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Infrastructure Coverage and the Poor

A Global Perspective

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The poor in most parts of the world may have electricity (especially in urban areas), but they rarely have water, sewer, and telephone services. When they gain access to local services, however, many do decide to connect.

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Summary findings

Komives, Whittington, and Wu use the World Bank's Living Standards Measurement Study (LSMS) surveys from 15 countries (covering more than 55,500 households) to examine the relationship between infrastructure coverage and household income. The results show that throughout the world all income groups have much higher levels of coverage for electricity than for other formal infrastructure services (in-house piped water service, sewerage service, and private telephone service).

In many countries most households in urban areas now have electricity service. As monthly household incomes increase from $100 to $250, coverage of all these infrastructure services rises, but at different rates.

The findings confirm that the very poor rarely have these infrastructure services—with exceptions. The very poor often do have electricity if they live in urban areas. The very poor in Eastern Europe and Central Asia have much higher levels of coverage than those elsewhere in the world; they often have electricity, water, sewer, and telephone services.

The results also suggest that if the poor gain access to services in their communities, many will decide to connect.

This paper—a product of the Private Provision of Public Services Group, Private Sector Advisory Services Department—is part of a larger effort in the department to identify ways of improving services to the poor through private participation in infrastructure. Preparation of the paper was supported by the Public-Private Infrastructure Advisory Facility, a multidonor technical assistance facility aimed at helping developing countries improve the quality of their infrastructure through private sector involvement. For more information on the facility see the Web site www.ppiaf.org. Copies of this paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Shokraneh Minovi, room I9-320, telephone 202-473-0012, fax 202-522-3481, email address sminovi@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at komives@email.unc.edu, dwhittin@email.unc.edu, or xun@email.unc.edu. February 2001. (46 pages)

Infrastructure Coverage and the Poor: A Global Perspective

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1. Introduction

This paper presents a global perspective on infrastructure coverage and the poor that many people will think they have seen before but in fact have not.[4] It is widely assumed that the poor in developing countries have fewer infrastructure services than middle and upper-income households, but there is surprisingly little information on the actual empirical relationship between household income and infrastructure service coverage in different countries. The available coverage statistics are typically country-wide averages. These are widely used to assess the scope and magnitude of infrastructure problems in developing countries, and they are often the only global, cross-country data available about infrastructure services. When such coverage statistics reveal that many households do not have service (i.e., are "not covered"), it is generally assumed that such households are poor. Global coverage statistics are often compiled by international organizations such as the World Health Organization and the World Bank, and have profoundly shaped the way many people conceptualize infrastructure policy problems.[5]

Despite their widespread use and influence, there are in fact numerous problems with the country-wide infrastructure coverage statistics currently available. The data on household coverage typically come from general-purpose household surveys (such as censuses) that include a few questions designed to determine whether a household has various infrastructure services. For example, a member of a household may be asked whether the house has an in-house piped water connection or electricity. The global statistics from such surveys are usually self-reported by countries and are of varying quality. In many cases the wording of questions in the different surveys

[4] By "coverage" we simply mean whether or not a household has an infrastructure service such as electricity or piped water supply; if a household does have a particular service, it is said to be "covered."

[5] Coverage data can aid in the description of an existing infrastructure situation, but they cannot be used to determine *why* such a situation exists, even if one were able to go back to the original data sets. This is because most surveys on which the coverage summaries are based do not ask respondents what services they could have chosen (but did not) and the attributes of such service options (e.g., price, quality, reliability). What we see in the coverage statistics is the *outcome* of both supply and demand factors that bear on a household's infrastructure choices, but policy analysts cannot generally disentangle such factors from the coverage statistics.

is not the same. The surveys may have been carried out in different years and with different sampling procedures.

Such general-purpose surveys typically ignore informal service options such as water vending or the provision of electricity from a private generator. Different surveys may use different definitions of some infrastructure service options.[6] Countries generally report summary statistics that cannot be related to the income of an individual household so that it is impossible to determine how coverage of the poor differs from coverage of other income groups. Moreover, the international agencies that compile coverage statistics for one infrastructure service (e.g., water) rarely coordinate their efforts with other agencies (or even other divisions within the same organization) interested in different infrastructure services, so it is unusual to see comparable coverage statistics reported for multiple infrastructure services.

In this paper we introduce a new data source for global coverage statistics, the World Bank's Living Standards Measurement Study (LSMS) surveys, that addresses some but not all of these limitations. These multi-topic surveys gather extensive socioeconomic and expenditure information from households, as well as limited information on a household's use of selected infrastructure services. The data used in this paper are drawn from LSMS surveys conducted in fifteen countries. The pooled sample includes more than 55,500 households in Asia, the Americas, sub-Saharan Africa, Eastern Europe, and Central Asia. The LSMS surveys enable us to examine coverage for several infrastructure services among different income groups in many different countries using household-level data.

The results of our analyses show that all income groups throughout the world have much higher levels of coverage for electricity than for other formal infrastructure services (in-house piped water service, sewer service, and private telephone service). In many countries most households in

[6] For example, a respondent may be asked, "What is the household's principal water source for drinking and cooking?" Some surveys may use precoded answers that distinguish between in-house connections and yard taps, but others may not.

urban areas now have electricity service. The relationship between income and coverage is remarkably similar for electricity, in-house water connections, and sewer. As monthly household incomes increase from US$100 to US$250, coverage of all these infrastructure services rises rapidly. As expected, coverage is much higher in urban than in rural areas for electricity, water, sewer, and telephone service.

The findings confirm that the very poor rarely have these infrastructure services. There are, however, exceptions. The very poor often do have electricity if they live in urban areas. The very poor in Eastern Europe and Central Asia have much higher levels of coverage than elsewhere in the world; they often have electricity, water, sewer, and telephone services. The results also suggest that if the poor have access to services in their communities, many will in fact decide to connect.[7]

Where the very poor do not have formal infrastructure services, informal, private, and community infrastructure solutions fill the gap for many households. Few households in any of the fifteen countries in our sample report using unimproved water sources or candles for lighting. However, many households at all income levels and in both rural and urban areas used wood, thatch, or dung for cooking fuel. Few poor households without private telephones have public telephones in their communities, and the vast majority of the poorest rural households have no toilet, sewer, or septic facilities in their homes.

2. The data: Livings Standard Measurement Study Surveys in fifteen countries

The World Bank initiated the LSMS program in the 1980s to improve the quality of survey data available for policy research and analysis in developing countries. Since then more than twenty countries have administered nationally-representative household surveys based on the LSMS model of questionnaire design and quality control. The multi-country data set used in this analysis is composed

[7] In this paper, we reserve the term "access" to refer to a household's ability to obtain an infrastructure connection, should the household decide to do so. For example, a household has access to sewer service if there is a sewer network in the household's neighborhood.

of surveys from fifteen of these countries (Table 1).[8] The pooled sample includes households on four continents in both low- and middle-income countries. The fifteen surveys were administered between 1988 and 1997.

This multi-country LSMS data set is unique in five important respects. First, it enables us to look at multiple infrastructure services for the same household. Second, because the LSMS surveys are primarily designed to measure households' economic well-being (i.e., living standard), the data set arguably contains the best information available on household expenditures, consumption, and income available anywhere for multiple developing countries. This enables us to clearly identify the poorest households in our sample and their use of infrastructure services. Third, the LSMS surveys generally utilize similar survey administration protocols, quality-control procedures, and survey questions across countries. Fourth, the LSMS surveys have been implemented in many developing countries; this enables us to construct a global perspective on infrastructure coverage and the poor that is not possible with a survey in a single country. It is important to emphasize, however, that the households in our sample from these fifteen countries are not in any sense a random sample of households in the developing world. Fifth, some LSMS households surveys were accompanied by community surveys that gathered information about the availability of infrastructure (and other) services in the areas where sample households live. The community surveys enable us to distinguish between (1) households that do not have infrastructure services and could not have such services because they do not have access in their neighborhoods; and (2) households that do not have infrastructure services, but do have access and could have chosen to have such services if they had the resources and desire to do so.

The fifteen LSMS surveys in the multi-country data set include roughly similar questions, but the answer categories and exact question wording are often different from country to country. For

[8] These fifteen LSMS surveys were chosen because the data and supporting documentation were readily available and because these surveys contain all or most of the infrastructure and household consumption variables of interest. When more

this analysis we have created new income, expenditure, and infrastructure variables that can be compared across countries. There are inevitably conceptual and measurement problems in the creation of such global variables. Our purpose here is to look for broad patterns of infrastructure use by households of different levels of economic well-being. We caution the reader not to make too much of individual results.[9]

Cross-country income and expenditure variables were created by converting local currency to 1998 US dollars, using first the official currency exchange rate in the survey year and then the U.S. consumer price index.[10] Our cross-country infrastructure variables classify infrastructure options in each sector as "advanced", "intermediate", or "basic" solutions (Table 2). Sections 3, 4, and 5 of this paper examine "advanced" solutions, which are typically provided by a utility (electricity, in-house water taps, sewer connections, and telephones). Section 6 looks at intermediate and basic solutions – more informal or private forms of infrastructure service (e.g. in the energy sector, kerosene would be an intermediate, and wood a basic energy source).

We use monthly household consumption aggregates as income proxies in this analysis because the consumption data are considered more accurate and reliable than the self-reported income data. For the purposes of this analysis, the poorest households are those with the lowest per capita income proxy.[11] The pooled sample of households from all countries is similarly divided into twenty quantiles of 5 percent each. We divide households in the urban and rural areas of each country into "income" deciles by per capita consumption. We present the results by decile or quantiles of 5

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than one survey year was available for a particular country, we used the most recent survey year.

[9] This note of caution is particularly important for country-specific results. Some but not all LSMS surveys are self-weighting. In this analysis no weights have been used to adjust for sample design or non-response. Thus, the results are applicable for the sample population only.

[10] Purchasing power parity conversion would have been preferable, but consumption-heading conversion factors (which would have been used to convert information on expenditures) were not available for all sectors, all countries, or all survey years.

[11] The consumption aggregates used here were prepared by LSMS survey research teams. The aggregates combine information collected from households about their expenditures on and consumption of a host of food and non-food items.

percent as appropriate, with special emphasis on infrastructure coverage among households in the poorest deciles and quantiles of 5 percent.

3. Who has infrastructure services?

3.1. Global infrastructure coverage

Over 65 percent of the households in the pooled cross-national sample had electricity in their homes at the time of the LSMS survey.[12] By contrast, only 38 percent of households had in-house water taps, 36 percent had sewer connections, and 24 percent had telephones.[13] The distribution of these utility connections among households is highly correlated with our income proxy (i.e. monthly aggregate household consumption): a higher percentage of wealthy than poor households have electricity, in-house taps, sewer connections, and telephones in their homes.

Figure 1 shows how coverage of these services varies by income level in the cross-country pooled sample. Each dot on the graph represents one quantile of 5 percent of households. The dots plot the quantile's median "income" against the coverage of electricity, in-house water taps, sewer connections or telephones within that group.

