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Is Low Coverage of Modern Infrastructure Services in African Cities due to Lack of Demand or Lack of Supply?

Quentin Wodon
Sudeshna Banerjee
Amadou Bassirou Diallo
Vivien Foster

The World Bank
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&
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Abstract

A majority of sub-Saharan Africa's population is not connected to electricity and piped water networks, and even in urban areas coverage is low. Lack of network coverage may be due to demand or supply-side factors. Some households may live in areas where access to piped water and electricity is feasible, but may not be able to pay for those services. Other households may be able to afford the services, but may live too far from the electric line or water pipe to have a choice to be connected to it. Given that the policy options for dealing with demand as opposed to supply-side issues are fairly different, it is important to try to measure the contributions of both types of factors in preventing better coverage of infrastructure services in the population. This paper shows how this can be done empirically using household survey data and provides results on the magnitude of both types of factors in explaining the coverage deficit of piped water and electricity services in urban areas for a large sample of African countries.

This paper—a product of the Development Dialogue on Values and Ethics in the Human Development Network and of the Sustainable Development Department in the Africa Region Vice Presidency—is part of a larger effort in the Network and Region to document the access to, and affordability of basic infrastructure services. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The corresponding author may be contacted at sbanerjee@worldbank.org.

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JEL codes: O12, R21, R31

1. Introduction

Many households are not connected to network-based infrastructure services such as electricity and piped water in sub-Saharan Africa (Komives et al., 2003; Anand, 2006; Banerjee et al., 2007), even in urban areas (Clarke and Wallsten, 2003). Yet it is not clear whether this is due mainly to demand-side or supply-side factors. On the demand-side, because most of the population is poor or near-poor, some households may simply not be able to afford to pay for piped water and electricity services even when connection to the network is feasible because the households live near an electric line or a water pipe. The lack of affordability of the service, or more generally of demand for the service, may be due to different reasons. A key reason could be that tariffs are too high for the households, or that connection charges are too high for getting access to the network (Franceys, 2005; Kayaga and Franceys, 2007). Other demand-side issues may relate to lack of land titles or illegal tenure, which makes it difficult for the utility company to accept the household as a client. Still another demand-side issue (from the point of view of the household) could be related to poor quality of service, so that some households may prefer to use alternative ways of satisfying their water and electricity needs rather than by using a network connection, at least when such alternatives such as a private well, a neighbor's tap, or a public stand-post are available.

On the supply-side, many households simply live in urban neighborhoods that do not have access to piped water or electricity. In addition, even when there is access somewhere in the neighborhood, many households may still live too far from the electric line or water pipe to have a chance to be connected to it. In addition, even if some households would like to be connected, there may be a lack of capacity within the utility company to provide such connections, for example due to lack of manpower or other resources (on ways to conduct an analysis of the investments needed in infrastructure, see for example Fay and Yepes, 2003). In some cases, a policy may be in place in the utility company not to extend the network, because the utility already faces capacity constraints to properly serve existing consumers. Indeed, in many sub-Saharan countries, power and water cuts are frequent, as the generation and production capacity of the utilities is limited and insufficient to meet the existing demand. There may also be financial factors affecting the capacity or willingness of the utilities to expand their network, especially if tariffs are too low to permit capital cost recovery.

As noted among others by Estache et al. (2002; see also Estache, 2004; Komives et al., 2005; and Estache and Wodon, forthcoming), the policies that need to be implemented in order to promote higher coverage rates are very different depending on the nature of the obstacles to increase coverage. If the main obstacle is a lack of demand due for example to a lack of affordability, utilities or governments may consider implementing special tariffs or subsidies for the poor, whether this is done for reducing the cost of the consumption of households once they are connected, or for reducing the cost of connecting itself. If the main problem is a lack of supply, the first line of answer lies in finding the necessary resources in order to expand the network to those who do not have access. Given that the policy options for dealing with demand as opposed to supply-side issues are fairly different, it is important to try to measure the contributions of both demand and supply-side obstacles to better coverage of infrastructure services. The aim of this paper is to show how this can be done empirically in a simple way using household survey data.

The importance of assessing the role of demand as opposed to supply-side issues has been recognized by Foster and Araujo (2004, hereafter F&A) in their study of the impact of infrastructure reforms on the poor in Guatemala. These authors proposed a nice and simple statistical method for assessing the contribution of pure demand-side problems, pure supply-side problems, and combined demand and supply-side problems to coverage deficits. If a household living in an area with access to piped water or electricity service was not connected, this was taken as a sign that the service was not affordable for the household (pure demand-side problem). In practice, the authors assessed whether households lived in an area with access simply by checking if any other household living in the same primary sampling unit of the survey had access. Indeed, household survey samples rely on geographically defined primary sampling units which tend to be well delimited areas, especially in an urban setting. To the extent that the primary sampling units in urban areas are small (about 15-20 households per primary sampling units who tend to live in specific neighborhoods), access by one household in the primary sampling unit could be considered as indicating potential access for all the households in that primary sampling unit.

