7**	**2.0**	**8.7**	38	15	**53**	1.7
	3	1.8	ND	0.0	0.3	NA	5.6	**1.9**	**2.2**	**7.8**	41	10	**51**	1.5
	4	1.3	ND	0.0	0.8	NA	4.7	**1.3**	**2.1**	**6.8**	42	6.5	**49**	2.3
	5	0.9	ND	0.6	1.5	NA	2.5	**1.5**	**3.0**	**5.5**	35	5.2	**41**	2.7
Vietnam	1	0.6	1.2	1.6	3.3	NA	3.6	**3.3**	**6.6**	**10**	47	13	**60**	0.3
	2	0.7	2.4	2.2	3.5	NA	3.1	**5.3**	**8.8**	**12**	50	6.2	**56**	0.6
	3	0.6	4.2	3.4	3.7	NA	2.1	**8.2**	**12**	**14**	47	4.5	**51**	0.4
	4	0.3	5.1	4.4	3.9	NA	1.3	**9.9**	**14**	**15**	43	2.1	**45**	0.5
	5	0.1	5.0	5.0	4.2	NA	0.5	**10**	**14**	**15**	37	0.9	**38**	0.5

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.
a. Twenty-one percent of the bottom quintile assigned a value of zero to nonpurchased biomass (see appendix A).

Pakistan, it fell for the bottom three quintiles but rose at higher income levels, while in Vietnam it rose throughout the quintile range. The share of total expenditure on energy was highest for the lowest-income groups in seven countries in urban areas and in four countries in rural.

The share of spending on electricity in rural areas increased with quintile level in Bangladesh, Cambodia, India, Kenya, Pakistan, Uganda, and Vietnam. The share in urban areas increased with rising quintile in Cambodia, India, Kenya, Uganda, and Vietnam, and through the bottom four quintiles in Bangladesh; no marked trend was observed in Indonesia or Pakistan. In Thailand, the share decreased in both rural and urban areas at higher income levels. Because urban household incomes are higher than rural for the same quintile groups, these results suggest that, as income increases, the share of expenditure on electricity also increases, until households reach the upper portion of the income distribution, at which point the share tends to decline.

The pattern of expenditure share for kerosene was consistent across all countries—the share fell at higher quintile levels except in rural Indonesia and urban Kenya, Pakistan, and Vietnam. By contrast, the share of expenditure on LPG increased with quintile level except for urban Thailand, the top quintile in rural Thailand, and urban Vietnam. In Kenya, LPG consumption use was negligible; in Bangladesh and Uganda, data were not available. The share of expenditure on gasoline and diesel

increased with quintile level in both rural and urban areas in all countries. The total expenditure share on petroleum products—characterized by a declining share for kerosene and increasing shares for LPG and automotive fuels—increased with rising quintile in both rural and urban areas in Pakistan and Vietnam, in rural Indonesia and Thailand, and in urban India. It declined in both rural and urban Bangladesh and rural Cambodia. The share of expenditure on biomass, although higher in rural than in urban areas at each quintile level, decreased with rising quintile in all countries in both rural and urban areas, except in Kenya where this pattern was not observed because many households assigned a value of zero to freely collected biomass.

The share of total food expenditure declined monotonically (steadily) with rising quintile in every country for both rural and urban households except urban India. The expenditure share of purchased food declined monotonically with rising quintile in all countries except Cambodia, Uganda, and Vietnam, and in rural Indonesia and urban India. The bottom two quintiles spent at least half of their total expenditure on purchased food in Bangladesh, India, and Indonesia, and in urban Cambodia. The expenditure share of purchased food in urban areas was higher than that in rural areas in 40 of the 45 quintiles in this study. Averaged across the 45 quintiles, the expenditure shares were 42 percent in rural areas and 48 percent in urban. This finding suggests that higher oil prices would have serious adverse indirect effects in terms of higher food prices on the poor, especially the urban poor.

If a 10 percent increase in petroleum product prices were to lead to a 1 percent increase in food prices, the indirect effect on food prices would be larger than the direct effect of higher oil prices for all quintiles except in India, Thailand, Vietnam, and urban Kenya. The indirect effect would fall most heavily on the poor. Excluding Thailand, the bottom quintile in both rural and urban areas in the remaining eight countries would be hit harder by rising food prices caused by higher oil prices than the increase in oil prices themselves. If a 10 percent increase in petroleum product prices were to result in a 2 percent increase in food prices, the indirect effect through higher food prices alone would be greater than the direct effects of higher oil prices everywhere except the top one to three quintiles in Thailand and Vietnam.

As expected, the imputed value of nonpurchased food was smaller for urban than rural households in every quintile across the nine countries. The expenditure share of nonpurchased food declined monotonically with rising quintile in Kenya, Thailand, Uganda, and Vietnam, and in

rural Cambodia and urban Pakistan. The value of nonpurchased food exceeded that of purchased food in every quintile except in rural Uganda.

The expenditure share of transport generally increased with rising quintile, except in Cambodia and Vietnam, the two countries with the lowest expenditure shares. The expenditure share was higher among urban households than among rural for every quintile only in Indonesia and Thailand. Expenditures on transport exceeded those on petroleum products for both rural and urban households in Bangladesh, Kenya, Pakistan, and Uganda.

The average total household expenditures for urban quintiles were often not equal to those for their rural quintile counterparts, and a comparison of energy consumption at similar income levels cannot be made by simply pairing equivalent quintile groups in urban and rural areas. However, there are a few cases where the mean expenditures for different quintiles were close, thereby permitting such a comparison. These include the following pairs of quintiles: Bangladesh urban quintile 1 (U1) and rural quintile 1 (R1), U2 and R2, U3 and R3, and U4 and R4; India U2 and R3; Indonesia U3 and R4; Kenya U4 and R4; and Uganda U3 and R3. Monthly household expenditures were within 2 percent of each other for Bangladesh, Kenya, and Indonesia; within 3 percent for Uganda (rural higher than urban); and within 4 percent in India (rural higher than urban). The expenditure shares for these pairings are displayed in table 3.7.

Apart from Kenya and Uganda—where the inclusion of the value of nonpurchased food increased total rural expenditures by a large amount, thus reducing energy shares—the total share of expenditure on energy was similar between rural and urban quintiles at the same total household expenditure level. However, in all cases, the shares of electricity and of modern energy were higher in the urban quintiles. Except for Kenya and Uganda, the share of expenditure on biomass was higher in the rural quintile. The share of expenditure on automotive fuels (gasoline and diesel) was higher in the rural households. This finding of higher rural expenditure on gasoline at the same total expenditure level was also identified by Bacon, Bhattacharya, and Kojima (2009) in their study of changing expenditure patterns in Indonesia and Pakistan. The share of expenditure on kerosene was higher in the urban quintile than in the corresponding rural quintile in India, Indonesia, Kenya, and Uganda; in Bangladesh, where the largest number of pairwise comparisons was available, the share was consistently larger in rural areas.

Table 3.7 Shares of Expenditure on Various Energy Sources, Food, and Transport for Quintiles at Similar Total Household Expenditure Levels (%)

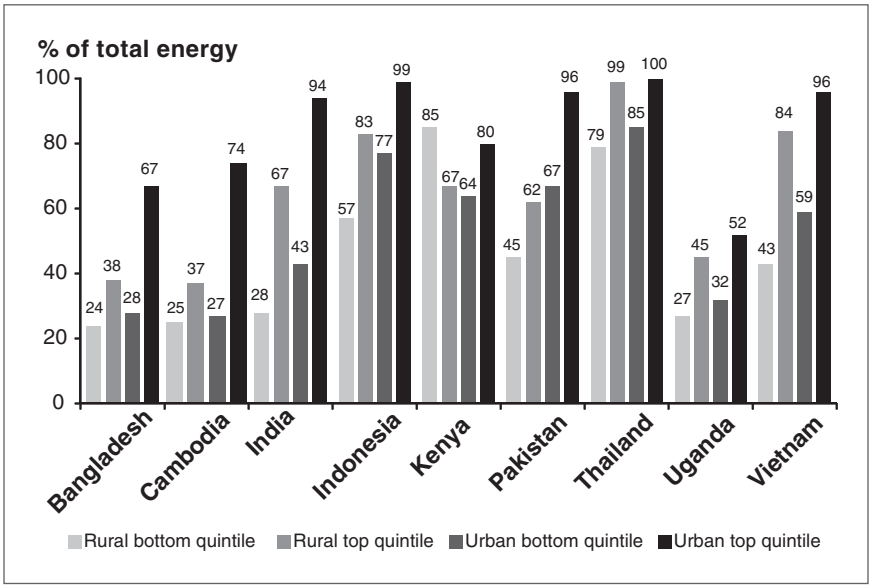
	Quintile	Kero-sene	LPG	Gaso-line & diesel	Elec-tricity	Nat-ural gas	Bio-mass	Petro-leum prod-ucts	Energy		Food			Trans-port
									Modern	Total	P	NP	Total	
Bangladesh	R1	1.5	ND	0.0	0.3	0.0	6.2	**1.5**	**1.8**	**8.0**	56	13	**70**	1.8
	U1	1.1	ND	0.0	1.1	0.1	5.9	**1.1**	**2.3**	**8.3**	62	6.5	**68**	1.7
	R2	1.3	ND	0.0	0.4	0.0	5.8	**1.3**	**1.8**	**7.6**	51	17	**68**	2.2
	U2	0.9	ND	0.0	1.6	0.3	5.0	**0.9**	**2.8**	**7.7**	60	6.6	**66**	2.0
	R3	1.1	ND	0.0	0.8	0.0	5.5	**1.2**	**2.0**	**7.5**	49	16	**65**	2.5
	U3	0.7	ND	0.0	2.0	0.6	4.3	**0.8**	**3.4**	**7.8**	57	5.3	**62**	2.4
	R4	0.9	ND	0.1	1.1	0.1	4.7	**1.0**	**2.2**	**6.9**	45	15	**60**	2.9
	U4	0.6	ND	0.0	2.6	0.9	3.3	**0.6**	**4.2**	**7.5**	55	4.0	**59**	2.8
India	R3	1.7	0.4	0.3	2.1	NA	6.9	**2.4**	**4.4**	**12**	49	12	**61**	2.4
	U2	1.9	0.7	0.1	2.6	NA	5.3	**2.6**	**5.2**	**11**	53	1.2	**54**	1.3
Indonesia	R4	2.4	0.1	1.3	3.5	0.0	1.6	**4.1**	**7.6**	**9.2**	56	8.4	**64**	2.2
	U3	3.1	0.1	0.8	3.9	0.0	0.7	**4.3**	**8.2**	**8.9**	56	5.0	**61**	2.8
Kenya	R4	1.8	0.0	0.2	0.1	NA	1.6	**2.0**	**2.0**	**3.7**	33	23	**56**	3.0
	U4	3.1	0.0	0.0	0.6	NA	2.5	**3.2**	**3.8**	**6.3**	45	7.0	**52**	4.3
Uganda	R3	1.5	ND	0.1	0.1	NA	4.5	**1.6**	**1.8**	**6.3**	26	33	**59**	1.7
	U3	1.8	ND	0.0	0.3	NA	5.6	**1.9**	**2.2**	**7.8**	41	10	**51**	1.5

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.

As expected, the expenditure share of purchased food was higher and that of nonpurchased food was lower in urban areas in every case. The expenditure share of transport was comparable, except in India where it was lower for urban than rural households, and in Indonesia and Kenya where the reverse was found.

The variation in shares of energy expenditures by quintile group indicates how the use of modern energy changes with rising income. Figure 3.4 shows the ratio of expenditure on modern energy to expenditure on all forms of energy for the highest and lowest quintile groups. In urban areas, the dependence on modern energy for the bottom quintiles was low in Bangladesh, Cambodia, India, and Uganda. The share was higher for the top quintile but remained relatively low in Uganda where

Figure 3.4 Share of Total Household Energy Expenditure Spent on Modern Energy by the Bottom and Top Quintiles



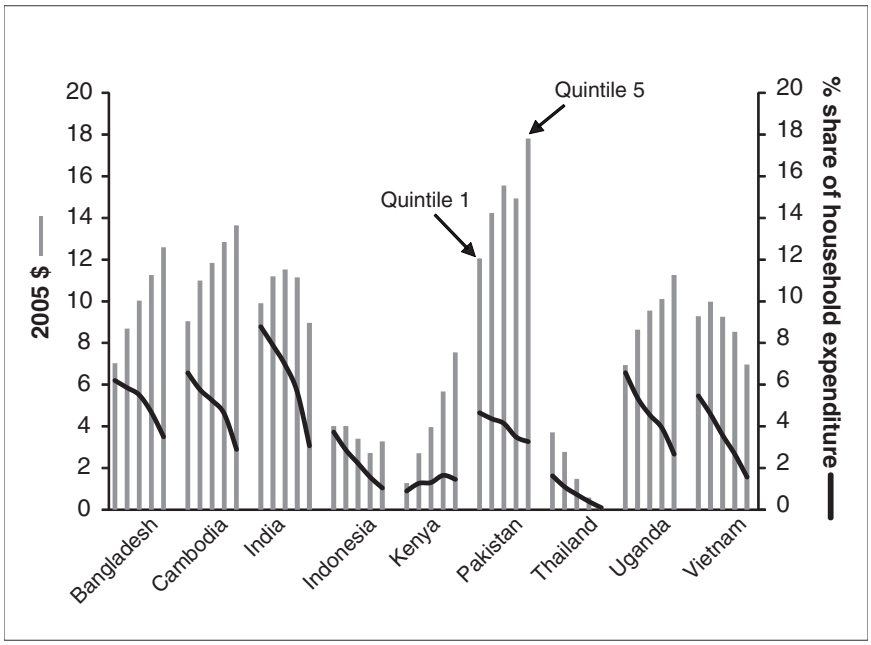
Source: Authors' calculations.

households still obtained a sizable portion of their energy from biomass; the share was not much higher in Bangladesh than in Uganda. In rural areas, except in Kenya (where 68 percent of the bottom rural quintile and 21 percent of the bottom urban quintile set imputed expenditures on biomass equal to zero), dependence on modern energy was even lower for the bottom quintile, and although much higher for the top quintile, was considerably less than in urban areas.

The expenditure shares for biomass and kerosene generally declined with rising quintile, but expenditures themselves could still rise. For kerosene, it would be reasonable to take expenditure levels as a first approximation for quantities consumed, particularly in countries with essentially pan-territorial (nationally uniform) pricing. For biomass, the relationship between quantity and value could be weak because of large geographical and temporal price variation. Figures 3.5 and 3.6 show monthly expenditure on biomass for rural and urban quintiles, respectively, together with the expenditure share of biomass. Similarly, figures 3.7 and 3.8 show expenditures on kerosene.

It is striking that only in Thailand did the value of biomass consumed decline from the bottom to the second quintile in rural areas; the value in urban areas declined only in Indonesia, Pakistan, and Thailand.

Figure 3.5 Monthly Rural Household Expenditure on Biomass



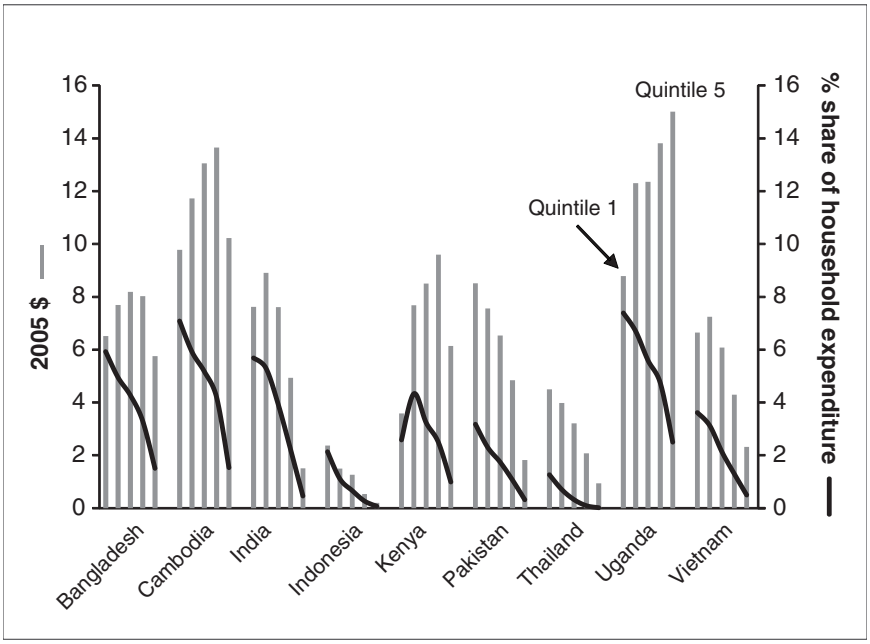
Source: Authors' calculations.
Note: In Kenya, 39 percent of rural households assigned an imputed value of zero to non-purchased biomass, including 68 percent of the bottom quintile, 48 percent of the second quintile, and 40 percent of the third quintile.

These findings might suggest that the quantity of biomass consumed in low-income countries tends to increase with rising income before falling. Similarly, the value of kerosene consumed generally rose with rising income among the bottom two quintiles in most countries. The evidence of rising consumption with income is stronger for kerosene than for biomass, because the relationship between quantity and value is more robust for kerosene.

Uptake of Different Energy Sources

The pattern of uptake of different sources of energy is important in understanding differences in expenditure share by income group and by location, and forms a valuable supplement to information on average group expenditure patterns. In this study, a household was assumed to be consuming a good if it reported a positive expenditure on that good. There are four exceptions, explained in appendix A:

Figure 3.6 Monthly Urban Household Expenditure on Biomass

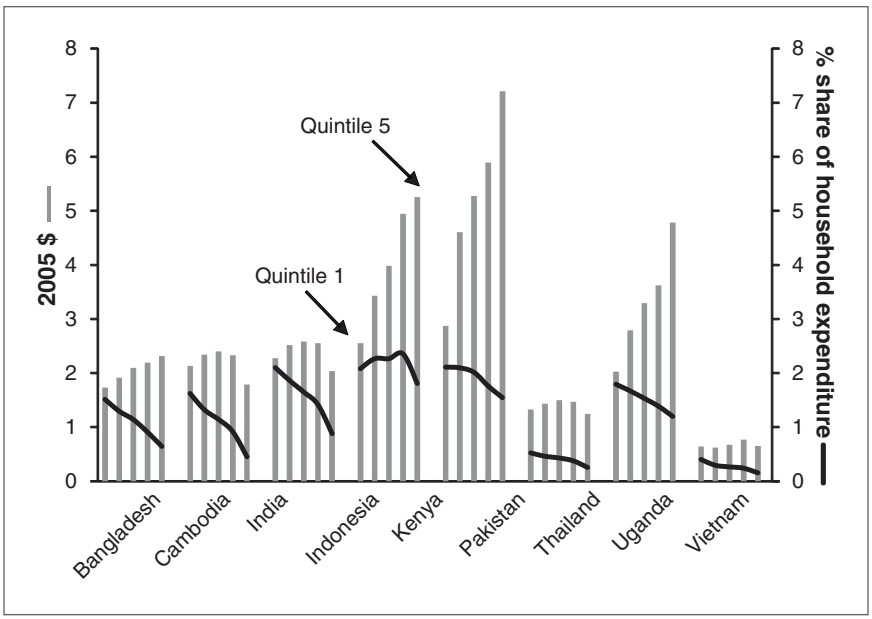


Source: Authors' calculations.
Note: In Kenya, 21 percent of the bottom urban quintile and 7 percent of the next two urban quintiles assigned an imputed value of zero to nonpurchased biomass.