Aggregate consumption among households in the poorest 5-percent quantile of the pooled sample was less than US$1.00 per household per day (US$27 per month, on average). These households came from all countries in the sample, but the majority live in Vietnam, Nepal, and Kyrgyz Republic -- the poorest of the fifteen countries.[14] Electricity was the only service with

[12] These households may obtain electricity from a utility connection or from an electrical generator. Unfortunately, it is only possible to differentiate between these sources in four of the 15 countries (Panama, Ecuador, Nicaragua, and Nepal). In these four countries, electrical generators for household use are rare. In Nicaragua and Nepal, less than 1 percent of households with electricity reported obtaining the electricity from a generator. In Panama and Nicaragua, 3.5 percent and 1.5 percent of households with electricity rely on generators. In Panama, poor households are somewhat more likely than rich households to rely on generators for electricity: nearly 12 percent of those in the poorest quintile who have electricity versus 2.3 percent of the richest quintile use generators. In Nicaragua, very few of the richest or poorest obtain electricity from generators; the Nicaraguan generator users are disproportionately concentrated in the middle-income quintiles.

[13] Information on telephone use is only available in 10 of the 15 countries. Sewer information is available in 12 countries, and electricity data in 14. These coverage figures reflect the percent of sample households *for whom data on the service is available* who have the service in their homes.

[14] Most of the richest households come from South Africa, Panama, Russia, Ecuador, and Jamaica – the wealthiest countries in the sample.

significant penetration in this group of households. Nearly 32 percent of these very poor households had electricity in their homes. Very few had in-house water taps (6 percent), sewer connections (3 percent), or telephones (3 percent).

Telephone coverage remains at 3 or 4 percent among households in the first five 5-percent quantiles (i.e., the lowest 25 percent of the sample households). Only when the median income proxy reaches US$120 per household per month does telephone coverage begin to rise. Coverage of electricity and of in-house water taps, on the other hand, begin to rise immediately and increases sharply from 5-percent quantile to 5-percent quantile. By the tenth 5-percent quantile (i.e., median income proxy = US$225 per household per month), 66 percent of the sample households had electricity, and 33 percent had in-house water taps. Above US$225 per household per month, use of electricity and in-house taps continues to rise, but at a slower rate (Figure 1). Nearly all of the households in the wealthiest 5-percent quantile (US$1300 per household per month) had electricity, 88 percent had in-house water taps, and 72 percent had telephones.

Electricity was the most widespread of these three services at all income levels, and telephone service was the least common. In Figure 1 the coverage lines for these three sectors never cross, and the slope of the three lines is remarkably similar among households with incomes (as approximated by the consumption aggregate) above US$250 per month.

Figure 1 does show one puzzling result. One would generally expect more households (and particularly more poor households) to have modern water services than advanced sanitation solutions, but coverage of in-house water taps and sewer connections appear to be virtually identical up to US$300 per household per month. In fact, there are two shortcomings in the LSMS data used for this analysis that cause this result in Figure 1.

First, *in-house* water taps are just one form of private household water connection. In many types of dwellings, in-house taps might not be feasible or desirable to install, or households may not initially want to invest in indoor plumbing facilities. In these cases households could choose to install

a yard tap, rather than an in-house tap. The in-house tap variable reported in Figure 1 thus understates the number of households with private water connections. It is only possible to identify households with yard taps in seven of the fifteen countries in this sample. In those seven countries, almost none of the poorest households had sewer connections or in-house connections and yard taps, but at higher income levels in-house connections and yard taps were much more prevalent than sewer connections (Figure 2).

Second, information on sewer connections is only available for twelve of the fifteen countries. When households in only those twelve countries are pooled and divided into quantiles of 5 percent, it becomes clear that sewer coverage lags behind coverage of in-house water taps as expected (Figure 3). Sewer coverage is consistently about 10 percent lower than in-house water tap coverage for households with incomes (as approximated by the consumption aggregate) under US$400 per month; above US$400 per month, the gap between in-house water service and sewer connections actually widens. As in Figure 1 electricity coverage is higher than coverage of other infrastructure services at all income levels. In the remainder of the paper we present results for the pooled sample of households from all fifteen countries (as in Figure 1), and, except where noted, we use coverage figures for in-house water taps (rather than in-house connections and yard taps).[15]

3.2. Coverage in urban and rural areas

As anticipated, a smaller percentage of rural than urban residents had infrastructure services in their homes.[16] Fewer rural households had electricity (46 percent vs. 89 percent in cities), in-house water taps (12 percent vs. 59 percent), sewer connections (7 percent vs. 61 percent), and telephones (8 percent vs. 38 percent). The poor live disproportionately in rural areas, but urban/rural location does not alone explain the urban/rural infrastructure gap.[17] Figures 4 and 5 show that a smaller percentage

[15] As a result, the coverage differences between sewer and water service and the important role of yard taps in water service coverage, both of which are apparent in Figures 2 and 3, will be obscured.
[16] The urban/rural classifications made by LSMS survey teams have been adopted for this analysis.
[17] More than 91 percent of households in the poorest quantile of the pooled sample live in rural areas, whereas only 13 percent of the richest households are rural residents.

of the poor than the rich in both urban and rural areas had electricity, in-house taps, sewer connections and telephones.

Very few of the poorest rural households had in-house water taps (2 percent), sewers (1 percent), or telephones (2 percent). Rural coverage of these three services remains under 10 percent up to US$200 per household per month. Perhaps surprisingly, electricity is reaching a substantial number of the rural poor (27 percent in the poorest quantile).

By contrast, a significant number of the poorest urban households had in-house water taps (31 percent), sewers (28 percent), and telephones (14 percent). Coverage of these services rises steeply from each 5-percent quantile to the next. Electricity coverage in urban areas is surprisingly similar across income groups. Nearly 80 percent of the poorest urban households had electricity, and coverage rises further among higher income groups.

3.3. Coverage by country

Of the fifteen sample countries, those in Eastern Europe and Central Asia stand out for their high coverage rates in all sectors. Albania, Bulgaria, Kazakhstan, and the Kyrgyz Republic all have virtually universal coverage of electricity.[18] Bulgaria, Kazakhstan, and Russia have the highest coverage rates for in-house water taps, sewers, and telephones as well.

Coverage rates among the poor are also higher in Eastern Europe and Central Asia than in the other countries in the sample (Table 3). Virtually all households in the poorest urban and rural deciles in Kyrgyz Republic, Albania, Bulgaria, and Kazakhstan had electricity. In contrast, in many other countries, fewer than half of the rural or urban poor had electricity. Bulgaria, Kazakhstan, and Russia are also the only countries in the sample where any significant number of the rural poor had in-house water taps, sewer connections, and telephones in their homes.

[18] Electricity data are not available for Russia. Albania survey does not include Tirana.

4. Who has access to services? Who has access and chooses not to connect?

One reason that many households do not have infrastructure connections in their homes is that they live in places where they do not have the option of connecting to a utility network (i.e., no network service exists in their neighborhoods).[19] Information on community access to infrastructure networks is available for most households in the urban and rural areas of five countries in our sample (Ecuador, Kazakhstan, Kyrgyz Republic, Nepal, and Panama).[20] Where this information is available, it is possible to begin to isolate the role that household choices play in creating the coverage patterns we observe, i.e., who has access but chooses not to connect?[21]

In these five countries community access to infrastructure is high in urban areas and low in rural areas (Figures 6 and 7). Households of all income levels and in both urban and rural areas were most likely to have electricity service, and least likely to have sewer service, available in their communities. In urban areas infrastructure access was not highly dependent on household income; the percentage of households with access to services was similar across income levels. But in rural areas the wealthy were much more likely than the poor to have access to all services except sewers. Very few rural households in any 5-percent quantile had access to sewer service.

Figures 8 and 9 present infrastructure coverage among households with access to infrastructure services in their communities. These figures show that in both urban and rural areas the vast majority of households with access to electricity had connections (i.e., chose to connect). This is not true for the other infrastructure sectors. A greater proportion of rich households than poor households chose to install in-house water taps, sewer connections, and telephones. In rural areas very few of the poor households with access to water, sewer, and telephone service actually had

[19] It should be noted that some such households may have consciously made this choice, i.e., located their home in a place without access because rents or land values were cheaper there.

[20] Information on community access to private telephone service is not available for Nepal, and the sewer access variable is missing for Kazakhstan.

[21] The LSMS community surveys provide an imperfect measure of access. The surveys make it possible to determine whether an infrastructure network is available within each respondent's community, but having a network in the area does not necessarily mean that it is technically or financially feasible to extend the network to all homes in the area. Despite this

connections.[22] Between 40 and 50 percent of the poorest urban households who had access to these three services in their communities had connections in their homes. This is much lower than the coverage rate among the richest urban households, but it does mean that nearly half of urban households with monthly household incomes around US$32 per month (as measured by our consumption aggregate) chose to install water, sewer, or phone service when these services were available to them. The percentage of households with access who connected was highest for electricity service in both urban and rural areas. Sewer, in-house tap, and telephone connection rates follow in that order.[23]

These figures do not necessarily imply that households would prefer electricity over other services if they could choose from among all four services (electricity, in-house water, sewer, or telephone). Of the households for whom access information is available on the four services, only 30 percent had access to all four.[24] Nearly all (98 percent) of these households had electricity, 82 percent had sewer connections, 75 percent had in-house water taps,[25] and 50 percent had phones. Because the LSMS surveys lack information on service prices, it is not possible to determine how differences in the price and connection fees for these services contribute to this outcome.

5. Household coverage: a multivariate analysis

The results presented in sections 3 and 4 demonstrate that infrastructure coverage varies with household income, by country of residence, and between urban and rural areas. In this section we

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downside, the community data roughly divide households into two groups: those with no possibility of connecting to a network and those who may have a chance of connecting.

[22] It is possible that the low connection rates in rural areas is more a reflection of problems with the access data than of the willingness of poor households to connect. Rural communities and primary sampling units cover a larger land area than urban communities. The fact that there is access a particular service somewhere within a rural community does not necessarily mean that it is technically or financially feasible to install a connection at every home in the area. While this is true in urban areas as well, this weakness in the community survey data is especially problematic in rural areas.

[23] In Ecuador and Panama, where information on yard taps is available, a greater percentage of urban and rural households of all quantiles chose an in-house or yard tap than a sewer connection (given access to each service).

[24] Sewer information is not available for Kazakhstan, and telephone access is not available in Nepal. Therefore, the households with access to all 4 services live in Ecuador, Kyrgyz Republic, and Panama.

[25] Nearly 2500 of the 3000 households with access to all four services live in Ecuador and Panama. In these countries information on yard taps is available. Nearly 95 percent of the 2500 households have an in-house or yard tap.

employ logistic regression models to examine the relative importance of these variables after statistically controlling for a number of other factors.