F&A then defined the magnitude of supply-side problems as the part of the lack of coverage that was not due to the pure demand-side problem mentioned above. In addition, they decomposed supply-side problems into two components. The authors noted that even if there were access to the service in neighborhoods currently without access, some households would still not connect to the network. They therefore argued that in areas without access, there was for some households a combined or mixed problem with both demand and supply-side problems. Next, for those households who would probably connect to the network if there were access in their neighborhood to the service, the authors argued that there was a genuine pure supply-side problem. Overall, the authors thus decomposed the lack of coverage of the network in the sum of a pure demand-side problem, a pure supply-side problem, and a combined demand and supply-side problem. Others, including Angel-Urdinola et al. (2006), Angel-Urdinola and Wodon (2007) and Komives et al. (2005; forthcoming) have expanded on the work of F&A in order to analyze factors determining not only who benefits or not from a connection to the network, but also who benefits (or is likely to benefit) from various connection or consumption subsidies for modern infrastructure services.

However, a weakness with the simple statistical approach used by F&A lies in the fact that there are limitations in the surveys used to assess empirically the magnitude of demand-side and supply-side problems, and that this may lead to biases in the estimates of demand as opposed to supply-side problems. As already mentioned, some households may live in an area where there is access to the service, but may still be located too far from the electric line or water pipe to be able to be connected (or perhaps the capacity of the electric line or water pipe may be designed to support a specific and limited number of households). Under the simple empirical procedure for estimating demand-side and supply-side problems proposed by F&A, these households would be considered as suffering from a demand-side problem, while the true nature of the issue may be a supply-side constraint. To some extent, this type of biases can be dealt with by using regression techniques. In this paper we suggest how this can be done, and we show that using an econometric as opposed to a statistical approach to the estimation can make a significant difference in the results.

The rest of the paper is structured as follows. In section 2, we describe and formalize in simple mathematical notations the methodology used by F&A for assessing the relative role of demand and supply-side problems to explain lack of coverage of modern infrastructure services. Results obtained with this methodology for African countries in the case of urban coverage of piped water and electricity are then provided. The next section presents our alternative econometric approach to assessing the magnitude of demand and supply-side constraints to coverage, as well as the results obtained from this alternative method. A conclusion follows.

2. Statistical approach

In this section, we start by presenting in mathematical notation the approach proposed by F&A for assessing demand and supply-side problems limiting coverage of network services. Denote by C the percentage coverage or connection rate of a service in the population. This is the number of households using the service divided by the total number of households (with appropriate survey-based household weights). Next define the access rate (A) as the number of households living in communities or primary sampling units where service is available divided by the total number of households. Finally, denote by U the take-up or hook-up rate which is the number of households actually using the service (i.e., connected to the network) divided by the number of households living in communities where service is available. The coverage rate is the product of the access and take-up rates (C=AxU). The share of the population not served by the network is 1-C. The objective is to assess whether the unserved population is not served due to a demand-side problem (the service is available, but not taken up by the households, probably because it is not affordable, but perhaps also because it is of low quality) or a supply-side problem (the service is simply not available). F&A define the pure demand-side gap (PDSG) as:

$$PDSG = A - C = A \times (1 - U) \qquad (1)$$

This definition implies that when there is access in the areas where the households live, if a household does not take-up the service, it is symptomatic of a demand issue. Thus, lack of demand is responsible for all of the difference between the neighborhood access rate and the actual coverage rate. Next, the authors define the supply-side gap as follows:

$$SSG = (1 - C) - PDSG = (1 - A \times U) - A \times (1 - U) = 1 - A \qquad (2)$$

In other words, the supply gap is the difference between the neighborhood access rate and the coverage rate. Said differently, the sum of the pure demand-side gap, the supply-side gap, and the coverage rate is equal to one:

$$PDSG + SSG + C = 1 \qquad (3)$$

However, in areas that are not covered by the network, and are responsible for the supply gap above, it is likely that even if supply were available, some households would not take up the service due to affordability issues. If one assumes that the take-up rate in non-served areas would be similar to the take-up rate in areas where there is service now, the additional coverage that we would obtain by providing access to these areas would be equal to the supply-side gap times the take-up rate where there is access. This is defined as the pure supply-side gap:

$$PSSG = SSG \times U = (1 - A) \times U \quad (4)$$

The difference between the pure supply-side gap and the supply-side gap can then be deemed to represent a combined demand and supply-side gap, since first there is no access to the service, and second even if there were access, some households would not be connected. F&A defined this as the mixed demand and supply-side gap, defined as follows:

$$MDSSG = SSG \times (1 - U) \quad (5)$$

Given the above definitions, the proportion of the deficit in coverage that is attributed to demand-side factors is defined as the ratio of the pure demand-side gap to the unserved population. The proportion of deficit attributable to supply-side factors is the ratio of the pure supply-side gap divided by the unserved population. Finally, the proportion of deficit attributable to both demand and supply-side factors is the ratio of the mixed demand and supply-side gap divided by the unserved population. The sum of the three proportions is equal to one.

The results from the decomposition are presented in tables 1 and 2 for urban areas in sub-Saharan African countries (it is not as useful to do the same work for rural areas, because access is very limited there in most countries, so that lack of coverage is principally a supply-side issue). The data used are from the latest Demographic and Health Survey (DHS) completed in each of the countries. Most of the countries have data after the year 2000. A household is deemed to have access to piped water or electricity if the household lives in an area (which is the primary sampling unit of the survey to which the household belongs) where at least one household has access. We discuss here the Africa averages, leaving the discussion of country-specific results for later. All Africa averages are provided both with population weights (in which case countries such as Nigeria play a larger role due to their larger population), and without weights.