- LPG in Thailand, where the numbers presented are for those owning one or more LPG cookstoves
- Biomass in Kenya, where the responses to a series of questions on different forms of biomass were used to determine whether the household was using biomass
- Electricity in Kenya, where the responses to a series of questions on sources of electricity were used to determine whether the household was using electricity
- Electricity in Uganda, where the higher of two percentages—those reporting positive expenditures or those reporting electricity as the primary source of lighting—for each rural and urban quintile was used to determine whether the household was using electricity and all other numbers calculated accordingly

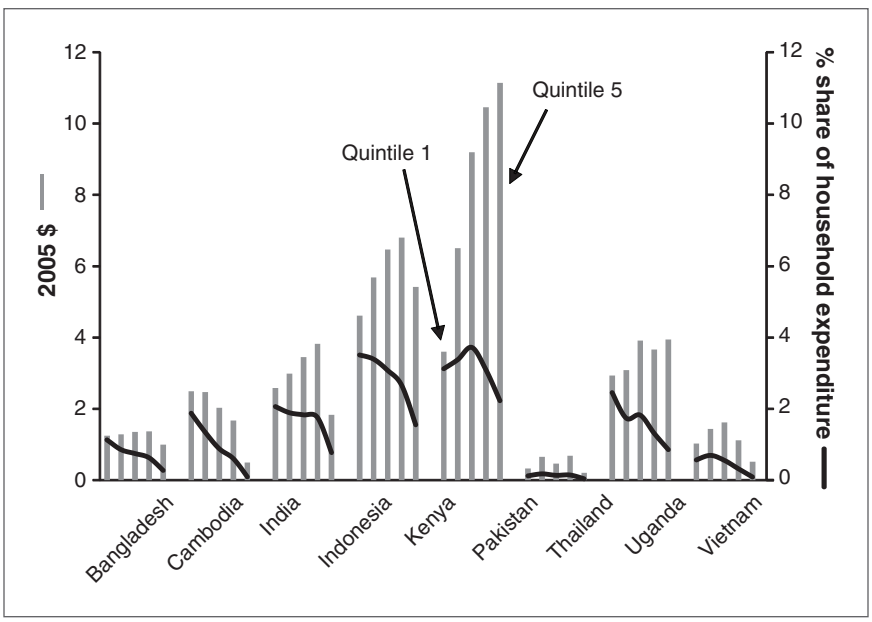
Uptake does not imply around-the-clock availability. Power outages in some of the survey countries are frequent. Irregular LPG supply is one reason many households continue to use biomass. What uptake does

Figure 3.7 Rural Household Expenditure on Kerosene



Source: Authors' calculations.

Figure 3.8 Urban Household Expenditure on Kerosene



Source: Authors' calculations.

indicate is that a particular energy source was sufficiently available for the household to have used it in the recent past.

Table 3.8 gives uptake rates for rural quintiles and table 3.9 for urban quintiles; table B.11 gives uptake rates averaged across all households in each quintile. Tables B.12–B.15 give the equivalent values for Cambodia, Kenya, Uganda, and Vietnam when the value of nonpurchased food is excluded (which affects both total household expenditure and assignment of households to quintile groups).

With the exception of Thailand, where access to electricity was virtually universal, the uptake rate for electricity increased with rising quintile. This trend was particularly pronounced in urban Cambodia. In Indonesia, Pakistan, and Vietnam, the urban uptake rate was very high for all but the bottom quintile. In Kenya and Uganda, the uptake rate was almost zero for the lowest quintile even in urban areas; only within the top two (Uganda) or three (Kenya) urban quintiles did more than 20 percent of households use electricity. The uptake rate of electricity in rural areas was considerably lower in all countries. The exceptions to this were Thailand and Vietnam, where there was essentially no difference between rural and urban areas and where the uptake rate was already very high. In Uganda, less than 5 percent of rural households on average were using electricity, and only for the highest quintile did the rate rise above 10 percent. In Kenya, less than 7 percent of the total rural population used electricity.

The uptake of LPG increased with quintile level in both rural and urban areas in those countries where this information was available. As an urban fuel, LPG was widely used in India (60 percent of households), Vietnam (70 percent), and Thailand (79 percent) but was little used in Indonesia, Kenya, and Pakistan, where the fuel of choice in urban areas was natural gas. In Thailand and Vietnam, the uptake rate for LPG in rural areas as a whole was substantial; elsewhere, only the top two rural quintiles in India, Indonesia, and Pakistan and the top quintile in Cambodia had uptake rates above 10 percent.

The expenditure share of kerosene tends to fall with income, and its uptake rate depends critically on whether the rate of electrification is high—in the absence of electricity, households almost universally rely on kerosene for lighting—and how its price compares with that of LPG or, where piped gas is available, natural gas. An earlier study compared the use of kerosene by households in Indonesia and Pakistan and related the consumption patterns to prices paid per unit of useful energy (Bacon, Bhattacharya, and Kojima 2009). Because many governments subsidize

Table 3.8 Percentage of Rural Households Consuming Various Energy Sources, Food, and Transport

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	93	ND	0.7	8.6	0.1	99	**93**	**95**	100	93	69
	2	91	ND	0.5	16	0.6	100	**91**	**94**	100	94	78
	3	90	ND	0.4	29	0.9	100	**91**	**96**	100	92	83
	4	90	ND	1.3	44	1.4	100	**90**	**97**	100	91	88
	5	85	ND	5.3	56	4.7	99	**87**	**97**	100	92	89
	All	**90**	**ND**	**1.4**	**29**	**1.3**	**99**	**91**	**96**	**100**	**93**	**80**
Cambodia	1	89	0.2	ND	1.2	NA	93	**89**	**90**	99	83	4.6
	2	88	0.5	ND	3.0	NA	93	**89**	**90**	100	85	5.3
	3	87	1.0	ND	6.0	NA	94	**88**	**90**	100	82	6.1
	4	81	3.1	ND	13	NA	94	**83**	**89**	100	77	7.7
	5	61	15	ND	33	NA	90	**74**	**89**	100	61	11
	All	**82**	**3.6**	**ND**	**11**	**NA**	**93**	**85**	**90**	**100**	**78**	**6.8**
India	1	95	0.4	0.5	32	NA	98	**95**	**99**	99	46	54
	2	95	2.1	1.9	46	NA	98	**96**	**100**	100	53	70
	3	92	6.5	4.7	56	NA	97	**95**	**100**	100	59	77
	4	86	17	11	69	NA	92	**94**	**100**	100	62	81
	5	68	48	29	85	NA	75	**92**	**99**	100	58	82
	All	**89**	**12**	**7.4**	**54**	**NA**	**94**	**95**	**99**	**100**	**55**	**72**
Indonesia	1	88	0.1	5.3	67	0.2	87	**88**	**98**	100	85	43
	2	89	0.3	13	80	0.1	76	**90**	**98**	100	82	50
	3	91	1.4	19	87	0.2	70	**92**	**100**	99	77	55
	4	91	3.6	29	88	0.2	58	**94**	**100**	100	71	54
	5	84	11	39	86	0.4	49	**91**	**96**	99	70	53
	All	**89**	**2.2**	**18**	**80**	**0.2**	**71**	**91**	**99**	**100**	**79**	**50**
Kenya[a]	1	75	0.0	0.1	0.7	NA	99	**75**	**75**	98	94	30
	2	87	0.1	0.2	1.2	NA	99	**87**	**87**	100	98	45
	3	90	0.1	0.6	3.5	NA	98	**90**	**90**	99	97	54
	4	89	0.7	1.8	8.1	NA	98	**90**	**90**	100	98	65
	5	87	5.6	4.7	21	NA	93	**89**	**90**	99	97	75
	All	**86**	**1.2**	**1.4**	**6.7**	**NA**	**97**	**86**	**87**	**99**	**97**	**54**
Pakistan	1	45	2.5	7.5	66	2.3	95	**51**	**97**	100	63	87
	2	44	5.2	11	71	2.7	96	**53**	**98**	100	72	91
	3	44	7.7	11	76	2.1	97	**54**	**99**	100	74	92
	4	38	10	20	81	4.3	93	**56**	**99**	100	76	91
	5	31	18	29	87	5.8	91	**58**	**99**	100	77	91
	All	**41**	**8.5**	**15**	**76**	**3.4**	**95**	**55**	**98**	**100**	**73**	**91**

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Thailand[b]	1	1.1	44	66	97	0.0	69	**68**	**99**	99	94	19
	2	0.8	67	78	99	0.0	60	**81**	**100**	99	91	25
	3	0.9	80	83	99	0.0	46	**86**	**100**	99	88	30
	4	0.6	86	85	99	0.0	28	**89**	**100**	99	78	32
	5	0.3	86	88	99	0.1	14	**91**	**100**	100	62	33
	All	**0.8**	**72**	**79**	**99**	**0.0**	**46**	**82**	**100**	**99**	**84**	**27**
Uganda[c]	1	88	ND	0.0	1.1	NA	96	**88**	**88**	99	97	13
	2	95	ND	1.1	1.8	NA	97	**95**	**95**	100	97	23
	3	97	ND	1.1	2.9	NA	97	**97**	**97**	99	95	32
	4	96	ND	3.0	3.8	NA	97	**97**	**97**	99	93	39
	5	91	ND	6.2	15	NA	89	**91**	**95**	99	80	48
	All	**94**	**ND**	**2.3**	**4.9**	**NA**	**95**	**94**	**95**	**99**	**92**	**33**
Vietnam	1	45	2.8	26	89	NA	95	**60**	**99**	100	94	40
	2	45	8.7	46	95	NA	95	**70**	**100**	100	93	48
	3	43	23	58	96	NA	89	**80**	**99**	100	89	53
	4	38	47	71	98	NA	76	**89**	**100**	100	84	55
	5	31	71	78	99	NA	57	**95**	**100**	100	74	57
	All	**41**	**26**	**53**	**95**	**NA**	**85**	**78**	**99**	**100**	**88**	**50**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.
a. For biomass and electricity, the percentages are for those households that reported consuming them.
b. For LPG, the percentages are for those households that reported owning one or more LPG cooking stoves.
c. For the top quintile for electricity, the percentage is set equal to that reporting electricity as the primary lighting source.

kerosene as a social fuel, the relative end-user prices of kerosene and LPG do not necessarily follow price trends on the world market.

Consistent with the foregoing general observations, the uptake rate of kerosene varied markedly from country to country. With the exception of Thailand, rural uptake was higher than urban, and indeed was about 90 percent in Bangladesh, India, Indonesia, Kenya, and Uganda. Urban uptake was also substantial in Indonesia, Kenya, and Uganda, but was about 50 percent in Bangladesh and India, much lower in Vietnam, very low in urban Pakistan (where the fuel of choice was natural gas), and essentially nonexistent in Thailand. Everywhere, apart from rural areas in Kenya and Uganda, uptake rates fell at higher quintile groups in both rural and urban areas.

Table 3.9 Percentage of Urban Households Consuming Various Energy Sources, Food, and Transport

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	81	ND	0.0	34	2.9	99	**81**	**90**	100	78	69
	2	72	ND	0.1	50	9.0	97	**72**	**90**	100	72	76
	3	66	ND	0.4	59	16	97	**66**	**89**	100	66	81
	4	57	ND	0.3	71	21	97	**57**	**84**	100	55	85
	5	40	ND	5.0	81	50	96	**44**	**87**	100	48	93
	All	**55**	**ND**	**2.2**	**68**	**29**	**97**	**57**	**87**	**100**	**58**	**85**
Cambodia	1	94	0.0	ND	5.5	NA	96	**94**	**96**	99	67	5.1
	2	82	1.1	ND	16	NA	96	**83**	**94**	99	72	6.3
	3	66	5.6	ND	34	NA	95	**71**	**93**	100	58	11
	4	51	12	ND	51	NA	94	**63**	**93**	100	50	10
	5	15	57	ND	90	NA	79	**70**	**98**	100	21	17
	All	**39**	**33**	**ND**	**64**	**NA**	**87**	**71**	**96**	**100**	**39**	**13**
India	1	81	2.4	0.5	51	NA	81	**82**	**94**	97	11	41
	2	88	9.8	1.0	70	NA	87	**92**	**98**	100	12	55
	3	81	22	2.6	80	NA	75	**91**	**99**	100	11	67
	4	69	45	10	89	NA	52	**93**	**99**	100	10	75
	5	34	76	40	96	NA	18	**93**	**99**	100	9	77
	All	**50**	**59**	**26**	**90**	**NA**	**36**	**92**	**99**	**100**	**10**	**74**
Indonesia	1	93	0.7	2.6	82	1.1	54	**93**	**99**	99	65	44
	2	95	0.0	12	96	0.5	36	**96**	**100**	100	50	58
	3	95	2.4	20	96	0.2	23	**96**	**100**	99	53	66
	4	95	6.6	33	99	0.3	13	**98**	**100**	100	39	68
	5	78	27	49	97	1.5	4.1	**96**	**99**	100	29	75
	All	**88**	**13**	**33**	**96**	**0.8**	**16**	**97**	**100**	**100**	**40**	**68**
Kenya[a]	1	82	0.0	0.0	0.5	NA	86	**82**	**82**	99	74	24
	2	87	0.0	0.0	16	NA	92	**87**	**87**	99	77	39
	3	86	0.4	0.1	23	NA	83	**86**	**87**	100	82	53
	4	86	1.5	0.4	39	NA	86	**86**	**89**	100	85	67
	5	80	22	9.5	66	NA	61	**91**	**93**	100	91	80
	All	**83**	**14**	**5.8**	**52**	**NA**	**70**	**89**	**91**	**100**	**88**	**71**
Pakistan	1	16	3.5	8.1	90	35	65	**25**	**99**	100	26	82
	2	13	4.6	11	96	46	51	**25**	**100**	100	22	83
	3	13	7.1	12	96	53	44	**27**	**99**	100	23	89
	4	9.8	7.9	20	97	64	32	**33**	**100**	100	20	92
	5	4.2	7.9	48	99	82	12	**55**	**100**	100	15	88
	All	**8.7**	**7.0**	**29**	**97**	**66**	**30**	**40**	**100**	**100**	**19**	**88**

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Thailand[b]	1	0.9	61	65	98	0.0	54	**68**	**99**	99	82	18
	2	0.3	78	76	99	0.0	39	**80**	**100**	100	80	28
	3	0.4	86	72	100	0.0	21	**80**	**100**	99	68	36
	4	0.3	84	68	99	0.0	8.5	**77**	**100**	100	55	51
	5	0.1	76	72	100	0.0	2.5	**77**	**100**	100	37	54
	All	**0.2**	**79**	**71**	**100**	**0.0**	**11**	**77**	**100**	**100**	**51**	**48**
Uganda[c]	1	96	ND	0.0	0.0	NA	95	**96**	**96**	99	72	16
	2	95	ND	0.0	5.1	NA	98	**95**	**96**	99	68	31
	3	90	ND	1.6	5.0	NA	97	**90**	**92**	100	62	32
	4	82	ND	0.5	21	NA	96	**82**	**92**	99	47	43
	5	69	ND	6.5	48	NA	82	**72**	**91**	99	44	51
	All	**76**	**ND**	**4.3**	**34**	**NA**	**87**	**78**	**92**	**99**	**48**	**47**
Vietnam	1	42	11	33	89	NA	83	**67**	**96**	98	73	26
	2	36	28	48	96	NA	74	**74**	**100**	100	56	39
	3	31	49	67	99	NA	58	**88**	**99**	100	54	40
	4	20	67	77	99	NA	42	**90**	**100**	100	41	43
	5	12	90	88	100	NA	22	**98**	**100**	100	31	47
	All	**19**	**71**	**77**	**99**	**NA**	**38**	**91**	**100**	**100**	**40**	**44**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.
a. For biomass and electricity, the percentages are for those households that reported consuming them.
b. For LPG, the percentages are for those households that reported owning one or more LPG cooking stoves.
c. For all quintiles but the second, the percentages are for those households reporting electricity as the main lighting source.

The uptake of gasoline and diesel was modest in most countries with the exception of Thailand and Vietnam. In all cases, the average urban uptake rate was higher than the rural rate; as expected, the uptake rate increased at higher quintiles in every country.

The uptake of biomass also varied considerably, with Bangladesh, Cambodia, and Uganda exhibiting almost universal uptake in both rural and urban households, while the urban uptake was 70 percent in Kenya and below 40 percent in the other countries. However, in all countries rural uptake of biomass was high: the lowest rate, found in Thailand, was 46 percent. In India, Indonesia, Pakistan, Thailand, and Vietnam, the urban uptake of biomass declined strongly at higher quintiles. Similarly,

in rural India, Indonesia, Thailand, and Vietnam, uptake of biomass declined at higher quintiles.

Natural gas was available to households only in urban Pakistan and, to a limited extent, urban Bangladesh. The uptake rate was very low in rural areas in both countries because, as in the rest of the world, natural gas is typically not available in such areas. Two-thirds of urban households in Pakistan used natural gas. Uptake increased steadily at higher quintiles among urban households in both countries. In Thailand, compressed natural gas as an automotive fuel was available, but at the time of the survey was used by few households.

As expected, virtually all households consumed purchased food; the handful that did not relied entirely on nonpurchased food. As expected, rural uptake of nonpurchased food was high, with the exception of India and the better-off in Cambodia and Thailand. The percentage of urban households consuming nonpurchased food was surprisingly high in many countries. The only group whose percentage was in single digits was the top quintile in India.

The percentage of households reporting positive expenditure on transport also showed wide variation across countries. Cambodia had by far the lowest uptake rate in both rural and urban areas. Rural Pakistan, surprisingly, had the highest uptake rate. With the exception of Pakistan and Vietnam, on average, a greater share of urban households than rural ones used transport.

Shares of Expenditure on Energy, Food, and Transport by User Households

Where uptake is not universal, the value of average expenditure on energy for a given group would not accurately indicate the average expenditure of those households actually consuming the item. The lower the rate of uptake, the greater the difference between the average expenditure for all households and the average expenditure for user households: the average expenditure share of users is equal to the average expenditure share of all households divided by the uptake rate. Because energy pricing policies may take into account the importance of expenditure for those households using the energy source, it is helpful to address the extent of usage by households that actually use that energy source as well as food and transport affected by energy prices.

Tables 3.10 and 3.11 show the average expenditure shares for energy sources by rural and urban user households, respectively; table B.16

Table 3.10 Shares of Rural Household Expenditure on Various Energy Sources, Food, and Transport, by Quintile: User Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	1.6	ND	3.9	3.5	4.8	6.3	**1.7**	**2.0**	56	14	2.6
	2	1.4	ND	3.7	2.7	3.6	5.9	**1.4**	**1.9**	51	18	2.8
	3	1.3	ND	6.2	2.8	3.3	5.5	**1.3**	**2.1**	49	17	3.0
	4	1.0	ND	8.2	2.6	3.8	4.7	**1.1**	**2.3**	45	16	3.3
	5	0.8	ND	6.9	2.2	3.2	3.5	**1.2**	**2.5**	39	13	3.3
	All	**1.3**	**ND**	**6.5**	**2.6**	**3.4**	**5.3**	**1.4**	**2.1**	**49**	**16**	**3.0**
Cambodia	1	1.8	5.7	ND	5.6	NA	7.1	**1.8**	**1.9**	50	33	4.5
	2	1.5	4.8	ND	5.1	NA	6.2	**1.5**	**1.7**	51	29	3.4
	3	1.3	4.3	ND	4.9	NA	5.6	**1.4**	**1.6**	54	26	3.5
	4	1.1	3.8	ND	4.5	NA	4.9	**1.3**	**1.8**	56	21	3.0
	5	0.7	2.4	ND	3.8	NA	3.2	**1.1**	**2.3**	50	15	1.3
	All	**1.3**	**2.9**	**ND**	**4.2**	**NA**	**5.4**	**1.4**	**1.8**	**52**	**25**	**2.9**
India	1	2.2	7.0	5.9	3.9	NA	9.0	**2.3**	**3.4**	55	19	2.9
	2	2.0	6.4	6.6	3.7	NA	8.0	**2.2**	**3.8**	52	20	2.7
	3	1.8	6.1	6.4	3.7	NA	7.2	**2.5**	**4.4**	49	21	3.1
	4	1.6	5.2	6.8	3.5	NA	6.1	**3.3**	**5.5**	45	19	3.6
	5	1.3	3.9	7.0	3.3	NA	4.1	**5.4**	**7.8**	41	15	4.7
	All	**1.9**	**4.7**	**6.8**	**3.6**	**NA**	**7.3**	**2.9**	**4.7**	**49**	**19**	**3.3**
Indonesia	1	2.4	4.4	4.6	3.6	2.0	4.3	**2.7**	**4.9**	55	18	2.9
	2	2.6	3.6	4.8	3.6	1.1	3.8	**3.4**	**6.1**	56	14	3.5
	3	2.5	4.0	4.7	3.9	2.7	3.2	**3.8**	**6.9**	56	14	3.9
	4	2.6	4.0	4.6	3.9	3.7	2.7	**4.4**	**7.7**	56	12	4.0
	5	2.2	2.8	4.2	3.5	1.2	2.1	**4.7**	**7.6**	53	12	4.2
	All	**2.5**	**3.4**	**4.6**	**3.7**	**2.2**	**3.5**	**3.6**	**6.4**	**55**	**15**	**3.6**
Kenya	1	2.8	—	11	1.3	NA	4.7	**2.8**	**2.8**	40	33	5.0
	2	2.4	5.2	7.6	3.7	NA	4.1	**2.4**	**2.5**	37	30	4.8
	3	2.2	5.2	5.8	4.1	NA	3.7	**2.3**	**2.3**	35	27	4.6
	4	2.0	3.5	9.9	3.6	NA	3.3	**2.2**	**2.3**	33	24	4.6
	5	1.8	4.5	10	2.2	NA	2.7	**2.6**	**2.7**	30	17	5.0
	All	**2.2**	**4.4**	**9.7**	**2.7**	**NA**	**3.5**	**2.4**	**2.5**	**35**	**26**	**4.8**