We hypothesize that the likelihood that a household will have a connection depends on six variables: 1) the monthly household income proxy, 2) whether or not the household lived in a rural area (RURAL), 3) whether or not the household lived in a low-income country, with GNP per capita below US$760 (LOWINCY), 4) whether or not the household is among the poorest 30% of the population in its own country (POOR), 5) whether or not the household was a homeowner (HOMEOWNER), 5) the size of the household (HHSIZE), and 6) whether or not the household lived in an Eastern European or Central Asian country (EEUROPE). Table 4 presents results of logistic regressions for five different binary dependent variables: whether or not the household has electricity, in-house tap, house/yard tap, sewer connection, and telephone. All models are estimated with the pooled cross-country data set.[26]

Among the six independent variables, three measure how income affects the likelihood that households will be connected to these services: the household income proxy, LOWINCY and POOR. The household income proxy measures household wealth across countries. The model results show that it has a significant and positive influence in all five models, and the magnitude of its effect is largest in the model for electricity, and smallest in the model for sewers. While the household income proxy measures the differences in wealth for households *across* countries, the second income-related variable, POOR, measures such differences *within* each country. The coefficients on POOR are very consistent for the five models. Being poor in one's own country thus dampens the chance of being connected to these services at all income levels.[27] The third income-related variable is LOWINCTY, which attempts to measure whether or not living in a low-income country would have an effect on the likelihood of having a connection. The results show that residing in a low-income country has a

[26] A country is only left out of these models if information on the dependent variable is not available for that country.
[27] The poor in some countries have incomes much lower than the poor in other countries.

negative impact on infrastructure connection, and for house/yard taps and telephones this influence can be quite substantial.

The other three independent variables are also statistically significant in most of the regressions. As one might expect, rural households are less likely to have network connections of any kind. The coefficients for RURAL are statistically significant and negative across the five models. In fact, of all the independent variables, RURAL has the largest impact on the dependent variable across all models. Homeownership is statistically significant and positive in the electricity, in-house tap, yard tap, and telephone models, but negative for sewer model. Household size has a small but negative effect on connection. Lastly, households in Eastern Europe and Central Asian countries are more likely to have connections than households in other countries.

Figure 10 depicts the relationship between household income and the predicted probability of having a connection, based on the results of regression models presented in Table 4. We used the mean value for all the independent variables except for the household income proxy, which we allowed to vary from 0 to $1,300. The probability of having an in-house water tap shows the largest increase across the household income range. The predicted probability of having a sewer connection is the flattest of the five curves, suggesting connections to sewers are the most invariant to household income. For both in-house taps and sewer, the marginal effect of income on the predicted probability of having a connection is fairly constant across the income range. This is not true for electricity and telephone service. The electricity curve in Figure 10 is concave, while the telephone curve is convex. This means that the marginal effect of income on the predicted probability of having an electricity connection declines as income rises. In the telephone model, the marginal effect of income is rising.

6. Are other service options filling the gap?

Formal sector utilities providing electricity, in-house water taps, sewer connections, and private telephones are just one means that poor households can use to meet their demand for

infrastructure services. In each of these sectors a number of other options exist (e.g. private electric generators, public water taps, private wells, septic tanks, public telephones). These alternatives may be more cost-effective solutions for serving some areas (e.g. septic tanks in rural areas), or may be more desirable for other reasons (e.g. formal utility service may be unreliable). In this section we examine the extent to which poor households that do not have electricity, in-house taps, sewer connections, and private telephones are relying on informal service providers (e.g. water vendors), private sources (e.g. private wells), or community service options (e.g. public phones). Are these services filling the infrastructure gap for poor households? How many poor households are left relying on very basic or unimproved sources?

6.1. The energy sector

Electricity is one of several energy sources that households around the world use in their homes. Most households rely on more than one energy source, choosing different fuels for different purposes, or substituting one fuel for another as prices, availability, or quality change. The majority of households in the pooled LSMS sample used electricity for lighting, but very few -- and even fewer of the poor --relied on electricity for their cooking needs.

Households without electricity used other fuels for lighting, cooking, and all other energy needs. Virtually all households without electricity connections used kerosene, gas, or oil lamps for lighting. Very few households used candles or flashlights, and even fewer reported having no source of lighting in the home. In Nicaragua, Ghana, Nepal, and Vietnam, only 1 percent, 4 percent, 7 percent, and 2 percent of households respectively used candles, flashlights, or something else other than electricity or gas, oil, or kerosene lamps for lighting.

In eight of the ten countries where data about households' cooking fuel are available, fewer than 2 percent of all households used electricity as cooking fuel.[28] Households that did not use

[28] South Africa and Bulgaria are the only two countries in the sample where a significant number of households reported using electricity for cooking (43 percent in South Africa and 75 percent in Bulgaria). In South Africa, almost no households

electricity for cooking chose from a range of possible fuels. Other modern fuels include bottled gas or natural gas. At the opposite end of the spectrum are wood, straw, dung, and thatch; in between are a number of intermediate energy sources for cooking, such as kerosene and charcoal. Wood, straw, dung, and thatch were overwhelmingly the most common cooking fuels among both the urban and rural poor in most countries.[29] Use of wood, dung, straw, and thatch was, not surprisingly, higher in rural than urban areas. The majority (and in some countries virtually all) of the poorest rural households use these basic cooking fuels. But poor households were not the only ones using wood, dung, thatch, or straw for cooking. In the poorest countries in the sample (Cote d'Ivoire, Nepal, Nicaragua, and Vietnam), the vast majority of the richest rural households also relied on these fuels. The rural rich in wealthier countries (Ecuador, Panama, South Africa) were, however, much less likely to cook with wood, dung, thatch, or straw than the rural poor.

The urban areas of Ecuador, Panama, and Bulgaria were the only exceptions in our data set to the widespread use of wood, straw, dung, and thatch by poor households. Only 14 percent and 17 percent of the poorest urban decile in Ecuador and Panama, respectively, were left using wood, dung, straw, or thatch for cooking fuel (Table 5). In Bulgaria, less than 7 percent of the poorest urban households cooked with these fuels.[30]

6.2. Water

Households without in-house connections obtained water in many other ways.[31] Some households used unimproved water sources, such as rivers and streams. Others chose from a range of informal, private, or improved community water sources (e.g. yard taps, public taps, wells, water vendors, or rainwater collection)

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in the poorest decile cook with electricity (3 percent). But 66 percent of the poorest decile of Bulgarian households rely on electricity for cooking.

[29] Information of cooking fuels is available for a subset of the fifteen countries: Bulgaria, Cote d'Ivoire, Ecuador, Ghana, Nepal, Nicaragua, Panama, South Africa, and Vietnam.

[30] In Bulgaria, it is not possible to differentiate between intermediate and basic fuels, but 7 percent of the poorest urban decile use either intermediate fuels or wood, dung, thatch, or straw.

Ghana, Nicaragua, Albania (not including Tirana), and Vietnam were the countries in our sample where the use of unimproved water sources was most prevalent. In Pakistan, Jamaica, Kazakhstan, Kyrgyz Republic, and Bulgaria, very few households (even in rural areas) obtained water from rivers or streams. It is interesting to note that in countries where coverage of in-house taps was high, the number of households still relying on rivers, streams, or springs was not necessarily low. In Albania (excluding Tirana), for example, 32 percent of households used in-house water taps and yet 42 percent still relied on basic water sources (relatively few households use other improved sources). In Cote d'Ivoire, on the other hand, the majority of households obtained water from informal, private, or community sources. Although only a minority of households in Cote d'Ivoire had in-house taps at the time of the LSMS survey, few households relied on rivers or streams as their primary water source.

Figures 11 and 12 examine the relationship between income and household water source choice in the pooled urban and rural samples from all countries except Nepal.[32] In both urban and rural areas, a smaller percentage of the poorest households than households in other income deciles had in-house taps, and a greater percentage of the poor used informal, private, or community sources. In urban areas very few households at any income level were using a river or stream as their primary water (or drinking water) source. In rural areas between 20 percent and 30 percent of households in all but the richest deciles relied on unimproved water sources.

Water vendors are an informal source that has recently attracted much attention in discussions of water service and the poor. Information about water vendors is available in four of our fifteen sample countries: Cote d'Ivoire, Ghana, Pakistan, and Nicaragua. Only 2.4 percent of households in these countries reported using water vendors as their primary source of drinking water.[33] Over 15

[31] Even households with water connections may obtain water from more than one source. LSMS surveys generally ask only for the primary water source or drinking water source.
[32] The Nepal LSMS does not permit analysis of those households using basic sources.
[33] Other households could be using vendors as a supplement to their primary water service.

percent of the households in Cote d'Ivoire used vendors, more than in any of the other three countries. Vendors were the primary source for 1 percent of households in Ghana and less than 1 percent in Pakistan and Nicaragua. In all four countries, a greater percentage of rich households than poor households used vendors. Less than 1 percent of households using vendors were in the poorest decile of their countries, whereas 20 percent were in the richest decile.

In three of the four countries, households using water vendors spent on average more per month than households with in-house water taps or those using other improved sources (Table 6). But only in Pakistan (where households with in-house service were spending very little per month on water) were the median expenditures of those using vendors significantly higher than those with in-house taps. It is striking that average monthly expenditures on vended water are not higher than the likely full cost of in-house piped water service. Although the per-unit price of vended water is certainly higher than the per-unit price of water from in-house service, total household expenditures on water were smaller than what one might expect from the water vending literature (e.g., Crane, 1994; Fass, 1988; Whittington et al., 1989, 1990, 1991; Zaroff and Okun, 1984).[34]

6.3. Sanitation

Some of the LSMS country data sets have information on two aspects of a household's sanitation situation: (1) whether a household had a toilet or latrine, and (2) whether a household had a means of removing wastewater from the house -- either a sewer connection or a septic tank. Information on septic tank usage is available in six of the fifteen countries (Bulgaria, Ecuador, Kazakhstan, Nepal, Nicaragua, and Pakistan). In these six countries more households had sewer connections than septic tanks, but septic tanks nonetheless made a significant contribution to sanitation infrastructure. More than half of all households in Bulgaria, Ecuador, and Kazakhstan had either a sewer connection or a septic tank. By contrast, most households in Nepal (84 percent),

[34] These findings should not, however, be considered definitive because such a small percentage of sample households in these countries used water vendors.

Nicaragua (74 percent), and Pakistan (63 percent) were without either sewer connections or septic tanks.

The poorest households in each country had lower rates of coverage of sewer connections and septic tanks than the population as a whole. Bulgaria is the only exception. In Bulgaria nearly all households had either a sewer connection or a septic tank, but the poorest households were more likely to have septic tanks than sewers.

Rural households of all income levels had lower rates of coverage of all sanitation facilities than urban households (Figures 13 and 14). Very few urban households were without a toilet or latrine in their home. By contrast, approximately 30 percent or more of each rural decile was without any sort of sanitation facilities. Not surprisingly, the greatest sanitation deficit was among the poorest rural households. Between 80 percent and 90 percent of households in the poorest two deciles in the pooled rural sample had no latrine or toilet in their homes. Approximately one quarter of households in the poorest urban decile of the sample have no sanitation facilities.

6.4. Telecommunications

For households without a private telephone in their home, having access to a public telephone in their community can be a real advantage. In the absence of a public phone, the presence of at least some private telephone connections in the community may still give households without a phone a means of communication. Phone owners may rent out their phones or allow others to use the phone for emergency communications. Information on such uses of private phones is not available in the LSMS surveys, but the community questionnaires in three countries (Ecuador, Kyrgyz Republic, and Panama) do ask about access to public phones.

