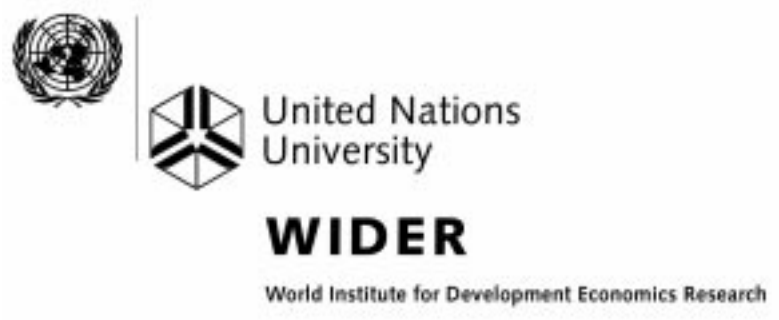

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Access to Utilities by the Poor

A Global Perspective

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Abstract

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. 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. In this paper we introduce a new data source for infrastructure coverage statistics, the World Bank's Living Standards Measurement Study (LSMS). 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). As expected, coverage is much higher in urban than in rural areas. 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 results also suggest that if the poor have access to services in their communities, many will in fact decide to connect.

Keywords: privatization, utilities, infrastructure, household behaviour, LSMS

JEL classification: C2, D1, I31, L92, L94, L96

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Note on tables and figures

The tables and figures to this paper appear at the end of the text.

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.[1] 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.

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 datasets. 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.

Despite their widespread use and influence, there are in fact numerous other 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 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.[2] 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

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1 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'.

2 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.

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 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. 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 neighbourhood.

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.

In the next, second section of the paper we describe in more detail the LSMS datasets on which our analyses are based. The third section describes who actually has infrastructure services in the countries in our datasets by income level, in different

countries, and in urban and rural areas. In the fourth section we distinguish between 'coverage' and 'access'. For a subset of countries in our sample, we attempt to answer the questions, (i) 'Who has access to services?' and (ii) 'Who has access and chooses not to connect?' The fifth section presents a multivariate analysis of the determinants of household coverage. We use logistic regression models to examine the relationship between household coverage for different infrastructure services and (a) household income, (b) country of residence, and (c) urban/rural location. The sixth section looks at what households who do not have formal infrastructure services are doing to meet their infrastructure needs. In the seventh section we offer some concluding remarks.

2 The data: Living 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 dataset used in this analysis is composed of surveys from fifteen of these countries (Table 1).[3] The pooled sample includes households on four continents in both low- and middle-income countries.

The fifteen surveys were administered between 1988 and 1997. For purposes of this study, it would be advantageous if these LSMS surveys were conducted before any of the fifteen countries attempted to reform their infrastructure sectors. If this were true, the analyses presented in this paper could provide a baseline picture of the status of infrastructure services in selected developing countries prior to privatization initiatives. Unfortunately, this is not strictly the case; some of the countries in our sample had initiated reform efforts in some infrastructure sectors before the LSMS survey was conducted. Table 2 lists the number of privatization efforts that were launched before the LSMS surveys in countries in our sample, and the sectors in which these privatization efforts were initiated. As shown, most of the privatization projects that occurred before the LSMS surveys were in electricity generation and telecoms; countries in Eastern Europe and the former Soviet Union had the greatest number of projects.

However, as illustrated in Figure 1 most of the investments in private infrastructure projects in developing countries occurred in the late 1990s. Most of the LSMS surveys in our sample were conducted between 1991-96. It is thus unlikely that the results of the privatization investments are broadly reflected in the LSMS data examined in this paper.

The multi-country LSMS dataset that we use for this analysis is unique in five important respects. First, it enables us to look at multiple infrastructure services for the same

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

household. Second, because the LSMS surveys are primarily designed to measure households' economic well-being (i.e., living standard), the dataset 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 (i) households that do not have infrastructure services and could not have such services because they do not have access in their neighbourhoods; and (ii) 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 dataset include roughly similar questions, but the answer categories and exact question wording are often different from country to country. For 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.[4]

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. 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. Our cross-country infrastructure variables classify infrastructure options in each sector as 'advanced', 'intermediate', or 'basic' solutions. 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-

[4] 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.

reported income data. For the purposes of this analysis, the poorest households are those with the lowest per capita income proxy.[5] The pooled sample of households from all countries is similarly divided into twenty quantiles of 5 per cent 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 per cent as appropriate, with special emphasis on infrastructure coverage among households in the poorest deciles and quantiles of 5 per cent.

3 Who has infrastructure services?

3.1 Global infrastructure coverage

Over 65 per cent of the households in the pooled cross-national sample had electricity in their homes at the time of the LSMS survey.[6] By contrast, only 38 per cent of households had in-house water taps, 36 per cent had sewer connections, and 24 per cent had telephones.[7] 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 2 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 per cent 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-per cent 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.[8]

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5 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.

6 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 per cent of households with electricity reported obtaining the electricity from a generator. In Panama and Nicaragua, 3.5 per cent and 1.5 per cent 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 per cent of those in the poorest quintile who have electricity versus 2.3 per cent 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.

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

8 Most of the richest households come from South Africa, Panama, Russia, Ecuador, and Jamaica—the wealthiest countries in the sample.

Electricity was the only service with significant penetration in this group of households. Nearly 32 per cent of these very poor households had electricity in their homes. Very few had in-house water taps (6 per cent), sewer connections (3 per cent), or telephones (3 per cent).

Telephone coverage remains at 3 or 4 per cent among households in the first five 5-per cent quantiles (i.e., the lowest 25 per cent 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-per cent quantile to 5-per cent quantile. By the tenth 5-per cent quantile (i.e., median income proxy = US$225 per household per month), 66 per cent of the sample households had electricity, and 33 per cent 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 2). Nearly all of the households in the wealthiest 5-per cent quantile (US$1300 per household per month) had electricity, 88 per cent had in-house water taps, and 72 per cent had telephones.

Electricity was the most widespread of these three services at all income levels, and telephone service was the least common. In Figure 2 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 2 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 2.

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 2 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 3).

Second, information on sewer connections is only available for ten of the fifteen countries. When households in only those ten countries are pooled and divided into quantiles of 5 per cent, it becomes clear that sewer coverage lags behind coverage of in-house water taps as expected (Figure 4). Sewer coverage is consistently about 10 per cent 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 2, 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 2), and, except where noted, we use coverage figures for in-house water taps (rather than in-house connections and yard taps).[9]

3.2 Coverage in urban and rural areas

As anticipated, a smaller percentage of rural than urban residents had infrastructure services in their homes.[10] Fewer rural households had electricity (46 per cent vs. 89 per cent in cities), in-house water taps (12 per cent vs. 59 per cent), sewer connections (7 per cent vs. 61 per cent), and telephones (8 per cent vs. 38 per cent). The poor live disproportionately in rural areas, but urban/rural location does not alone explain the urban/rural infrastructure gap.[11] Figures 5 and 6 show that a smaller percentage 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 per cent), sewers (1 per cent), or telephones (2 per cent). Rural coverage of these three services remains under 10 per cent up to US$200 per household per month. Perhaps surprisingly, electricity is reaching a substantial number of the rural poor (27 per cent in the poorest quantile).

By contrast, a significant number of the poorest urban households had in-house water taps (31 per cent), sewers (28 per cent), and telephones (14 per cent). Coverage of these services rises steeply from each 5-per cent quantile to the next. Electricity coverage in urban areas is surprisingly similar across income groups. Nearly 80 per cent 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 (Figures 7-10). Albania, Bulgaria, Kazakhstan, and the Kyrgyz Republic all have virtually universal coverage of electricity.[12] 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

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9 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 3 and 4, will be obscured.

10 The urban/rural classifications made by LSMS survey teams have been adopted for this analysis.

11 More than 91 per cent of households in the poorest quantile of the pooled sample live in rural areas, whereas only 13 per cent of the richest households are rural residents.

12 Electricity data are not available for Russia. Albania survey does not include Tirana.

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.

The lowest country-wide coverage rates tend to be in the poorest countries (e.g. Nepal, Ghana, Kyrgyz Republic, and Vietnam). But poor countries do not necessarily have low country-wide coverage in all sectors. In Pakistan and Nicaragua, for example, electricity and in-house water tap coverage is equal to or greater than coverage in some wealthier countries. Interestingly, coverage of electricity, in-house water taps, sewer, and telephones among the poor in Panama, the wealthiest country in the sample, is lower than in most other countries. Coverage in South Africa, the second wealthiest country, is also quite low.

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 neighbourhoods).[13] 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).[14] 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?[15]

In these five countries, community access to infrastructure is high in urban areas and low in rural areas (Figures 11 and 12). 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-per cent quantile had access to sewer service.

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13 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.

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

15 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 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.

Figures 13 and 14 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 connections.[16] Between 40 and 50 per cent 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.[17]

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 per cent had access to all four.[18] Nearly all (98 per cent) of these households had electricity, 82 per cent had sewer connections, 75 per cent had in-house water taps,[19] and 50 per cent 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.

Figures 15-18 show how household choice among the four services varies across income quintiles in Ecuador, Panama, Kyrgyz Republic, and Nepal.[20] What is most remarkable about these figures is how similar they are to one another. In all four countries and in all quintiles, more households with access to all four services chose

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16 It is possible that the low connection rates in rural areas are 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 to 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.

17 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).

18 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.

19 Nearly 2,500 of the 3,000 households with access to all four services live in Ecuador and Panama. In these countries information on yard taps is available. Nearly 95 per cent of the 2,500 households have an in-house or yard tap.

20 Information on telephone access is not available in Nepal, so that graph shows coverage levels by quintile and sector for households with access to just 3 services (electricity, water service, and sewer service). The water sector variable on the Ecuador and Panama graphs is house or yard taps. The Nepal and Kyrgyz Republic graphs include only in-house taps.

electricity, and fewer households chose telephones, than any other service. A greater percentage of households chose in-house connections or yard taps ('advanced water infrastructure') than sewer connections. Nepal stands out among the four figures because in the first three quintiles none or only a very small percentage of households chose water or sewer connections. But by the richest quintile, coverage levels in Nepal approximate coverage in quintiles with similar median income proxies in other countries (e.g. the poorest quintile in Ecuador).[21]

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 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 seven variables: (i) the monthly household income proxy, (ii) whether or not the household lived in a rural area (RURAL), (iii) whether or not the household lived in a low-income country, with GNP per capita below US$760 (LOWINCY), (iv) whether or not the household is among the poorest 30 per cent of the population in its own country (POOR), (v) whether or not the household was a homeowner (HOMEOWNER), (vi) the size of the household (HHSIZE), and (vii) 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 dataset.[22]

Among the seven 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.[23] 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

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21 In Kazakhstan (not shown), a greater percentage of households also chose electricity than in-house water taps or telephones. Kazakhstan departs from the pattern in Figures 15-18, however, in that coverage rates for electricity, in-house taps, and telephones are fairly flat across all quintiles.

22 A country is only left out of these models if information on the dependent variable is not available for that country.

23 The poor in some countries have incomes much lower than the poor in other countries.

connection. The results show that residing in a low-income country has a negative impact on infrastructure connection, and for house/yard taps and telephones this influence can be quite substantial.

The other four 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 19 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 US$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 19 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.

Predicted probability curves for urban and rural households are presented in Figures 20 and 21. As one would expect, the predicted probabilities for all five infrastructure services at all income levels are much higher for urban areas than for rural areas. In both rural and urban areas, the probability of having a sewer connection or a yard tap is fairly flat across income levels. For the other sectors, income effects differ between rural and urban areas. Income has a greater effect on the probability of having an electricity connection in rural areas than it does in urban areas. The case of telephone service appears to be exactly the opposite: income has a greater effect in urban than in rural areas.