(continued)

Table 3.10 Shares of Rural Household Expenditure on Various Energy Sources, Food, and Transport, by Quintile: User Households (%) (continued)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Pakistan	1	1.2	2.1	1.5	4.8	3.7	4.9	**1.4**	**4.1**	48	19	3.0
	2	1.1	2.5	2.5	4.6	3.1	4.5	**1.6**	**4.3**	44	20	3.1
	3	1.0	2.3	3.7	4.4	2.9	4.3	**1.9**	**4.5**	42	20	3.3
	4	1.0	3.1	4.8	4.3	3.3	3.7	**2.9**	**5.3**	39	21	3.4
	5	0.8	2.9	6.1	4.2	2.5	3.6	**4.3**	**6.4**	35	19	3.8
	All	**1.0**	**2.7**	**4.4**	**4.4**	**3.0**	**4.2**	**2.4**	**4.9**	**42**	**20**	**3.3**
Thailand	1	1.1	3.9	7.0	3.3	—	2.3	**7.3**	**8.3**	37	18	4.2
	2	1.6	3.4	7.4	3.1	—	1.8	**8.0**	**9.6**	37	14	4.1
	3	1.0	2.7	7.9	3.0	—	1.6	**8.5**	**10**	36	11	4.6
	4	0.5	2.2	8.5	2.9	—	1.3	**9.0**	**11**	34	9.4	5.1
	5	0.3	1.4	9.5	2.4	2.4	0.6	**9.7**	**11**	28	6.6	4.9
	All	**1.1**	**2.5**	**8.0**	**3.0**	**2.4**	**1.8**	**8.5**	**9.9**	**35**	**13**	**4.6**
Uganda	1	2.0	ND	—	6.9	NA	6.8	**2.0**	**2.1**	26	36	6.6
	2	1.8	ND	3.7	5.5	NA	5.5	**1.8**	**1.9**	25	36	5.8
	3	1.6	ND	9.4	4.4	NA	4.7	**1.7**	**1.8**	26	34	5.3
	4	1.4	ND	8.5	3.7	NA	4.0	**1.7**	**1.8**	28	31	5.6
	5	1.3	ND	9.0	3.5	NA	3.0	**1.9**	**2.4**	31	21	5.2
	All	**1.6**	**ND**	**8.3**	**4.0**	**NA**	**4.8**	**1.8**	**2.0**	**27**	**31**	**5.5**
Vietnam	1	0.9	8.3	4.4	2.7	NA	5.7	**3.0**	**4.2**	37	28	1.5
	2	0.7	8.7	4.3	2.8	NA	4.8	**4.2**	**5.7**	38	21	1.3
	3	0.6	8.1	4.9	2.9	NA	4.0	**6.1**	**7.7**	40	16	1.3
	4	0.6	7.5	5.2	2.8	NA	3.5	**8.3**	**10**	39	12	1.1
	5	0.5	6.1	5.6	2.9	NA	2.7	**9.4**	**12**	37	7	0.9
	All	**0.7**	**7.3**	**4.9**	**2.8**	**NA**	**4.4**	**6.1**	**7.5**	**38**	**18**	**1.2**

Source: Authors' calculations.
Note: NA = fuel not available; — = no household reported expenditure; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.

shows the average expenditures for user households averaged across both rural and urban areas. The shares for petroleum products and for modern energy are calculated by averaging over households that use at least one petroleum product or modern source of energy, respectively, and hence are not equal to the sum of the expenditures by user households over the separate fuels.

Table 3.11 Shares of Urban Household Expenditure on Various Energy Sources, Food, and Transport, by Quintile: User Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	1.4	ND	—	3.2	4.1	6.0	**1.4**	**2.6**	62	8.3	2.5
	2	1.2	ND	5.6	3.2	3.5	5.1	**1.2**	**3.1**	60	9.1	2.7
	3	1.1	ND	7.1	3.4	3.8	4.4	**1.2**	**3.9**	57	8.0	2.9
	4	1.1	ND	4.2	3.7	4.5	3.4	**1.1**	**4.9**	55	7.3	3.3
	5	0.7	ND	5.2	3.1	3.2	1.6	**1.5**	**5.5**	42	4.1	3.6
	All	**1.0**	**ND**	**5.2**	**3.3**	**3**	**3.2**	**1.3**	**4.6**	**51**	**6.7**	**3.3**
Cambodia	1	2.0	—	ND	4.9	NA	7.4	**2.0**	**2.2**	61	24	0.9
	2	1.6	4.5	ND	6.7	NA	6.2	**1.7**	**2.6**	59	23	0.7
	3	1.3	3.7	ND	4.3	NA	5.4	**1.5**	**2.7**	60	21	1.0
	4	1.2	2.9	ND	4.5	NA	4.4	**1.5**	**3.5**	60	15	1.6
	5	0.7	2.2	ND	4.3	NA	1.9	**1.9**	**5.3**	47	10	0.6
	All	**1.3**	**2.3**	**ND**	**4.4**	**NA**	**3.7**	**1.8**	**4.2**	**53**	**17**	**0.8**
India	1	2.5	7.5	7.4	4.5	NA	7.0	**2.8**	**4.9**	53	8.7	4.0
	2	2.2	7.1	5.3	3.7	NA	6.1	**2.9**	**5.3**	53	9.9	2.4
	3	2.3	6.9	4.9	3.8	NA	5.3	**3.8**	**6.6**	50	11	2.6
	4	2.5	5.8	5.2	3.9	NA	4.3	**5.2**	**8.4**	47	10	3.1
	5	2.3	3.8	5.6	4.0	NA	2.5	**6.4**	**9.9**	37	5.9	3.7
	All	**2.3**	**4.3**	**5.6**	**3.9**	**NA**	**4.3**	**5.7**	**8.9**	**41**	**7.8**	**3.4**
Indonesia	1	3.8	1.5	3.5	4.3	3.9	4.0	**3.9**	**7.3**	60	7.8	2.7
	2	3.6	—	4.2	4.2	4.5	3.1	**4.2**	**8.1**	58	7.9	3.5
	3	3.2	3.6	4.2	4.1	6.6	2.9	**4.4**	**8.2**	57	9.4	4.2
	4	2.8	3.2	3.8	4.2	4.9	2.1	**4.6**	**8.7**	55	7.9	4.9
	5	2.0	2.1	3.8	4.1	2.2	1.7	**4.6**	**8.5**	48	6.8	4.9
	All	**2.7**	**2.3**	**3.8**	**4.1**	**2.9**	**2.9**	**4.5**	**8.4**	**53**	**7.9**	**4.6**
Kenya	1	3.8	—	—	2.2	NA	5.0	**3.8**	**3.8**	54	16	5.0
	2	3.9	—	—	4.6	NA	6.1	**3.9**	**4.5**	49	13	5.2
	3	4.3	11	5.6	3.3	NA	4.5	**4.4**	**4.7**	48	9.3	6.2
	4	3.6	4.2	4.6	3.4	NA	3.3	**3.7**	**4.3**	45	8.3	6.5
	5	2.8	2.6	8.8	2.1	NA	1.9	**4.0**	**4.8**	35	6.8	7.1
	All	**3.2**	**2.7**	**8.8**	**2.4**	**NA**	**2.9**	**4.0**	**4.6**	**40**	**7.8**	**6.9**

(continued)

Table 3.11 Shares of Urban Household Expenditure on Various Energy Sources, Food, and Transport, by Quintile: User Households (%) (continued)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Pakistan	1	0.7	3.4	2.6	5.3	3.5	4.9	**1.8**	**6.5**	51	12	2.9
	2	1.3	3.4	2.7	5.2	3.0	4.5	**2.5**	**7.0**	49	12	3.2
	3	1.1	3.6	3.2	5.1	2.8	4.0	**2.9**	**7.3**	46	11	3.1
	4	1.5	3.9	4.3	5.2	2.6	3.4	**4.0**	**8.0**	44	11	3.8
	5	0.9	4.0	6.6	4.7	2.0	2.7	**6.4**	**9.8**	36	10	3.7
	All	**1.1**	**3.8**	**5.8**	**5.0**	**2.4**	**3.9**	**5.1**	**8.5**	**42**	**11**	**3.5**
Thailand	1	0.6	4.0	7.2	3.9	—	2.3	**7.7**	**9.1**	42	14	4.1
	2	1.1	2.9	6.8	3.8	—	1.8	**7.4**	**9.7**	41	11	4.6
	3	0.8	2.4	7.1	3.8	—	1.6	**7.4**	**9.7**	39	10	5.0
	4	0.7	1.7	7.3	3.6	1.9	1.1	**7.3**	**9.2**	38	8.6	5.4
	5	0.4	1.1	8.6	3.3	2.8	0.6	**8.5**	**9.8**	31	7.0	5.4
	All	**0.7**	**1.6**	**7.9**	**3.5**	**2.7**	**1.6**	**7.9**	**9.6**	**35**	**8.8**	**5.3**
Uganda	1	2.6	ND	—	—	NA	7.8	**2.6**	**2.6**	41	23	6.7
	2	1.8	ND	—	4.4	NA	6.8	**1.8**	**2.0**	38	22	5.5
	3	2.0	ND	3.0	6.7	NA	5.8	**2.1**	**2.4**	41	17	4.5
	4	1.6	ND	3.9	3.8	NA	4.9	**1.6**	**2.3**	43	14	5.3
	5	1.2	ND	9.2	3.2	NA	3.1	**2.0**	**3.3**	36	12	5.4
	All	**1.5**	**ND**	**8.8**	**3.4**	**NA**	**4.2**	**2.0**	**2.9**	**38**	**14**	**5.3**
Vietnam	1	1.4	11	4.7	3.7	NA	4.4	**5.0**	**6.9**	48	18	1.2
	2	1.9	8.4	4.6	3.7	NA	4.3	**7.1**	**8.8**	50	11	1.6
	3	1.8	8.6	5.2	3.7	NA	3.6	**9.3**	**12**	47	8.3	1.0
	4	1.6	7.6	5.7	3.9	NA	3.1	**11**	**14**	43	5.2	1.1
	5	0.7	5.5	5.6	4.3	NA	2.2	**10**	**14**	37	2.9	1.0
	All	**1.4**	**6.4**	**5.6**	**4.0**	**NA**	**3.2**	**10.0**	**13**	**41**	**6.4**	**1.1**

Source: Authors' calculations.
Note: NA = fuel not available; — = no household reported expenditure; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.

For rural and urban quintiles, the share of expenditure on electricity by users tended to fall at the upper quintile levels. This suggests that the increasing share by quintile group for all households was in large part due to increasing uptake. The declining expenditure share for electricity suggests that the income elasticity of demand for user households may be less than unity; this hypothesis could be explored from surveys where quantities purchased are available.

For LPG, the expenditure share by user households also tended to decline at higher quintile levels, suggesting that the quantity purchased by these households did not increase markedly with quintile expenditure, thus resulting in a declining share. This finding is in strong contrast to the share for all households, which tended to increase with quintile level, suggesting that the increased uptake rate was the dominant factor underpinning the increase in share for all households.

Uptake rates for kerosene were generally high, so the pattern of expenditure share by user households was similar to that for all households. For gasoline and diesel, where uptake rates were much lower, the share of expenditure by user households was markedly higher than for all households. For those households that have decided to use these fuels, their importance in the budget was significant even in low-quintile groups—indicating that, for a subgroup of households, increases in the price of these fuels would have had a large effect on household welfare.

The share of expenditure for those households that purchased at least one petroleum product was higher than for the group of all households, indicating that there were some households that did not purchase any petroleum products at all. The difference was largest for the lowest quintiles.

The expenditure share of transport is high in some countries. The bottom two quintiles in Kenya, Thailand, and Uganda and in rural Cambodia stand out in this regard. In Uganda, the expenditure share in every quintile except one exceeded 5 percent—a much larger share than that spent by users on modern energy.

Main Energy Source for Cooking

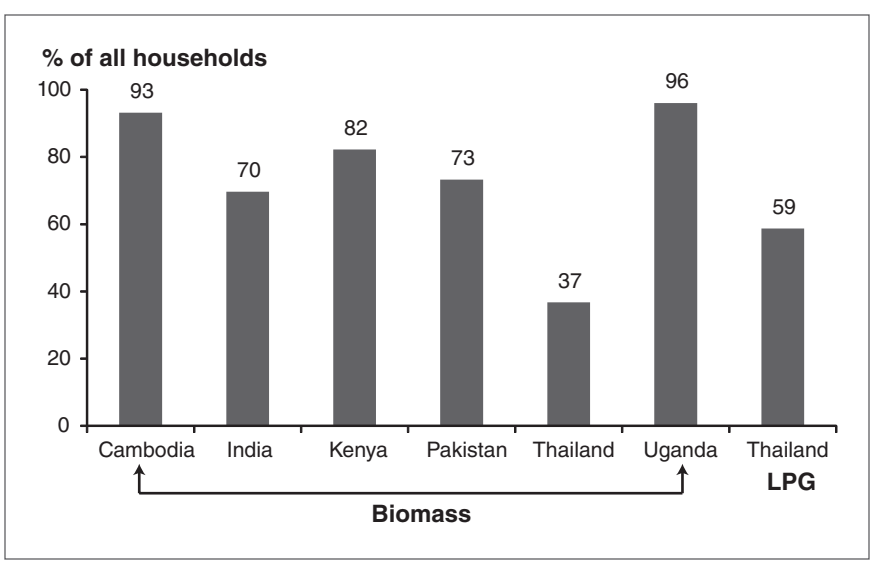
A household's choice of primary cooking fuel is of interest because, as with lighting, this is a major activity for which a choice of energy sources exists and fuel substitution is possible. Among the energy choices for cooking, the factors leading to the decision to use biomass as the main source of energy are particularly complex—cooking with biomass may be time consuming, not only in terms of getting the fire started but also because, if not purchased, the fuel must be collected. Also, traditional use of biomass creates considerable indoor air pollution, which is injurious to health; nonetheless, many households continue to use it given its low (or nonexistent) cost and their limited cash income. Cooking practices and cultural preferences also influence the decision to rely on biomass.

Six of the nine surveys examined (all except those in Bangladesh, Indonesia, and Vietnam) asked about the main cooking fuel used. The definition of "main" could indicate the fuel used for the longest period per unit time, or for generating the most heating power, or costing the most if fuels are purchased; the surveys do not use a consistent or precise definition. Generally, it is understood that "main" refers to the fuel used for the longest amount of time. One complication is that many households use multiple fuels, and which should be classified as the main one was likely not clear to some. The following results should be interpreted with these limitations in mind.

Figure 3.9 shows that biomass was by far the most commonly used main cooking fuel in five of the six countries. The one exception was Thailand, where LPG was widely used. When the data are analyzed by area (figure 3.10), a clear divide between rural and urban households becomes evident in India, Kenya, and Pakistan. The most common main cooking fuels in urban areas are LPG in India (60 percent), kerosene in Kenya (45 percent), and natural gas in Pakistan (67 percent).

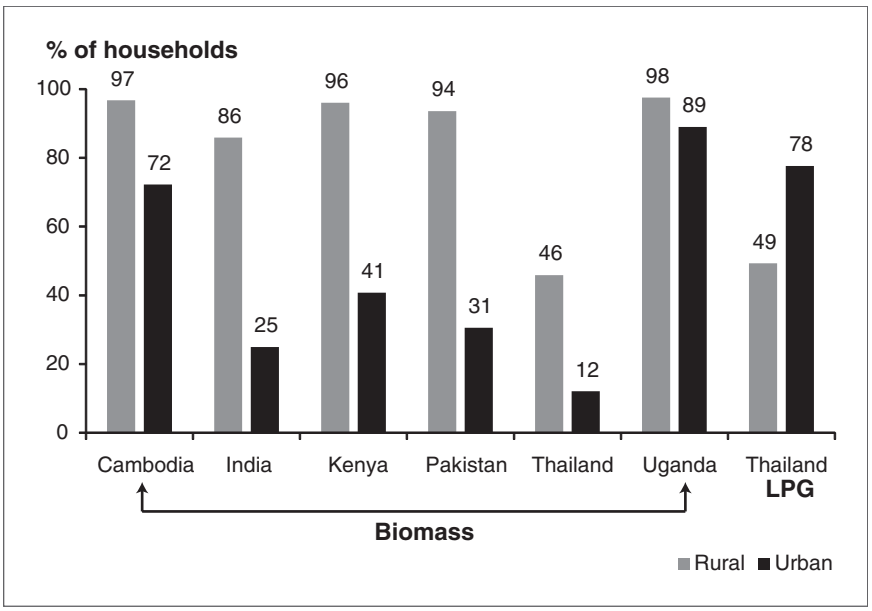
Table 3.12 presents the results by rural and urban quintiles, while table B.17 gives the national statistics by quintile. This paper groups answers according to five energy sources—electricity, kerosene, biomass, LPG or natural gas, and other (mainly coal and coke). The results

Figure 3.9 Main Cooking Fuel Across All Households



Source: Authors' calculations

Figure 3.10 Main Cooking Fuel in Rural and Urban Areas



Source: Authors' calculations

indicate that in the countries for which information was available, electricity was almost never used as the main cooking source, even by the highest urban quintile groups. Thailand was the one exception to this: 15 percent of households in the highest urban quintile used electricity as their main cooking fuel. When these figures are compared to the proportion of households with electricity uptake, it is clear that uptake was not related to the non-use of electricity as the main energy source for cooking: apart from Uganda, the uptake rates at the top quintile levels were substantial. Electricity is widely used in Asia for cooking rice by those households connected to electricity, and is used increasingly everywhere for reheating food and limited cooking using microwave ovens by those who own them. However, for other cooking activities, even high-income households seem to prefer a gaseous fuel to electricity.