In these three countries poor households were less likely than the population as a whole to have access to public telephones in their communities. In Panama and Nepal access to public telephone service increases with aggregate household income (as measured by our income proxy). In Ecuador access to public phones is fairly uniform across income deciles. Most of the poorest urban

and poorest rural households in these three countries did not have either their own private phone or access to a public phone in their community. The only exception is urban areas in the Kyrgyz Republic, where just over half of the poorest urban households had access to a public phone in their communities (Table 7).

7. Conclusions

Coverage statistics are widely used to paint a picture of infrastructure conditions in developing countries, and they are often the only global, cross-country data available for infrastructure services. It is thus important to utilize coverage statistics to their fullest advantage while at the same time being careful not to read more into the data than they can in fact reveal. In this paper we have utilized a new data source, the World Bank's LSMS surveys, to construct infrastructure coverage statistics for a pooled sample of households from fifteen countries.

Several of the results from our analyses using of these LSMS data sets are worth recapping. First, electricity coverage was higher than coverage of other infrastructure services at all income levels; 65 percent of the households in the sample had electricity in their homes. By contrast, only 38 percent of households had in-house water taps (the infrastructure service with the next highest level of coverage). The relative ranking of coverage rates among the four infrastructure services (electricity ▶ water ▶ sewer ▶ telephone) held across all income levels.

Second, infrastructure coverage for electricity, water connections, and sewer connections all rise but at different rates as household income (as measured by a consumption aggregate) increases from about US$100 to US$250 per month. We want to emphasize again that the 55,500 households in this pooled data set are not representative of the global population in developing countries. We believe, however, that our findings regarding these relationships between infrastructure coverage and household income are relatively robust with respect to the countries in the pooled sample and the sampling procedures used within countries.

Third, electricity was the only infrastructure service with significant penetration among the poorest 5 percent of the sample households (32 percent had service). Only 6 percent of the poorest households had an in-house water connection; only 3 percent had a sewer connection. Almost 80 percent of the poorest households in urban areas had electricity service. Even in rural areas, 27 percent of the poorest households in our sample had electricity service. When a household had the

opportunity to connect to the electricity network, the vast majority did so, regardless of their income level (this was not true for the other three infrastructure sectors). Moreover, when households had a choice among all four infrastructure services, it appears that they chose electricity first.

Fourth, few households in the sample relied on electricity as a cooking fuel. The vast majority of poor households in both rural and urban areas used wood, straw, dung, and/or thatch as their primary cooking fuel. In the poorest countries in the sample, even the majority of the richest rural households also relied on these basic fuels.

Fifth, although the majority of households in the pooled sample did not have an in-house water connection, relatively few households were using unimproved water sources (such as a river or stream) as their primary source. In urban areas very few households at any income level were using unimproved water sources. In rural areas between 20-30 percent of households in all except the richest income deciles relied on unimproved water sources. Water vendors were not a major water source for households in the four countries in the sample in which these data were collected. However, those households that purchased water from vendors were usually not paying much more per month than the likely full cost of private in-house water service (although the price per unit of water purchased from vendors is almost always higher than the price of water from piped distribution systems).

Sixth, in those countries in which the LSMS surveys collected information on toilets, latrines, and septic tanks, the majority of urban households had a toilet or latrine in their home. The greatest sanitation deficit existed among the rural poor; 80-90 percent of poor, rural households had no sanitation facilities of any kind. This will come as no surprise to those working in the water and sanitation sector.

Acknowledgements: We would like to thank Penelope Brook for her insights and support throughout this project, and Diane Steele for her help in assembling the LSMS data sets. We would also like to thank Margaret Grosh and Paul Glewwe for introducing us to the LSMS data sets and for their long commitment to ensuring both the quality and the accessibility of the data from these unique household surveys.

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TABLES

Table 1:
LSMS data sets used in this study

Country (1998 per capita GNP)[1]	Survey year	Number of households	Community-level survey available and used in the analyses for this paper?
Asia			
Pakistan (480)	1991	4800	
Vietnam (330)	1992-3	4800	
Nepal (210)	1996	3373	Yes
Eastern Europe & Central Asia			
Russia (2,300)	1994-95	3973	
Kazakhstan (1,310)	1996	1996	Yes
Bulgaria (1,230)	1995	2468	
Albania[2] (810)	1997	1503	
Kyrgyz (350)	1993	1937	Yes
Latin America & the Caribbean			
Panama (3,080)	1997	4938	Yes
Jamaica (1,680)	1997	2016	
Ecuador (1,530)	1995	5661	Yes
Nicaragua (390)	1993	4454	
Sub-Saharan Africa			
South Africa (2,880)	1993	8850	
Cote d'Ivoire (700)	1988	1584	
Ghana (390)	1988-89	3193	

Notes:
(1) 1998 GNP per capita in U.S. dollars. Source: World Bank (Atlas method).
(2) The Albanian survey does not include households in Tirana.

Table 2:
Construction of cross-national infrastructure variables

Cross-country variable	The answer categories for infrastructure questions[35] varied across LSMS surveys, so answers were combined to create three categories of infrastructure use that could be compared across countries:		
	Advanced	Intermediate	Basic
Water sector			
WATER SOURCE	In-house water tap	Other improved sources, such as yard tap, public tap, well, rainwater, vendor	River, stream, spring
Sanitation sector			
TOILET	Flush toilet	Latrine, no-flush toilet, or other toilet (e.g. chemical)	No toilet or latrine (includes bucket toilet, open hole)
SEWER/SEPTIC	Sewer connection or septic tank		
Energy sector			
ELECTRICITY	Electricity (from grid or generator)		
COOKING FUEL	Electricity, bottled gas, natural gas	Kerosene, charcoal, coal	Wood, dung, thatch, straw
Telecoms			
TELEPHONE	Private phone	Access to public phone in community	No access to public phone and no private phone

[35] LSMS surveys generally ask for each household's primary source of drinking water, the energy source used for light and cooking, and whether or not the household has a telephone.

Table 3:
Percent of poor households with infrastructure in home,
in poorest urban and rural deciles in each country[1,2]

Country	Electricity		In-house water		Sewer		Telephone	
	Urban[4]	Rural[4]	Urban	Rural	Urban	Rural	Urban	Rural
Asia								
Pakistan	88	44	34	5	20	0	1	0
Vietnam	57	16	4	0	-	-	-	-
Nepal	43	1	7	4	7	0	0	0
Eastern Europe & Central Asia								
Russia	-	-	84	31	78	12	39	13
Kazakhstan	100	100	78	12	70	8	38	20
Bulgaria	100	100	84	27	86	18	51	20
Albania[3]	100	100	90	0	-	-	0	0
Kyrgyz	99	99	54	5	22	3	20	5
Latin America & the Caribbean								
Panama	91	2	36	4	25	0	20	0
Jamaica	55	44	23	2	15	6	10	6
Ecuador	92	63	25	7	42	5	5	0
Nicaragua	71	13	44	4	9	0	0	0
Sub-Saharan Africa								
South Africa	32	8	23	1	-	-	6	0
Cote d'Ivoire	39	8	7	0	-	-	-	-
Ghana	38	0	2	0	-	-	-	-

Source: Living Standards Measurement Study surveys from 15 countries.

Notes:
(1) The urban and rural households in each country were separately divided into deciles based on the per capita aggregate consumption of each household.
(2) Some but not all LSMS surveys are designed to be self-weighting. Here weights were not used to adjust for sample design or non-response.
(3) Albania survey does not include Tirana.
(4) The urban/rural divisions used by LSMS survey designers were adopted for this study.

Table 4:
Logistic regression co-efficiencies (and standard errors) from multivariate analysis of infrastructure coverage, in pooled sample of households from fifteen LSMS surveys

	Dependent variable (Yes/No)				
	Electricity	In-house tap	House/yard tap	Sewer	Telephone
INCOME PROXY[2] in units of US$100	0.271* (0.008)	0.226* (0.005)	0.129* (0.007)	0.075* (0.004)	0.217* (0.004)
RURAL[3] =1 if in rural area =0 if in urban area	-1.981* (0.027)	-2.211* (0.025)	-1.928* (0.034)	-3.003* (0.039)	-1.580* (0.032)
LOWINCTY =1 if low income country =0 if not	-0.068* (0.029)	-0.189* (0.028)	-1.853* (0.038)	-0.735* (0.036)	-1.059* (0.041)
POOR =1 if Hh decile ranking is 3 and below =0 if Hh decile ranking is 4 and above	-0.573* (0.033)	-0.502* (0.037)	-0.427* (0.042)	-0.634* (0.046)	-0.582* (0.049)
HOMEOWNER =1 if owner =0 if renter or other	0.135* (0.029)	0.282* (0.027)	0.140* (0.037)	-0.527* (0.036)	0.660* (0.036)
HHSIZE Size of the household	-0.038* (0.004)	-0.082* (0.004)	-0.021* (0.005)	-0.038* (0.006)	-0.086* (0.006)
EEUROPE =1 if in E. Europe or Central Asia = 0 otherwise	N/A	1.555* (0.030)	N/A	1.477* (0.037)	1.301* (0.033)
Pseudo R^2	0.28	0.28	0.31	0.37	0.32

* = significant at the 95% confidence level

Source: Living Standards Measurement Study surveys from 15 countries.

Notes:
(1) 1998 GNP per capita. Source: World Bank (Atlas method)
(2) Aggregate monthly household consumption is used as an income proxy. The consumption aggregates prepared by LSMS survey research teams were adopted for this analysis.
(3) The urban/rural definitions used by LSMS survey designers were used in this analysis.
(4) Households were grouped into deciles in each country based on their per capita aggregate consumption.
(4) Eastern European countries were left out of the electricity equation because virtually all households in these countries have
electricity.

Table 5:
Use of wood, dung, thatch, and straw as cooking fuel,
Among the poorest and richest urban and rural deciles[1,2]

Country	Urban areas[3]		Rural areas	
	Poorest 10%	Richest 10%	Poorest 10%	Richest 10%
Low-income economies[4]				
Cote d'Ivoire	92	4	100	94
Ghana	69	20	100	82
Nepal	85	4	100	86
Nicaragua	95	28	99	87
Vietnam	88	27	99	88
Middle-income economies				
Ecuador	13	0	56	22
Panama	10	0	99	11
South Africa	7	0	84	4

Source: Sample households from Living Standards Measurement Study surveys.

Notes:
(1) The urban and rural households in each country were separately divided into deciles based on the per capita aggregate consumption of each household.
(2) Some but not all LSMS surveys are designed to be self-weighting. Here weights were not used to adjust for sample design or non-response.
(3) The urban/rural divisions used by LSMS researchers were adopted for this study.
(4) Countries are classified by 1998 GNP per capita (Source: World Bank). Low-income economies had GNPs under $760. The middle-income economies in this sample of countries all have GNPs less than $3080.

Table 6:
Median Monthly Household Expenditures on Water in US$1998,
by households relying on different primary drinking water sources [1]

Country	Median expenditure among all households using....		
	In-house water tap	Vendor	Other improved[2]
Cote d'Ivoire	12.40	13.90	6.90
Ghana	4.90	4.40	1.90
Nicaragua	4.60	6.00	2.40
Pakistan	1.00	7.50	0.80

Source: Sample households from Living Standards Measurement Study surveys in these four countries.

