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Poverty, Living Conditions, and Infrastructure Access

A Comparison of Slums in Dakar, Johannesburg, and Nairobi

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Abstract

In this paper the authors compare indicators of development, infrastructure, and living conditions in the slums of Dakar, Nairobi, and Johannesburg using data from 2004 World Bank surveys. Contrary to the notion that most African cities face similar slum problems, they find that slums in the three cities differ dramatically from each other on nearly every indicator examined.

Particularly striking is the weak correlation of measures of income and human capital with infrastructure access and quality of living conditions. For example, residents of Dakar's slums have low levels of education and high levels of poverty but fairly decent living conditions. By contrast, most of Nairobi's slum residents have jobs and comparatively high levels of education, but living conditions are but extremely bad. And in Johannesburg, education and unemployment levels are high, but living conditions are not as bad as in Nairobi. These findings suggest that reduction in income poverty and improvements in human development do not automatically translate into improved infrastructure access or living conditions.

Since not all slum residents are poor, living conditions also vary within slums depending on poverty status. Compared to their non-poor neighbors, the poorest residents of Nairobi or Dakar are less likely to use water (although connection rates are similar) or have access to basic infrastructure (such as electricity or a mobile phone). Neighborhood location is also a powerful explanatory variable for electricity and water connections, even after controlling for household characteristics and poverty. Finally, tenants are less likely than homeowners to have water and electricity connections.

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1 Introduction

Today more than half the world's population lives in urban areas. The transition from a rural world to an urban one has been led by the rapid, dramatic, and difficult urbanization in the developing world. The shift has been difficult, not least because cities in the developing world have neither been able to plan for nor to keep pace with this transformation. Consequently, more and more urban residents live in unplanned, squalid settlements that lack access even to basic services such as piped water, sanitation, drainage, and electricity. The situation is deemed so alarming that one analyst describes Earth as a "planet of slums" (Davis 2006).

Despite the magnitude of urbanization, and despite widespread agreement on its significance, however, we lack answers to fundamental questions about the lives of urban residents—especially slum residents—in the developing world. This gap is particularly pronounced in Africa, which is both the most rapidly urbanizing and the poorest region of the world (UNFPA 2007).

In this study, we empirically examine development and living conditions in slums. What levels of infrastructure services do slum residents tolerate? How do these levels vary, within and across cities? What explains these variations? Drawing on random samples of slum residents in Dakar, Johannesburg, and Nairobi, this paper explores these questions and offers some novel, provocative, and policy-relevant empirical evidence. Our main findings are as follows:

- The cities in our sample exhibit heterogeneity—slums in the three cities differ dramatically from each other on nearly every development indicator that we examined. This finding belies the notion that most African cities face a more or less similar slum problem. By extension, it also challenges the idea that one approach to—or template for—the upgrading of slums can work in all African cities.

- In comparing the three cities, it is striking that measures of income and human capital correlate poorly with infrastructure access and quality of living conditions. In Dakar, slum residents have fairly decent living conditions, even though they have low levels of educational attainment and high levels of income poverty. By contrast, in Nairobi slum's living conditions are appalling although most slum residents have jobs and a comparatively high level of education. Although far from conclusive, this evidence suggests that reduction in income poverty and improvements in human development do *not automatically* translate into improved infrastructure access and quality of living conditions for the urban poor. Future research will want to focus on the factors that explain the variation—and facilitate improvements—in quality of living conditions.

- Within each city, and even within a given slum, we again find heterogeneity. First, we were encouraged to find that not all slum households are poor. Second, slum residents have heterogeneous living conditions, depending on their welfare/poverty status and on the neighborhood in which they reside.

- In comparing poor and nonpoor slum residents within a given city, we find the poor often lagging behind their nonpoor neighbors in access to some basic infrastructure and they endure worse living conditions. For instance, in both Nairobi and Dakar, the poor are systematically less likely to have

either an electricity connection or a mobile phone. Water-connection rates are similar for the two groups, but water-use is lower among poor households. We were encouraged to find no statistically significant difference in their educational attainment levels.

- Spatially, we find considerable variation across slum neighborhoods within a city. In Nairobi and Dakar, and for both electricity and water connections, neighborhood location is a powerful explanatory variable, even after controlling for household characteristics and poverty. This suggests that supply-side factors play an important role in determining infrastructure access.

- Finally, tenancy is a key variable in this issue of access to certain services—tenants are systematically less likely to have water and electricity connections as compared with homeowners. A tenant might be less willing or able to pay. The utilities might be less willing (or able) to connect. It might be a combination of the two.

The current paper also contributes to a methodological framework for a comparative analysis of slum residents' experiences. We show how radar graphs of thematically grouped variables—the development diamond, the infrastructure polygon, and the living conditions diamond—provide a useful way to aggregate data and to examine differences within and across cities. To our knowledge, this is the first comparative study of African cities that draws on multisectoral random samples of slum residents (indeed, the three data sets that we analyze appear to be the only high-quality multisectoral household survey data available for urban slums in Africa).