The use of biomass as the main cooking fuel was surprisingly high in some urban areas: the third quintile in India had a 60 percent rate, that in Pakistan a 45 percent rate, and that in Thailand a 20 percent rate. Kerosene was the main cooking fuel for some upper-quintile urban households in India (16 percent in the fourth quintile), Kenya (50 percent in the top quintile), and Uganda (5 percent in the top quintile). Elsewhere, it was scarcely ever the main cooking source. In Thailand, LPG was the

Table 3.12 Main Energy Source for Cooking: Percentage of Rural/ Urban Households Using That Source

	Quintile	Electricity	Kerosene	Biomass	LPG/natural gas	Other
Cambodia	Rural 1	0.0	0.0	99	0.1	0.7
	2	0.0	0.0	99	0.1	0.7
	3	0.0	0.0	98	0.5	1.0
	4	0.0	0.1	98	1.3	0.7
	5	0.3	0.1	88	10	1.2
	All	**0.1**	**0.1**	**97**	**2.3**	**0.9**
	Urban 1	0.6	0.0	97	0.6	1.7
	2	0.4	0.0	97	1.0	1.3
	3	0.0	0.0	97	2.0	1.1
	4	0.2	0.2	91	5.8	2.8
	5	0.9	0.2	52	45	1.9
	All	**0.6**	**0.1**	**72**	**25**	**1.9**
India	Rural 1	0.0	0.5	94	0.4	5.6
	2	0.0	0.7	93	1.7	5.0
	3	0.0	0.8	90	4.9	4.0
	4	0.1	1.8	82	13	3.4
	5	0.1	3.6	57	38	1.9
	All	**0.0**	**1.3**	**86**	**8.6**	**4.2**
	Urban 1	0.2	6.7	80	2.8	11
	2	0.1	7.2	75	9.2	8.2
	3	0.1	11	59	21	9.2
	4	0.2	16	36	43	5.3
	5	0.3	9.4	8.1	80	2.2
	All	**0.2**	**11**	**25**	**60**	**4.2**
Kenya	Rural 1	0.0	0.4	100	0.1	0.0
	2	0.0	0.6	99	0.0	0.1
	3	0.2	1.1	98	0.0	0.5
	4	0.2	1.8	97	0.2	0.7
	5	0.9	9.9	85	3.4	0.6
	All	**0.2**	**2.6**	**96**	**0.7**	**0.4**
	Urban 1	0.0	13	86	0.2	0.5
	2	0.0	19	81	0.2	0.1
	3	0.8	36	62	0.5	0.9
	4	0.5	43	54	0.9	1.9
	5	2.6	50	27	19	1.0
	All	**1.8**	**45**	**41**	**12**	**1.1**

	Quintile	Electricity	Kerosene	Biomass	LPG/natural gas	Other
Pakistan	Rural 1	0.0	0.6	96	2.7	1.2
	2	0.0	0.4	96	3.0	0.9
	3	0.0	0.7	96	2.7	0.6
	4	0.0	0.7	92	6.0	1.3
	5	0.2	1.0	88	10	0.7
	All	**0.1**	**0.7**	**94**	**4.8**	**0.9**
	Urban 1	0.0	0.5	65	33	0.7
	2	0.0	1.6	51	47	0.7
	3	0.0	0.8	45	54	1.1
	4	0.0	1.6	33	65	0.3
	5	0.2	0.9	13	85	1.1
	All	**0.1**	**1.1**	**31**	**67**	**0.9**
Thailand	Rural 1	0.6	0.3	80	19	0.4
	2	0.6	0.2	61	38	0.3
	3	1.1	0.3	43	55	0.1
	4	2.2	0.1	24	74	0.1
	5	1.6	0.3	47	51	0.2
	All	**1.5**	**0.3**	**46**	**49**	**2.9**
	Urban 1	1.6	0.7	63	35	0.1
	2	2.7	0.2	41	56	0.1
	3	4.3	0.2	20	75	0.1
	4	9.2	0.2	7.5	83	0.0
	5	14	0.2	2.1	83	0.1
	All	**10**	**0.2**	**12**	**78**	**0.1**
Uganda	Rural 1	0.0	0.1	100	0.0	0.3
	2	0.2	0.2	99	0.0	0.2
	3	0.0	0.5	99	0.0	0.7
	4	0.0	0.3	98	0.0	1.4
	5	0.2	2.8	91	0.1	5.7
	All	**0.1**	**0.8**	**98**	**0.0**	**1.6**
	Urban 1	0.0	0.0	100	0.0	0.0
	2	0.0	0.0	99	0.0	0.9
	3	0.0	0.0	100	0.0	0.3
	4	0.0	0.8	98	0.0	1.5
	5	1.4	5.4	83	1.2	9.2
	All	**0.8**	**3.5**	**89**	**0.7**	**6.0**

Source: Authors' calculations.
Note: Biomass includes firewood, charcoal, dung, and agricultural waste. The category of LPG and natural gas is combined in the questionnaire for Pakistan; in Cambodia, India, Kenya, and Uganda, households do not use natural gas. For Cambodia, those households that reported using a combination of LPG and electricity as their main energy source for cooking are categorized under LPG. "Other" includes coal and coke.

most common main cooking fuel at higher quintile groups in both rural and urban areas. In Cambodia, LPG was important in the top urban quintile. The use of LPG as the main cooking fuel was low in all other rural areas except at the highest quintile level in India, but its importance increased steadily with rising income in urban India, reaching 80 percent for the top quintile. In Pakistan, where natural gas is widely available in urban areas, the uptake rates for gas were almost identical to the rate of choice of natural gas for cooking. Where households had uptake of gas, it was their main cooking fuel.

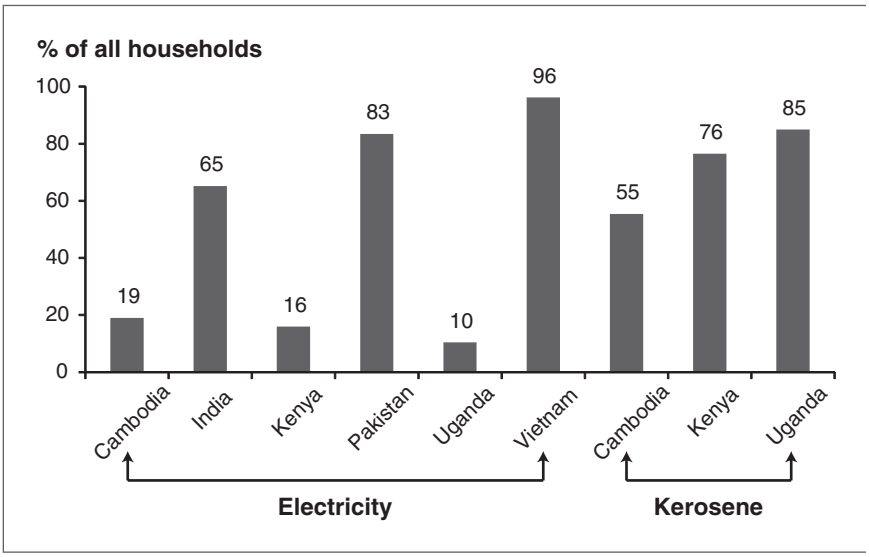
Main Energy Source for Lighting

Lighting is another activity that can be powered by different energy sources, of which electricity and—in its absence—kerosene are usually the dominant choices. No question on main lighting fuel was asked in the surveys in Bangladesh, Indonesia, and Thailand (this last presumably because of Thailand's near-universal access to electricity). In Kenya, detailed data on energy sources used other than electricity and kerosene revealed that firewood was important for lower quintiles; in Cambodia, batteries were an important third main energy source.

Figure 3.11 shows the percentage of households using electricity as their main lighting source, and, for the three countries for which electricity use was limited, the share of households using kerosene for lighting. The percentages of households using electricity match the uptake rates. Figure 3.12 shows the same statistics for rural and urban households separately.

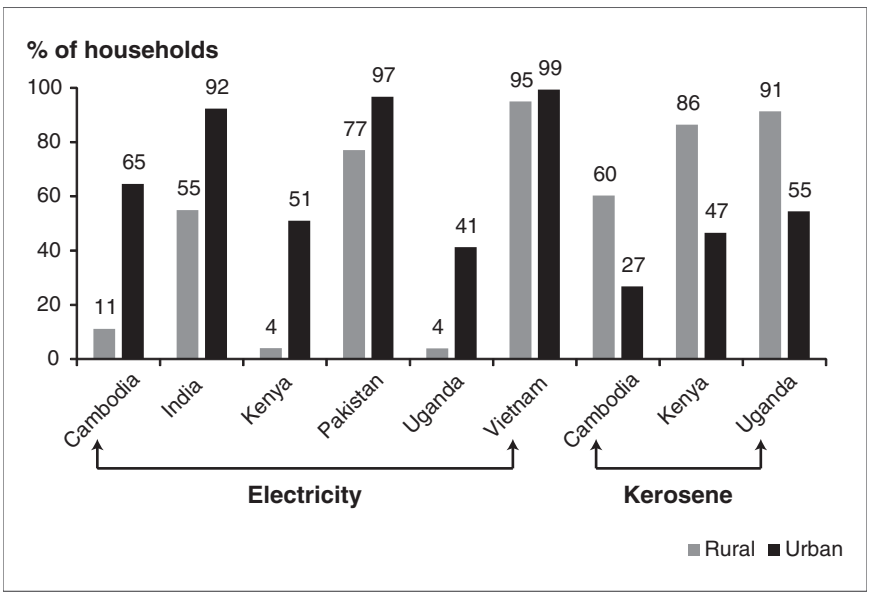
Tables 3.13 and 3.14 show the results by quintile for rural and urban households, respectively, while tables B.18 and B.19 give the percentages averaged across the country. Generally, the share of households using electricity as a main lighting source corresponded to the rate of uptake of this energy source; absent its uptake, kerosene was the most widely used source of lighting, consumed disproportionately by the poor. In India, Pakistan, and Vietnam, the proportion of households indicating that something other than electricity or kerosene was their main lighting source was very small in all quintiles. Only in some quintiles in Cambodia, Kenya, and Uganda did more than 10 percent of households indicate an energy source other than electricity or kerosene as their main lighting source. Batteries were the main lighting source for at least one-quarter of households for the top four quintiles in rural Cambodia. Batteries were also important in urban Cambodia, except for the bottom and top

Figure 3.11 Main Lighting Source for All Households



Source: Authors' calculations.

3.12 Main Lighting Source in Rural and Urban Areas



Source: Authors' calculations.

Table 3.13 Main Energy Source for Lighting in India, Pakistan, Uganda, and Vietnam: Percentage of Rural/Urban Households Using That Source

	Quintile	Electricity	Kerosene	Other	Quintile	Electricity	Kerosene	Other
India	Rural 1	33	67	0.5	Urban 1	58	42	0.9
	2	46	54	0.7	2	71	28	1.2
	3	56	43	0.4	3	81	18	0.8
	4	69	31	0.5	4	91	8.7	0.5
	5	86	14	0.4	5	98	1.7	0.2
	All	**55**	**45**	**0.5**	**All**	**92**	**7.2**	**0.4**
Pakistan	1	69	29	1.8	1	92	6.5	1.2
	2	72	26	2.1	2	95	3.7	1.5
	3	77	22	1.6	3	97	2.1	1.1
	4	82	17	0.9	4	97	1.4	1.3
	5	87	12	0.8	5	98	0.4	2.1
	All	**77**	**22**	**1.5**	**All**	**97**	**1.7**	**1.6**
Uganda	1	0.2	89	11	1	0.6	99	0.0
	2	0.6	95	4.4	2	1.4	97	1.3
	3	1.6	96	2.3	3	9.2	87	3.5
	4	2.6	96	1.7	4	26	69	4.3
	5	15	80	4.6	5	57	38	4.8
	All	**4.0**	**91**	**4.7**	**All**	**41**	**55**	**4.2**
Vietnam	1	90	8.0	2.4	1	96	3.2	1.0
	2	95	2.9	1.9	2	97	2.2	1.3
	3	96	2.8	1.4	3	100	0.0	0.0
	4	98	1.0	1.5	4	100	0.0	0.1
	5	99	0.6	0.8	5	100	0.0	0.3
	All	**95**	**3.3**	**1.7**	**All**	**99**	**0.3**	**0.3**

Source: Authors' calculations.
Note: In Vietnam, the categories for lighting are grid electricity; LPG, vegetable oil, or kerosene (categorized here as "kerosene"); and batteries, generators, and other (categorized here as "other").

quintile groups. Firewood was the main lighting source for the lowest quintile in rural and urban Kenya. Also in Kenya, as comparison of table A.2 and table 3.14 shows, the use of electricity as the main lighting source was most closely linked to having access to grid electricity.

Table 3.14 Main Energy Source for Lighting in Cambodia and Kenya: Percentage of Rural/Urban Households Using That Source

	Quintile	Electricity	Kerosene	Batteries	Other
Cambodia	Rural 1	1.6	80	16	2.5
	2	3.5	71	24	1.3
	3	6.4	64	29	1.1
	4	13	53	34	0.5
	5	34	34	32	0.6
	All	**11**	**60**	**27**	**1.2**
	Urban 1	6.2	85	6.6	2.6
	2	16	69	13	2.3
	3	34	50	14	2.0
	4	52	33	15	0.8
	5	91	5.7	2.8	0.2
	All	**65**	**27**	**7.7**	**0.9**
Kenya	Rural 1	0.3	78	17	4.6
	2	0.7	90	6.3	3.2
	3	1.8	93	3.7	1.8
	4	4.0	91	2.0	3.4
	5	13	79	1.5	6.8
	All	**3.8**	**86**	**5.9**	**3.9**
	Urban 1	0.2	87	8.9	3.9
	2	15	79	0.8	5.0
	3	22	76	0.9	0.8
	4	38	60	0.3	2.0
	5	65	32	0.2	2.2
	All	**51**	**47**	**0.5**	**2.2**

Source: Authors' calculations.

Stylized Energy Facts

The findings of a group of earlier energy survey studies compared to a series of stylized facts were presented in table 2.14. These studies were based mainly on surveys carried out in the late 1990s or early 2000s, while the current study is based on later surveys from a period centering around 2005. Of the nine countries that formed the basis of the current analysis, only India and Vietnam were covered in these earlier studies. It is useful to assess whether the earlier findings held true in this later period and for a largely different group of countries. The same patterns

can be checked (see the section on common findings in chapter 2 for the specific questions asked), apart from expenditure on diesel, which was not identified in these surveys (table 3.15).

The surveys included here show fairly consistent patterns. The share of expenditure on all energy for the lowest quintile was greater than 5 percent in every country, except in rural Kenya. When biomass is excluded, the share of expenditure on modern energy exceeded 5 percent for the bottom rural quintile only in Pakistan, indicating that the exclusion of biomass—for which values are imputed for collected fuels—can change the apparent importance of energy to the household budget. The previous studies showed a mixed picture, which may have depended in part on the treatment of biomass.

When all sources of energy are considered, urban households spent a greater proportion of their total expenditures except in India, Indonesia, and Thailand. When only modern sources of energy are considered, the share was higher in urban than in rural areas everywhere except Thailand. Previous studies had also largely indicated a greater importance of energy for urban households.

The share of kerosene declined with income group in all cases, except for rural Indonesia (where kerosene was heavily subsidized at the time

Table 3.15 Patterns of Energy Use Based on Selected Surveys

Country and survey year	Share > 5%	Urban > rural	Kerosene falls	Electricity rises	LPG rises	Gasoline rises	U-shaped response
Bangladesh, 2005	Y	Y	Y	Y	ND	Y	N
Cambodia, 2003–04	Y	Y	Y	Y	Y	ND	ND
India, 2004–05	Y	N	Y	Y	Y	Y	N
Indonesia, 2005	Y	N	N	N	Y	Y	N
Kenya, 2005–06	N	Y	N	Y	Y	Y	N
Pakistan, 2004–05	Y	Y	Y	N	Y	Y	N
Thailand, 2006	Y	N	Y	N	N	N	N
Uganda, 2005–06	Y	Y	Y	Y	ND	Y	Y
Vietnam, 2006	Y	Y	Y	Y	Y	Y	N

Source: Authors' calculations.
Note: Y = yes; N = no; ND = no question was asked concerning the fuel.

of the survey and, equally important, not rationed; kerosene was also heavily subsidized in India but was tightly rationed) and urban Kenya, conforming to the universal pattern found in earlier surveys. The share of LPG increased in six of the seven countries where data were available. This result was in contrast to the previous surveys where the share increased in only three of the seven countries for which there was information.

The share of electricity increased with quintile level in six countries, while in Indonesia and Pakistan it neither increased nor decreased; it showed a downward trend in Thailand. This mixed pattern was also identified in the earlier surveys, where the expenditure share increased in four of the eight cases for which information was presented.

The clearest pattern of household energy expenditure was that of gasoline and diesel. In the current study, seven out of eight countries for which there were data showed an increasing share, Thailand being the one notable exception. In the earlier surveys, the share had similarly increased in every country for which information was available.

Although the surveys examined here showed increasing shares of LPG and of gasoline and diesel and decreasing share of kerosene with income, only in Uganda did these opposing trends produce a U-shaped expenditure share for petroleum products, primarily in rural areas (tables 3.5 and 3.6). In some countries, the share of total expenditure on petroleum products increased, while in Bangladesh it decreased monotonically with income. Earlier surveys had shown a U-shaped response in the majority of cases, but it appears that the relative strengths of the demands for the different petroleum products varied sufficiently among countries to rule out a general pattern. However, it may well be that, even in Bangladesh, as incomes increase further, the share of kerosene will decline to such a low level that the increasing share of gasoline will produce an increasing share for petroleum products.

Implications for Universal Price Subsidies for Petroleum Products

Patterns of household energy use and consumption guide policies for energy subsidies. Komives and others (2005) propose three dimensions of subsidy performance:

- Benefit incidence (how well the subsidy targets benefits to poor, as opposed to other, households)

- Beneficiary incidence (what proportion of poor households as a whole receive the subsidy)
- Materiality (how significant the amount of the subsidy received by poor households is)

It would be possible to have a scheme in which the subsidies were well targeted (most of the benefits go to poor households) but with low beneficiary incidence because only a few poor households actually received the subsidy. Alternatively, a subsidy might reach only poor households and most poor households but be small in value relative to household income.

One useful measure is the benefit-targeting indicator ($\mathbf{\Omega}$), defined as the ratio of the share of total benefits received by poor households to the proportion of households that are poor. If the indicator takes a value of unity, the scheme is *neutral*, and the poor receive benefits in proportion to their numbers. A subsidy is *progressive* if $\mathbf{\Omega}$ is greater than 1, and *regressive* if it is less than 1, with nonpoor households receiving a larger share of the total subsidy pool than their proportion in the population. Beneficiary incidence is measured by the exclusion rate (E)—the percentage of poor households that do not receive the subsidy—while materiality is defined as the average value of the subsidy received by poor households benefiting from the subsidy as a percentage of their household income.

The benefit-targeting indicator can be shown to be equal to the product of five ratios:

$$\mathbf{\Omega} = \underset{(1)}{(A_p / A_H)} \times \underset{(2)}{(U_p / U_H)} \times \underset{(3)}{(T_p / T_H)} \times \underset{(4)}{(R_p / R_H)} \times \underset{(5)}{(Q_p / Q_H)}$$

where

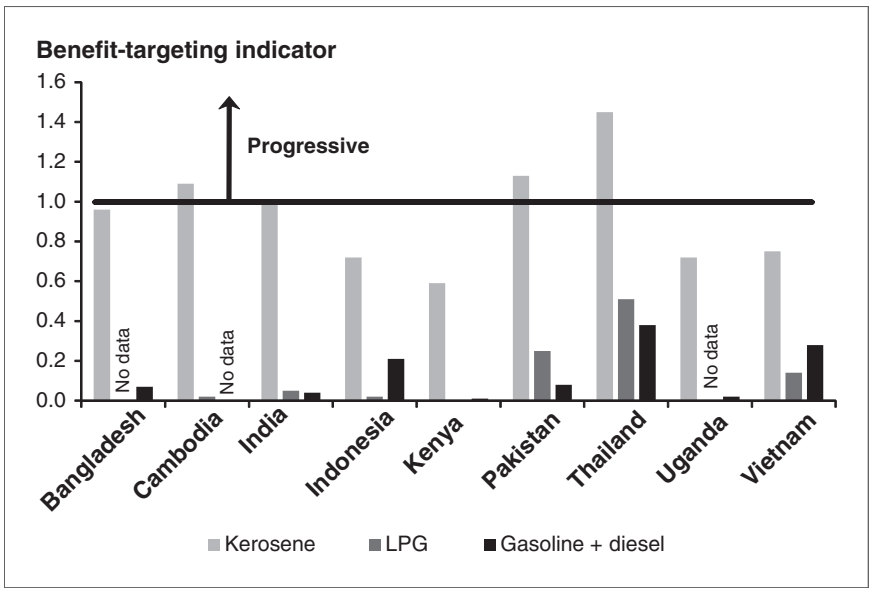
A = percentage of households that have potential access to the energy source
U = percentage of households with access that are connected to the energy source
T = share of households that are connected that are eligible for the subsidy
R = average rate of subsidization for eligible households
Q = average quantity consumed by subsidy recipients
$_p$ = group of poor households
$_H$ = group of all households

It is possible to compute Ω for hypothetical price subsidies for petroleum products under certain restricted conditions using the data analyzed in this paper. The simplifying assumptions are that the surveyed households faced similar unit prices for the petroleum product in question, the hypothetical subsidy is universal, and the subsidy is constant per unit of the petroleum product and not a function of the amount purchased. The first assumption—essentially pan-territorial pricing—is a weak one for countries with liberalized pricing, particularly Uganda. Because many poor households live in areas with poor transport infrastructure, they tend to pay more for fuels. If that is the case, this assumption will lead to an overestimation of the quantity of fuel consumed by the poor and make the subsidy look more progressive than it would be in practice. The product of (1) and (2) is the proportion of poor households that consume the petroleum product divided by the proportion of all households that consume the product. The ratio of the proportions of all poor and all users that would receive a subsidy, (3), is equal to unity because of the universality of petroleum product subsidies. The ratio of the average rate of subsidization for eligible poor and all eligible households, (4), is also unity because the subsidy is a constant amount per unit quantity, independent of the quantity purchased. The final term, (5), is the ratio of the average quantity consumed by eligible (user) poor households to that consumed by all eligible (user) households. For the purpose of this illustration, the ratio of expenditures is taken as a proxy for the ratio of quantities, assuming the price should be more or less the same for all users and therefore a common factor in the two sets of expenditures. Multiplying the percentage of households using the energy source by the average quantity consumed by user households is equal to the average consumption of all households in the group (users and non-users). Hence, the benefit-targeting indicator would be equal to the average consumption of the poor relative to the average consumption of all households.