Notes:
(1) Some but not all LSMS surveys are designed to be self-weighting. No weights were used in this analysis to correct for sample design and non-response.
(2) "Other improved sources" include yard taps, public taps, wells, and rainwater collection.

Table 7:
Percent of poorest urban and poorest rural decile with access to a public telephone in their community[1,2]

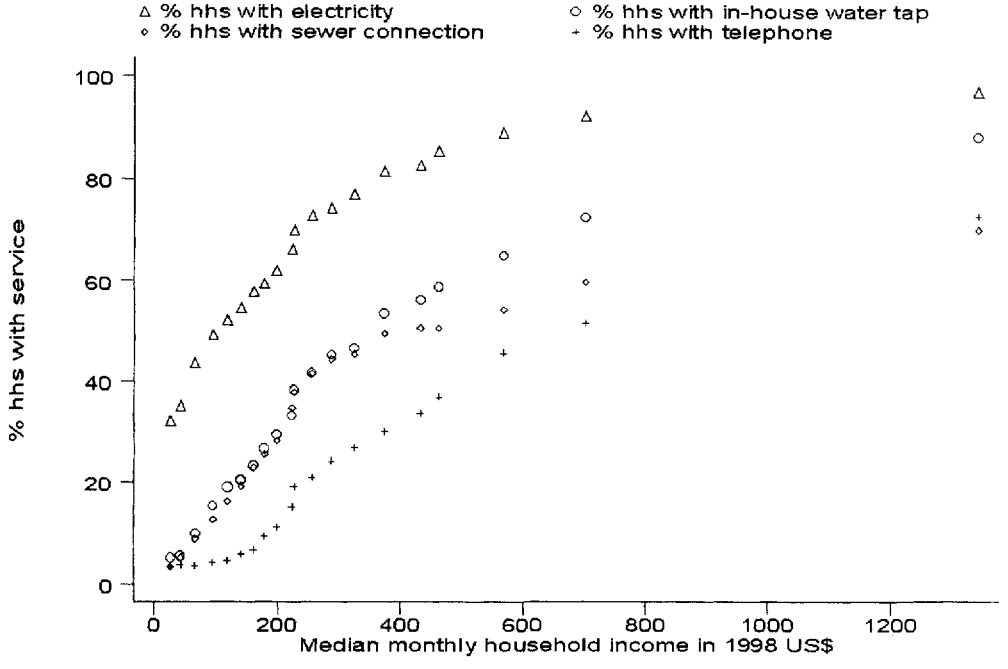
	% of poorest urban decile	% of poorest rural decile
Ecuador	15	12
Kyrgyz Republic	60	29
Panama	33	4

Source: Sample households from Living Standards Measurement Study surveys in these 3 countries.

Notes:
(1) Some but not all LSMS surveys are designed to be self-weighting. No weights were used in this analysis to correct for sample design and non-response.
(2) Urban and rural households were separately grouped into deciles in each country based on the income proxy (per capita aggregate consumption).
(3) Community is defined as the primary sampling unit in which the household lives. In urban areas, this is typically smaller
than the entire city, and in rural areas the community may consist of more than one village.

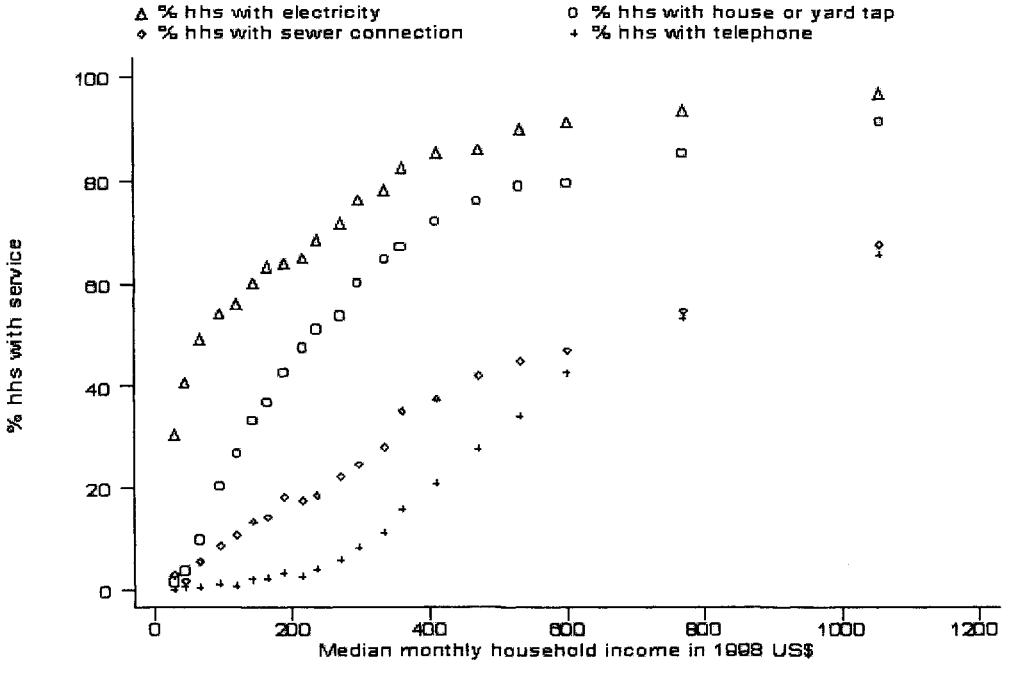
FIGURES

Figure 1:
Global infrastructure coverage[1] vs. monthly household income proxy, [2]
by quantile of 5 percent[3]



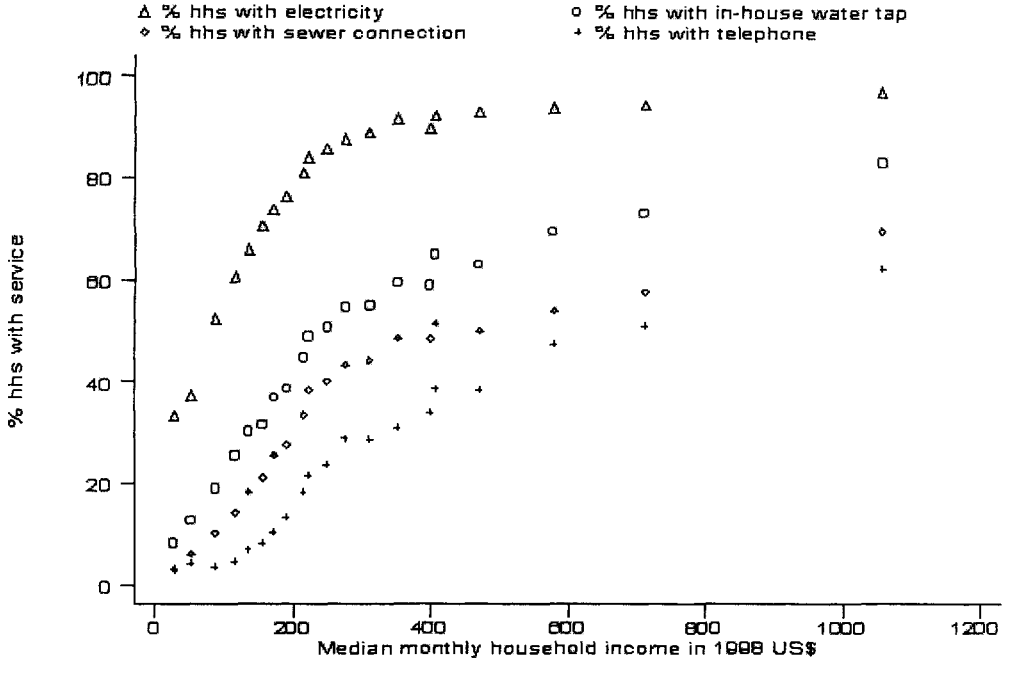
Source: 55,546 sample households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) The in-house water curve reports coverage levels among sample households from all 15 countries used in this study. The other three curves report coverage in a subset of countries because some LSMS surveys are missing information on these services. Information on electricity is available in 14 countries, telephone data in 12, and sewer information in 10.
(2) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(3) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 55,546 households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing (see note 1), households from that country are simply left out of the quantile coverage calculations.

Figure 2:
Infrastructure coverage vs. monthly household income proxy, (1)
by quantile of 5 percent of households in 7 countries (2,3)



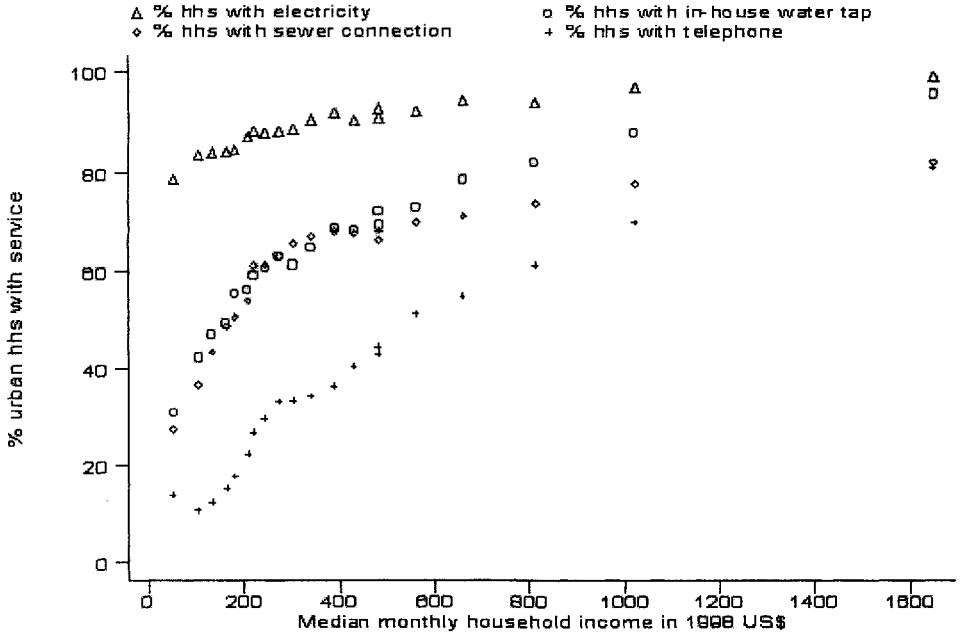
Source: 14,900 sample households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(2) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 14,900 households.
(3) Countries for which information on both in-house and yard taps is available are included on this graph: Cote d'Ivoire, Ecuador, Jamaica, Nicaragua, Panama, Pakistan, and Vietnam. None of the Eastern European and Central Asian countries that are included in other parts of this study are present here. Also missing are Ghana, Nepal, and South Africa.