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 per cent, 4 per cent, 7 per cent, and 2 per cent 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 per cent of all households used electricity as cooking fuel.[24] Households that did not use 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.[25] 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 (Côte 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 dataset to the widespread use of wood, straw, dung, and thatch by poor households. Only 14 per cent and 17 per cent of the poorest urban decile in Ecuador and Panama,

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24 South Africa and Bulgaria are the only two countries in the sample where a significant number of households reported using electricity for cooking (43 per cent in South Africa and 75 per cent in Bulgaria). In South Africa, almost no households in the poorest decile cook with electricity (3 per cent). But 66 per cent of the poorest decile of Bulgarian households rely on electricity for cooking.

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

respectively, were left using wood, dung, straw, or thatch for cooking fuel (Table 5). In Bulgaria, less than 7 per cent of the poorest urban households cooked with these fuels.[26]

6.2 Water

Households without in-house connections obtained water in many other ways.[27] 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).

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 (Figure 22). In Albania (excluding Tirana), for example, 32 per cent of households used in-house water taps and yet 42 per cent still relied on basic water sources (relatively few households use other improved sources). In Côte 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 Côte 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 23 and 24 examine the relationship between income and household water source choice in the pooled urban and rural samples from all countries except Nepal.28 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 per cent and 30 per cent 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: Côte d'Ivoire, Ghana, Pakistan, and Nicaragua. Only 2.4 per cent of households in these countries reported using water vendors as their primary source of drinking water.[29] Over 15 per cent of the households in Côte d'Ivoire used vendors, more than in any of the other three countries. Vendors were the primary source for 1 per cent of households in Ghana and less than 1 per cent in Pakistan and Nicaragua. In all four countries, a greater percentage of rich households than poor

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

[27] 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.

[28] The Nepal LSMS does not permit analysis of those households using basic sources.

[29] Other households could be using vendors as a supplement to their primary water service.

households used vendors. Less than 1 per cent of households using vendors were in the poorest decile of their countries, whereas 20 per cent 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. Figures 25 and 26 present the distribution of monthly water expenditures by those households in these four countries who rely on vendors and those with in-house taps.[30]

Two aspects of these figures and Table 6 are striking. First, 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).[31] Second, a large percentage of households with in-house water taps were spending almost nothing for water.

6.3 Sanitation

Some of the LSMS country datasets have information on two aspects of a household's sanitation situation: (i) whether a household had a toilet or latrine, and (ii) 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 per cent), Nicaragua (74 per cent), and Pakistan (63 per cent) were without either sewer connections or septic tanks. 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 (Table 7).

Rural households of all income levels had lower rates of coverage of all sanitation facilities than urban households (Figures 27 and 28). Very few urban households were without a toilet or latrine in their home. By contrast, approximately 30 per cent 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 per cent and 90 per cent 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.

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[30] Only households with non-zero expenditures are included.

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

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 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 countries did not have either their own private phone or access to a public phone in their community. In urban areas of the Kyrgyz Republic just over half of the poorest urban households had access to a public phone in their communities (Table 8).

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 datasets are worth recapping. First, electricity coverage was higher than coverage of other infrastructure services at all income levels; 65 per cent of the households in the sample had electricity in their homes. By contrast, only 38 per cent 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 dataset 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 per cent of the sample households (32 per cent had service). Only 6 per cent of the poorest households had an in-house water connection; only 3 per cent had a sewer connection. Almost 80 per cent of the poorest households in urban areas had electricity service. Even in rural areas, 27 per cent 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 per cent 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 per cent 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.

To conclude, for the purposes of this study an interesting question to ask is the extent to which these findings hold for the Latin American countries in the sample (Ecuador, Jamaica, Panama, and Nicaragua). Figures 29-31 present the relationship between coverage and income for the total, urban, and rural Latin American samples, which consist of households from Ecuador, Jamaica, Panama, and Nicaragua. As shown, the coverage patterns in this Latin American subsample are essentially the same in all important respects as in the global sample.

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Table 1
LSMS datasets 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	4,800	
Vietnam (330)	1992-93	4,800	
Nepal (210)	1996	3,373	Yes
Eastern Europe & Central Asia			
Russia (2,300)	1994-95	3,973	
Kazakhstan (1,310)	1996	1,996	Yes
Bulgaria (1,230)	1995	2,468	
Albania[2] (810)	1997	1,503	
Kyrgyz (350)	1993	1,937	Yes
Latin America & the Caribbean			
Panama (3,080)	1997	4,938	Yes
Jamaica (1,680)	1997	2,016	
Ecuador (1,530)	1995	5,661	Yes
Nicaragua (390)	1993	4,454	
Sub-Saharan Africa			
South Africa (2,880)	1993	8,850	
Côte d'Ivoire (700)	1988	1,584	
Ghana (390)	1988-89	3,193	

Source: World Bank (Atlas method).

Notes: (1) 1998 GNP per capita in US dollars.

(2) The Albanian survey does not include households in Tirana.

Table 2
Privatizations or projects with private participation initiated before the date of the LSMS surveys

	Number of privatizations or projects involving:		
Country	Water and sanitation	Electricity	Telecoms
Asia			
Pakistan	0	0	2
Vietnam	0	0	0
Nepal	0	1 (generation)	0
Eastern Europe & Central Asia			
Russia	0	Many privatizations	Many privatizations
Kazakhstan	0	1 (distribution)	1
Bulgaria	0	0	2
Albania	0	3 (distribution)	0
Kyrgyz Republic	0	0	0
Latin America & the Caribbean			
Panama	0	1 (generation)	1
Jamaica	0	1 (generation)	1
Ecuador	0	0	2
Nicaragua	0	0	0
Sub-Saharan Africa			
South Africa	1	0	0
Côte d'Ivoire	1	0	0
Ghana	0	0	0

Source: World Bank Private Participation in Infrastructure database.

Table 3
Per cent of poor households with infrastructure in home, in poorest urban and rural deciles in each country

	Electricity		In-house water		Sewer		Telephone	
	Urban	Rural	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[1]	100	100	90	0	–	–	0	0
Kyrgyz Republic	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
Côte d'Ivoire	39	8	7	0	–	–	–	–
Ghana	38	0	2	0	–	–	–	–

Source: LSMS from 15 countries.

Notes: The urban and rural households in each country were separately divided into deciles based on the per capita aggregate consumption of each household;

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;

The urban/rural divisions used by LSMS survey designers were adopted for this study;

(1) Albania survey does not include Tirana.

Table 4
Logistic regression coefficients (and standard errors) from multivariate analysis of infrastructure coverage, in pooled sample of households (Hh) from fifteen LSMS surveys

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

Source: LSMS from 15 countries.

Notes: * = significant at the 95% confidence level;

1998 GNP per capita. Source: World Bank (Atlas method);

Aggregate monthly household consumption is used as an income proxy. The consumption aggregates prepared by LSMS survey research teams were adopted for this analysis;

The urban/rural definitions used by LSMS survey designers were used in this analysis;

Households were grouped into deciles in each country based on their per capita aggregate consumption;

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

	Urban areas		Rural areas	
	Poorest 10%	Richest 10%	Poorest 10%	Richest 10%
Low-income economies				
Côte 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 LSMS surveys.

Notes: The urban and rural households in each country were separately divided into deciles based on the per capita aggregate consumption of each household;

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;

The urban/rural divisions used by LSMS researchers were adopted for this study;

Countries are classified by 1998 GNP per capita (World Bank). Low-income economies had GNPs under $760. The middle-income economies in this sample of countries all have GNPs less than $3,080.

Table 6
Median monthly household expenditures on water in 1998 US dollars,
by households relying on different primary drinking water sources

	Median expenditure among all households using:		
	In-house water tap	Vendor	Other improved
Côte 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 LSMS surveys in these four countries.

Notes: 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;

'Other improved sources' include yard taps, public taps, wells, and rainwater collection.

Table 7
Per cent of poorest urban and rural households with sewer connections or septic tanks

	Poorest urban decile		Poorest rural decile	
	% with sewer	% with septic	% with sewer	% with septic
Bulgaria	86	12	18	70
Ecuador	41	14	5	13
Kazakhstan	70	8	8	4
Nepal	7	4	<1	0
Nicaragua	9	3	0	<1
Pakistan	20	15	<1	2

Source: Sample households from LSMS surveys in these six countries.

Notes: 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;

Households were grouped into deciles in each country based on the income proxy (per capita aggregate consumption).

The urban/rural definition used by LSMS survey teams was adopted for this analysis.

Table 8
Per cent of poorest urban and poorest rural decile with access to a public telephone in their community

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

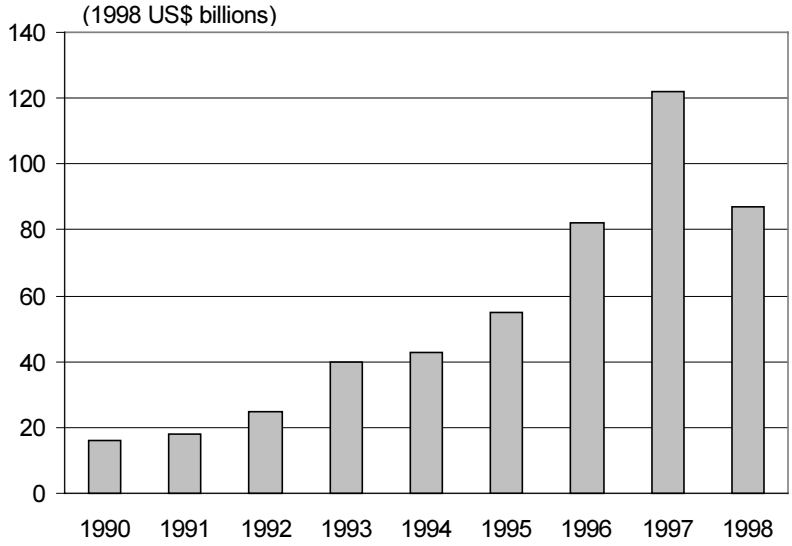
Source: Sample households from LSMS surveys in these 3 countries.

Notes: 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;

Urban and rural households were separately grouped into deciles in each country based on the income proxy (per capita aggregate consumption);

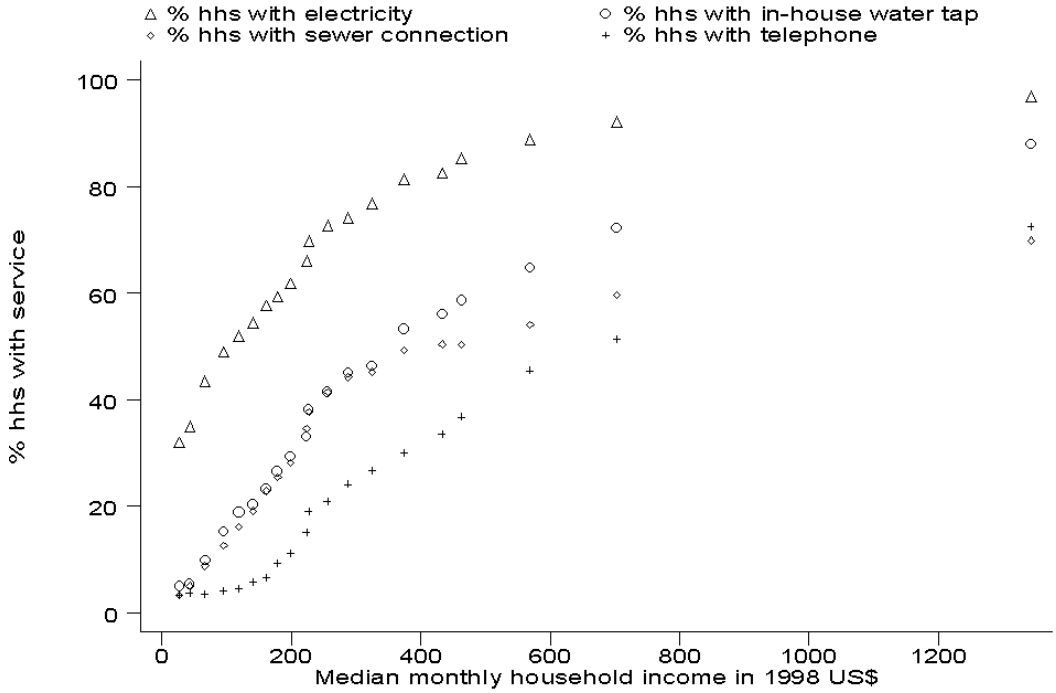
Community is defined as the primary sampling unit in which the household lives. In urban areas, this is typically smaller than the entire city, and in rural areas the community may consist of more than one village.