The paper proceeds as follows. Section 2 presents cross-city comparisons that are organized around the development diamond, the infrastructure polygon, and the living conditions diamond. Section 3 uses this framework to compare poor and nonpoor households. The fourth section examines spatial heterogeneity and what it implies about supply and demand of key infrastructure, while Section 5 offers conclusions.

Data

In February–March 2004, a World Bank-led research team conducted household surveys in the slums of Nairobi and Dakar. The questionnaires in the two cities were almost identical to allow for an apples-to-apples comparative analysis and to establish a base for comparative studies including other cities. Although the sampling methodology differed somewhat for the two cities, both sought to produce a population-weighted stratified random sample of slums. The study covered 1,755 households in Nairobi and 1,960 households in Dakar.

In Nairobi the 1,755 households were selected from 88 Enumeration Areas (EAs). For census purposes, Kenya's Central Statistics Bureau (CBS) has divided Nairobi into about 4,700 EAs, of which 1,263 are categorized as EA5, or slums, which are characterized by substandard housing and poor infrastructure. The 88 EAs in our sample were selected randomly from the subset of 1,263 EA5s and weighted by population. Because the household lists were not up-to-date, a complete relisting was conducted in each EA selected for study, and the sample households were chosen randomly from the revised lists. CBS collaborated with the World Bank's team in designing the sampling frame of this study and also carried out the field-based relisting of households in the 88 EAs. Overall, the Nairobi data set is a

population-weighted stratified random sample, and it is representative of the 1,263 EAs that CBS categorized as slums.

The Dakar survey covered 1,960 households selected randomly from a random sample of 99 EAs, from a universe of 2,074 EAs in the city, stratified by level of past slum-upgrading efforts. The household sample was selected from a 2002 listing of households, and stratification was carried out based on both official and unofficial information.

In Johannesburg, a different World Bank research team led surveys of 5,100 households over six weeks in August and September 2001. The survey formed part of a larger effort to monitor service delivery to the poor and focused on what the study team termed "poorly served" areas. Using data from a 1996 citywide sample, Bank staff identified 921 EAs that qualified as poorly served.[1] These EAs comprise 125,409 households, or about 24 percent of the city's population. The 5,100 surveyed households are representative of this underserved quartile and are drawn from 253 of the 921 poorly served EAs. For purposes of comparison with the slums of Nairobi and Dakar, however, we analyze only a subset comprising 1,618 households living in informal housing, mostly shacks.

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[1] Cut-off points for inclusion in the set of poorly served areas is as follows: 5 percent of the households with less than basic water and sanitation, 10 percent for electricity, and 20 percent for housing quality. These cut-off points were selected to give the maximum feasible population of EAs to be surveyed.

2   Comparing cities

This section focuses on variations across the three cities on key development indicators. We start by briefly summarizing the differences in demographic profiles across the slum residents in the three cities.

The mean household size (9.6) in Dakar is strikingly larger than in Nairobi (3.0) and Johannesburg (3.7) (appendix table 1). A relatively high percentage of single-person households exist in the slums of Nairobi (28 percent) as compared to Dakar (1.7 percent) and Johannesburg (9.2 percent). Although the proportion of males to females is about 50:50 in the slums of Dakar and Johannesburg, in Nairobi it is about 55:45. Household heads in Nairobi's slums were much younger (with a mean age of about 35 years) than those in Dakar (with a mean age of about 52 years); for Johannesburg, corresponding data are not available.

The development diamond: a multidimensional view of poverty in the slums

We map poverty in the slums of the three cities using a four-dimensional framework that includes monetary welfare, employment, education, and living conditions. These factors are graphically represented as four vertices of the development diamond (figure 2.1), which is discussed in more detail in Gulyani and Talukdar (2007, 2008); we use it here to provide a snapshot of different aspects of poverty in the slums.

We select absolute indicators for each of the four aspects and suggest that the (normative) goal should be to achieve a 100 percent score along each axis. Thus, a fully shaded diamond would indicate a city that has eliminated deprivation. For this comparative analysis of slums in the three cities, we plot the proportion of (i) households living above the absolute (expenditure-based) poverty line as defined by the government; (ii) adults employed in jobs or microenterprises; (iii) adults with primary education; and (iv) households with living conditions that meet at least a minimal quality threshold, defined as a unit with permanent walls, water, and electricity.[2]

We posit that the dimensions of the development diamond interact over time to determine the welfare of a given community or household. For instance, improvements in education can improve access to jobs, and this can, in turn, help lower the incidence of income poverty. With more income, residents can invest in improving living conditions and education levels.

Slums in all three cities fall far short of the 100 percent target along each of the four dimensions—poverty incidence is high, unemployment is a serious problem, education is anything but universal, and living conditions are poor. What is striking, however, is the variation among the cities—slum residents in

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[2] These indicators establish only a basic or minimum development diamond and are meant to be illustrative. Conceptually, the famework can be modified for a given context and the indicators can be more sophisticated. For example, the indicators can be changed to include both "access" and "quality" aspects, and the thresholds can be set at higher levels. For instance, the measure for education could be set at "proportion completing high school" rather than primary or secondary education and/or modified to record the proportion who can successfully pass certain types of tests.