The data suggest that access at the neighborhood level is fairly widespread for both water (73 percent of households have access, see table 1, and this increases to 79 percent when no population weights are used) and electricity (93 percent of households have access, see table 2, and this is slightly reduced to 89 percent without weights) in African cities. Take-up rates are lower, at 48 percent for piped water (49 percent without weights), and 75 percent for electricity (61 percent without weights). This means that the coverage rate for piped water on average is 38 percent (41 percent without weights), and for electricity it is a much higher 71 percent (56 percent without weights). Conversely, the share of households not currently served is 62 percent for piped water (59 percent without weights), and 29 percent for electricity (44 percent without weights).

The proportion of the deficit in coverage attributable to demand-side factors is large for piped water, at 59 percent on average for the region when countries are population-weighted, and at 68 percent when we use a straight average for all countries. For electricity, the corresponding figures are 79 percent, both with and without country population weights. The proportion of the deficit in coverage that is attributable only to supply-side factors is much lower, at 15 percent to 18 percent for piped water depending on whether country weights are used, and at 12 percent to 15 percent for electricity. The combined demand and supply-side problems account for 18 to 23 percent of the coverage deficit for piped water, and 6 to 9 percent for electricity on average for all the countries in the sample. Clearly, these results suggest that demand-side factors may be much larger than supply-side factors in explaining lack of infrastructure coverage in African cities.

3 Econometric approach

As mentioned in the introduction, a key weakness of statistical approach presented in the previous section is that all households not connecting to the network where there is access are assumed to suffer from a demand-side problem, which may lead to an overestimation of the proportion of deficit coverage that is attributed to demand-side factors. In this section, we propose an alternative econometric method to try to better identify demand and supply-side problems. The idea is simple. We estimate for each country a regression of the determinants of the take-up of the household as a function of the following variables: a set of dummies for the quintile of wealth to which the household belongs, and the leave-out take-up rate in the primary sampling unit where the household lives.

The index of wealth is estimated using factor analysis because we do not have household income or expenditure data in the DHS. The variables used for the factor analysis are allowed to differ between countries depending on the data available in each survey so as to maximize the information used. In practice, the variables used include housing variables, variables on the access to various types of provision for basic infrastructure services (there is a slight issue of endogeneity here, since we are modeling take-up of utility services, but it is minor given the many other variables included in the index), and variables on a range of assets owned.

The regressions on take-up of service are estimated only on the samples of households who live in neighborhoods where there is access, and the estimation follows a simple probit procedure. The regressions are not presented here, as there are many of them, but they are rather straightforward. The leave-out access rate is meant to capture the general conditions of the neighborhood (including factors such as the average distance from the water pipes or electic lines), while the wealth index quintiles are used to deal with the affordability issue.

Once the regressions have been estimated, we simulate what the access rate would be if all households living in areas where there is access would be lifted in terms of wealth from wherever they are in the distribution of wealth to the top wealth quintile. That is, we simulate what the take-up rate would be for all households living in primary sampling units where there is access based on what the behavior of the households would be if they were in the top quintile, which corresponds implicitly to an assumption of no affordability problem, since the households in the top quintile should be able to afford the cost of piped water and electricity services. When aggregating the results for urban areas as a whole, we denote by U* the alternative take-up rate obtained in this way (U*>U). We then define the adjusted pure demand-side gap (APDSG) as:

$$APDSG = A \times (U^* - U) \qquad (6)$$

This definition means that we consider as a demand-side or affordability issues the difference between the simulated take-up rate when all households are given the wealth of the richest households in the country and the observed take-up rate. We next define the adjusted supply-side gap as follows:

$$ASSG = (1 - C) - APDSG = (1 - A \times U) - A \times (U^* - U) = 1 - AU^* \qquad (7)$$

The adjusted supply-side gap is thus the difference between full coverage and the coverage that would be achieved taking into account first the current level of availability of the network in areas (the A variable), and second the take-up rate expected when there is no affordability issue. As before, the sum of the adjusted pure demand-side gap, the adjusted supply-side gap, and the coverage rate is equal to one:

$$APDSG + ASSG + C = 1 \qquad (8)$$

The third step is to decompose the adjusted supply-side gap into two components. First, the adjusted pure supply-side gap is defined as follows:

$$APSSG = ASSG \times U^* = (1 - AU^*) \times U^* \qquad (9)$$

Finally, the adjusted mixed demand and supply-side gap is defined as follows:

$$AMDSSG = ASSG \times (1 - U^*) = (1 - AU^*) \times (1 - U^*) \qquad (10)$$

The proportions of the deficit in coverage due to demand-side, supply-side, and combined problems can then be computed using the above adjusted definitions, with the sum of the three proportions still being equal to one. The results are provided in tables 3 and 4. The findings are fundamentally reversed versus what was obtained with the simple statistical decomposition. The proportion of the deficit in coverage attributable to demand-side factors is now small for piped water, at 19 percent (population weighted data) to 23 percent (unweighted data). For electricity, the corresponding figures are 39 percent (unweighted data) to 52 percent (population weighted data). By contrast, the proportion of the deficit in coverage that is attributable only to supply-side factors is now much larger, at 41 percent to 42 percent for piped water depending on whether country population weights are used or not, and at 37 percent to 39 percent for electricity. The combined demand and supply-side problems account for 35 to 39 percent of the coverage deficit for piped water, and 11 to 21 percent for electricity on average for all the countries in the sample. Given that the combined supply and demand factors reflect first a supply issue (these are urban areas where the network is not available today), it is clear that supply appears to be a larger constraining factor than demand in terms of explaining coverage deficit in urban areas in Africa.