Simulated Ω and E based on the foregoing are shown in figures 3.13 and 3.14, respectively. The poor were defined as those households with per capita income in the bottom 40 percent of the population. The simulation illustrates the projected performance of the two indicators were the government to introduce a flat-rate universal subsidy.

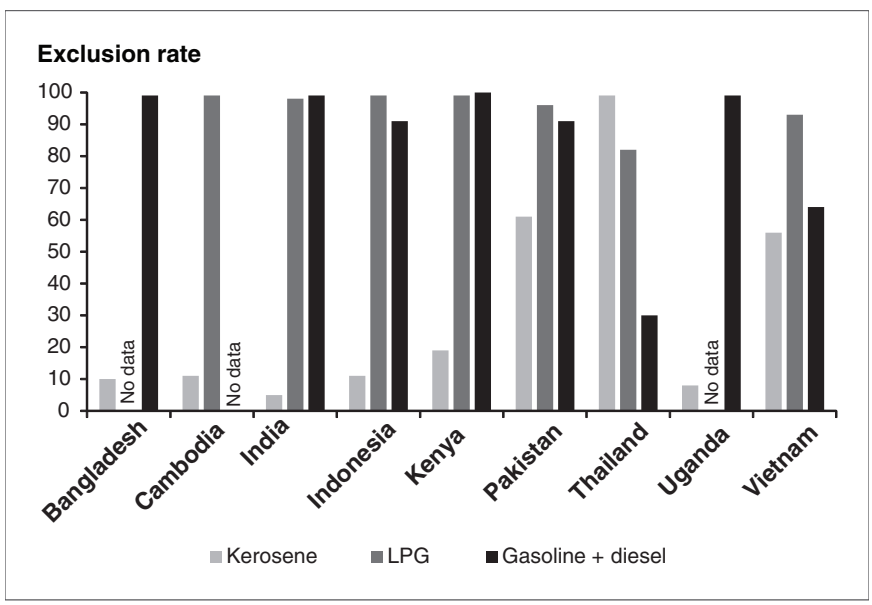
The results show a clear pattern for Ω. Focusing on kerosene consumed only by households, a subsidy on kerosene would be mildly progressive in some countries and only modestly regressive in the others. The proportion of the poor that would not have benefited from such a

Figure 3.13 Simulated Flat-Rate Universal Price Subsidy: Ω



Source: Authors' calculations.

Figure 3.14 Simulated Flat-Rate Universal Price Subsidy: E



Source: Authors' calculations.

subsidy (because of not consuming kerosene) would generally be low, although there are notable exceptions. In Pakistan, Thailand, and Vietnam, more than half the poor households did not use kerosene and the percentage of exclusion would have been correspondingly high.

These findings should be interpreted with caution, because the data analyzed exclude kerosene consumed by other users. If diesel prices are higher, subsidized kerosene is inevitably diverted to the automotive sector and added to diesel fuel because kerosene is a nearly perfect substitute for diesel (Kojima and Bacon 2001). When this diversion is taken into account, a kerosene subsidy can become highly regressive. A study in India found that subsidized kerosene consumed by households was evenly shared between the rich and the poor, but up to as much as half of subsidized kerosene might have been diverted to nonhousehold users (ESMAP 2003a).

For LPG and gasoline/diesel, Ω would be low, indicating high regressivity. The main exception to this pattern was Thailand where the much higher per capita consumption and income (twice that of the next highest country, Indonesia, when measured at PPP) led to a wider-scale use of these fuels and a smaller difference in consumption between low-income and other households. The range for Ω could be between 0 and 1.5, with a value above 1 signaling progressivity. Excluding Thailand, Ω was 0.28 or smaller in every country for LPG and gasoline/diesel. Even in Thailand, Ω was 0.51 for LPG and 0.38 for gasoline/diesel. The exclusion figures indicate that the great majority of the poor would be excluded from receiving any direct benefit from subsidies on LPG or gasoline and diesel. These simulated results based on the expenditure patterns of a variety of countries with different fuel-use patterns and price levels suggest that subsidies on transportation fuels and LPG are likely to be strongly regressive in countries with low to moderate income levels.

Chapter 4

Conclusions

This paper analyzed nine household expenditure surveys conducted in the few years centered around 2005 in Asia and Africa. The importance of energy in household expenditure was confirmed in all the countries studied. When the imputed value of nonpurchased food was included, the share of energy expenditure in both rural and urban areas ranged from 6 to 14 percent; if the value of nonpurchased food was large, as in Cambodia, Kenya, Uganda, and Vietnam, and was excluded, the shares of rural energy expenditure were markedly higher, nearly doubling the expenditure share in rural Cambodia and Uganda.

The share of expenditure devoted to modern energy sources was also generally large. In urban areas, with the exception of Uganda, the share ranged between 4 and 13 percent. In rural areas, the share was somewhat lower, ranging from about 2 percent in Bangladesh, Cambodia, Kenya, and Uganda up to 10 percent in Thailand. The use of modern sources in the total consumption of energy increased at higher income levels in both rural and urban areas. However, even for the top quintile, reliance on traditional energy sources (biomass of all forms) was about 50 percent of all energy expenditure in Bangladesh, Cambodia, and Uganda. At the lowest quintile level in rural areas in Bangladesh, Cambodia, India, and Uganda, three-quarters of energy expenditure was on traditional fuels; with the exception of India, this proportion declined to less than 50 percent at the top quintile.

Expenditure shares of petroleum products did not follow the pattern exhibited with modern energy, on which urban households spend more than rural ones. Rural households on average spent more than urban households in Bangladesh, Pakistan, Thailand, and Uganda. At the opposite end of the spectrum, urban households spent nearly twice as much as rural on petroleum products in Kenya and Vietnam. The share for petroleum products was greater than 5 percent in urban Thailand and Vietnam. For the bottom 40 percent, the spending on petroleum products was concentrated on kerosene, with the exception of Thailand, Vietnam, and urban Pakistan: for this latter group of households, the

expenditure share ranged from 0.6 percent in urban Pakistan to 5.7 percent in urban Thailand. In those countries where the expenditure shares were already high in the middle of the last decade, subsequent oil price increases in 2007 and 2008 likely hit the poor hard.

The analysis of energy expenditures by quintile group gave useful information on the relative importance of energy to the poorest households in each country. In Bangladesh, Cambodia, India, and Uganda, the share of expenditure on energy in rural and urban areas was greatest for the bottom quintile; this was also true of urban areas in Indonesia and Thailand. Only Kenya, Pakistan, and Vietnam showed no such pattern, with the top quintile having the highest energy expenditure share in both rural and urban areas in Pakistan and Vietnam. The share of expenditure on modern energy generally rose with income in all the Asian countries. However, there was no clear evidence that the share for modern energy increased steadily with quintile level in Kenya and Uganda. There was no consistent pattern for the share of petroleum products with respect to income.

A subset of the surveys allowed some comparisons to be made between rural and urban households at comparable income levels. Since rural and urban households may have quite different average expenditures, it was necessary to identify pairwise quintile comparisons where the total household expenditure levels were similar. This set of comparisons showed that, although total energy expenditure shares were similar, their composition was quite different. As expected, the share for modern energy was higher, and the share for biomass lower, in urban areas at the same income level. The expenditure on electricity was higher in urban areas, but the share for gasoline and diesel was higher in rural areas. The picture for kerosene, regarded as predominantly a rural fuel, showed no consistent pattern. The limited evidence on LPG suggested that it is more important as an energy source to urban than rural households.

The pattern of uptake revealed a large difference between the Asian and African countries surveyed. In Asia, with the exception of Cambodia, uptake of electricity for urban households was high above the bottom quintile, and almost universal at the top quintile. In Kenya and Uganda, urban uptake was less than 40 percent in the fourth quintile and less than 70 percent for the top quintile—even though total expenditure (excluding nonpurchased food) for the top urban quintile in Kenya ($914 in 2005 dollars at PPP) and Uganda ($715) was well above that for the top quintile in Bangladesh ($567), India ($471), or Indonesia ($452). It is apparent that uptake of electricity in urban Kenya and Uganda was

not limited by income alone but by the generally poor power sector infrastructure, a common problem in Sub-Saharan Africa. Rural uptake of electricity, while rising with income, was much lower than urban uptake everywhere except Thailand and Vietnam. However, in Kenya, the highest rural quintile had an uptake rate of only 21 percent; in Uganda, the highest rural quintile had an uptake rate of 15 percent; and in Cambodia, the fourth rural quintile had an uptake rate of 13 percent. Predictably, where a household had uptake of electricity, this was its primary source of energy for lighting.

The uptake of kerosene, an important fuel for lighting where households do not have electricity, was very high in all rural areas except in Pakistan, Thailand, and Vietnam—but still averaging 40 percent of rural households in both Pakistan and Vietnam—and in most countries, it did not decline much with income. In urban areas, kerosene was important at lower income levels, except again in Pakistan, Thailand, and Vietnam. LPG, by contrast, was not used much by low-income urban households, except in Vietnam, but its use increased at higher incomes. It was generally not used much in rural areas, but was used by half the households in the top quintile in India, and by 70 percent of households in the top quintile in Vietnam. In Bangladesh and Pakistan, where natural gas is found in urban areas, the uptake rate increased rapidly with quintile level, reaching 50 percent of the top quintile in Bangladesh and 80 percent of this group in Pakistan.

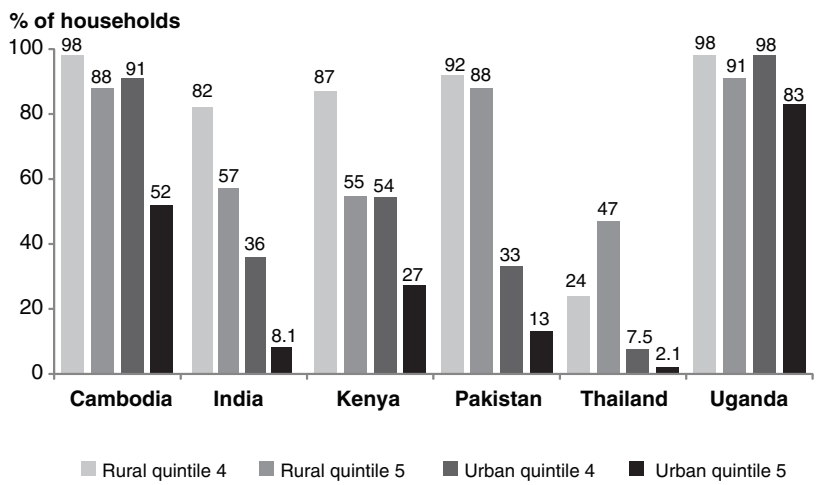
The share of urban households using biomass was high in most countries, and exceeded 80 percent even at the top quintile level in Bangladesh, Cambodia, and Uganda; in rural areas, the uptake rate was even higher. The top rural quintile had an uptake rate of more than 90 percent in five countries. Even in Thailand, which was the highest-income country of the nine and had the lowest uptake rate, close to half of all rural households were using biomass.

An interesting finding is the extent to which the rich in the survey countries were using biomass as their primary cooking fuel. These results should be interpreted with caution because households use a portfolio or fuel-stacking approach to cooking as income rises, and some households using two or more sources of energy might not have found it easy to name their primary cooking fuel. Only in high-income countries do households use only gas, only electricity, or some combination of both for cooking. What is surprising is how many rich households said biomass was their primary cooking fuel. Households do not abandon biomass use altogether for a variety of reasons, including cost, the fact that

modern fuel supplies are not always reliable or are time consuming to acquire where they live, and because of cooking practices and cultural preferences. Figure 4.1 shows the percentage of households in the top two quintiles in the six countries surveyed that reported biomass as their main cooking fuel.

The persistent use of biomass even in urban areas and even as monthly household expenditure reached upwards of $800, valued in 2005 dollars at PPP, shows that steps to move households away from biomass will need to address a variety of concerns and problems. This is particularly true of LPG, which, apart from electricity, is the most realistic modern fuel option in rural areas for cooking and heating. There are economies of scale in LPG delivery, which also requires good road infrastructure.

Figure 4.1 Use of Biomass as Main Cooking Fuel by Households in the Top Two Quintiles



Monthly household expenditures in 2005 $ at PPP

Quintile	Cambodia	India	Kenya	Pakistan	Thailand	Uganda
Rural 4	291	215	391	445	755	311
Urban 4	337	252	395	518	853	329
Rural 5	757	335	675	623	1,406	558
Urban 5	993	471	993	904	1,588	784

Source: Authors' calculations.
Note: There may have been data entry problems for biomass in rural Thailand during the survey.

If LPG is delivered only once every so many days, a backup cylinder (at $20–30 each) becomes essential. Delivery may also not be regular and reliable in a low-volume market, particularly if it is remote. The cost of cylinder management rises with declining cylinder size, but large cylinders mean large refill payments, a problem for households with irregular cash income flow. These challenges all too often exist against the backdrop of more readily available and much cheaper biomass, which is also suited for cooking traditional meals—for example, in an earlier Mexican study, many considered fuelwood essential for tortilla making (Masera, Saatkamp, and Kammen 2000).

For policy to shift household fuel use from traditional biomass to cleaner cooking fuels, it would make sense to examine first how the urban rich could be persuaded to make this shift, because they are most likely to be able to afford it and have ready access to the LPG service infrastructure. If there are distortions in the market—a lack of competition; an inadequate regulatory framework for the industry; poor enforcement of regulations; or any combination of these factors resulting in high prices, low quality of service, or both—the national energy ministry should take the lead in addressing them. The principal problems may, however, lie outside the energy sector: port congestion and slow customs clearance incurring high demurrage charges, bad road infrastructure, or the cost of doing business discouraging investment in bottling plants. Identifying and addressing these issues would require the involvement of other government ministries and agencies.

Universal price subsidies for petroleum products are common, and many governments resorted to such subsidies as oil prices soared to historic heights in 2008 (Kojima 2009b). A recent estimate suggests that global pretax petroleum product subsidies increased from $57 billion in 2003 to $519 billion by mid-2008. After falling to $136 billion in mid-2009, the total is projected to rise to $240 billion in 2010. When tax reductions are also included, the estimate for 2010 amounts to 1 percent or more of global gross domestic product (Coady and others 2010). Simulation of universal flat-rate price subsidies for petroleum products suggested that, when direct effects on households are considered, such subsidies would be regressive for LPG, gasoline, and diesel in all countries where data were available, and for kerosene in half the countries. The exclusion rate is very high for LPG, gasoline, and diesel. It is low for kerosene in six countries where that energy source is widely used. These findings might suggest that a kerosene price subsidy could be pro-poor under certain circumstances. However, because kerosene is a nearly

perfect substitute for diesel, when the price of subsidized kerosene is lower than that of diesel, the former is almost universally diverted to the automotive sector, benefiting businesses and higher-income households and potentially making the kerosene subsidy regressive even in countries where an analysis of household energy use might suggest it would be progressive.

Further insights into subsidy policy may be gleaned from examining cash expenditures on food. The expenditure share of purchased food constituted one-third or more of total household expenditures for every urban quintile and as much as 60 percent for the bottom four urban quintiles in Cambodia and the bottom two in Bangladesh. In rural areas, cash expenditures on food in every quintile comprised 50 percent or more of total household expenditure in Cambodia and Indonesia and one-third or more in Bangladesh, India, Pakistan, and Vietnam. The indirect effects of higher energy prices—especially of gasoline and diesel which are used to transport food—on the welfare of these households would be high. In India, Indonesia, Kenya, Pakistan, Thailand, and Vietnam, the ratio of expenditures on purchased food to those on petroleum products declined monotonically with income in both rural and urban areas. The expenditure shares of purchased food were at least an order of magnitude larger than those for petroleum products among the poor everywhere except Thailand, and were in fact two orders of magnitude larger among the urban poor in Pakistan. The indirect effects of higher oil prices through higher food prices could be larger than the direct effects of higher oil prices for many households. If that is the case, the policy response to help the poor cope with higher gasoline and diesel prices might more productively focus on assistance, ideally through targeted cash transfers, for food purchase—and, more generally, the basket of goods that the poor consume—than subsidizing fuel prices.

This analysis of household surveys leaves several unanswered questions and suggests avenues for future investigation. Some issues will require more detailed surveys, but others could be based on the surveys used here. Most questions relate to the changing patterns of energy consumption at progressively higher income levels. Although this study has confirmed the presence of fuel stacking, with households initially adding extra fuels as income rises without dropping other fuels, it is less clear how the quantities of the different fuels change. In particular, further information could be sought on the following:

- The extent to which the demand for electricity is income elastic, and evidence on how fuel-use levels change once electricity is added to the household portfolio
- The extent to which the demand for LPG (and natural gas where available) is income elastic, and evidence on how fuel-use levels change once LPG is added to the household portfolio
- How the use of purchased versus nonpurchased biomass changes as income rises
- Whether charcoal and other forms of biomass exhibit different expenditure and use patterns at increasing income levels
- How total household biomass usage may change as modern forms of energy are introduced into the household budget
- Why the share of expenditure on gasoline and diesel is higher for rural households than for urban at similar income levels

Appendix A

Survey Data Sets and Estimation of Total Household Expenditure

The data used for this study cover countries in Asia and Sub-Saharan Africa. Nationally collected household-level socioeconomic survey data formed the basis of the analysis. These large surveys provide detailed household-level information on the consumption patterns of energy in every income class.

A bottom-up approach, summing all expenditure components, was used to compute the total household expenditure in each country using a uniform procedure. Monthly total household expenditure was defined as the sum of the following:

- **Food expenditures:** Expenditures for all food items using the 7-day recall period (if available) were prorated to a 30-day level, to provide a "monthly" value.
- **Nonfood expenditures:** Expenditures on nonfood items were prorated to a 30-day level where required. Where both monthly and annual expenditures were provided, the following practice was followed:
  - **Monthly:** For expenditures on items such as fuel and light, entertainment, non-institutional medical, personal, toiletries, consumer services, rent, and commuting, the monthly recall values were used.
  - **Annual:** Expenditures on such items as clothing, bedding, footwear, education, medical (institutional), durable goods, life insurance premiums, vehicle insurance premiums, and membership fees were prorated from their annual levels to 30-day levels.

The surveys provided information on certain large expenditure items (such as furniture; household appliances including refrigerators, air conditioners, washing machines, televisions, DVD players; expensive jewelry; automobiles; personal computers; ceremonies; and taxes and

cesses). Expenditures on these items—which ranged from 0 percent to greater than 90 percent of total expenditure in some cases, and which averaged about 1–5 percent of total household expenditure—were removed. This was done for two reasons: first, to avoid misrepresentation of households in their respective income quintiles since large expenditures are not made regularly, and second, to enable cross-country comparison fuel shares given that the various categories of large expenditure items were treated differently, in that they were included in some surveys but not in others.

The data set was inspected for the presence of any outliers in energy consumption values. This inspection involved examining households whose consumption levels and shares in total household expenditure for energy-related variables (kerosene, LPG, gasoline, diesel, electricity, natural gas, coal, firewood, charcoal, other biomass) were very different from what could be considered a reasonable household consumption level based on the levels of consumption of other households in the survey.

The analysis was based on alternative definitions of total household expenditure:

- For all countries, a measure of total household expenditure excluding durable items as explained above
- For those countries (Cambodia, Kenya, Uganda, and Vietnam) where the value of nonpurchased food formed a substantial portion of total expenditure, a second measure excluding this item from the total

The data sets were divided into five population quintiles based on monthly per capita expenditure levels derived from the above two definitions of total household expenditure. Each quintile contained the same number of *individuals* and not *households*. As well as national quintiles, separate urban and rural quintile groups were defined by drawing households from the national quintile depending on whether they resided in an urban or rural area. The numbers of people in these quintile groups were not the same and depended on the relative numbers of urban and rural households in the nationally defined quintile.

Average expenditures of energy-related variables were computed at the household level. The various categories of energy sources identified in the different surveys were aggregated where necessary to the following items to allow a comparison among surveys: kerosene, LPG, gasoline and diesel, electricity, natural gas, and biomass. The expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene, LPG, gasoline, and diesel. Expenditure on modern

energy was defined as the sum of expenditures on petroleum products, natural gas (where available), and electricity. Expenditure on biomass was defined as the sum of expenditures on firewood, charcoal, and other forms of biomass. Expenditure on total energy products was defined as aggregate expenditures on all fuels, including biomass, and electricity.