Figure 3:
Infrastructure coverage vs. monthly household income proxy, [1]
by quantiles of 5 percent of households from 10 countries [2,3]



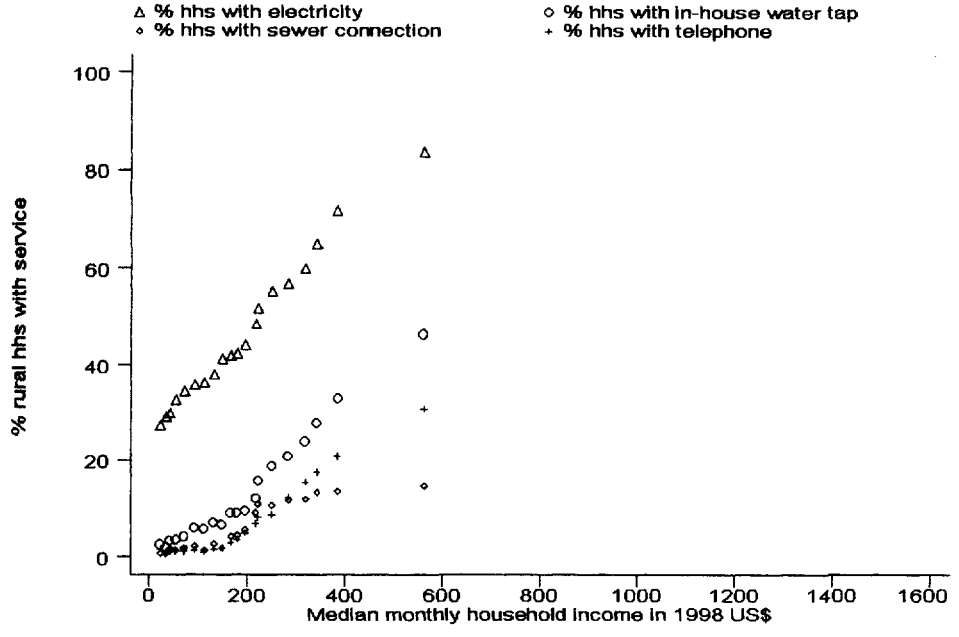
Source: 22,692 sample households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(2) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 22,692 households.
(3) The countries included in this graph all have available data on sewer connections: Bulgaria, Ecuador, Jamaica, Kazakhstan, Kyrgyz Republic, Nepal, Nicaragua, Panama, Pakistan, and Russia. Sewer data are not available for the sub-Saharan African countries included in other parts of this study (Côte d'Ivoire, Ghana, and South Africa) or for Albania or Vietnam.

Figure 4:
Urban infrastructure coverage vs. monthly household income proxy, (1)
by quantiles of 5 percent of urban households (2,3)



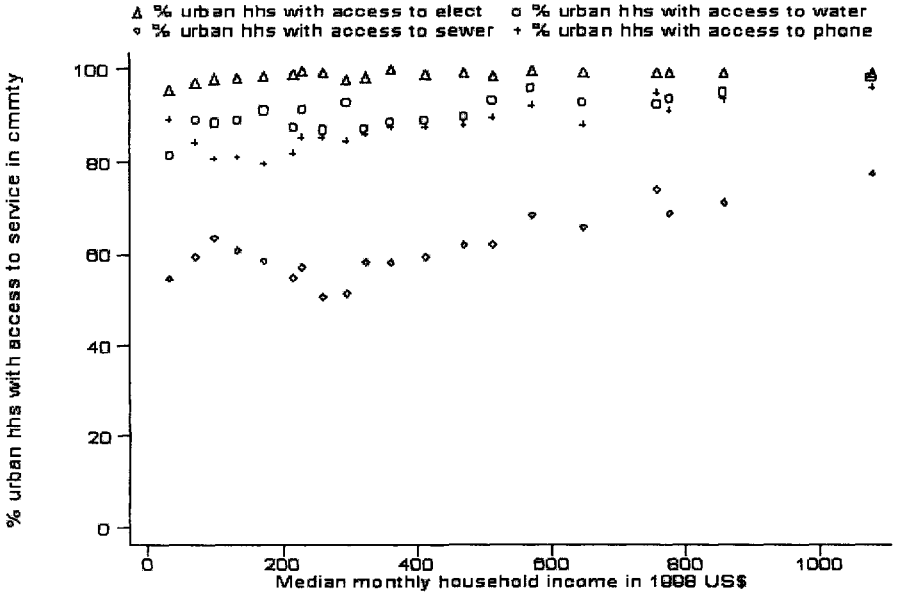
Source: 26,233 urban households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(2) The in-house water curve reports coverage levels among sample households from all 15 countries used in this study. The other three curves report coverage in a subset of countries because some LSMS surveys are missing information on these services. Information on electricity is available in 14 countries, telephone data in 12, and sewer information in 10.
(3) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 26,233 urban households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing (see note 2), households from that country are simply left out of the quantile coverage calculations.

Figure 5:
Rural infrastructure coverage vs. monthly household income proxy, (1)
by quantiles of 5 percent of rural households (2,3)



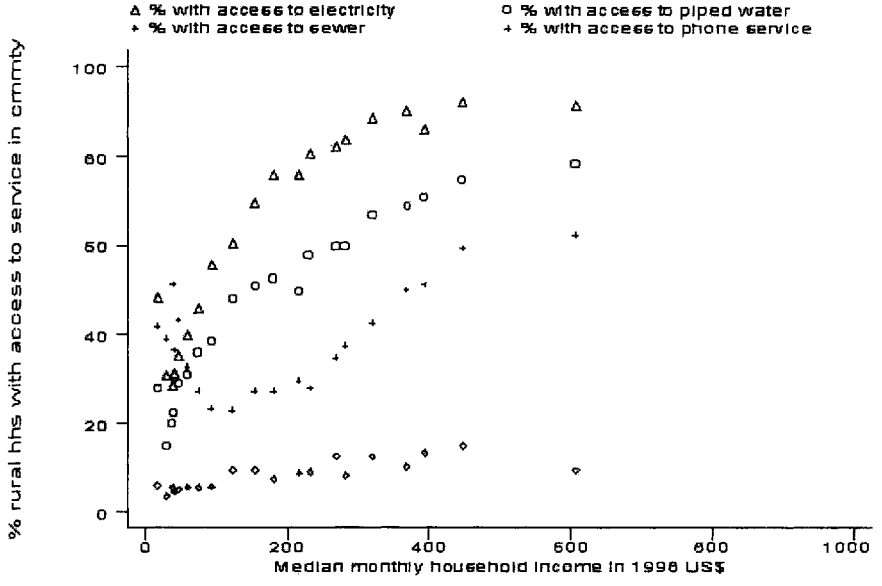
Source: 28,791 rural households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(2) The in-house water curve reports coverage levels among sample households from all 15 countries used in this study. The other three curves report coverage in a subset of countries because some LSMS surveys are missing information on these services. Information on electricity is available in 14 countries, telephone data in 12, and sewer information in 10.
(3) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 28,791 rural households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing (see note 2), households from that country are simply left out of the quantile coverage calculations.

Figure 6:
Percent of urban households with access to infrastructure services in their communities [1]
versus monthly household income proxy [2],
by quantiles of 5 percent of urban hhs in 5 countries [3,4]



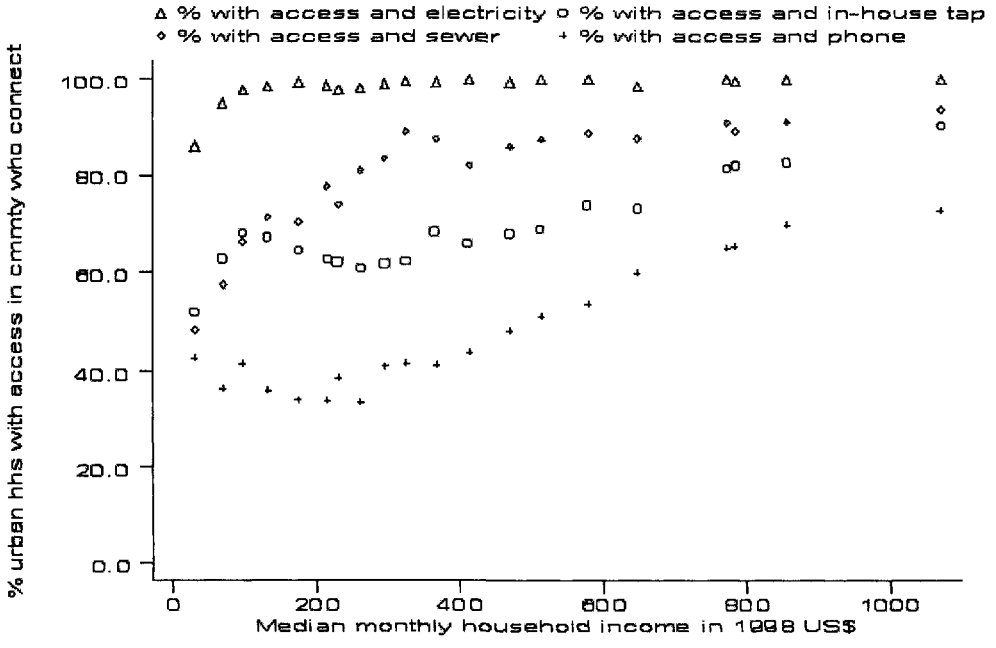
Source: 6,816 urban hhs in a pooled data set of Livings Standards Measurement Study surveys from 5 countries.
Notes:
(1) Households "have access to infrastructure services in the community" if there is an infrastructure network in the community where they live. The presence of a network presumable gives the household the opportunity to connect to the network. Information on community access comes from surveys of community characteristics that were administered in most primary sampling units as a supplement to the LSMS household questionnaires. There is inevitably some error in the community access data (e.g. a household could live in a PSU with a water network but be too far away to make connecting to the network financially feasible) Error is likely to be smaller in urban communities than in rural communities because the PSUs in urban areas cover smaller areas.
(2) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(3) The five countries are: Ecuador, Kazakhstan, Kyrgyz Republic, Nepal, and Panama. Only households for whom access data are available are included.
(4) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 6,816 urban households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing, households from that country are simply left out of the quantile coverage calculations. Information on access to private phones is missing for Nepal, and on sewer for Kazakhstan.