Beyond these average results for the continent as a whole, it is also useful to provide graphical representations of the results for different countries. This is done in Figures 1 through 6. In each Figure, we have a scatter plot with the neighborhood access rate in the country in urban areas on the horizontal axis, and the estimates along the econometric method for the proportions of deficit coverage due respectively to demand-side factors, supply-side factors, and combined factors on the vertical axis. The curves through the scatter plots have been simply fitted in Excel for visual purposes.

Clearly, pure demand-side factors are much more important in countries where access is already high, as expected. Pure supply-side factors appear not to depend as much on access rates. This may at first seem surprising, but one should remember that even in countries where access is high, there are significant neighborhoods or parts of neighborhoods that remain unserved. In addition, supply-side factors are expressed in the Figures in percentage terms of the lack of coverage, so that the share of the unserved population due to supply-side issues should not necessarily be smaller where neighborhood access and thereby supply are higher. As to combined demand and supply-side factors, they are lower in percentage terms where there are higher access rates, essentially because when the access rate is higher, demand-side issues tend to show up more in the pure demand-side component of the decomposition than as mixed problems. Overall, given substantial differences in the nature of the obstacles to coverage between countries at different levels of neighborhood access, when thinking of policy options, it is clearly important to look at the specific estimates obtained for a given country. In fact, ideally, it would be even better to look at a lower level of disaggregation, for example for the capital city as opposed to other urban areas, if the data so permit. Census data would be useful, as the type of work conducted here is based on variables that are typically available in censuses.

4. Conclusion

As part of the efforts needed to reach the Millennium Development Goals, many countries in sub-Saharan Africa are aiming to improve coverage of network-based infrastructure services such as piped water and electricity in the population. Yet in order to inform policies necessary to do so, it is important to first understand whether lack of coverage is due primarily to demand-side or affordability issues, or to a lack of supply. Indeed, some households may live in areas where access to piped water and electricity is available, but may not be able to pay for those services. Other households may be able to pay for the services, but may live too far from the electric line or water pipe to be able to connect to it.

In this paper, using DHS data for a large sample of African countries, we have relied on two different methods for decomposing the lack of coverage observed in urban areas into three components: pure demand-side problems, pure supply-side problems, and mixed demand and supply-side problems. The results obtained with the statistical method suggest that for Africa as a whole, demand-side problems are prominent on average. But the results obtained from the sounder econometric method suggest that for piped water, lack of supply appears to be the main issue, and for electricity, supply-side problems loom as large as demand-side problems. At the country level, whether one is confronted mostly with demand- or supply-side problems depends in large part on the underlying access rate to the services at the neighborhood level.

Because we have been dealing in this paper with data from a large number of countries, we have only tried to provide a broad snapshot of the issues. The method used here could easily be refined in order to be applied for policy work with more depth for any given country. For example, one could check the robustness of the econometric simulations to alternative estimation techniques, or alternative specifications of the regressions. One could also rely on census data in order to obtain estimates of demand as opposed to supply-side problems for smaller geographic areas. The results obtained from survey or census data could also be combined with additional information from willingness to pay studies, or focus group discussions. Data from household surveys with information on the service cuts imposed on households for non-payment of their utility bills would also provide additional information in order to assess the magnitude of supply as opposed to demand-side problems. Finally, changes over time in the estimates obtained with repeated cross-sections of data would also be very useful to assess how the mix of demand and supply-side issues evolves when, for example, neighborhood access is being improved.

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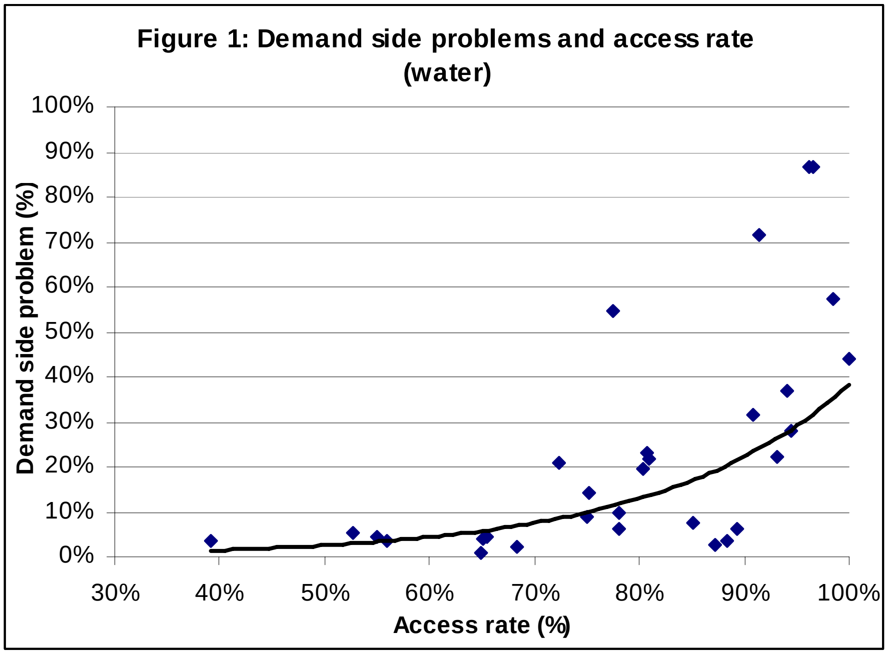


Figure 1: Demand side problems and access rate (water)

Source: Authors using DHS data.