Figure 1
Investment in private infrastructure projects in developing countries, 1990-98



Source: PPI Database.

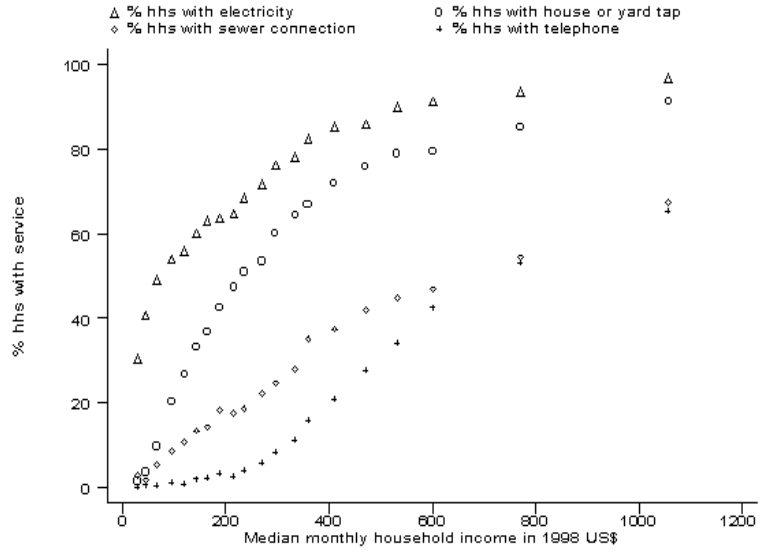
Figure 2
Global infrastructure coverage versus monthly household income proxy, by quantiles of 5%



Source: 55,546 sample households in a pooled dataset of LSMS.

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% according to the per capita consumption of the households. The quantiles of 5% are groups that each consist of 5% 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 (note 1), households from that country are simply left out of the quantile coverage calculations.

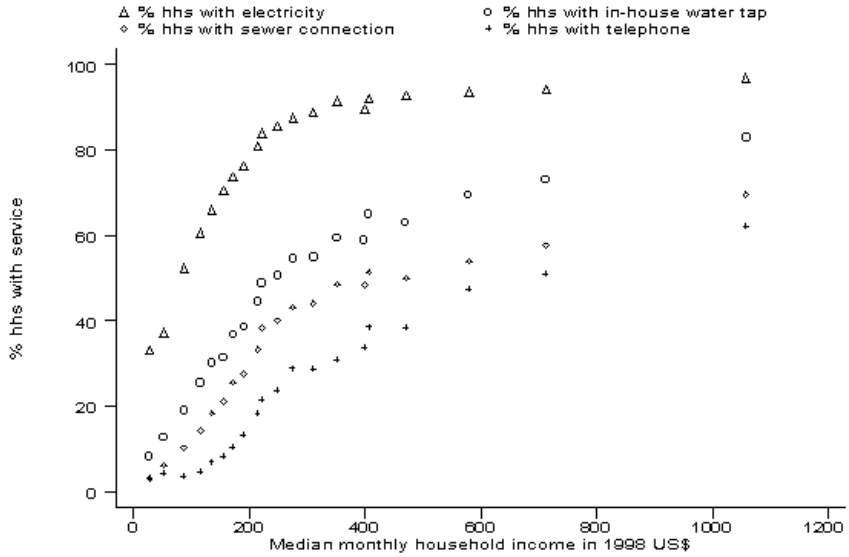
Figure 3
Infrastructure coverage versus monthly household income proxy, by quantiles of 5% of households from seven countries where information on yard taps is available



Source: 14,900 sample households in a pooled dataset of LSMS.

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% according to the per capita consumption of the households; The quantiles of 5% are groups that each consist of 5% of the number of sample households in the pooled dataset; (3) Countries for which information on both in-house and yard taps is available are included in this graph (Côte 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.

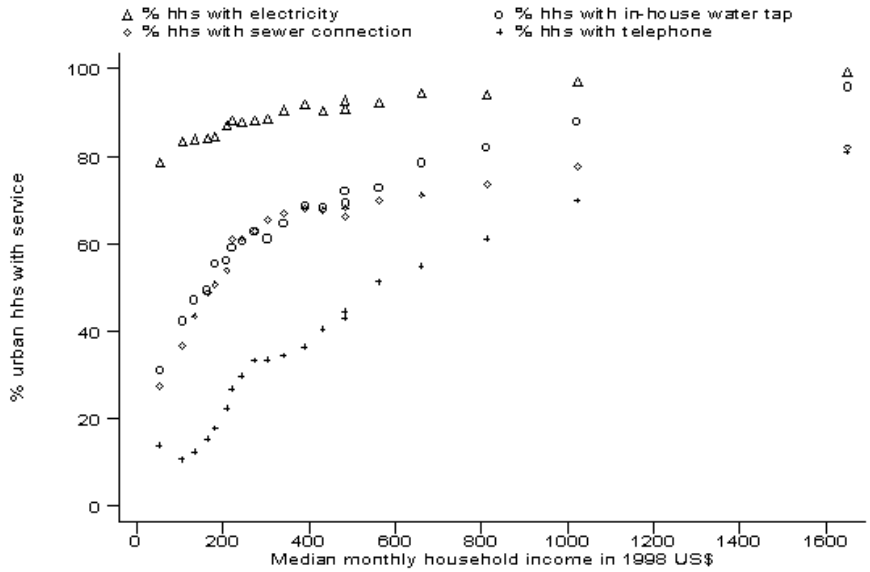
Figure 4
Infrastructure coverage versus monthly household income proxy, by quantiles of 5% of households from ten countries where information on all four infrastructure sectors is available



Source: 22,692 sample households in a pooled dataset of LSMS.

Notes: See (1) and (2) above. The countries in this graph all have data available 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).

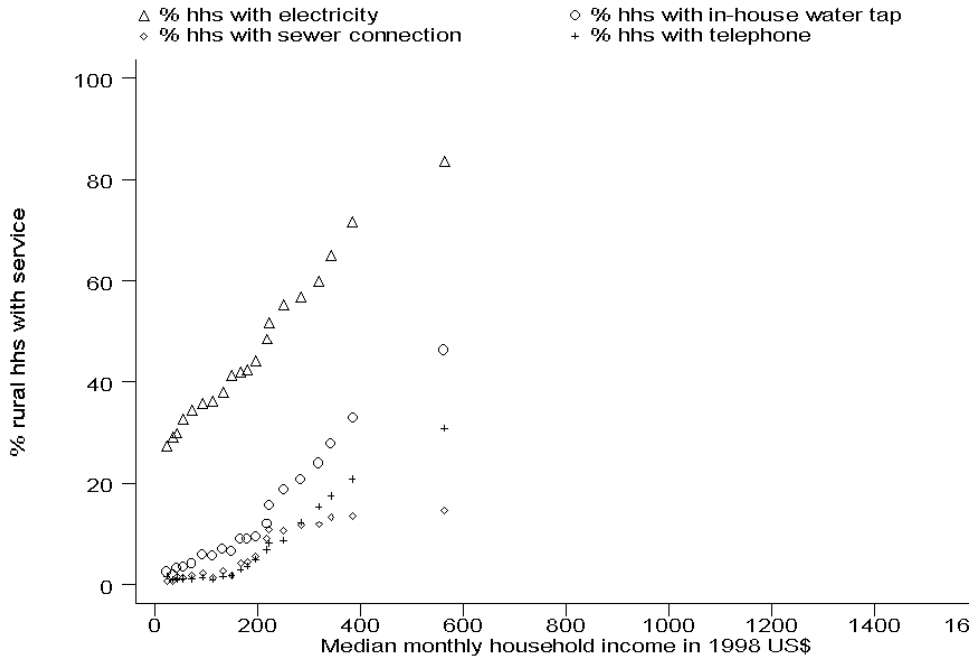
Figure 5
Urban infrastructure coverage versus monthly household income proxy,
by quantiles of 5% of urban households



Source: 26,233 urban households in a pooled dataset of LSMS.

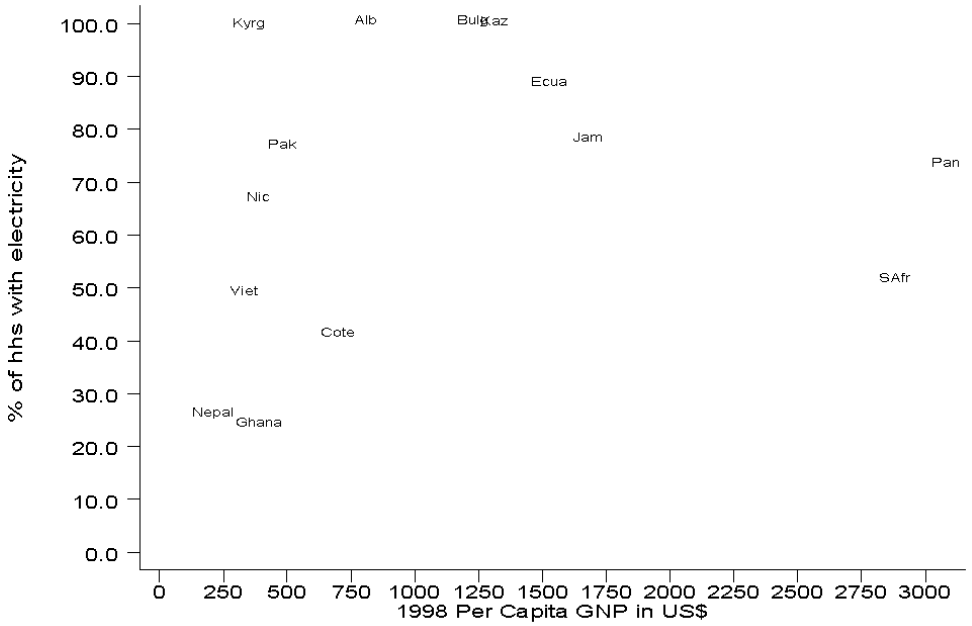
Notes: (1) Median monthly household aggregate consumption is used as a household income proxy. The consumption aggregates prepared by the LSMS survey research teams were adopted for this analysis; (2) The in-house water curve reports coverage levels among sample households from all 15 countries used 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% according to the per capita consumption of the households. The quantiles of 5% are groups that each consist of 5% of the number of relevant (urban or 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
Rural infrastructure coverage versus monthly household income proxy,
by quantiles of 5% of rural households



Source: 28,791 rural households in a pooled dataset of LSMS.
Notes: See (1), (2), and (3) above.