Where the same item appears in more than one question, it may be possible to check internal consistency. For example, the percentage of households using a specific source of energy as their primary source for an activity, say lighting, should be the same as or smaller than the percentage that use that energy source for any number of activities, of which lighting is one. Defining "use" to mean reporting positive expenditures (cash or imputed) led to internal inconsistencies, violating this simple rule, for the uptake of electricity in Kenya and Uganda, of biomass in Kenya, and of LPG in Thailand. For all cases, alternative means of calculating uptake were used for internal consistency.

Where expenditures are lumpy and a given energy source appears to be paid for less frequently than once a month—such as LPG in Thailand and possibly electricity in Kenya and Uganda—average expenditures are not necessarily affected as long as the sample size is large enough: zero expenditures of some households will be offset by others that paid for the energy source to cover more than one month of consumption; on average, the expenditures should be equal to what households would spend for one month's consumption. However, the share of households using the energy source would be underestimated if positive expenditures were taken as an indication of uptake.

Bangladesh (HIES 2005)

The data for this study are from the Household Income and Expenditure Survey (HIES) conducted by the government's Bureau of Statistics. The fieldwork for this survey was conducted between January and December 2005. The sample size was 10,054 households, 64 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 139 million people, of whom 75 percent were in rural areas, and 29 million households. The actual population of Bangladesh in 2005 was 153 million, and the proportion of the population living in rural areas in the same year was 74 percent (World Bank 2009).

The large expenditure items, excluded from the definition of total household expenditures, averaged slightly more than 2 percent of aggregate total household expenditure. The value of nonpurchased food

accounted for 15 percent of aggregate total expenditure for rural households and 4 percent for urban households.

Overall, 10,080 households were interviewed. The cleaned data set contained observations from 10,054 households after excluding those with duplicate observations, or for which there was no information on major expenditure categories. Nine households that had reportedly spent more than 35 percent of their total monthly household expenditure on either gasoline or diesel were also excluded.

Data on household expenditure on kerosene, firewood, electricity, gas, gasoline, diesel, lubricant oil, "coal and charcoal," cow dung, jute sticks, other agricultural wastes (paddy, hag, pressed sugarcane, dried corn plants), and other unclassified fuels which included matches and candles were available as were the imputed values of all nonpurchased fuels. The category "gas" represents both natural gas and biogas since the survey questionnaire combined both expenditures.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene, diesel, gasoline, and lubricant oil. Expenditure on biomass was defined as the sum of expenditures on firewood, dungcake, jute sticks, other agricultural wastes (paddy, hag, pressed sugarcane, dried corn plants) and coal and charcoal. Expenditure on modern energy was defined as the aggregate of expenditures on total petroleum products, natural gas, and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy, biomass, and other unclassified fuels which included matches and candles.

Cambodia (Cambodia Socio-Economic Survey, 2003–04)

The data for this study are from the Cambodia Socio-Economic Survey conducted by the National Institute of Statistics of the Cambodian Ministry of Planning. The fieldwork for the survey was conducted between October 2003 and January 2005. The sample size was 14,572 households, 80 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to approximately 12.6 million people, of whom 85 percent were in rural areas, and 2.5 million households. The actual population of Cambodia in 2003 and 2004 was 13.5 million and 13.7 million, respectively. The proportion of the population living in rural areas in these years was 81 percent (World Bank 2009).

Large expenditure items, which averaged slightly more than 5 percent of total household expenditures, were removed. The value of nonpurchased food comprised 20 percent of the budget of rural households and 7 percent of that of urban households.

Overall, 15,000 households were interviewed. The cleaned data set contained observations from 14,572 households after excluding households that had missing or differently coded information on either food expenditures or most of the other expenditure categories. Thirty-three households were removed because their expenditure on electricity, kerosene, or firewood comprised more than 40 percent of their total expenditure. However, 16 households that gave no information on their main lighting or cooking fuel were retained for the rest of the analysis since fuel consumption information was available.

Data on household expenditures on kerosene, firewood, charcoal, electricity, LPG, batteries, and other unspecified fuels were available. Imputed values of any nonpurchased fuels were not reported. Expenditures on diesel and gasoline were also not reported.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene and LPG. Expenditure on modern energy was defined as the sum of expenditures on petroleum products and electricity. Expenditure on biomass was defined as the sum of cash expenditures on firewood and charcoal. Total expenditure on energy sources was defined as the aggregate of expenditure on modern energy, biomass, batteries, and other unclassified fuels.

India (National Sample Survey, 2004–05)

The data for this study are from the 61st round of the National Sample Survey of India conducted by the government's National Sample Survey Organization. The fieldwork was conducted between July 2004 and June 2005. The sample size was 121,630 households, 64 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 959 million people, of whom 75 percent were in rural areas, and 203 million households. The actual population of India in 2004 and 2005 was 1.08 billion and 1.09 billion, respectively. The proportion of the population in rural areas in these years was 71 percent (World Bank 2009).

Large expenditure items, which averaged slightly more than 2 percent of total household expenditures, were removed. The value of nonpur-

chased food comprised 11 percent of the budget of rural households and 1 percent of that of urban households.

Overall, 124,644 households were interviewed. The cleaned data set contained observations from 121,630 households: 3,014 households that reported having paid prices that were far from those prevailing for the rest of the sample for LPG, kerosene, or electricity were dropped.

Data on household expenditures on LPG, subsidized and rationed kerosene sold through the Public Distribution System (PDS), market (non-PDS) kerosene, diesel, gasoline, lubricant oil, coke, coal, "firewood and chips," dungcake, electricity, charcoal, candles, matches, gobar gas (biogas), and other unspecified fuels were available. The imputed values of firewood and chips, dungcake, gobar gas, and other unspecified nonpurchased fuels were also provided. Expenditure on total petroleum products was defined as the sum of a household's expenditures on LPG, kerosene (PDS and non-PDS), diesel, gasoline, and lubricant oil. Expenditure on biomass was defined as the sum of expenditures on firewood and chips, charcoal, dungcake, biogas, and other unspecified fuels. Expenditure on modern energy was defined as the sum of expenditures on petroleum products and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy, biomass, coke, coal, candles, and matches.

Indonesia (SUSENAS, January Panel Module 2005)

The data for this study are from the National Socio-Economic Survey (SUSENAS) conducted by BPS-Statistics Indonesia. The SUSENAS comprises a series of large-scale socioeconomic surveys initiated in the 1960s and fielded annually. The main survey consists of two parts: the core questionnaire, which is administered to about 200,000 households, and a module administered to about 65,000 households. There are three module sections—consumption, health, and social—each of which is repeated every three years. The data for this study were taken from the consumption module, which provides detailed information on household-level expenditure patterns. A panel version of the consumption module is administered in January to March every year to about 10,000 households.

The panel consumption module for 2005 was used because the full module data set for the survey conducted later that year was not available. The fieldwork for the panel consumption module was conducted

between January and March 2005. The sample size was 9,925 households, 57 percent of which were based in rural areas. Using the weights provided in the survey, this corresponded to 206 million people, of whom 55 percent were in rural areas, and 52 million households. The actual population of Indonesia in 2005 was 221 million, and the proportion of the population living in rural areas in the same time period was 52 percent (World Bank 2009).

Large expenditure items, which averaged slightly more than 3 percent of total household expenditures, were removed. The value of nonpurchased food accounted for 11 percent of the budget of rural households and 3 percent of that of urban households.

Overall, 10,575 households were interviewed. The cleaned data set contained observations from 9,925 households. Seventy-four households were dropped because their expenditure on a particular fuel appeared to be an outlier, while another 576 households that seem to have paid prices for LPG, kerosene, gasoline, or electricity that were far from those prevailing, or that lacked data on important expenditure items, were dropped.

Data on household expenditures were available for LPG, kerosene, city gas (natural gas), automotive diesel, automotive gasoline, coal/briquette, "firewood and other fuels," and electricity. "Firewood and other fuels" included biomass fuels not included in other categories. No data were included for the value of nonpurchased fuels. The questionnaire asked separately about fuels used for electricity generation, but the authors of this study were not able to obtain the data; hence, fuels used for power generation are not included in the results presented here.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene, LPG, automotive diesel, and automotive gasoline. Expenditure on modern energy was defined as the sum of expenditures on petroleum products, city gas, and electricity. Expenditure on biomass was defined as expenditures on firewood and other fuels. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy, biomass, and coal/briquette.

Kenya (Kenya Integrated Household Budget Survey 2005–06)

The data for this study are from the Kenya Integrated Household Budget Survey conducted by the Kenya National Bureau of Statistics within the Ministry of Planning and National Development.

The fieldwork for this survey was conducted between May 2005 and April 2006. The sample size was 12,996 households, 65 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 35 million people, of whom 80 percent were in rural areas, and 6.9 million households. The actual population of Kenya in 2005 and 2006 was 36 million and 37 million, respectively. The proportion of the population living in rural areas in these years was 79 percent (World Bank 2009).

Large expenditure items, which averaged slightly more than 1 percent of total household expenditures, were removed. The value of nonpurchased food comprised 25 percent of the budget of rural households and 7 percent of that of urban households.

Overall, 13,114 households were interviewed. The cleaned data set contained observations from 12,996 households after excluding households that had duplicate or inconsistent observations, lacked information on food expenditures or some other expenditure category, or whose expenditure on an individual energy source comprised more than 40 percent of their total household expenditure (21 households).

Data on household expenditures on kerosene/paraffin, electricity, LPG (referred to as gas in the survey questionnaire), firewood, charcoal, other unspecified cooking fuels, gasoline, and diesel were available. The imputed values of all nonpurchased fuels were also available.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene, LPG, diesel, and gasoline. Expenditure on modern energy was defined as the sum of expenditures on petroleum products and electricity. Expenditure on biomass was defined as the sum of expenditures on firewood and charcoal; there was no separate category for other forms of biomass (animal and agricultural wastes) in section J of the survey on fuel and power expenditures. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy, biomass, and other unspecified cooking fuels.

Comparison of reported expenditures and quantities consumed for firewood in section J showed that many households assigned a value of zero to nonpurchased biomass. To define consumption of biomass in order to calculate uptake, section H of the survey—which asked whether households used purchased firewood, collected firewood, animal wastes, straws and stalks, and charcoal—was used. Because animal wastes may be used for housing, only animal wastes used for boiling, heating, and cooking were considered for this purpose. The differences are shown in table A.1.

Table A.1 Percentage of Households Using Biomass in Kenya

Quintile	Positive expenditures on firewood and charcoal			Consumption of firewood and charcoal			Use of firewood, charcoal, & animal & agricultural wastes		
	Rural	Urban	Nat'l	Rural	Urban	Nat'l	Rural	Urban	Nat'l
1	19	52	20	58	66	58	99	86	99
2	31	71	34	59	76	60	99	92	98
3	35	72	41	58	77	61	98	83	96
4	49	76	56	66	79	69	98	86	95
5	54	53	54	67	54	60	93	61	76
All	**38**	**61**	**44**	**62**	**63**	**62**	**97**	**70**	**91**

Source: Authors' calculations.

Similarly, responses in sections J and H were compared to estimate the uptake of electricity. Table A.2 shows the results based on positive expenditures on electricity as reported in section J; the percentage of households citing grid electricity as one of the sources of electricity in section H; and the percentages of households citing grid electricity, own, a neighbor's, or the community's electricity generation, or solar power among their sources of electricity in section H. It is clear that expenditures during the preceding 30 days on electricity cannot be equated with the uptake of electricity, and the last set of numbers were used instead in tables 3.8, 3.9, and B.11.

Table A.2 Percentage of Households Using Electricity in Kenya

Quintile	Positive expenditures on electricity			Grid electricity as a source of electricity			Grid, own generation, or solar panels as sources of electricity		
	Rural	Urban	Nat'l	Rural	Urban	Nat'l	Rural	Urban	Nat'l
1	0.1	0.2	0.1	0.3	0.2	0.3	0.6	0.5	0.6
2	0.4	12	1.3	0.6	16	1.7	1.2	16	2.2
3	0.6	9.2	2.0	1.6	22	4.8	3.3	23	6.3
4	1.9	18	5.7	4.2	38	12	8.1	39	15
5	6.2	37	23	13	65	40	21	66	45
All	**1.8**	**28**	**8.3**	**3.7**	**51**	**16**	**6.6**	**52**	**18**

Source: Authors' calculations.

Pakistan (HIES 2004–05)

The data for this study are from the 2004–05 HIES, conducted by Pakistan's Federal Bureau of Statistics. The fieldwork for this survey was conducted between July 2004 and June 2005. The sample size was 14,700 households, 61 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 130 million people, of whom 68 percent were in rural areas, and 19 million households. The actual population of Pakistan in 2004 and 2005 was 152 million and 156 million, respectively. The proportion of the population living in rural areas in these years was 65 percent (World Bank 2009).

Large expenditure items, which averaged slightly less than 1 percent of total household expenditures, were removed. The value of nonpurchased food comprised 14 percent of the budget of rural households and 2 percent of that of urban households.

Overall, 14,744 households were interviewed. The cleaned data set contained observations from 14,700 households after excluding 44 households for which there was no information on food expenditures, fuel expenditures, other nonfood expenditures, or household size.

Data on household-level expenditures on LPG, kerosene, natural gas, coal, firewood, dungcake, electricity, charcoal, other forms of biomass (bagasse, cotton sticks, sawdust, shrubs, weeds, tobacco sticks, and so on), and "diesel and gasoline" were available. The imputed values of all nonpurchased fuels were also available. Expenditures on diesel and gasoline along with minor repairs such as punctures were reported as a single item.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on LPG, kerosene, and the combined expenses for "diesel and gasoline." Expenditure on biomass was defined as the sum of expenditures on firewood, charcoal, dungcake, and other forms of biomass. Expenditure on modern energy was defined as the sum of expenditures on petroleum products, natural gas, and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy, biomass, coal, candles, and matches.

Thailand (Household Socio-Economic Survey 2006)

The data for this study are from the Household Socio-Economic Survey conducted by Thailand's Economic and Social Statistics Bureau within the National Statistical Office. The fieldwork for the survey was

conducted in calendar year 2006. The sample size was 44,888 households, 38 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 60 million people, of whom 70 percent were in rural areas, and 18 million households. The actual population of Thailand in 2006 was 63 million. The proportion of the population living in rural areas in the same time period was 67 percent (World Bank 2009).

Large expenditure items, which averaged slightly less than 3 percent of total household expenditures, were removed. The value of nonpurchased food comprised 11 percent of the budget of rural households and 4 percent of that of urban households.

Overall, 44,918 households were interviewed. The cleaned data set contained observations from 44,888 households because the households that had duplicate observations, or for which there was no information on food expenditures, were dropped. In addition, 27 households whose expenditure on unleaded gasoline (octanes 91 or 95), high-speed diesel, automotive LPG, or electricity comprised more than 40 percent of their total household expenditure were excluded.

Data on household expenditures on electricity, cooking gas (LPG), "gas (LPG) for other purposes," "charcoal and wood," kerosene, unleaded gasoline (octane 91), unleaded gasoline (octane 95), gasohol (mixture of gasoline and ethanol), automotive compressed natural gas, automotive LPG, and high-speed diesel were available. The imputed values of nonpurchased fuels were also available.

Expenditure on gasoline and diesel was defined as the sum of expenditures on unleaded gasoline (octanes 91 and 95), gasohol, and high-speed diesel. Expenditure on total petroleum products was defined as the sum of a household's expenditures on cooking gas (LPG), LPG gas for other purposes, kerosene, automotive LPG, and gasoline and diesel. Expenditure on biomass was defined as expenditures on "charcoal and wood." Expenditure on modern energy was defined as the sum of expenditures on petroleum products, automotive compressed natural gas, and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy and biomass.

The percentage of households reporting positive expenditures for LPG was significantly smaller than that reporting LPG as their main cooking fuel; that in turn was smaller than the percentage that owned an LPG cooking stove. One possible explanation is that the size of the LPG cylinder commonly used by households is 15 kilograms, which lasts more than a month. The questionnaire asked about monthly expenditures on

LPG, but if households were asked how much they had spent on LPG during the preceding 30 days, many might have reported zero expenditures. Because the differences are very large, the uptake tables report the percentages of households owning LPG cooking stoves rather than those reporting positive expenditures.

Uganda (Uganda National Household Survey 2005–06)

The data for this study are from the Uganda National Household Survey conducted by the Uganda government's Bureau of Statistics. The fieldwork for the survey was conducted between May 2005 and April 2006. The sample size was 7,414 households, 77 percent of which were based in rural areas. Based on the weights provided in the survey, this corresponded to 27 million people, of whom 85 percent were in rural areas, and 5.2 million households. The actual population of Uganda in 2005 and 2006 was 29 million and 30 million, respectively. The proportion of the population living in rural areas in these years was 87 percent (World Bank 2009).

Large expenditure items, which averaged slightly more than 1 percent of total household expenditures, were removed. The value of nonpurchased food comprised 31 percent of the budget of rural households and 7 percent of that of urban households.

Overall, 7,421 households were interviewed. The cleaned data set contained observations from 7,414 households because those households that had duplicate observations, or for which there was no information on either food expenditures or some other expenditure categories, were dropped. Also, seven households whose expenditure on gasoline and diesel comprised more than 40 percent of their total household expenditure were excluded.

Data on household expenditures on paraffin (kerosene), firewood, charcoal, electricity, generator/lawn mower fuels, and "diesel and gasoline" were available. The imputed values of nonpurchased fuels were also available. The questionnaire asked about expenditures on fuels used to operate lawn mowers and electricity generators, but the type of fuel was not specified; this study assumed that the fuels were either gasoline or diesel.

Expenditure on total petroleum products was defined as the sum of a household's expenditures on kerosene, generator/lawn mower fuels, and combined expenses for diesel and gasoline. Expenditure on biomass was

defined as the sum of expenditures on firewood and charcoal. Expenditure on modern energy was defined as the sum of expenditures on petroleum products and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy and biomass.

For the top rural quintile and all urban quintiles except the second, the percentages of households reporting electricity as their primary lighting source were higher than those reporting positive expenditures on electricity. Unlike in Kenya, the household survey in Uganda did not contain sufficient supplementary questions to probe this discrepancy further. The only related question in the survey asked whether the household owned one or more solar panels. Only 0.2 percent of households owned them. To compute the uptake rate for electricity in Uganda, the higher of the two—the percentage of households reporting positive expenditures or that citing electricity as the primary lighting source—was selected for each quintile. The rural and urban averages, as well as all national quintiles, were computed based on the uptake rates for the rural and urban quintiles.

Vietnam (Living Standard Measurement Survey 2006)

The data for this study are from the Vietnam Household Living Standards Survey conducted by the General Statistics Office of Vietnam, with technical assistance from the World Bank. The fieldwork for the survey was conducted between January and December 2006. The sample size was 9,127 households, 75 percent of which were based in rural areas. This corresponded to 82 million people, of whom 73 percent were in rural areas, and 19 million households. The actual population of Vietnam in 2006 was 84 million, with 73 percent living in rural areas (World Bank 2009).

Large expenditure items, which averaged 14 percent of total household expenditures, were removed. No values for imputed rent were provided in the data set. The value of nonpurchased food comprised 16 percent of the budget of rural households and 3 percent of that of urban households.

Overall, 9,189 households were interviewed. The cleaned data set contained observations from 9,127 households, because households with duplicate observations or for which there was no information on food expenditures or inconsistent information in some other expenditure category, as well as four households whose expenditure shares for gasoline

or “coal and firewood” comprised more than 40 percent of their total household expenditure, were removed.

Data on household-level expenditures on LPG, paraffin (kerosene), “gasoline and lubricants,” agricultural by-products (biomass), electricity, and “coal and firewood” were available. Expenditure on diesel was not recorded. The imputed values of all nonpurchased fuels were also available.

Expenditure on total petroleum products was defined as the sum of a household’s expenditures on LPG, kerosene, and gasoline and lubricants. Expenditure on biomass was defined as the sum of expenditures on “coal and firewood,” and agricultural by-products (biomass). Expenditure on modern energy was defined as the sum of expenditures on petroleum products and electricity. Total expenditure on energy sources was defined as the aggregate of expenditures on modern energy and biomass.