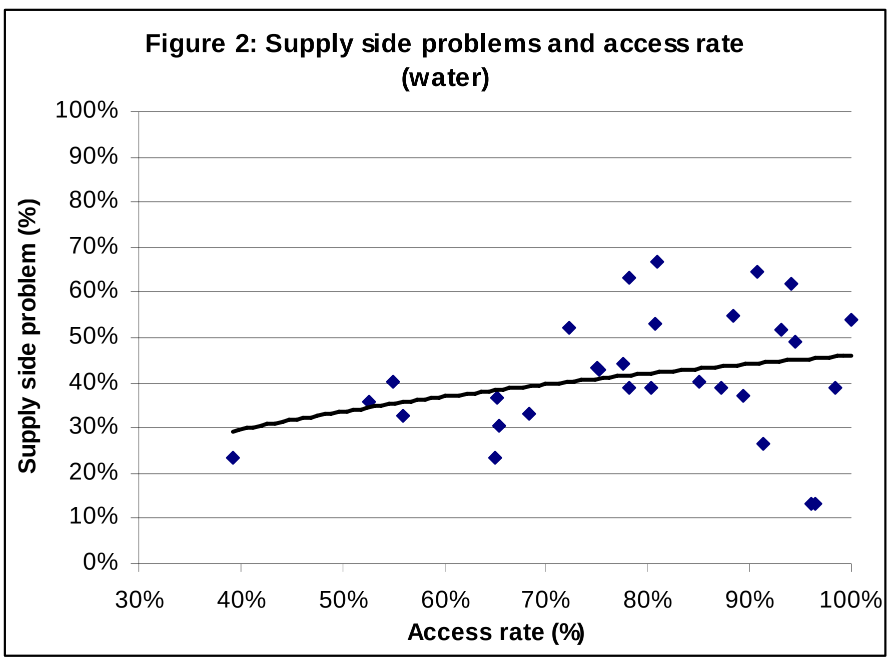
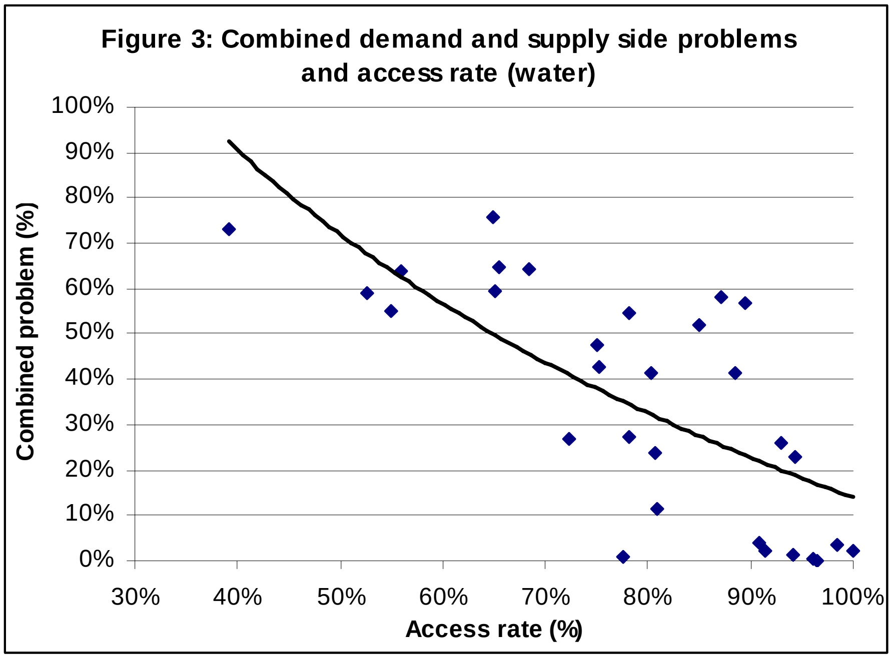
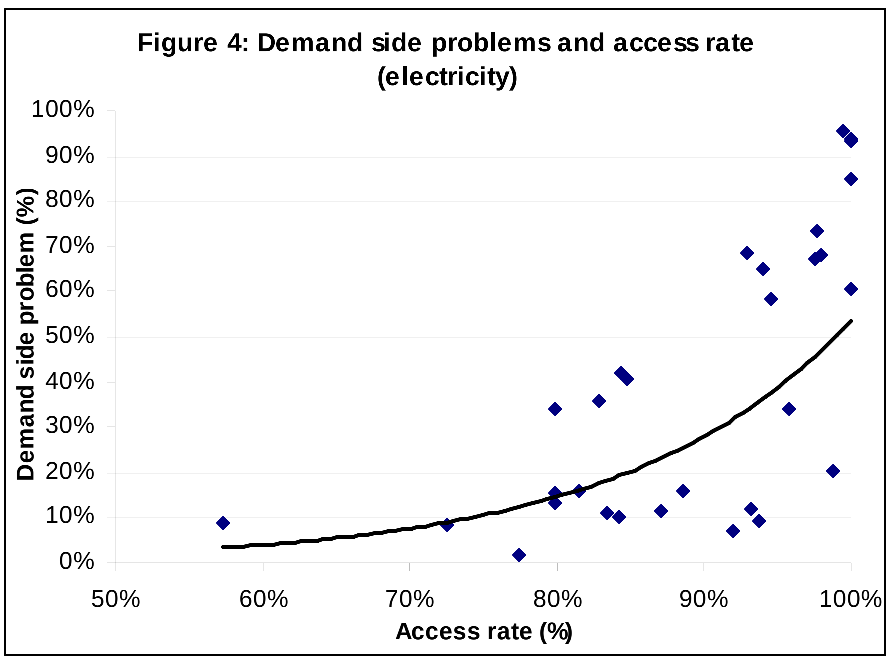


Figure 2: Supply side problems and access rate (water)

Source: Authors using DHS data.