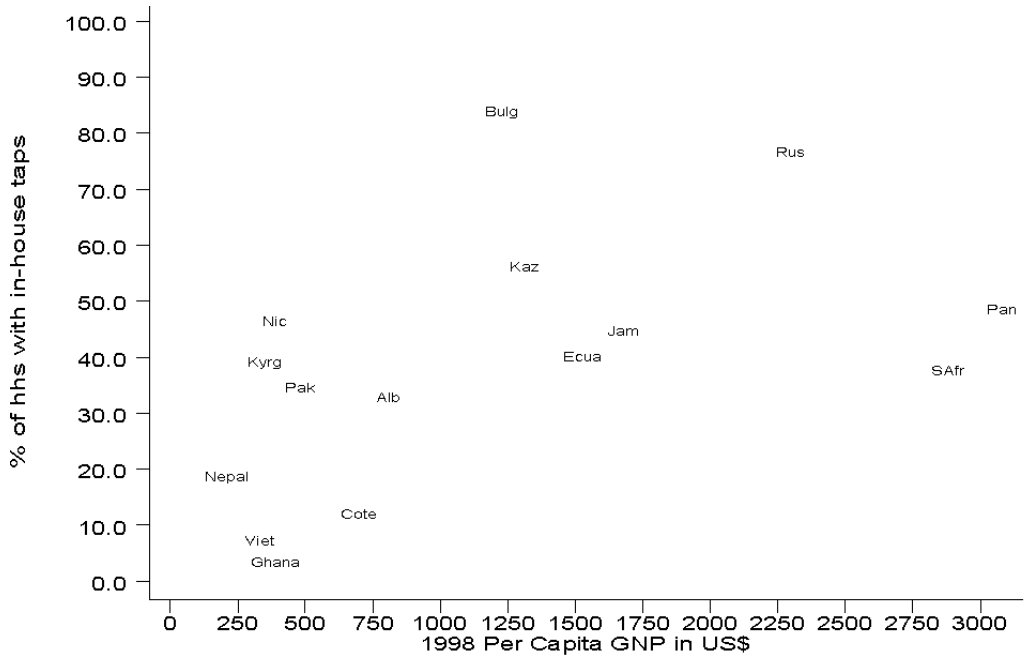
Figure 7
National electricity coverage in survey year versus 1998 GNP per capita



Sources: For coverage: 51,523 households in a pooled dataset of LSMS; for GNP: World Bank.

Notes: (1) Countries and survey years are Albania (1997), Bulgaria (1995), Côte d'Ivoire (1988), Ecuador (1995), Ghana (1988-89), Jamaica (1997), Kazakhstan (1996), Kyrgyz Republic (1993), Nepal (1996), Nicaragua (1993), Pakistan (1991), Panama (1997), South Africa (1993), and Vietnam (1992-93); (2) The Albania coverage figures do not include Tirana; (3) 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.

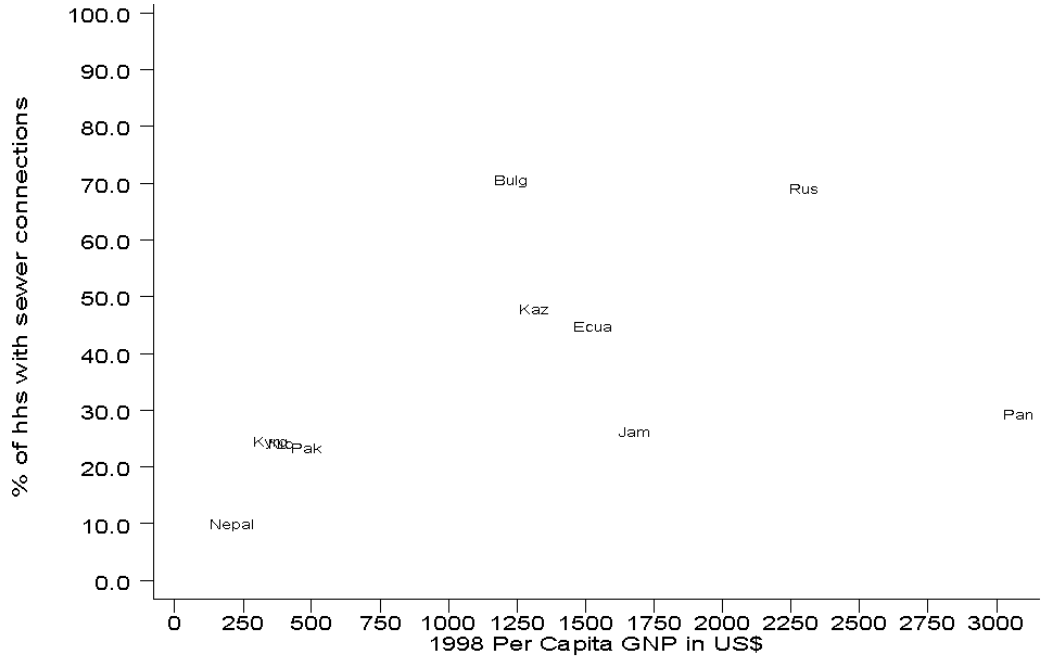
Figure 8
National coverage of in-house water taps in survey years versus 1998 GNP per capita



Sources: For coverage, 55,546 households in a pooled dataset of LSMS; for GNP, World Bank.

Notes: For countries, see (1) above plus Russia (1994-95); See also (2) and (3) above.

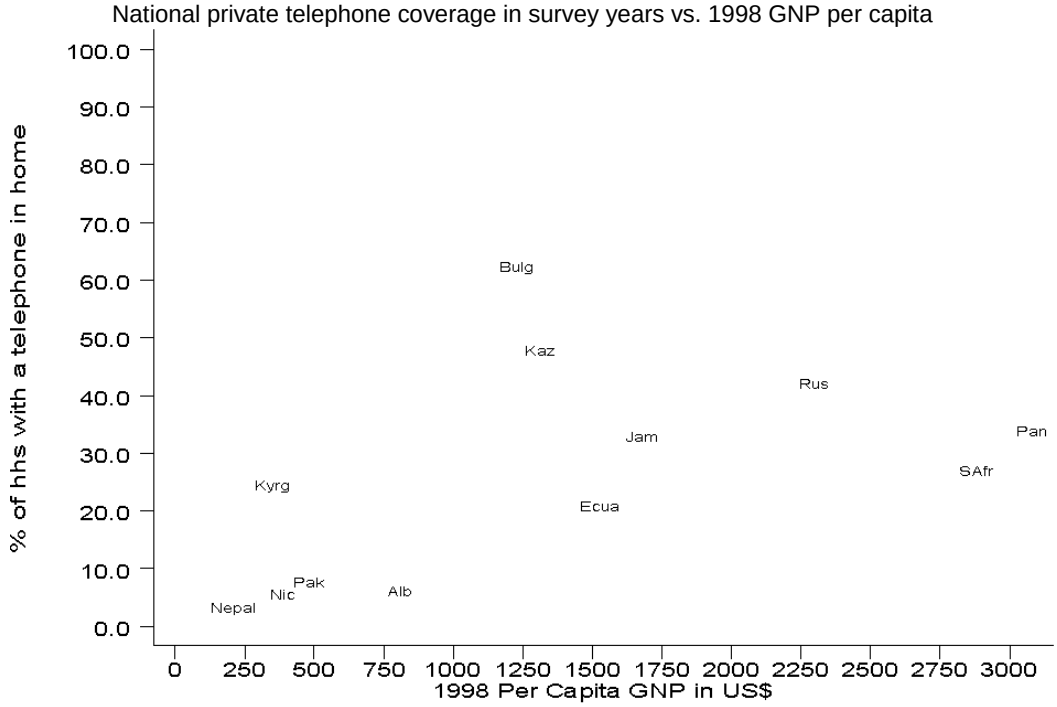
Figure 9
National sewer coverage in survey years versus 1998 GNP per capita



Sources: For coverage: 35,515 households in a pooled dataset of LSMS; for GNP: World Bank.

Notes: (1) Countries and survey years are Bulgaria (1995), Ecuador (1995), Jamaica (1997), Kazakhstan (1996), Kyrgyz Republic (1993), Nepal (1996), Nicaragua (1993), Pakistan (1991), Panama (1997), and Russia (1994-95); (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.

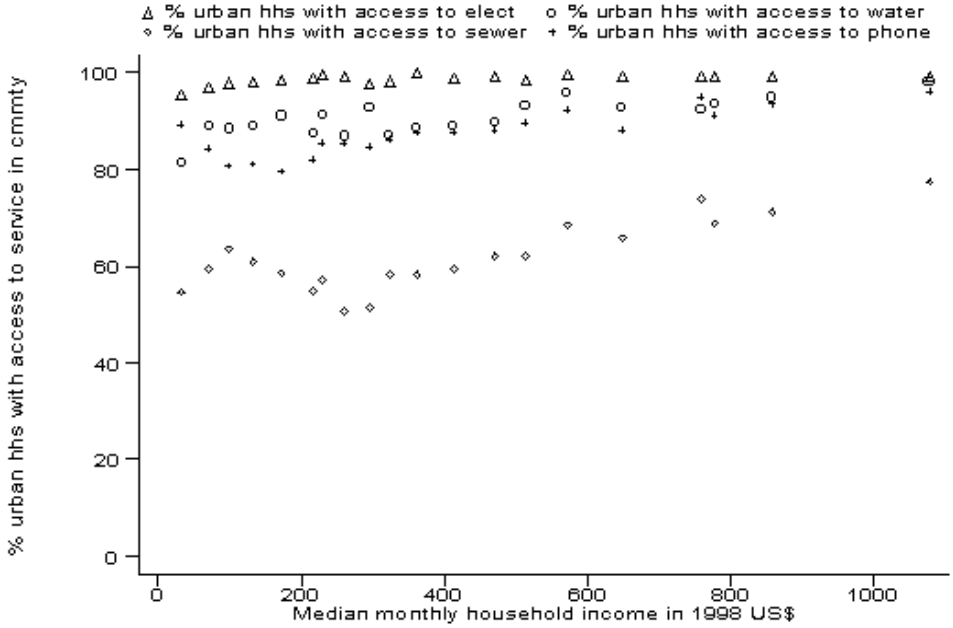
Figure 10
National private telephone coverage in survey years vs. 1998 GNP per capita



Sources: For coverage, 45,413 households in a pooled dataset of LSMS; for GNP, World Bank.

Notes: (1) Countries and survey years as given in note 1 above, plus Albania (1997) and South Africa (1993); (2) The Albania coverage figures do not include Tirana; (3) 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.