Figure 7:
Percent of rural households with access to infrastructure services in their communities [1] versus monthly household income proxy [2],
by quantiles of 5 percent of rural hhs in 5 countries [3,4]



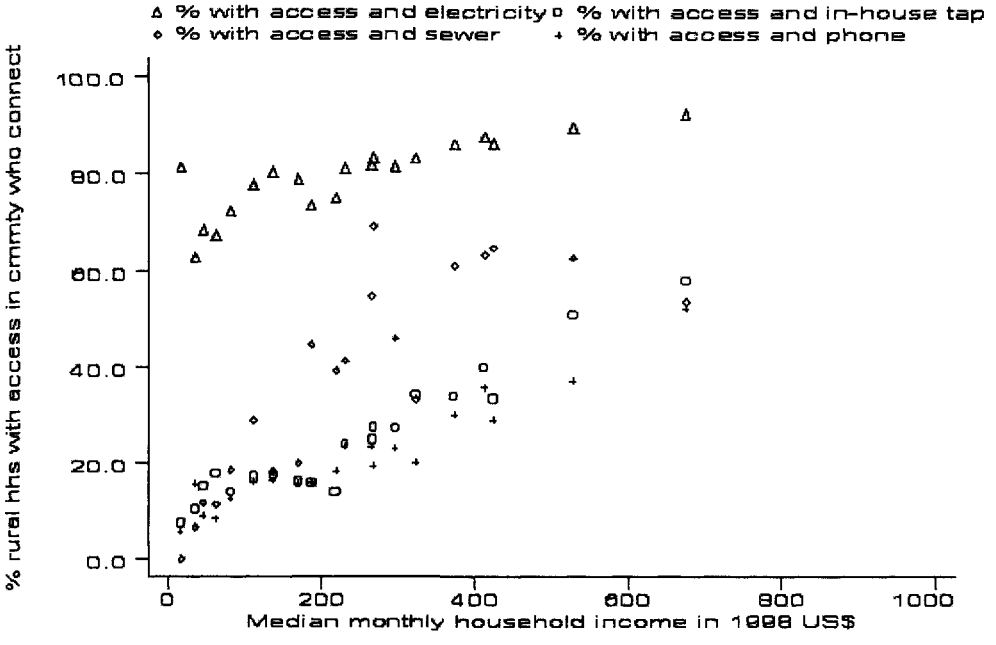
Source: 8,797 rural hhs in a pooled data set of Living Standards Measurement Study surveys from 5 countries
Notes:
(1) Households "have access to infrastructure services in the community" if there is an infrastructure network in the community where they live. The presence of a network presumable gives the household the opportunity to connect to the network. Information on community access comes from surveys of community characteristics that were administered in most primary sampling units as a supplement to the LSMS household questionnaires. There is inevitably some error in the community access data (e.g. a household could live in a PSU with a water network but be too far away to make connecting to the network financially feasible) Error is likely to be smaller in urban communities than in rural communities because the PSUs in urban areas cover smaller areas.
(2) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(3) The five countries are: Ecuador, Kazakhstan, Kyrgyz Republic, Nepal, and Panama. Only households for whom access data are available are included.
(4) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 8,797 rural households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing, households from that country are simply left out of the quantile coverage calculations. Information on access to private phones is missing for Nepal, and on sewer for Kazakhstan.

Figure 8:
Percent of urban households with access to a service in their communities who choose to connect to that service, versus monthly household income proxy [1,2],
by quantiles of 5 percent of urban hhs in 5 countries [3,4]



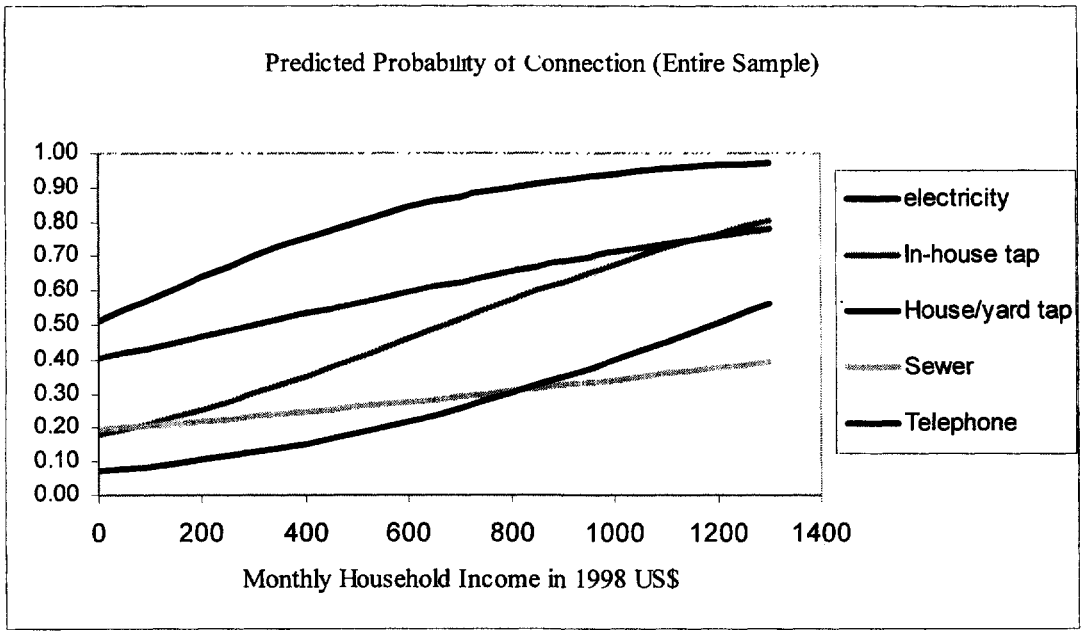
Source: 6,737 urban hhs in a pooled data set of Livings Standards Measurement Study surveys from 5 countries.
Notes:
(1) Households "have access to infrastructure services in the community" if there is an infrastructure network in the community where they live. The presence of a network presumable gives the household the opportunity to connect to the network. Information on community access comes from surveys of community characteristics that were administered in most primary sampling units as a supplement to the LSMS household questionnaires. There is inevitably some error in the community access data (e.g. a household could live in a PSU with a water network but be too far away to make connecting to the network financially feasible) Error is likely to be smaller in urban communities than in rural communities because the PSUs in urban areas cover smaller areas.
(2) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(3) The five countries are: Ecuador, Kazakhstan, Kyrgyz Republic, Nepal, and Panama. Only households with access to services are included.
(4) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 6,737 urban households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing, households from that country are simply left out of the quantile coverage calculations. Information on access to private phones is missing for Nepal, and on sewer for Kazakhstan.

Figure 9:
Percent of rural households with access to a service in their communities who choose to connect to that service versus monthly household income proxy [1,2],
by quantiles of 5 percent of rural hhs in 5 countries [3,4]



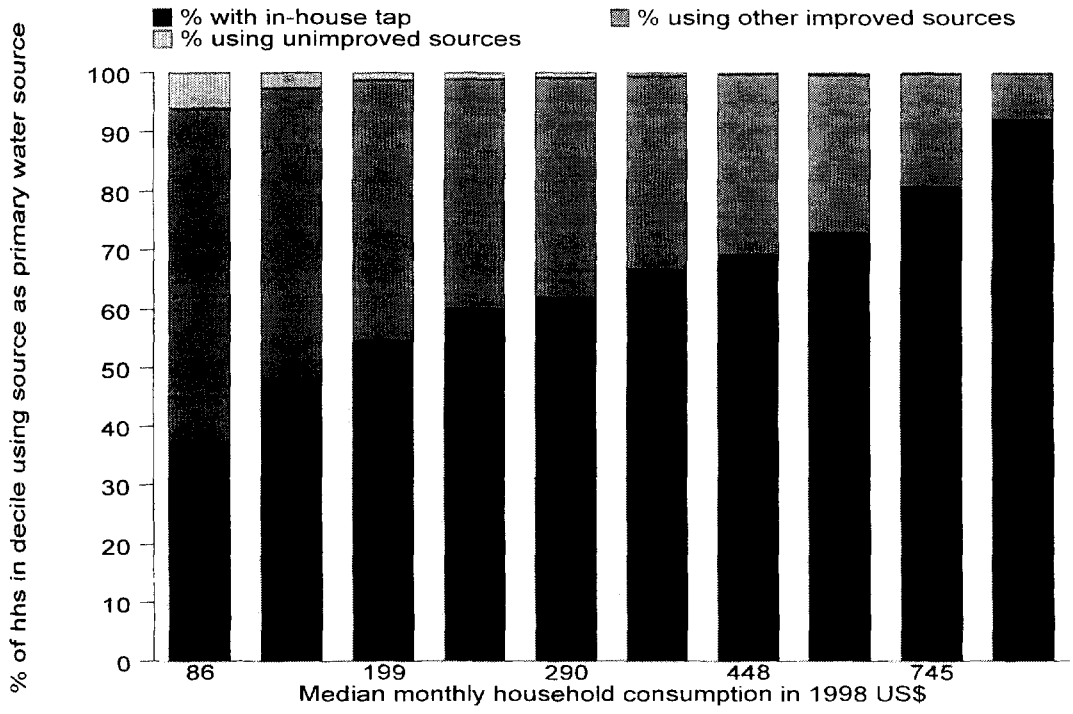
Source: 6,334 rural hhs in a pooled data set of Living Standards Measurement Study surveys from 5 countries.
Notes:
(1) Households "have access to infrastructure services in the community" if there is an infrastructure network in the community where they live. The presence of a network presumable gives the household the opportunity to connect to the network. Information on community access comes from surveys of community characteristics that were administered in most primary sampling units as a supplement to the LSMS household questionnaires. There is inevitably some error in the community access data (e.g. a household could live in a PSU with a water network but be too far away to make connecting to the network financially feasible) Error is likely to be smaller in urban communities than in rural communities because the PSUs in urban areas cover smaller areas.
(2) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.
(3) The five countries are: Ecuador, Kazakhstan, Kyrgyz Republic, Nepal, and Panama. Only households with access to services are included.
(4) Households are divided into quantiles of 5 percent according to the per capita consumption of the households. The quantiles of 5 percent are groups that each consist of 5 percent of the 6,334 rural households. The per capita consumption cut-offs for the quantiles are the same for the electricity, water, sewer, and telephone curves. When data on a particular country are missing, households from that country are simply left out of the quantile coverage calculations. Information on access to private phones is missing for Nepal, and on sewer for Kazakhstan.

Figure 10



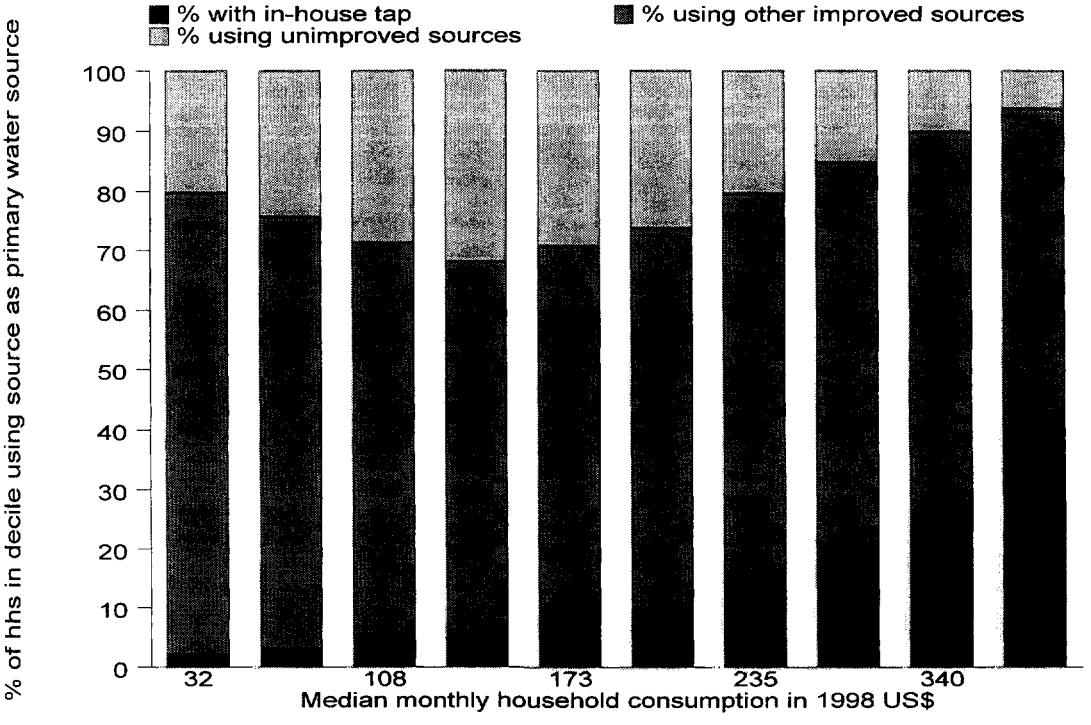
Source: 55,546 sample households in a pooled data set of Living Standards Measurement Study surveys.
Notes:
(1) The in-house water curve reports coverage levels among sample households from all 15 countries used in this study. The other curves report coverage in a subset of countries because some LSMS surveys are missing information on these services. Information on electricity is available in 14 countries, telephone data in 12, sewer information in 10, and house/yard taps in 7.
(2) The predicted probabilities of connection and monthly household income are computed by using the results of the regression models presented in Table 4. The mean values of the independent variables (except for household income proxy) are used in the calculation.