Source: Authors using DHS data.



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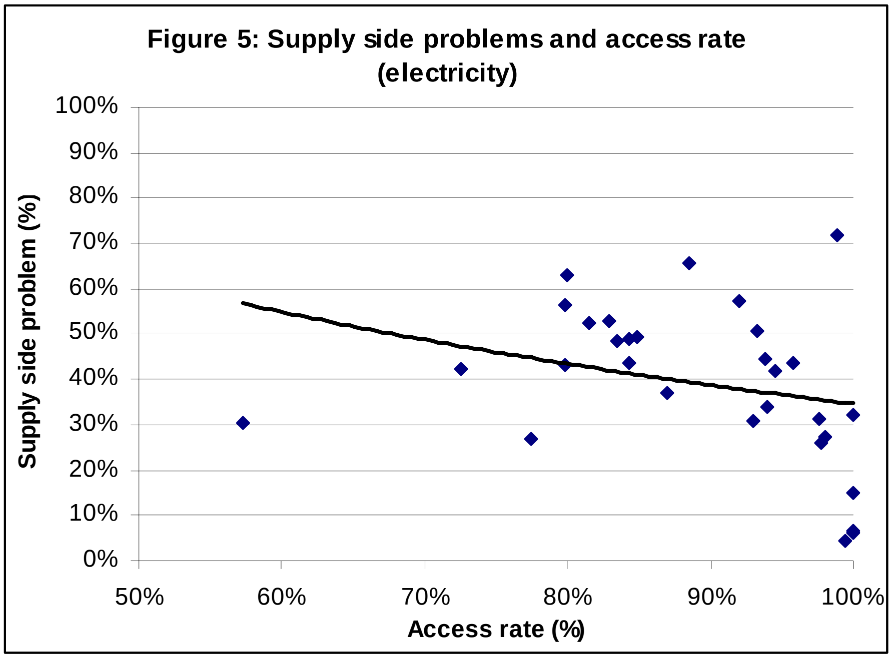

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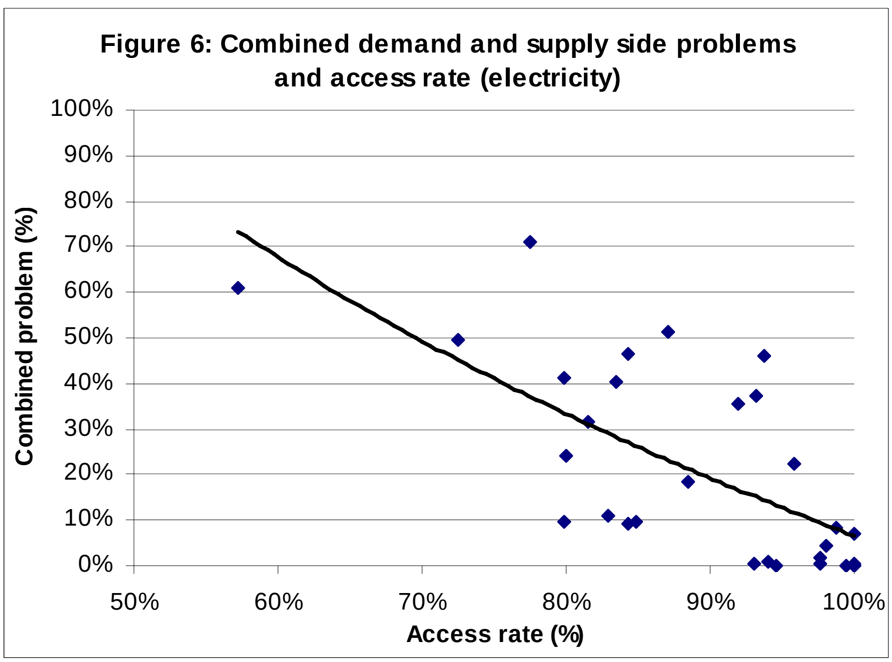

Source: Authors using DHS data.