Appendix B

Additional Results

This appendix provides results beyond those presented in the main report, notably material that highlights differences when nonpurchased food is included/excluded from total expenditure in Cambodia, Kenya, Uganda, and Vietnam.

- Tables B.1–B.4 show total household expenditure with and without nonpurchased food for rural and urban quintiles in Cambodia, Kenya, Uganda, and Vietnam.
- Table B-5 shows national statistics for shares of expenditure on energy, food, and transport.
- Tables B.6–B.9 show expenditure shares when total household expenditures exclude nonpurchased food in Cambodia, Kenya, Uganda, and Vietnam, respectively.
- Table B.10 shows national statistics for expenditure shares by quintile.
- Table B.11 shows national statistics for shares of households consuming energy, food, and transport.
- Tables B.12–B.15 show shares of households in Cambodia, Kenya, Uganda, and Vietnam, respectively, consuming energy, food, and transport when expenditures on nonpurchased food are excluded from total household expenditure.
- Table B.16 shows expenditure shares when only those households reporting positive expenditures on a given item are considered.
- Table B.17 shows the main energy source for cooking by quintile; tables B.18 and B.19 show the main lighting source.

Table B.1 Total Household Expenditure by Quintile Including and Excluding Nonpurchased Food: Cambodia (2005 $ at PPP)

Rural quintile	Including nonpurchased food	Excluding nonpurchased food	Urban quintile	Including nonpurchased food	Excluding nonpurchased food
1	140	85	1	140	99
2	187	139	2	199	143
3	228	185	3	256	206
4	291	257	4	337	297
5	757	749	5	993	964
All	**310**	**266**	**All**	**650**	**631**

Source: Authors' calculations.

Table B.2 Total Household Expenditure by Quintile Including and Excluding Nonpurchased Food: Kenya (2005 $ at PPP)

Rural quintile	Including nonpurchased food	Excluding nonpurchased food	Urban quintile	Including nonpurchased food	Excluding nonpurchased food
1	139	82	1	126	83
2	229	158	2	202	148
3	295	223	3	276	233
4	391	334	4	395	336
5	675	646	5	993	914
All	**343**	**273**	**All**	**729**	**689**

Source: Authors' calculations.

Table B.3 Total Household Expenditure by Quintile Including and Excluding Nonpurchased Food: Uganda (2005 $ at PPP)

Rural quintile	Including nonpurchased food	Excluding nonpurchased food	Urban quintile	Including nonpurchased food	Excluding nonpurchased food
1	118	63	1	127	72
2	181	109	2	201	109
3	240	161	3	247	178
4	311	239	4	329	271
5	558	495	5	784	715
All	**280**	**205**	**All**	**586**	**557**

Source: Authors' calculations.

Table B.4 Total Household Expenditure by Quintile Including and Excluding Nonpurchased Food: Vietnam (2005 $ at PPP)

Rural quintile	Including nonpurchased food	Excluding nonpurchased food	Urban quintile	Including nonpurchased food	Excluding nonpurchased food
1	179	126	1	199	148
2	239	192	2	260	214
3	288	258	3	325	293
4	377	353	4	422	400
5	568	559	5	749	737
All	**304**	**264**	**All**	**556**	**547**

Source: Authors' calculations.

Table B.5 Shares of Household Expenditure on Various Energy Sources, Food, and Transport: All Households (%)

Expenditure item	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Kerosene	1.0	1.0	1.5	2.3	2.1	0.3	0.0	1.5	0.3
LPG	ND	0.2	1.1	0.2	0.1	0.2	0.6	ND	2.6
Gasoline and diesel	0.1	ND	0.8	1.0	0.2	1.0	6.1	0.2	3.1
Petroleum products	**1.1**	**1.2**	**3.4**	**3.8**	**2.5**	**1.6**	**6.7**	**1.7**	**5.9**
Electricity	1.1	0.8	2.4	3.4	0.2	3.8	3.1	0.4	3.0
Natural gas	0.3	NA	NA	0.0	NA	0.6	0.0	NA	NA
Modern energy	**2.5**	**2.0**	**5.8**	**7.2**	**2.7**	**6.0**	**9.8**	**2.0**	**9.0**
Biomass	4.7	4.8	5.4	1.6	1.4	3.1	0.6	4.4	3.1
Total energy	**7.3**	**6.8**	**12**	**8.8**	**4.1**	**9.0**	**10**	**6.5**	**12**
Purchased food	49	52	47	54	36	42	35	29	39
Nonpurchased food	12	18	7.9	7.8	21	10	8.7	24	12
Total food	**61**	**70**	**55**	**62**	**57**	**52**	**44**	**53**	**51**
Transport	2.5	0.2	2.4	2.4	3.2	3.0	1.7	2.0	0.6

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel. Nonpurchased items, including cashfree biomass, are included.

Table B.6 Shares of Household Expenditure on Various Energy Sources, Food, and Transport in Cambodia: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food, NP	Transport
									Modern	Total		
Rural	1	2.9	0.0	ND	0.0	NA	12	**2.9**	**3.0**	**15**	60	0.3
	2	1.9	0.0	ND	0.1	NA	7.9	**1.9**	**2.0**	**10**	67	0.3
	3	1.4	0.0	ND	0.3	NA	6.5	**1.4**	**1.7**	**8.2**	68	0.2
	4	1.1	0.1	ND	0.6	NA	5.3	**1.2**	**1.8**	**7.1**	67	0.3
	5	0.5	0.4	ND	1.5	NA	3.1	**0.9**	**2.4**	**5.6**	56	0.1
	All	**1.6**	**0.1**	**ND**	**0.5**	**NA**	**7.0**	**1.7**	**2.1**	**9.2**	**64**	**0.3**
Urban	1	2.7	0.0	ND	0.0	NA	9.2	**2.7**	**2.8**	**12**	67	0.1
	2	1.8	0.0	ND	0.6	NA	8.4	**1.8**	**2.4**	**11**	67	0.0
	3	1.4	0.1	ND	1.3	NA	6.2	**1.6**	**2.9**	**9.2**	70	0.4
	4	0.7	0.3	ND	2.3	NA	4.7	**1.0**	**3.2**	**7.9**	67	0.1
	5	0.1	1.3	ND	3.9	NA	1.7	**1.4**	**5.3**	**7.0**	49	0.1
	All	**0.6**	**0.8**	**ND**	**2.8**	**NA**	**3.7**	**1.4**	**4.2**	**8.0**	**58**	**0.1**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.7 Shares of Household Expenditure on Various Energy Sources, Food, and Transport in Kenya: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food, NP	Transport
									Modern	Total		
Rural	1	3.7	0.0	0.0	0.0	NA	1.2	**3.8**	**3.8**	**5.0**	52	2.1
	2	3.2	0.0	0.0	0.0	NA	1.8	**3.2**	**3.2**	**5.0**	51	3.0
	3	2.7	0.0	0.0	0.0	NA	1.7	**2.8**	**2.8**	**4.5**	48	3.2
	4	2.2	0.0	0.3	0.1	NA	2.2	**2.5**	**2.6**	**4.7**	43	4.0
	5	1.8	0.3	0.6	0.2	NA	1.7	**2.7**	**2.8**	**4.5**	35	4.7
	All	**2.7**	**0.1**	**0.2**	**0.1**	**NA**	**1.7**	**3.0**	**3.0**	**4.8**	**46**	**3.3**
Urban	1	4.4	0.0	0.0	0.0	NA	2.6	**4.4**	**4.4**	**7.0**	58	1.5
	2	3.9	0.0	0.0	0.5	NA	4.8	**3.9**	**4.4**	**9.3**	54	2.3
	3	4.1	0.0	0.0	0.4	NA	3.7	**4.1**	**4.5**	**8.3**	52	2.3
	4	3.3	0.1	0.0	0.4	NA	3.0	**3.4**	**3.8**	**6.8**	49	4.9
	5	2.5	0.6	0.8	0.9	NA	1.1	**3.9**	**4.8**	**5.9**	38	5.9
	All	**2.9**	**0.4**	**0.5**	**0.7**	**NA**	**1.9**	**3.8**	**4.5**	**6.4**	**42**	**5.2**

Source: Authors' calculations.
Note: NA = fuel not available. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.8 Shares of Household Expenditure on Various Energy Sources, Food, and Transport in Uganda: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food, NP	Transport
									Modern	Total		
Rural	1	3.6	ND	0.0	0.2	NA	12	**3.6**	**3.8**	**16**	29	1.5
	2	2.8	ND	0.0	0.2	NA	9.0	**2.8**	**3.0**	**12**	36	2.2
	3	2.4	ND	0.2	0.1	NA	7.0	**2.5**	**2.7**	**9.6**	38	2.5
	4	1.9	ND	0.4	0.2	NA	5.3	**2.2**	**2.4**	**7.7**	39	2.8
	5	1.4	ND	0.6	0.6	NA	3.1	**2.1**	**2.6**	**5.7**	38	3.1
	All	**2.4**	**ND**	**0.2**	**0.2**	**NA**	**7.4**	**2.7**	**2.9**	**10**	**36**	**2.5**
Urban	1	3.6	ND	0.0	0.1	NA	11	**3.6**	**3.7**	**15**	36	1.6
	2	2.8	ND	0.0	0.0	NA	10	**2.8**	**2.8**	**13**	42	1.6
	3	2.2	ND	0.0	0.4	NA	7.0	**2.2**	**2.6**	**9.6**	40	2.2
	4	1.7	ND	0.0	0.7	NA	5.6	**1.7**	**2.4**	**8.0**	44	2.0
	5	0.9	ND	0.6	1.5	NA	2.8	**1.5**	**3.1**	**5.9**	38	2.9
	All	**1.3**	**ND**	**0.4**	**1.2**	**NA**	**4.1**	**1.7**	**2.9**	**7.0**	**39**	**2.7**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.9 Shares of Household Expenditure on Various Energy Sources, Food, and Transport in Vietnam: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food, NP	Transport
									Modern	Total		
Rural	1	0.6	0.1	1.7	3.3	NA	8.7	**2.4**	**5.7**	**14**	46	0.8
	2	0.4	0.8	2.5	3.3	NA	5.7	**3.7**	**7.0**	**13**	47	0.8
	3	0.3	2.0	3.2	3.2	NA	4.3	**5.5**	**8.7**	**13**	46	0.8
	4	0.3	4.1	4.1	3.1	NA	2.6	**8.5**	**12**	**14**	44	0.7
	5	0.2	4.8	4.6	3.0	NA	1.4	**9.5**	**12**	**14**	39	0.5
	All	**0.4**	**2.0**	**3.0**	**3.2**	**NA**	**5.0**	**5.4**	**8.6**	**14**	**45**	**0.7**
Urban	1	0.7	0.8	1.7	4.1	NA	5.1	**3.2**	**7.3**	**13**	50	0.3
	2	0.7	1.9	2.1	3.7	NA	4.4	**4.6**	**8.3**	**13**	53	0.4
	3	0.5	3.8	3.3	3.9	NA	2.4	**7.7**	**12**	**14**	50	0.6
	4	0.4	5.3	4.3	3.9	NA	1.4	**10**	**14**	**15**	44	0.5
	5	0.1	5.0	5.0	4.3	NA	0.5	**10**	**14**	**15**	38	0.5
	All	**0.3**	**4.6**	**4.4**	**4.1**	**NA**	**1.3**	**9.3**	**13**	**15**	**42**	**0.5**

Source: Authors' calculations.
Note: NA = fuel not available; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.10 Shares of Household Expenditure on Various Energy Sources, Food, and Transport, by Quintile: All Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Bangladesh	1	1.5	ND	0.0	0.4	0.0	6.2	**1.5**	**1.9**	**8.1**	57	12	70	1.8
	2	1.2	ND	0.0	0.6	0.1	5.7	**1.2**	**1.9**	**7.7**	53	15	68	2.1
	3	1.1	ND	0.0	1.1	0.1	5.3	**1.1**	**2.3**	**7.6**	50	14	64	2.5
	4	0.8	ND	0.1	1.5	0.3	4.3	**0.9**	**2.8**	**7.1**	48	12	60	2.8
	5	0.5	ND	0.3	1.9	0.9	2.5	**0.8**	**3.6**	**6.1**	40	7.1	47	3.1
	All	**1.0**	**ND**	**0.1**	**1.1**	**0.3**	**4.7**	**1.1**	**2.5**	**7.3**	**49**	**12**	**61**	**2.5**
Cambodia	1	1.6	0.0	ND	0.1	NA	6.6	**1.6**	**1.7**	**8.4**	50	27	77	0.2
	2	1.3	0.0	ND	0.2	NA	5.8	**1.3**	**1.6**	**7.4**	51	24	76	0.2
	3	1.1	0.1	ND	0.4	NA	5.2	**1.2**	**1.6**	**6.9**	54	20	74	0.2
	4	0.9	0.1	ND	0.8	NA	4.5	**1.0**	**1.8**	**6.4**	56	15	71	0.2
	5	0.3	0.7	ND	2.2	NA	2.4	**1.0**	**3.2**	**5.6**	49	6.9	56	0.1
	All	**1.0**	**0.2**	**ND**	**0.8**	**ND**	**4.8**	**1.2**	**2.0**	**6.8**	**52**	**18**	**70**	**0.2**
India	1	2.1	0.0	0.0	1.3	NA	8.7	**2.2**	**3.4**	**13**	54	8.5	63	1.5
	2	1.9	0.2	0.1	1.8	NA	7.7	**2.2**	**3.9**	**12**	52	9.8	62	1.8
	3	1.7	0.6	0.3	2.2	NA	6.5	**2.5**	**4.7**	**12**	49	11	59	2.3
	4	1.5	1.4	0.7	2.7	NA	4.7	**3.6**	**6.3**	**11**	46	8.9	55	2.7
	5	0.8	2.5	2.2	3.5	NA	1.4	**5.6**	**9.1**	**11**	38	3.4	41	3.2
	All	**1.5**	**1.1**	**0.8**	**2.4**	**NA**	**5.4**	**3.4**	**5.8**	**12**	**47**	**7.9**	**55**	**2.4**
Indonesia	1	2.3	0.0	0.2	2.6	0.0	3.5	**2.6**	**5.2**	**8.6**	55	14	69	1.2
	2	2.6	0.0	0.6	3.2	0.0	2.4	**3.3**	**6.5**	**8.9**	57	9.5	66	1.8
	3	2.6	0.1	0.9	3.6	0.0	1.6	**3.8**	**7.4**	**9.0**	56	8.5	64	2.4
	4	2.5	0.2	1.3	3.8	0.0	0.9	**4.3**	**8.2**	**9.1**	55	5.6	61	2.8
	5	1.6	0.5	1.8	3.7	0.0	0.3	**4.4**	**8.1**	**8.4**	49	3.6	53	3.4
	All	**2.3**	**0.2**	**1.0**	**3.4**	**0.0**	**1.6**	**3.8**	**7.2**	**8.8**	**54**	**7.8**	**62**	**2.4**
Kenya	1	2.2	0.0	0.0	0.0	NA	1.0	**2.2**	**2.2**	**3.1**	39	30	70	1.5
	2	2.2	0.0	0.0	0.1	NA	1.5	**2.2**	**2.3**	**3.8**	38	28	66	2.2
	3	2.3	0.0	0.0	0.1	NA	1.6	**2.3**	**2.4**	**4.0**	37	24	60	2.6
	4	2.1	0.0	0.1	0.2	NA	1.8	**2.2**	**2.4**	**4.3**	36	19	55	3.3
	5	1.9	0.4	0.7	0.5	NA	1.2	**3.0**	**3.5**	**4.7**	32	11	43	4.8
	All	**2.1**	**0.1**	**0.2**	**0.2**	**NA**	**1.4**	**2.5**	**2.7**	**4.1**	**36**	**21**	**57**	**3.2**

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Energy		Food			Transport
									Modern	Total	P	NP	Total	
Pakistan	1	0.5	0.1	0.1	3.4	0.3	4.4	**0.7**	**4.4**	**8.8**	48	10	59	2.6
	2	0.4	0.1	0.3	3.6	0.3	3.9	**0.8**	**4.8**	**8.7**	45	12	57	2.8
	3	0.4	0.2	0.4	3.7	0.4	3.5	**1.0**	**5.1**	**8.7**	43	12	55	3.0
	4	0.3	0.3	0.9	4.0	0.7	2.7	**1.5**	**6.2**	**8.9**	41	11	52	3.2
	5	0.1	0.4	2.5	4.2	0.9	1.7	**3.1**	**8.2**	**9.9**	36	7.6	43	3.3
	All	**0.3**	**0.2**	**1.0**	**3.8**	**0.6**	**3.1**	**1.6**	**6.0**	**9.0**	**42**	**10**	**52**	**3.0**
Thailand	1	0.0	0.3	4.6	3.2	0.0	1.6	**5.0**	**8.2**	**9.8**	38	17	54	0.8
	2	0.0	0.7	5.7	3.2	0.0	1.0	**6.4**	**9.6**	**11**	38	12	50	1.0
	3	0.0	0.8	6.2	3.1	0.0	0.6	**7.0**	**10**	**11**	37	9.0	46	1.5
	4	0.0	0.7	6.4	3.1	0.0	0.3	**7.1**	**10**	**11**	35	6.3	42	2.1
	5	0.0	0.4	7.0	2.9	0.0	0.0	**7.4**	**10**	**10**	30	3.2	33	2.4
	All	**0.0**	**0.6**	**6.1**	**3.1**	**0.0**	**0.6**	**6.7**	**9.8**	**10**	**35**	**8.7**	**44**	**1.7**
Uganda	1	1.8	ND	0.0	0.1	NA	6.6	**1.8**	**1.9**	**8.5**	26	35	61	0.9
	2	1.7	ND	0.0	0.1	NA	5.4	**1.7**	**1.8**	**7.2**	25	34	59	1.4
	3	1.6	ND	0.1	0.1	NA	4.6	**1.7**	**1.8**	**6.4**	27	31	58	1.7
	4	1.4	ND	0.2	0.2	NA	4.0	**1.6**	**1.8**	**5.9**	30	25	55	2.2
	5	1.1	ND	0.6	0.9	NA	2.6	**1.6**	**2.5**	**5.1**	33	12	44	2.6
	All	**1.5**	**ND**	**0.2**	**0.4**	**NA**	**4.4**	**1.7**	**2.0**	**6.5**	**29**	**24**	**53**	**2.0**
Vietnam	1	0.4	0.3	1.2	2.4	NA	5.3	**1.9**	**4.3**	**9.7**	38	25	63	0.6
	2	0.3	0.9	2.0	2.8	NA	4.4	**3.3**	**6.0**	**11**	39	18	57	0.6
	3	0.3	2.2	2.9	2.9	NA	3.3	**5.4**	**8.3**	**12**	41	13	54	0.6
	4	0.3	4.0	3.9	3.2	NA	2.2	**8.2**	**11**	**14**	40	7.3	47	0.6
	5	0.1	4.7	4.7	3.7	NA	0.9	**9.6**	**13**	**14**	37	2.5	39	0.5
	All	**0.3**	**2.6**	**3.1**	**3.0**	**NA**	**3.1**	**5.9**	**9.0**	**12**	**39**	**12**	**51**	**0.6**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.