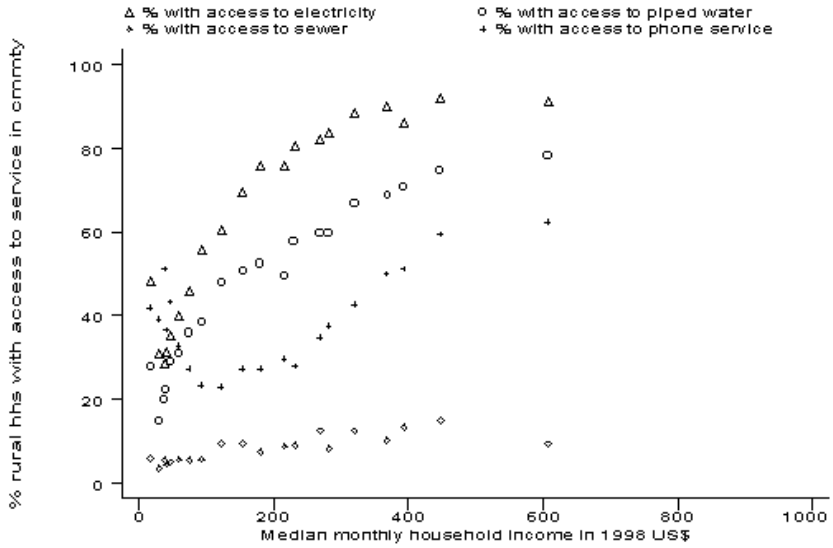
Figure 11
Per cent of urban households with access to infrastructure services in the communities
versus monthly household income proxy, by quantiles of 5% of urban households in five countries



Source: 6,816 urban households in a pooled dataset of LSMS surveys.

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 presumably 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 data are included; (4) Households are divided into quantiles of 5% according to the per capita consumption of the households. The quantiles of 5% are groups that each consist of 5% of the relevant (urban or rural) households in the pooled dataset. 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 12
Per cent of rural households with access to infrastructure services
versus monthly household income proxy, by quantiles of 5% of rural households in five countries

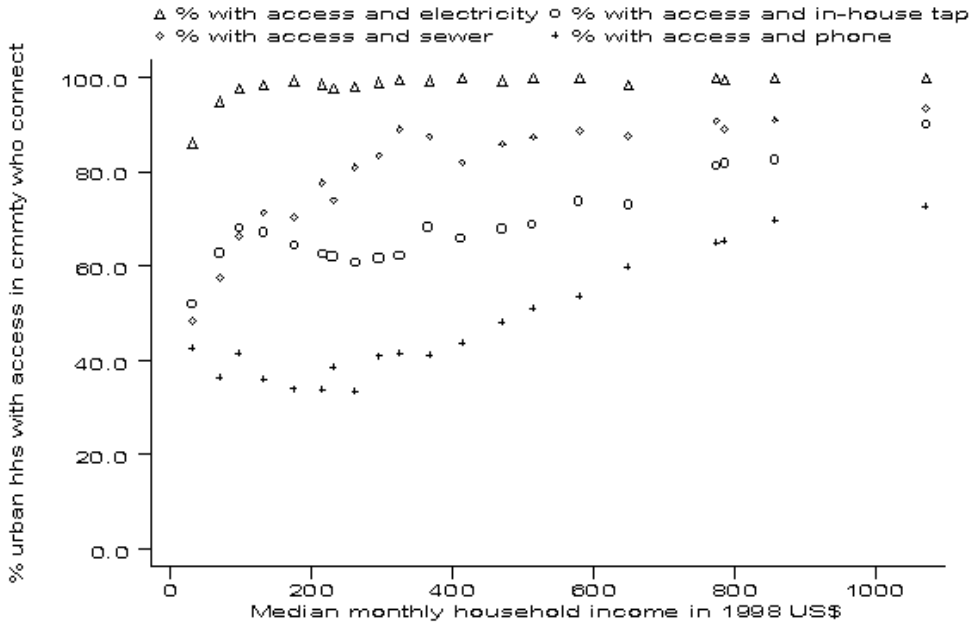


Source: 8,797 rural households in a pooled dataset of LSMS surveys.

Notes: See (1), (2), (3), and (4) above.

Figure 13

Per cent of urban households with access to a service in their communities who choose to connect to that service, versus monthly household income proxy, by quantiles of 5% of urban households in five countries

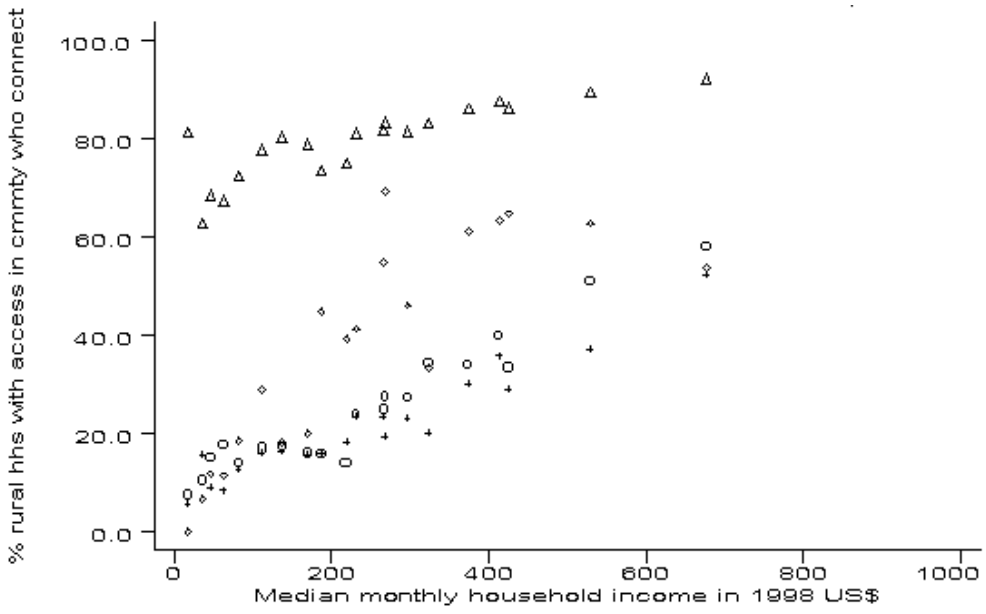


Source: 6,737 urban households in a pooled dataset of LSMS surveys.

Notes: See (1), (2), (3), and (4) given above in Figure 11.

Figure 14

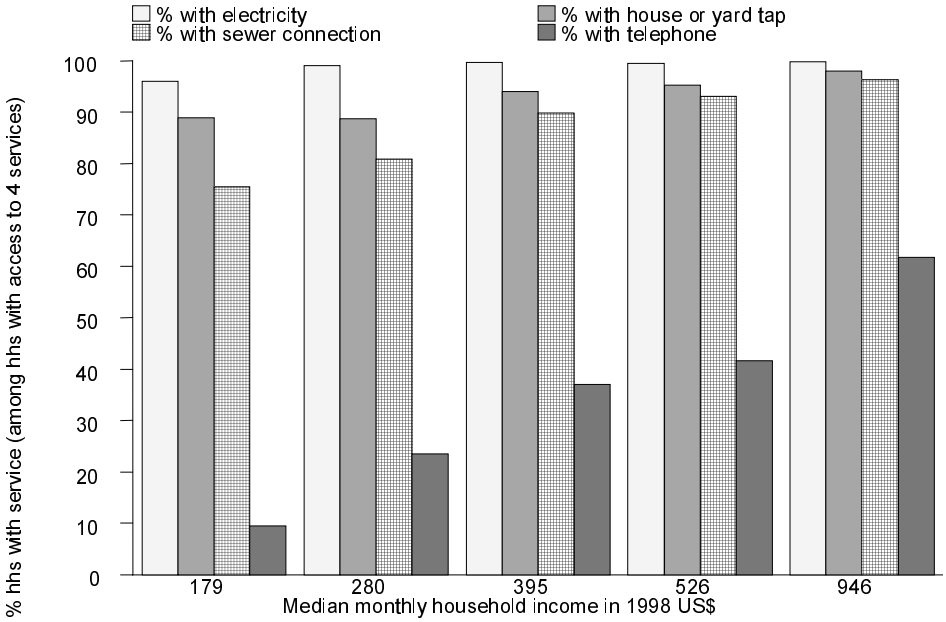
Per cent of rural households with access to a service in their communities who choose to connect to that service, versus monthly household income proxy, by quantiles of 5% of rural households in five countries



Source: 6,334 rural households in a pooled dataset of LSMS surveys.

Notes: See (1), (2), (3), and (4) for Figure 11 above.

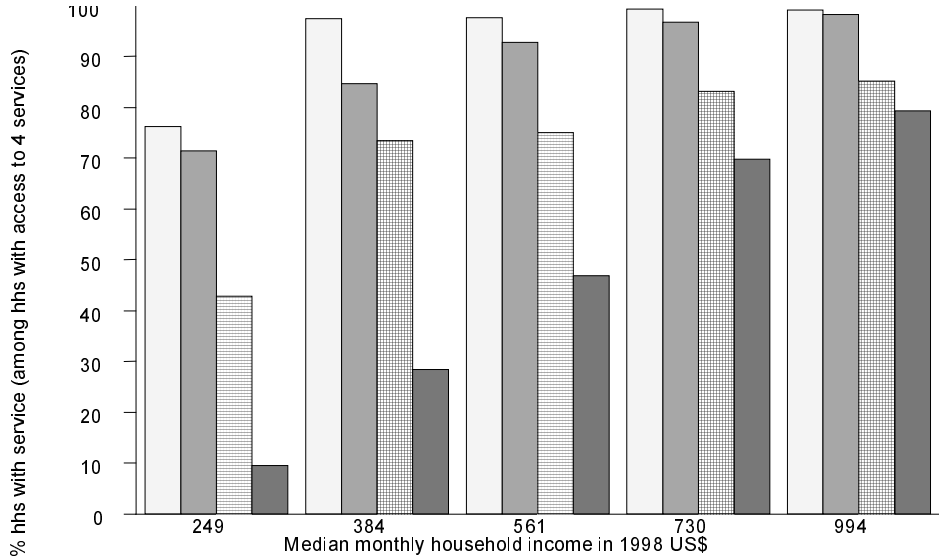
Figure 15
Household infrastructure coverage in Ecuador by quintile,
among households who have access to all four services in their communities



Source: 1,462 households from Ecuador 1995 LSMS survey.

Notes: (1) Households are divided into quintiles according to the per capita consumption of the households. The quintiles each consist of 20% of the 5,661 households in the country LSMS sample. Households in each quintile for whom community access information is not available, and households without access to these services in their communities, are left out of the quintile coverage calculations; (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. The median income proxies listed on the graph are the medians among the households included in this graph, not the medians among all households in each country quintile; (3) Households 'have access to infrastructure services in the community' if there is an infrastructure network in the community where they live. 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 questionnaire. 1,462 households out of the 5,661 in the Ecuadorian sample are considered to have access to the 4 services.

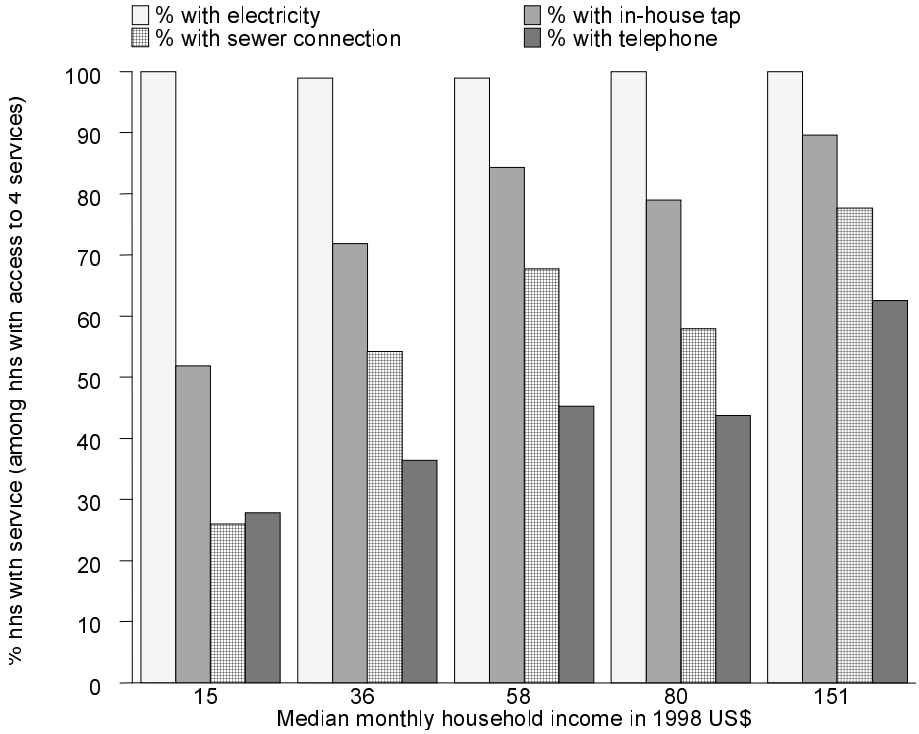
Figure 16
Household infrastructure coverage in Panama by quintile,
among households who have access to all four services in their communities



Source: 1,027 households from Panama LSMS survey.