Table 1: Estimation without controls of demand and supply-side obstacles for access to piped water, Africa – Urban areas (%)

Country	Access Rate	Take-up rate given access	Coverage rate	Unserved Population	Pure demand-side gap	Supply-side gap	Pure supply-side gap	Mixed demand and supply-side gap	Proportion of deficit attributable to demand-side factors only	Proportion of deficit attributable to supply-side factors only	Proportion of deficit attributable to both supply and demand-side factors
Benin	81	75	60	40	21	19	14	5	52	36	12
Burkina Faso	87	38	33	67	54	13	5	8	81	7	12
CAR	39	16	6	94	33	61	10	51	35	10	55
Cameroon	80	30	24	76	56	20	6	14	74	8	18
Chad	68	32	22	78	47	32	10	22	60	13	28
Comoros	81	53	43	57	38	19	10	9	66	18	16
Republic of Congo	91	51	46	54	45	9	4	4	84	8	8
Côte d'Ivoire	96	67	65	35	32	4	2	1	90	7	3
Ethiopia	88	55	48	52	40	12	6	5	78	12	10
Gabon	96	57	55	45	41	4	2	2	91	5	4
Ghana	72	47	34	66	38	28	13	15	58	20	22
Guinea	78	36	28	72	50	22	8	14	70	11	19
Kenya	78	64	50	50	28	22	14	8	57	28	16
Lesotho	94	53	50	50	44	6	3	3	89	6	5
Madagascar	65	26	17	83	48	35	9	25	58	11	31
Malawi	85	38	32	68	53	15	6	9	78	8	14
Mali	75	39	29	71	46	25	10	15	65	14	22
Mauritania	75	37	28	72	48	25	9	16	66	12	22
Mozambique	55	36	20	80	35	45	16	29	44	20	36
Namibia	91	87	79	21	12	9	8	1	56	39	6
Niger	89	35	31	69	58	11	4	7	85	5	10
Nigeria	53	29	15	85	37	47	14	33	44	16	40
Rwanda	56	29	16	84	40	44	13	32	47	15	37
Senegal	98	78	77	23	22	2	1	0	93	5	1
South Africa	94	93	88	12	6	6	5	0	52	45	3
Tanzania	65	34	22	78	43	35	12	23	55	15	30
Togo	93	55	51	49	42	7	4	3	86	8	6
Uganda	65	22	14	86	51	35	8	27	59	9	32
Zambia	78	60	46	54	31	22	13	9	58	25	17
Zimbabwe	100	93	93	7	7	0	0	0	100	0	0
Simple average	**79**	**49**	**41**	**59**	**38**	**21**	**8**	**13**	**68**	**15**	**18**
Weighted average	**73**	**48**	**38**	**62**	**34**	**27**	**10**	**18**	**59**	**18**	**23**

Source: Authors using DHS data. All variables are expressed as percentages (%).

Table 2: Estimation without controls of demand and supply-side obstacles for access to electricity, Africa – Urban areas (%)

Country	Access Rate	Take-up rate given access	Coverage rate	Unserved Population	Pure demand-side gap	Supply-side gap	Pure supply-side gap	Mixed demand and supply-side gap	Proportion of deficit attributable to demand-side factors only	Proportion of deficit attributable to supply-side factors only	Proportion of deficit attributable to both supply and demand-side factors
Benin	83	61	51	49	32	17	11	7	65	21	13
Burkina Faso	92	58	54	46	38	8	5	3	83	10	7
CAR	57	19	11	89	46	43	8	34	52	9	39
Cameroon	94	82	77	23	17	6	5	1	74	21	5
Chad	77	26	20	80	58	23	6	17	72	7	21
Comoros	100	54	54	46	46	0	0	0	100	0	0
Republic of Congo	98	52	51	49	47	2	1	1	96	2	2
Côte d'Ivoire	100	90	90	10	10	0	0	0	100	0	0
Ethiopia	99	87	86	14	13	1	1	0	92	7	1
Gabon	100	91	91	9	9	0	0	0	100	0	0
Ghana	98	79	77	23	21	2	2	1	90	8	2
Guinea	89	72	63	37	25	11	8	3	69	23	9
Kenya	80	64	51	49	29	20	13	7	59	27	15
Lesotho	87	32	28	72	59	13	4	9	82	6	12
Madagascar	80	65	52	48	28	20	13	7	58	27	15
Malawi	84	40	34	66	50	16	6	9	76	10	14
Mali	81	51	41	59	40	19	9	9	68	16	16
Mauritania	85	60	51	49	34	15	9	6	69	18	12
Mozambique	80	37	30	70	50	20	7	13	71	11	18
Namibia	93	80	75	25	18	7	6	1	72	22	5
Niger	94	43	41	59	53	6	3	4	90	5	6
Nigeria	98	86	84	16	14	2	2	0	86	12	2
Rwanda	72	37	27	73	45	28	10	17	62	14	24
Senegal	99	82	82	18	17	1	0	0	97	2	1
South Africa	95	91	86	14	8	5	5	0	60	37	3
Tanzania	83	47	39	61	45	17	8	9	73	13	14
Togo	96	46	44	56	51	4	2	2	92	3	4
Uganda	93	51	47	53	46	7	3	3	87	7	6
Zambia	84	59	50	50	34	16	9	6	69	19	13
Zimbabwe	100	90	90	10	10	0	0	0	100	0	0
Simple average	**89**	**61**	**56**	**44**	**33**	**11**	**5**	**6**	**79**	**12**	**9**
Weighted average	**93**	**75**	**71**	**29**	**22**	**7**	**4**	**3**	**79**	**15**	**6**

Source: Authors using DHS data. All variables are expressed as percentages (%).