Table B.11 Percentage of All Households Consuming Various Energy Sources, Food, and Transport

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	92	ND	0.6	12	0.4	99	**92**	**94**	100	92	69
	2	88	ND	0.5	22	1.9	99	**88**	**94**	100	91	77
	3	86	ND	0.4	35	3.9	99	**86**	**95**	100	87	83
	4	80	ND	1.0	52	7.1	99	**81**	**93**	100	81	87
	5	63	ND	5.2	68	27	98	**66**	**93**	100	71	91
	All	**81**	**ND**	**1.6**	**39**	**8.4**	**99**	**82**	**94**	**100**	**84**	**82**
Cambodia	1	90	0.2	ND	1.5	NA	93	**90**	**91**	99	83	4.6
	2	88	0.5	ND	3.8	NA	93	**88**	**90**	100	84	5.3
	3	85	1.4	ND	8.6	NA	94	**86**	**91**	100	79	6.6
	4	77	4.2	ND	18	NA	94	**80**	**90**	100	74	8.0
	5	45	29	ND	53	NA	86	**73**	**92**	100	47	13
	All	**76**	**8.0**	**ND**	**18**	**NA**	**92**	**83**	**91**	**100**	**72**	**7.8**
India	1	95	0.5	0.5	32	NA	97	**95**	**98**	99	45	53
	2	95	2.7	1.9	48	NA	98	**96**	**99**	100	50	68
	3	91	8.8	4.4	60	NA	94	**94**	**100**	100	52	75
	4	82	25	11	74	NA	81	**94**	**100**	100	47	79
	5	46	66	36	92	NA	38	**93**	**99**	100	26	79
	All	**79**	**24**	**13**	**64**	**NA**	**78**	**94**	**99**	**100**	**43**	**72**
Indonesia	1	89	0.2	4.9	69	0.4	82	**89**	**98**	100	82	43
	2	90	0.3	13	84	0.2	66	**91**	**99**	100	74	52
	3	92	1.8	20	91	0.2	51	**94**	**100**	99	68	59
	4	93	5.2	31	94	0.2	34	**96**	**100**	100	54	62
	5	80	24	46	94	1.2	15	**95**	**98**	100	39	70
	All	**89**	**7.1**	**25**	**87**	**0.5**	**47**	**93**	**99**	**100**	**62**	**58**
Kenya[a]	1	76	0.0	0.1	0.6	NA	99	**76**	**76**	98	93	30
	2	87	0.1	0.2	2.2	NA	98	**87**	**87**	100	96	45
	3	90	0.2	0.5	6.3	NA	96	**90**	**90**	99	95	54
	4	88	0.9	1.5	15	NA	95	**89**	**90**	100	95	66
	5	83	14	7.2	45	NA	76	**90**	**92**	100	94	77
	All	**85**	**4.3**	**2.5**	**18**	**NA**	**91**	**87**	**88**	**99**	**95**	**58**
Pakistan	1	40	2.7	7.6	70	7.4	90	**47**	**98**	100	58	87
	2	38	5.1	11	76	11	87	**48**	**98**	100	62	90
	3	36	7.6	12	81	16	83	**47**	**99**	100	61	91
	4	29	9.6	20	86	24	73	**49**	**99**	100	57	91
	5	17	12	39	93	47	48	**56**	**99**	100	43	89
	All	**30**	**8.0**	**20**	**83**	**24**	**74**	**50**	**99**	**100**	**55**	**90**

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Thailand[b]	1	1.1	45	66	97	0.0	68	**68**	**99**	99	93	19
	2	0.7	69	78	99	0.0	57	**81**	**100**	99	90	25
	3	0.8	81	80	99	0.0	40	**84**	**100**	99	83	31
	4	0.5	85	78	99	0.0	21	**84**	**100**	99	69	39
	5	0.1	80	78	100	0.0	6.9	**82**	**100**	100	46	46
	All	**0.6**	**74**	**77**	**99**	**0.0**	**35**	**81**	**100**	**100**	**74**	**34**
Uganda[c]	1	88	ND	0.0	1.1	NA	96	**88**	**88**	99	96	13
	2	95	ND	1.1	2.0	NA	97	**95**	**95**	100	95	24
	3	96	ND	1.2	3.5	NA	97	**96**	**96.**	99	92	32
	4	94	ND	2.6	7.4	NA	97	**94**	**96**	99	85	39
	5	82	ND	6.3	33	NA	86	**83**	**93**	99	65	50
	All	**91**	**ND**	**2.6**	**11**	**NA**	**94**	**91**	**94**	**99**	**82**	**36**
Vietnam	1	44	3.4	27	88	NA	95	**60**	**98**	99	92	39
	2	44	11	46	95	NA	93	**73**	**100**	100	89	47
	3	41	27	59	96	NA	84	**81**	**99**	100	84	51
	4	32	54	73	99	NA	65	**90**	**100**	100	70	51
	5	19.	82	84	99	NA	36	**96**	**100**	100	47	51
	All	**35**	**38**	**60**	**96**	**NA**	**73**	**81**	**99**	**100**	**75**	**48**

Source: Authors' calculations.
Note: NA = fuel not available; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.
a. For biomass, the percentages shown are a combination of those households reporting positive expenditures (upper three urban quintiles) and those reporting biomass as the primary cooking fuel (the remaining quintiles).
b For LPG, the percentages are those households that own an LPG cook stove.
c. Data for electricity are computed from tables 3.8 and 3.9.

Table B.12 Percentage of Households Consuming Various Energy Sources, Food, and Transport in Cambodia

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Rural	1	90	0.3	ND	0.6	NA	94	**90**	**90**	99	95	4.1
	2	90	0.3	ND	1.7	NA	93	**90**	**91**	100	87	6.0
	3	87	0.7	ND	4.6	NA	94	**87**	**89**	100	80	5.5
	4	81	2.8	ND	14	NA	94	**82**	**89**	100	72	7.9
	5	58	17	ND	38	NA	90	**72**	**90**	100	52	11
	All	**82**	**3.6**	**ND**	**11**	**NA**	**93**	**85**	**90**	**100**	**78**	**6.8**
Urban	1	96	0.0	ND	0.9	NA	95	**96**	**97**	99	84	6.6
	2	85	0.3	ND	10	NA	94	**85**	**92**	99	79	4.3
	3	77	2.5	ND	23	NA	97	**78**	**94**	100	71	12
	4	52	9.9	ND	51	NA	95	**62**	**94**	100	45	9.7
	5	14	56	ND	90	NA	80	**69**	**98**	100	20	17
	All	**39**	**33**	**ND**	**64**	**NA**	**87**	**71**	**96**	**100**	**39**	**13**

Source: Authors' calculations.
Note: NA = fuel not available; ND = survey did not ask for information about the fuel; P = purchased; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.13 Percentage of Households Consuming Various Energy Sources, Food, and Transport in Kenya

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Rural	1	74	0.1	0.1	0.5	NA	99	**74**	**74**	98	97	26
	2	88	0.0	0.2	1.4	NA	98	**89**	**89**	99	97	47
	3	90	0.1	0.4	3.3	NA	98	**90**	**91**	100	98	56
	4	89	0.8	2.3	8.7	NA	98	**90**	**90**	100	97	68
	5	86	6.3	5.1	23	NA	92	**89**	**90**	100	96	78
	All	**86**	**1.2**	**1.4**	**6.6**	**NA**	**97**	**86**	**87**	**99**	**97**	**54**
Urban	1	73	0.0	0.0	0.9	NA	95	**73**	**73**	98	87	25
	2	91	0.0	0.0	8.0	NA	91	**91**	**91**	100	78	33
	3	87	0.1	0.0	23	NA	83	**87**	**88**	99	82	46
	4	86	0.7	0.4	33	NA	86	**86**	**89**	100	86	65
	5	81	21	9.0	65	NA	62	**90**	**93**	100	90	79
	All	**83**	**14**	**5.8**	**52**	**NA**	**70**	**89**	**91**	**100**	**88**	**71**

Source: Authors' calculations.
Note: NA = fuel not available; ND = survey did not ask for information about the fuel; P = purchased; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.14 Percentage of Households Consuming Energy, Food, and Transport in Uganda

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Rural	1	88	ND	0.3	1.8	NA	95	**88**	**88**	98	100	13
	2	95	ND	0.2	1.5	NA	96	**95**	**95**	98	98	23
	3	97	ND	1.8	2.2	NA	98	**97**	**97**	100	98	33
	4	96	ND	2.9	4.1	NA	97	**97**	**97**	99	92	40
	5	90	ND	6.6	15	NA	89	**91**	**95**	100	75	49
	All	**94**	**ND**	**2.3**	**4.6**	**NA**	**95**	**94**	**94**	**99**	**92**	**33**
Urban	1	98	ND	0.0	5.7	NA	92	**98**	**98**	95	94	12
	2	92	ND	0.0	0.0	NA	96	**92**	**92**	98	81	18
	3	94	ND	0.3	5.8	NA	94	**94**	**97**	95	74	30
	4	86	ND	1.2	14	NA	96	**86**	**92**	100	58	39
	5	70	ND	5.9	46	NA	84	**73**	**91**	100	42	51
	All	**76**	**ND**	**4.3**	**34**	**NA**	**87**	**78**	**92**	**99**	**48**	**47**

Source: Authors' calculations.
Note: NA = fuel not available; ND = survey did not ask for information about the fuel; P = purchased; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.15 Percentage of Households Consuming Various Energy Sources, Food, and Transport in Vietnam

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Rural	1	46	1.3	28	88	NA	96	**61**	**98**	99	98	38
	2	44	8.3	45	95	NA	96	**72**	**99**	100	94	49
	3	42	23	59	96	NA	90	**80**	**99**	100	89	54
	4	40	51	72	98	NA	73	**91**	**100**	100	80	56
	5	28	74	78	99	NA	53	**95**	**100**	100	68	56
	All	**41**	**26**	**53**	**95**	**NA**	**85**	**77**	**99**	**100**	**88**	**50**
Urban	1	40	7.4	32	85	NA	88	**62**	**94**	97	86	23
	2	35	18	39	94	NA	77	**68**	**99**	100	71	37
	3	33	45	62	99	NA	63	**85**	**100**	100	52	39
	4	22	65	76	100	NA	44	**91**	**100**	100	42	43
	5	12	90	88	100	NA	22	**97**	**100**	100	30	47
	All	**19**	**71**	**77**	**99**	**NA**	**38**	**91**	**100**	**100**	**40**	**44**

Source: Authors' calculations.
Note: NA = fuel not available; P = purchased; NP = nonpurchased. Quintiles are based on total per capita expenditure excluding nonpurchased food.

Table B.16 Shares of Expenditure on Various Energy Sources, Food, and Transport: User Households (%)

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Bangladesh	1	1.6	ND	3.9	3.4	4.3	6.2	**1.6**	**2.0**	57	14	2.6
	2	1.4	ND	3.8	2.9	3.5	5.8	**1.4**	**2.1**	53	17	2.8
	3	1.2	ND	6.3	3.0	3.7	5.3	**1.3**	**2.4**	50	16	3.0
	4	1.0	ND	7.8	3.0	4.4	4.3	**1.1**	**3.0**	48	14	3.3
	5	0.7	ND	6.1	2.7	3.2	2.6	**1.3**	**3.8**	40	10	3.4
	All	**1.2**	**ND**	**6.0**	**2.9**	**3.5**	**4.8**	**1.4**	**2.7**	**49**	**14**	**3.0**
Cambodia	1	1.8	5.7	ND	5.5	NA	7.1	**1.8**	**1.9**	50	33	4.3
	2	1.5	4.8	ND	5.5	NA	6.2	**1.5**	**1.7**	52	29	3.2
	3	1.3	4.1	ND	4.7	NA	5.5	**1.4**	**1.7**	54	25	3.1
	4	1.1	3.5	ND	4.5	NA	4.8	**1.3**	**2.0**	56	21	2.8
	5	0.7	2.3	ND	4.1	NA	2.8	**1.4**	**3.4**	49	14	1.0
	All	**1.3**	**2.5**	**ND**	**4.3**	**NA**	**5.2**	**1.5**	**2.2**	**52**	**25**	**2.4**
India	1	2.2	7.1	5.9	4.0	NA	8.9	**2.3**	**3.5**	55	19	2.9
	2	2.0	6.6	6.5	3.7	NA	7.9	**2.3**	**4.0**	52	19	2.7
	3	1.9	6.4	6.3	3.7	NA	6.9	**2.7**	**4.7**	49	20	3.1
	4	1.9	5.5	6.3	3.6	NA	5.8	**3.9**	**6.4**	46	19	3.5
	5	1.8	3.8	6.0	3.8	NA	3.6	**6.1**	**9.2**	38	13	4.1
	All	**1.9**	**4.4**	**6.1**	**3.7**	**NA**	**6.9**	**3.6**	**5.9**	**47**	**18**	**3.3**
Indonesia	1	2.6	2.4	4.5	3.7	2.9	4.2	**2.9**	**5.3**	56	17	2.8
	2	2.8	3.6	4.6	3.8	3.1	3.7	**3.6**	**6.6**	57	13	3.5
	3	2.8	3.8	4.5	3.9	4.0	3.1	**4.0**	**7.4**	56	12	4.0
	4	2.7	3.5	4.1	4.1	4.4	2.6	**4.5**	**8.2**	55	10	4.6
	5	2.0	2.2	3.8	3.9	2.2	2.0	**4.6**	**8.3**	49	9	4.8
	All	**2.6**	**2.5**	**4.1**	**3.9**	**2.7**	**3.4**	**4.0**	**7.3**	**54**	**13**	**4.1**
Kenya	1	2.9	—	11	1.3	NA	4.8	**2.9**	**2.9**	40	32	5.0
	2	2.5	5.2	7.6	4.4	NA	4.4	**2.5**	**2.6**	38	29	4.8
	3	2.6	7.4	5.8	3.5	NA	3.9	**2.6**	**2.7**	37	25	4.8
	4	2.3	3.8	9.5	3.4	NA	3.3	**2.5**	**2.7**	36	20	5.1
	5	2.3	3.0	9.3	2.1	NA	2.2	**3.3**	**3.8**	33	12	6.2
	All	**2.5**	**3.1**	**9.2**	**2.4**	**NA**	**3.3**	**2.8**	**3.0**	**36**	**22**	**5.4**
Pakistan	1	1.1	2.3	1.7	4.9	3.6	4.9	**1.4**	**4.5**	48	18	3.0
	2	1.1	2.7	2.6	4.7	3.1	4.5	**1.7**	**4.9**	45	19	3.2
	3	1.0	2.6	3.6	4.6	2.8	4.2	**2.1**	**5.2**	43	19	3.3
	4	1.0	3.3	4.6	4.6	2.7	3.7	**3.1**	**6.2**	41	19	3.5
	5	0.8	3.3	6.4	4.5	2.0	3.5	**5.4**	**8.3**	36	18	3.7
	All	**1.0**	**3.0**	**5.1**	**4.6**	**2.4**	**4.2**	**3.1**	**6.1**	**42**	**19**	**3.4**

	Quintile	Kerosene	LPG	Gasoline & diesel	Electricity	Natural gas	Biomass	Petroleum products	Modern energy	Food		Transport
										P	NP	
Thailand	1	1.1	3.9	7.1	3.3	—	2.3	**7.3**	**8.3**	38	18	4.2
	2	1.6	3.3	7.3	3.2	—	1.8	**7.9**	**9.6**	38	13	4.1
	3	1.0	2.6	7.7	3.2	—	1.6	**8.3**	**10**	37	11	4.7
	4	0.6	2.0	8.1	3.1	1.9	1.3	**8.4**	**10**	36	9.1	5.3
	5	0.3	1.2	8.9	2.9	2.5	0.6	**9.0**	**10**	30	6.8	5.3
	All	**1.0**	**2.2**	**8.0**	**3.1**	**2.5**	**1.8**	**8.3**	**9.8**	**35**	**12**	**4.9**
Uganda	1	2.1	ND	—	6.9	NA	6.9	**2.1**	**2.1**	26	36	6.6
	2	1.8	ND	3.7	5.3	NA	5.6	**1.8**	**1.9**	26	36	5.8
	3	1.6	ND	8.6	4.7	NA	4.8	**1.7**	**1.9**	28	33	5.2
	4	1.5	ND	8.3	3.8	NA	4.2	**1.7**	**1.9**	30	29	5.5
	5	1.3	ND	9.1	3.3	NA	3.0	**2.0**	**2.7**	33	18	5.3
	All	**1.6**	**ND**	**8.5**	**3.6**	**NA**	**4.7**	**1.8**	**2.2**	**29**	**29**	**5.4**
Vietnam	1	0.9	8.9	4.4	2.8	NA	5.6	**3.1**	**4.4**	38	27	1.5
	2	0.8	8.6	4.4	2.9	NA	4.7	**4.5**	**6.1**	39	21	1.3
	3	0.8	8.2	4.9	3.0	NA	4.0	**6.7**	**8.4**	41	15	1.2
	4	0.8	7.6	5.4	3.2	NA	3.4	**9.1**	**11**	40	10	1.1
	5	0.6	5.7	5.6	3.7	NA	2.5	**9.9**	**13**	37	5.3	0.9
	All	**0.8**	**6.8**	**5.1**	**3.2**	**NA**	**4.3**	**7.3**	**9.0**	**39**	**17**	**1.2**

Source: Authors' calculations.
Note: NA = fuel not available; — = no household reported expenditure; ND = no question was asked concerning the fuel; P = purchased; NP = nonpurchased.

Table B.17 Main Energy Source for Cooking: Percentage of All Households Using That Source

	Quintile	Electricity	Kerosene	Biomass	LPG/natural gas	Other
Cambodia	1	0.1	0.0	99	0.1	0.7
	2	0.0	0.0	99	0.2	0.8
	3	0.0	0.0	98	0.7	1.0
	4	0.1	0.1	97	1.9	1.0
	5	0.5	0.2	76	22	1.4
	All	**0.2**	**0.1**	**93**	**5.6**	**1.0**
India	1	0.0	0.7	93	0.5	5.8
	2	0.0	1.2	91	2.3	5.3
	3	0.0	2.3	86	7.2	4.7
	4	0.1	5.7	69	21	3.9
	5	0.2	7.3	25	65	2.1
	All	**0.1**	**3.8**	**70**	**22**	**4.2**
Kenya	1	0.0	0.9	99	0.1	0.0
	2	0.0	2.0	98	0.0	0.1
	3	0.3	6.4	93	0.1	0.6
	4	0.2	11	87	0.4	0.9
	5	1.8	31	55	12	0.8
	All	**0.6**	**13**	**82**	**3.5**	**0.6**
Pakistan	1	0.0	0.6	91	7.5	1.1
	2	0.0	0.6	87	12	0.9
	3	0.0	0.7	83	16	0.7
	4	0.0	1.0	73	26	1.0
	5	0.2	0.9	47	51	0.9
	All	**0.1**	**0.8**	**73**	**25**	**0.9**
Thailand	1	0.7	0.3	78	20	0.4
	2	0.8	0.2	58	41	0.3
	3	1.8	0.3	38	60	0.1
	4	4.8	0.2	18	77	0.1
	5	11	0.5	5.3	84	0.0
	All	**4.1**	**0.3**	**37**	**59**	**0.2**
Uganda	1	0.0	0.1	100	0.0	0.3
	2	0.2	0.2	99	0.0	0.3
	3	0.0	0.5	99	0.0	0.7
	4	0.0	0.4	98	0.0	1.4
	5	0.7	3.9	88	0.6	7.1
	All	**0.2**	**1.2**	**96**	**0.2**	**2.4**

Source: Authors' calculations.

Note: Biomass includes firewood, charcoal, dung, and agricultural waste. The category of LPG and natural gas is combined in the questionnaire for Pakistan; in Cambodia, India, Kenya, and Uganda, households do not use natural gas. For Cambodia, those households that reported using a combination of LPG and electricity as their main energy source for cooking are categorized under LPG. "Other" includes coal and coke.

Table B.18 Main Energy Source for Lighting in India, Pakistan, Uganda, and Vietnam: Percentage of All Households Using That Source

	Quintile	Electricity	Kerosene	Other
India	1	34	66	0.5
	2	48	52	0.7
	3	60	40	0.5
	4	75	24	0.5
	5	94	5.9	0.3
	All	**65**	**34**	**0.5**
Pakistan	1	73	26	1.7
	2	76	22	2.0
	3	82	17	1.5
	4	87	12	1.0
	5	93	5.9	1.5
	All	**83**	**15**	**1.5**
Uganda	1	0.2	89	10
	2	0.6	95	4.3
	3	2.3	95	2.4
	4	6.4	91	2.1
	5	33	63	4.7
	All	**10**	**85**	**4.6**
Vietnam	1	90	7.7	2.3
	2	95	2.8	1.8
	3	97	2.3	1.1
	4	98	0.7	1.0
	5	99	0.2	0.5
	All	**96**	**2.5**	**1.3**

Source: Authors' calculations.
Note: In Vietnam, the categories for lighting are grid electricity; LPG, vegetable oil, or kerosene (categorized here as "kerosene"); and batteries, generators, and other (categorized here as "other").

Table B.19 Main Energy Source for Lighting in Cambodia and Kenya: Percentage of All Households Using That Source

	Quintile	Electricity	Kerosene	Batteries	Other
Cambodia	1	1.9	80	16	2.6
	2	4.2	71	24	1.4
	3	9.1	62	28	1.2
	4	18	50	31	0.5
	5	54	24	22	0.5
	All	**19**	**55**	**24**	**1.1**
Kenya	1	0.3	79	16	4.6
	2	1.7	89	5.9	3.4
	3	5.0	90	3.3	1.7
	4	12	83	1.6	3.1
	5	40	54	0.8	4.4
	All	**16**	**76**	**4.5**	**3.5**

Source: Authors' calculations.

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