Notes: See Figure 15 above for legend. (1) Households are divided into quintiles according to the per capita consumption of the households. The quintiles each consist of 20% of the 4,938 households in the Panama LSMS sample. Households in each quintile for whom community access information is not available, and households without access to these services in their communities, are left out of the quantile coverage calculations; Notes (2) and (3) as given above in Figure 15. 1,027 households out of 4,938 in the Panamanian sample are considered to have access to the 4 services.

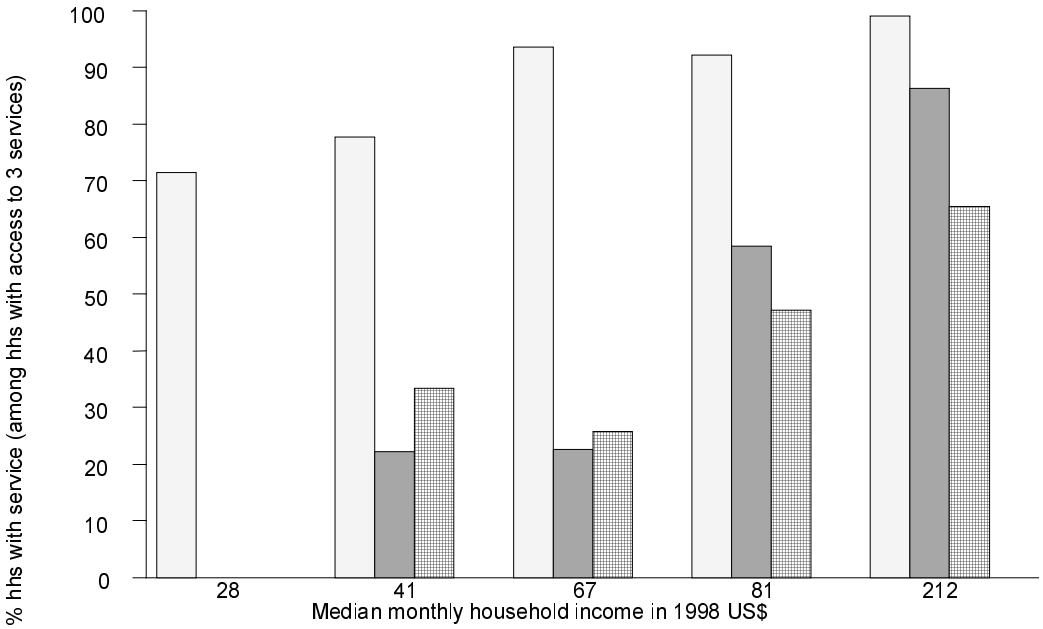
Figure 17
Household infrastructure coverage in Kyrgyz Republic by quintile,
among households who have access to all four services in their communities



Source: 509 households from Kyrgyz Republic LSMS survey.

Notes: (1) Households are divided into quintiles according to the per capita consumption of the households. The quintiles each consist of 20% of the 1,937 households in the Kyrgyz Republic LSMS sample. Households in each quintile for whom community access information is not available, and households without access to these services in their communities, are left out of the quantile coverage calculations; See (2) and (3) above in Figure 15. Five hundred and nine households out of 1,937 in the sample are considered to have access to the four services.

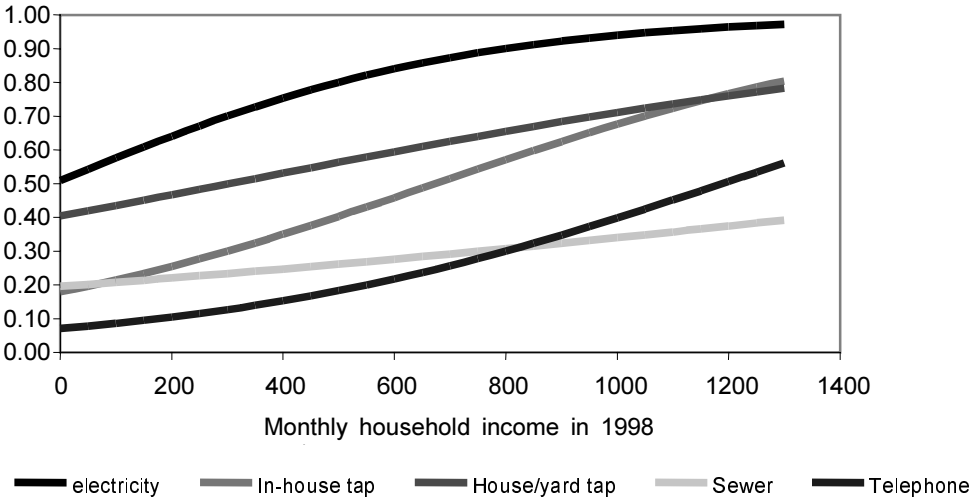
Figure 18
Household infrastructure coverage in Nepal by quintile,
among households who have access to all four services in their communities



Source: 472 households from Nepal LSMS survey.

Notes: See Figure 17 above for legend; (1) Households are divided into quintiles according to the per capita consumption of the households. The quintiles each consist of 20% of the 1996 households in the Nepal LSMS sample. Households in each quintile for whom community access information is not available, and households without access to these services in their communities, are left out of the quantile coverage calculations; See (2), and (3) above in Figure 15. Four hundred and seventy-three households out of the 1,996 in the sample are considered to have access to the four services.

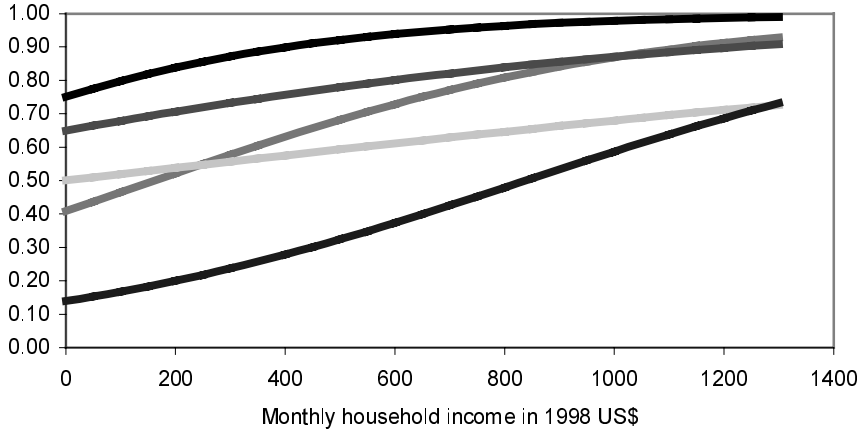
Figure 19
Predicted probability of connection: Entire sample



Source: 55,546 sample households in a pooled dataset of LSMS.

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.

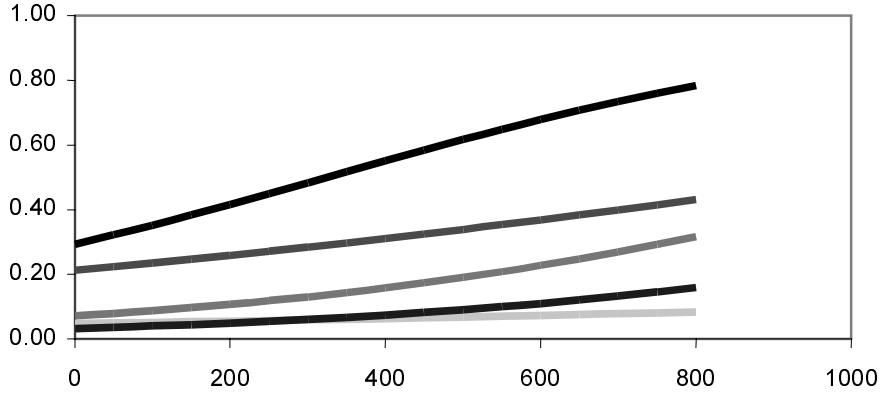
Figure 20
Predicted probability of connection: Urban areas



Source: 26,233 urban households in a pooled dataset of LSMS.

Notes: See Figure 19 for legend. See also notes (1) and (2) given in Figure 19. The mean values of the independent variables (except for household income proxy and RURAL) are used in the calculation. The value for RURAL is assumed to be zero.

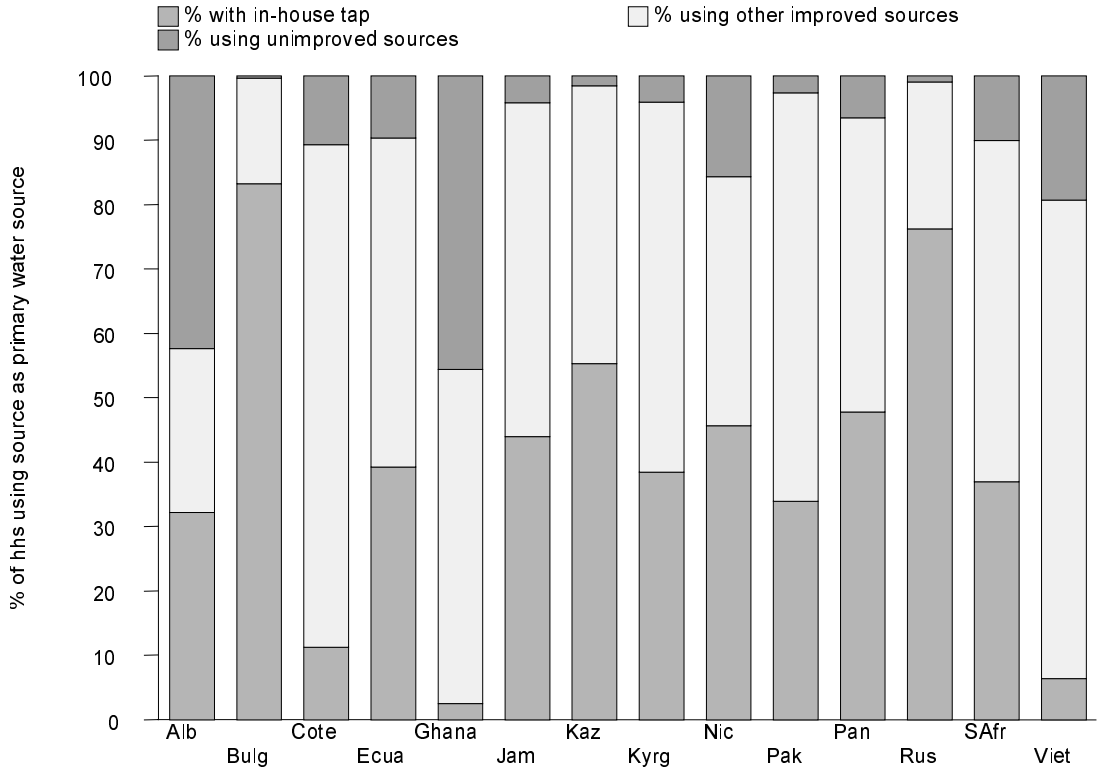
Figure 21
Predicted probability of connection: Rural Areas



Source: 29,313 rural households in a pooled dataset of LSMS.