Table 3: Estimation with controls of demand and supply-side obstacles for access to piped water, Africa – Urban areas (%)

Country	Access Rate	Adjusted Take-up rate given access	Coverage rate	Unserved Population	Adjusted pure demand-side gap	Adjusted supply-side gap	Adjusted pure supply-side gap	Adjusted mixed demand and supply-side gap	Adjusted proportion of deficit attributable to demand-side factors only	Adjusted proportion of deficit attributable to supply-side factors only	Adjusted proportion of deficit attributable to both supply and demand-side factors
Benin	81	85	60	40	9	31	26	5	22	67	12
Burkina Faso	87	40	33	67	2	65	26	39	3	39	58
CAR	39	24	6	94	3	90	22	68	3	23	73
Cameroon	80	49	24	76	15	61	30	31	20	39	41
Chad	68	34	22	78	2	77	26	51	2	33	65
Comoros	81	69	43	57	13	44	31	14	23	53	24
Republic of Congo	91	93	46	54	38	15	14	1	71	26	2
Côte d'Ivoire	96	99	65	35	31	5	5	0	87	13	0
Ethiopia	88	57	48	52	2	50	28	21	4	55	42
Gabon	96	98	55	45	39	6	6	0	86	13	0
Ghana	72	66	34	66	14	52	35	18	21	52	27
Guinea	78	42	28	72	5	67	28	39	6	39	54
Kenya	78	70	50	50	5	45	32	14	10	63	27
Lesotho	94	68	50	50	14	36	24	11	28	49	23
Madagascar	65	32	17	83	4	79	25	54	5	31	65
Malawi	85	44	32	68	5	63	27	35	8	40	52
Mali	75	48	29	71	6	64	31	34	9	43	48
Mauritania	75	50	28	72	10	62	31	31	14	43	43
Mozambique	55	42	20	80	3	77	32	44	4	40	55
Namibia	91	95	79	21	7	14	13	1	31	65	4
Niger	89	40	31	69	4	65	26	39	6	37	57
Nigeria	53	38	15	85	4	80	30	50	5	36	59
Rwanda	56	34	16	84	3	81	27	54	3	33	64
Senegal	98	92	77	23	13	10	9	1	57	39	4
South Africa	94	98	88	12	5	8	8	0	37	62	1
Tanzania	65	38	22	78	3	75	29	46	4	37	59
Togo	93	67	51	49	11	38	25	13	22	52	26
Uganda	65	24	14	86	1	85	20	65	1	23	76
Zambia	78	98	46	54	29	24	24	1	55	44	1
Zimbabwe	100	96	93	7	3	4	4	0	44	54	2
Simple average	**79**	**61**	**41**	**59**	**10**	**49**	**23**	**26**	**23**	**41**	**35**
Weighted average	**73**	**58**	**38**	**62**	**8**	**54**	**24**	**30**	**19**	**42**	**39**

Source: Authors using DHS data. All variables are expressed as percentages (%).

Table 4: Estimation with controls of demand and supply-side obstacles for access to electricity, Africa – Urban areas (%)

Country	Access Rate	Adjusted Take-up rate given access	Coverage rate	Unserved Population	Adjusted pure demand-side gap	Adjusted supply-side gap	Adjusted pure supply-side gap	Adjusted mixed demand and supply-side gap	Adjusted proportion of deficit attributable to demand-side factors only	Adjusted proportion of deficit attributable to supply-side factors only	Adjusted proportion of deficit attributable to both supply and demand-side factors
Benin	83	83	51	49	18	31	26	5	36	53	11
Burkina Faso	92	62	54	46	3	43	27	16	7	57	35
CAR	57	33	11	89	8	81	27	54	9	30	61
Cameroon	94	98	77	23	15	8	8	0	65	34	1
Chad	77	28	20	80	1	79	22	57	2	27	71
Comoros	100	82	54	46	28	18	15	3	61	32	7
Republic of Congo	98	86	51	49	33	16	13	2	68	27	4
Côte d'Ivoire	100	99	90	10	10	1	1	0	93	7	0
Ethiopia	99	90	86	14	3	11	10	1	20	72	8
Gabon	100	99	91	9	9	1	1	0	94	6	0
Ghana	98	95	77	23	15	8	7	0	67	31	2
Guinea	89	78	63	37	6	31	24	7	16	66	18
Kenya	80	72	51	49	6	42	31	12	13	63	24
Lesotho	87	42	28	72	8	64	27	37	12	37	51
Madagascar	80	86	52	48	16	32	27	5	34	56	10
Malawi	84	48	34	66	7	59	29	31	10	43	47
Mali	81	62	41	59	9	49	31	19	16	52	32
Mauritania	85	84	51	49	20	29	24	5	41	49	10
Mozambique	80	51	30	70	11	59	30	29	16	43	41
Namibia	93	99	75	25	17	8	8	0	69	31	0
Niger	94	49	41	59	6	54	26	27	9	45	46
Nigeria	98	98	84	16	12	4	4	0	73	26	1
Rwanda	72	46	27	73	6	67	31	36	8	42	49
Senegal	99	100	82	18	17	1	1	0	95	5	0
South Africa	95	100	86	14	8	6	6	0	58	42	0
Tanzania	83	55	39	61	7	54	30	25	11	49	40
Togo	96	66	44	56	19	37	24	12	34	44	22
Uganda	93	58	47	53	6	46	27	20	12	51	37
Zambia	84	84	50	50	21	29	24	5	42	49	9
Zimbabwe	100	99	90	10	8	2	1	0	85	15	0
Simple average	**89**	**74**	**56**	**44**	**12**	**32**	**19**	**14**	**39**	**39**	**21**
Weighted average	**93**	**87**	**71**	**29**	**11**	**18**	**12**	**6**	**52**	**37**	**11**

Source: Authors using DHS data. All variables are expressed as percentages (%).