Figure 11:
Primary water source in urban areas, by decile of urban households [1-5]



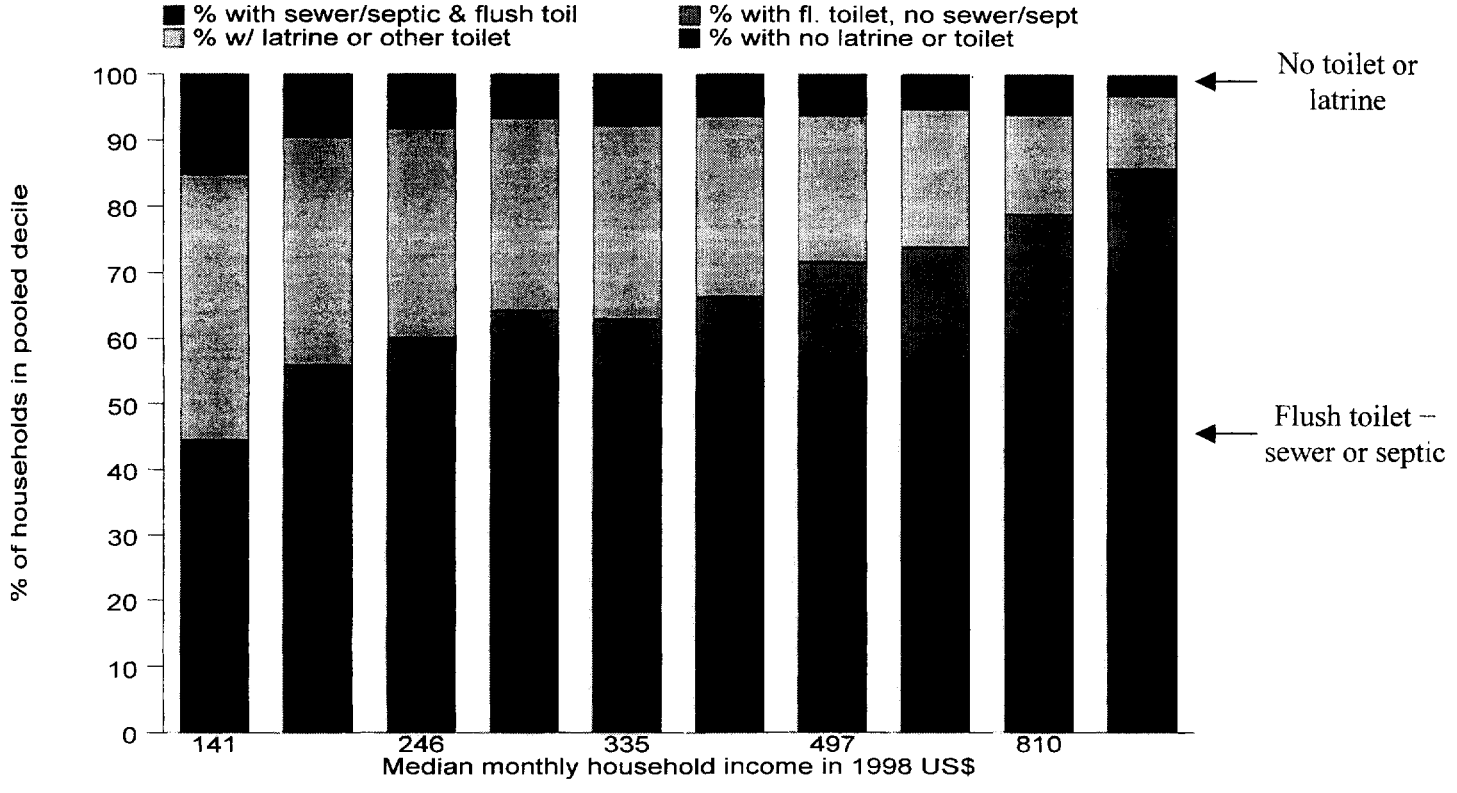
Source: 25,458 urban households in pooled data set of Livings Standards Measurement Study surveys from 14 countries.
Notes:
(1) Some LSMS surveys ask for respondents' primary water source (Albania, Bulgaria, Ecuador, Nicaragua, South Africa). The remaining surveys ask for primary drinking (or drinking and cooking) water source.
(2) The urban/rural definitions used by LSMS researchers were adopted for this analysis.
(3) The 25,458 households were divided into deciles according to the per capita consumption of the households.
(4) "Other improved sources" include yard taps, standposts, wells, vendors, and rainwater collection. "Unimproved sources" include rivers, streams, and springs.
(5) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.

Figure 12:
Primary water source in rural areas, by decile of rural households [1-5]



Source: 26,104 rural households in pooled data set of Living Standards Measurement Study surveys from 14 countries.
Notes:
(1) Some LSMS surveys ask for respondents' primary water source (Albania, Bulgaria, Ecuador, Nicaragua, South Africa). The remaining surveys ask for primary drinking (or drinking and cooking) water source.
(2) The urban/rural definitions used by LSMS researchers were adopted for this analysis.
(3) The 26,104 households were divided into deciles according to the per capita consumption of the households.
(4) "Other improved sources" include yard taps, standposts, wells, vendors, and rainwater collection. "Unimproved sources" include rivers, streams, and springs.
(5) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis.

Figure 13:
Sanitation in urban households,
by decile of pooled sample of six countries[1,2,3]



Source: 13248 households in pooled data set of Living Standards Measurement Study surveys from 6 countries.
Notes:
(1) Households in this graph come from Bulgaria, Ecuador, Jamaica, Nicaragua, Panama, and Pakistan.
(2) Monthly aggregate household consumption is used as a proxy for household income.
(3) Households are divided into deciles based on the per capita consumption of the household.

Figure 14:
Sanitation in rural households,
by decile of pooled sample of six countries[1,2,3]

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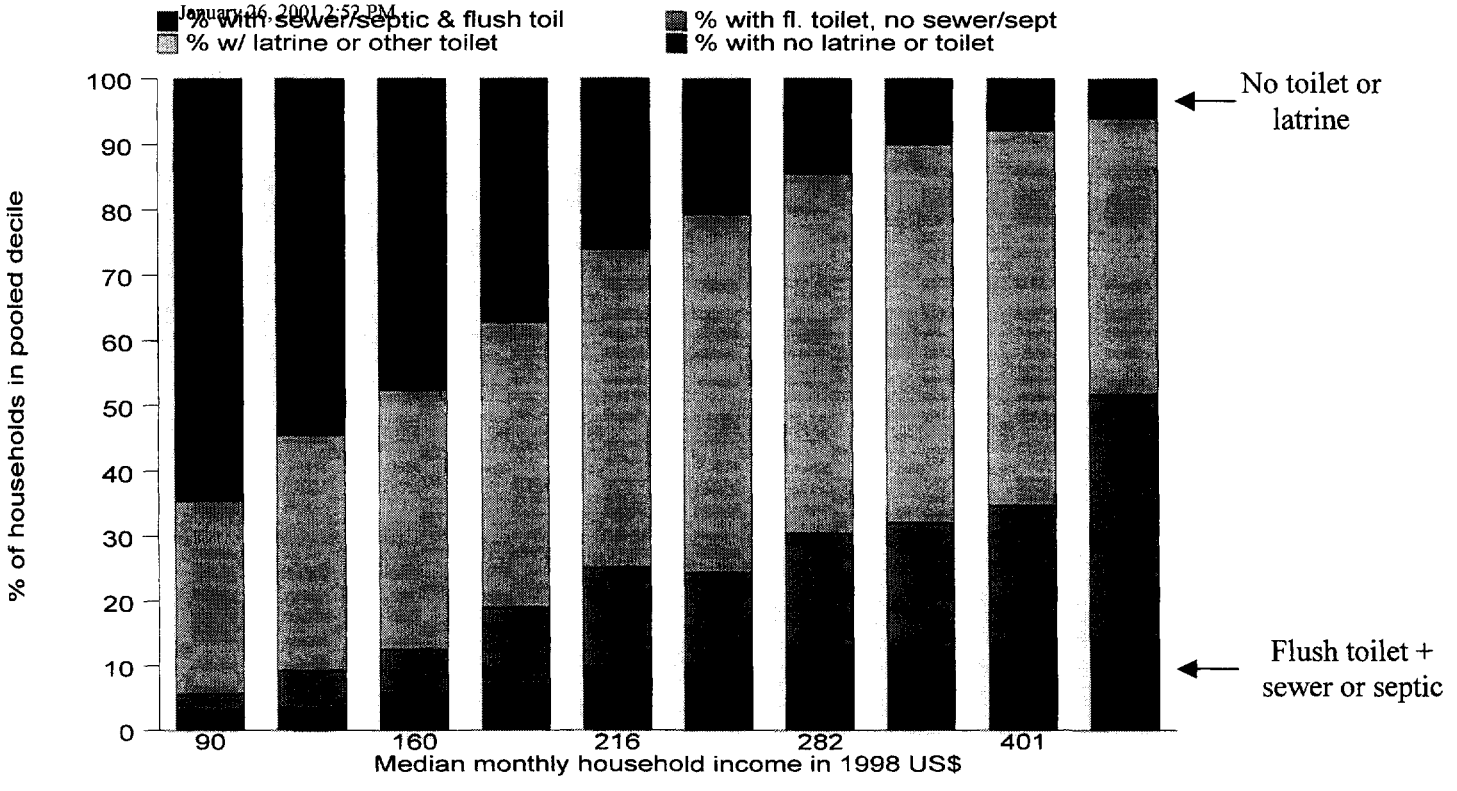

Source: 10770 households in pooled data set of Living Standards Measurement Study surveys from 6 countries.
Notes:
(1) Households in this graph come from Bulgaria, Ecuador, Jamaica, Nicaragua, Panama, and Pakistan.
(2) Monthly aggregate household consumption is used as a proxy for household income.
(3) Households are divided into deciles based on the per capita consumption of the household.

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