Notes: See Figure 19 above for legend. (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 and RURAL) are used in the calculation. The value for RURAL is assumed to be one.

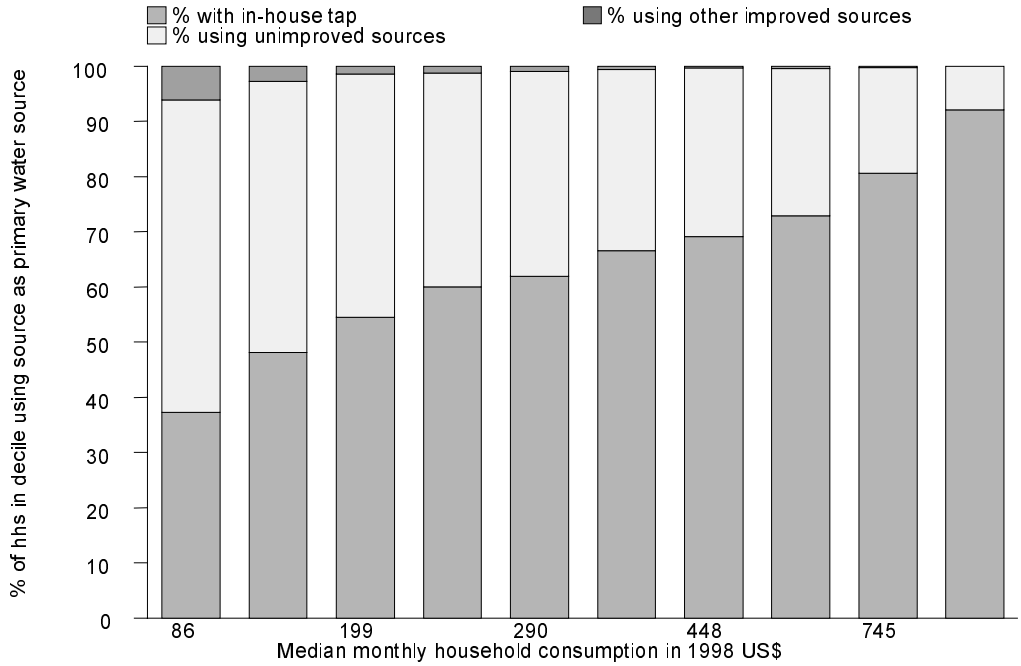
Figure 22
Household choice of primary water source, by country



Source: 51,617 households from 14 LSMS surveys.

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) 'Other improved sources' include yard taps, standposts, wells, vendors, and rainwater collection. 'Unimproved sources' include rivers, streams, and springs.

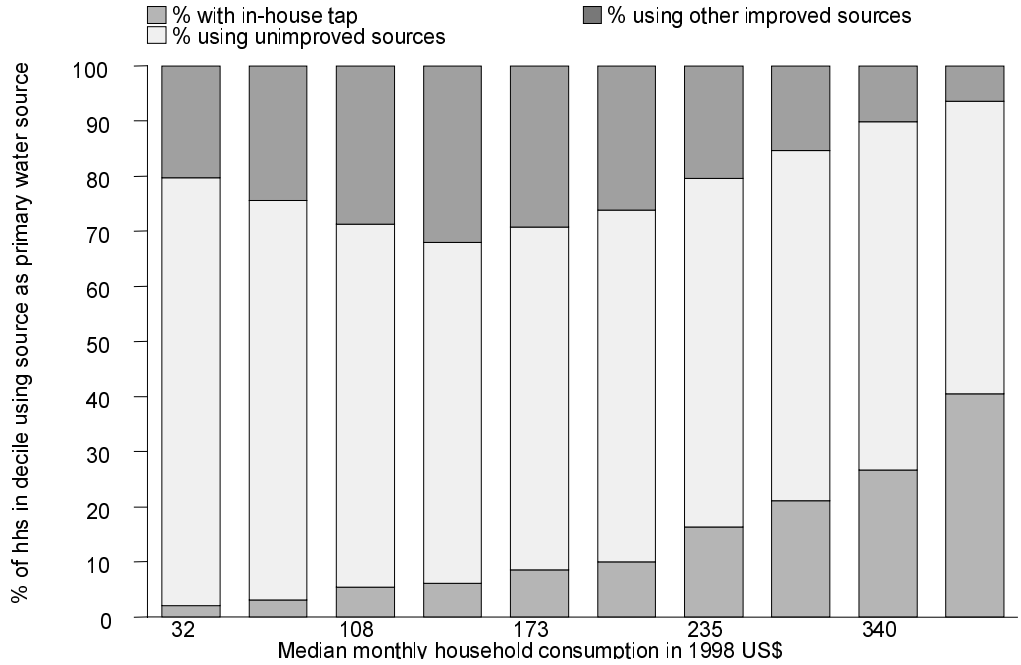
Figure 23
Primary water source in urban areas, by decile of urban households



Source: 25,458 urban households in pooled data set of LSMS 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 25,458 households were divided into deciles according to the per capita consumption of the households; (3) The urban/rural definitions used by LSMS researchers were adopted for this analysis; (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.

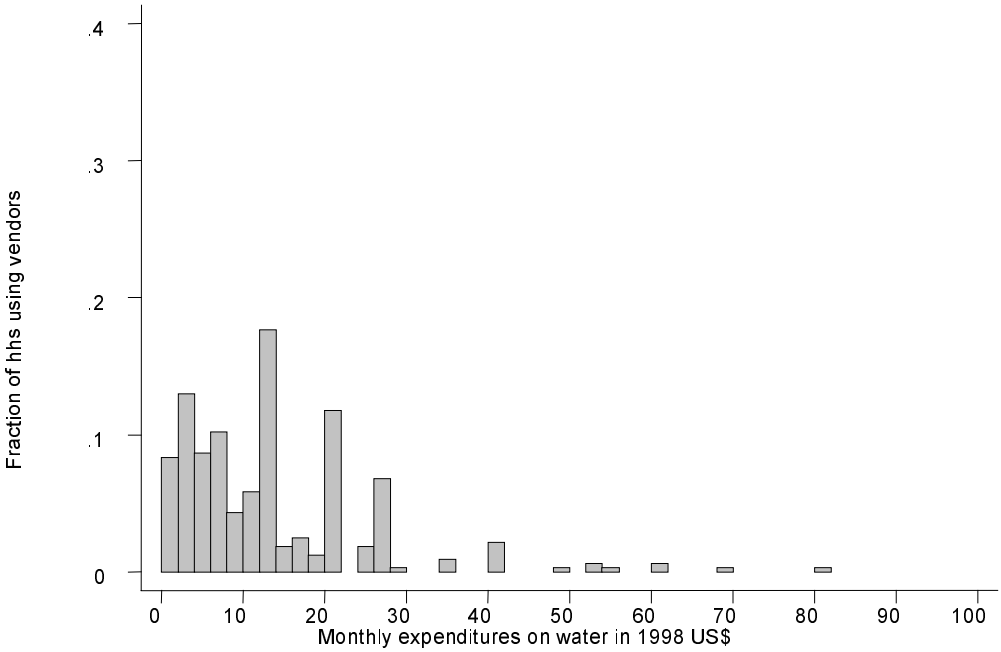
Figure 24
Primary water source in rural areas, by decile of rural households



Source: 26,104 rural households in pooled dataset of LSMS 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 26,104 households were divided into deciles according to the per capita consumption of the households; See (3), (4), and (5) given above in Figure 23.

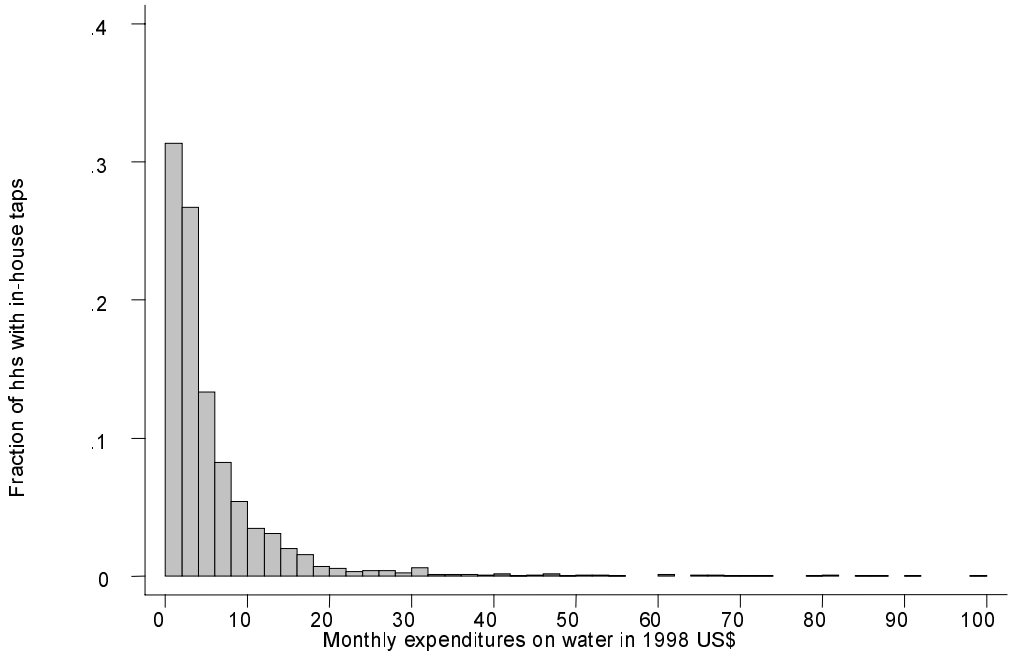
Figure 25
Frequency distribution of monthly expenditures on water by households in four countries using water vendors as primary drinking water source



Source: 328 households in pooled data set of LSMS surveys from Côte d'Ivoire, Ghana, Pakistan, and Nicaragua.

Note: Nicaraguan households were asked about their primary water source, rather than primary drinking water source.

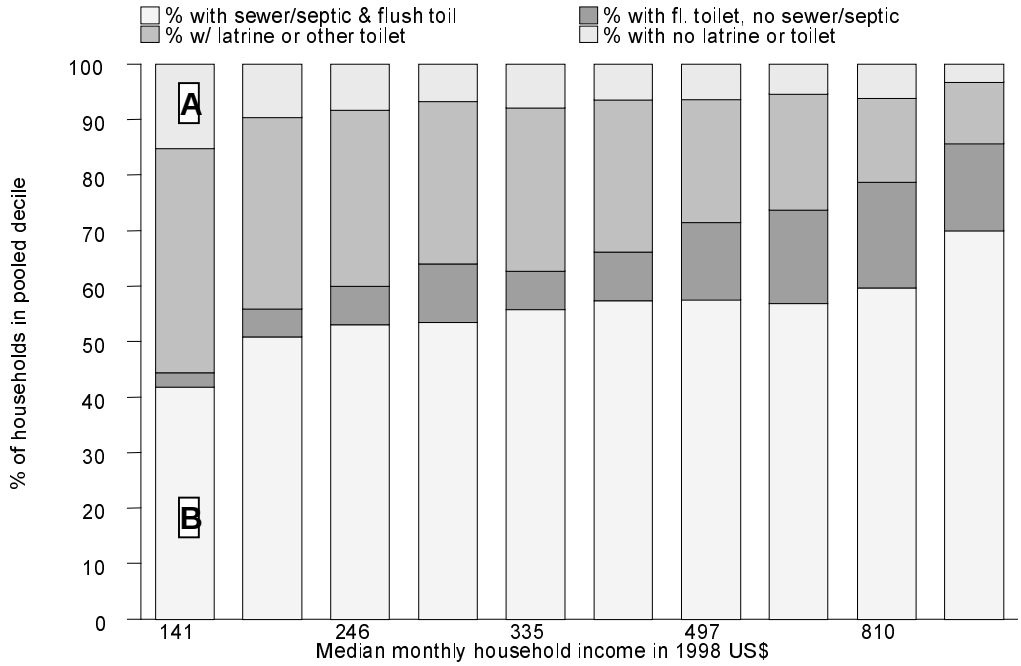
Figure 26
Frequency distribution of monthly expenditures on water by households in four countries using in-house taps as primary drinking water source



Source: 3,073 households in pooled dataset of LSMS surveys from Côte d'Ivoire, Ghana, Pakistan, and Nicaragua.

Notes: (1) Nicaraguan households were asked about their primary water source, rather than primary drinking water source; (2) Only households with non-zero expenditures on water are included.

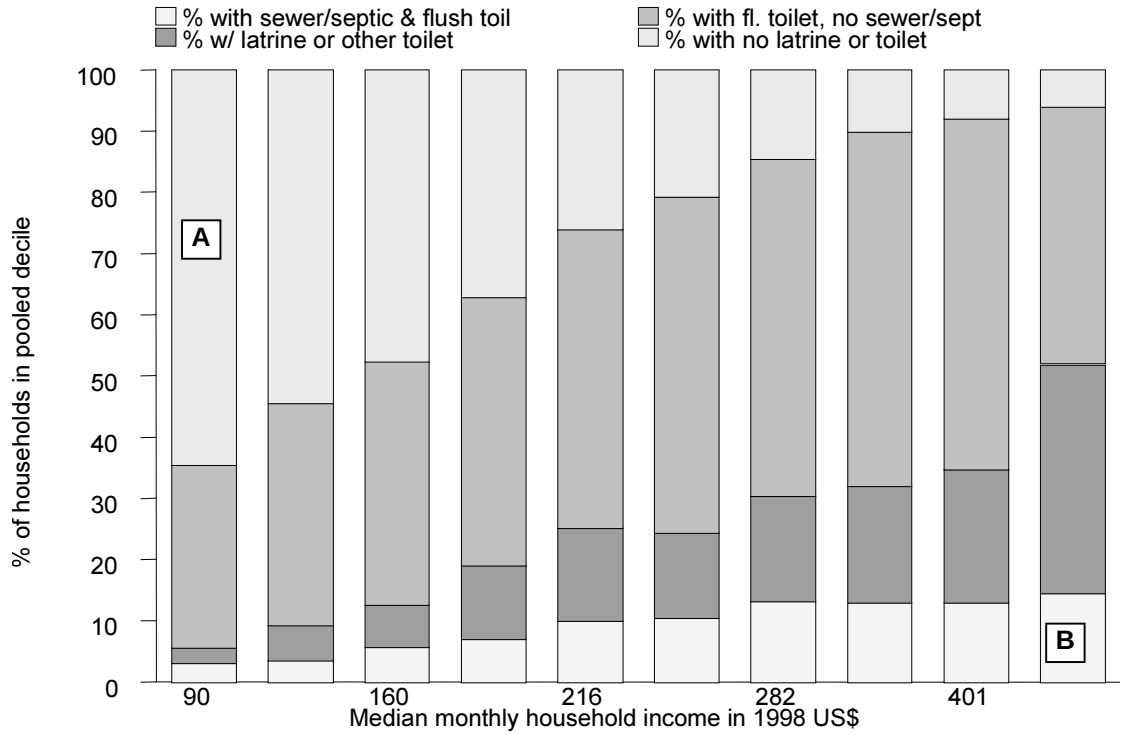
Figure 27
Sanitation in urban households, by decile of pooled sample of six countries



Source: 13,248 households in pooled dataset of LSMS surveys.

Notes: A = no toilet or latrine; B = Flush toilet + sewer or septic tank; (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.

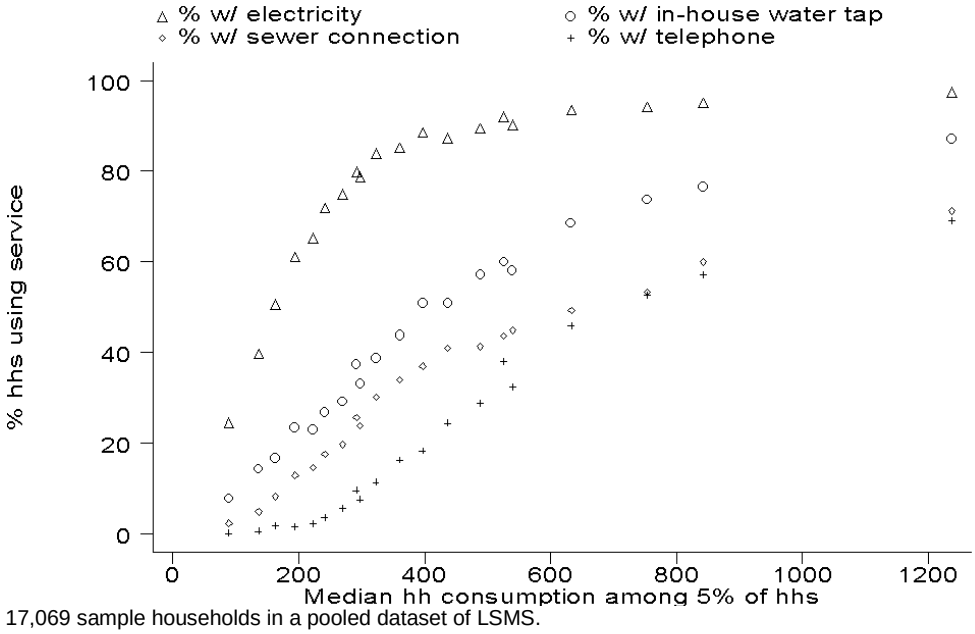
Figure 28
Sanitation in rural households, by decile of pooled sample of six countries



Source: 10,770 households in pooled dataset of LSMS surveys.

Notes: See above in Figure 27.

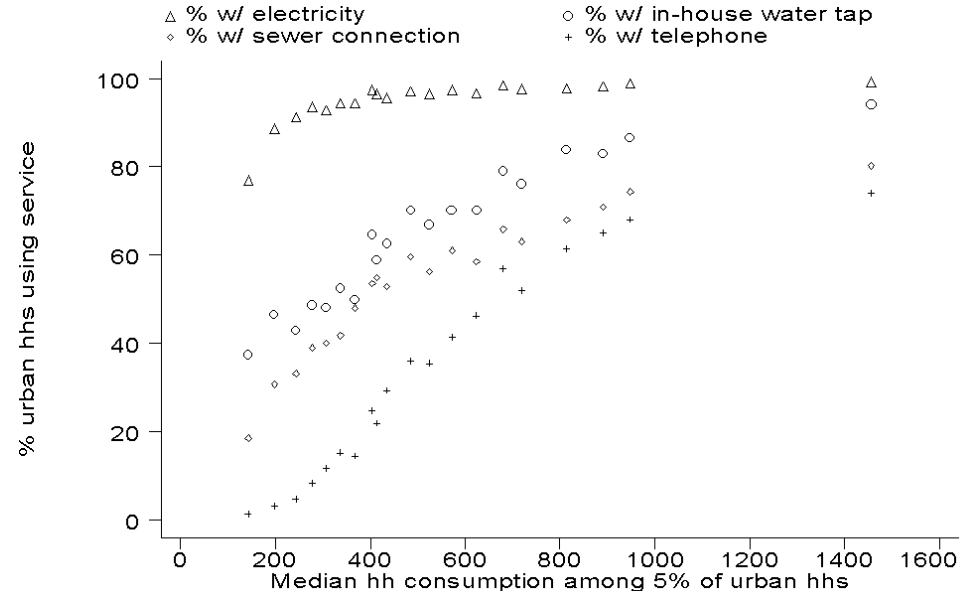
Figure 29
Infrastructure coverage in Latin America and the Caribbean versus monthly household income proxy, by quantile of 5%, pooled sample



Source: 17,069 sample households in a pooled dataset of LSMS.

Notes: (1) The curves report coverage levels among sample households from 4 countries used in this study: Ecuador, Jamaica, Panama, and Nicaragua; (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% according to the per capita consumption of the households in these four countries. The quantiles of 5% are groups that each consist of 5% of the 17,069 households.

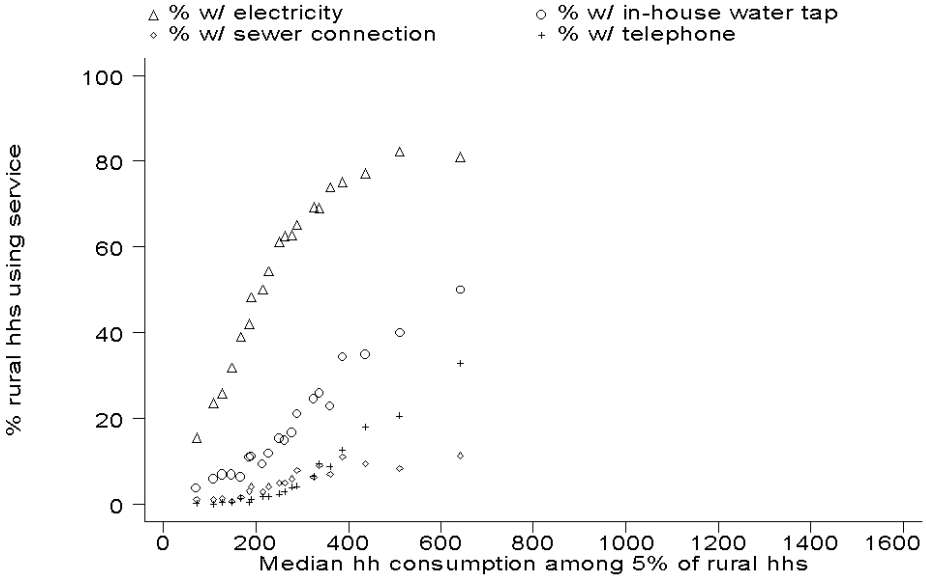
Figure 30
Urban infrastructure coverage in Latin America and the Caribbean
versus monthly household income proxy, by quantile of 5% of urban households



Source: 9,232 urban households in a pooled dataset of LSMS.

Notes: (1) The curves report coverage levels among sample urban households from 4 countries used in this study (Ecuador, Jamaica, Panama, and Nicaragua); (2) and (3) as given in Figure 29 above. The quantiles of 5% are groups that each consist of 5% of the 9,232 households.

Figure 31
Rural infrastructure coverage in Latin America and the Caribbean
versus monthly household income proxy, by quantile of 5% of rural households



Source: 7,584 rural households in a pooled dataset of LSMS.
Notes: (1) The curves report coverage levels among sample rural households from 4 countries used in this study (Ecuador, Jamaica, Panama, and Nicaragua); (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% according to the per capita consumption of the households in these four countries. The quantiles of 5% are groups that each consist of 5% of the 7,584 households.

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