Nairobi are much better educated; those in Dakar enjoy better living conditions overall, and those in Johannesburg have both the greatest access to regular jobs and the most unemployment. This means that the key problems, and thus high-priority actions, differ rather dramatically by city.

Figure 2.1   Development diamonds for three cities
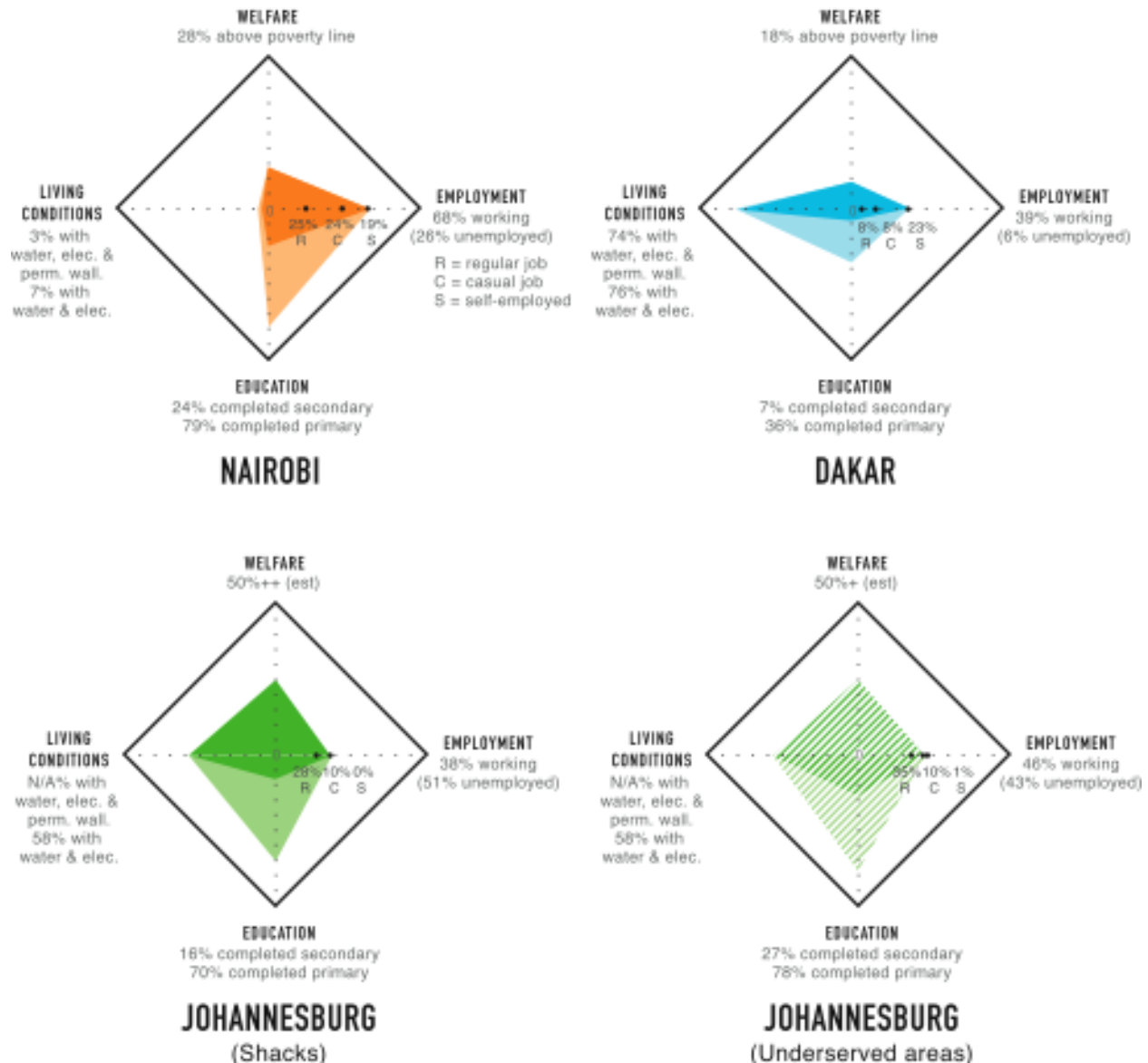
As figure 2.1 illustrates, the four factors are weakly correlated in each of the three cities. These asymmetries suggest that reduction in income poverty is in itself insufficient to ensure better living conditions for slum residents, although it may help to meet this goal. Similarly, improved access to education alone is not sufficient to ensure access to jobs. These implications are both commonsensical and well supported by research, yet governments and development practitioners tend to favor sector-specific initiatives. Such initiatives rarely reflect the multiple dimensions of welfare implicit in the development diamond. The development diamond offers a composite picture of the multifaceted and

interactive nature of the challenge of development in a given context. Over time, this composite picture helps us come to a more nuanced understanding of the relationship among the four dimensions. In the rest of this section we briefly discuss these four dimensions.

Monetary welfare

Income and expenditure underpin a household's economic life, and yet they are difficult to measure. Respondents may gain little from revealing their real income, or they may not remember and aggregate their numerous transactions. With these concerns in mind, the surveys in Dakar and Nairobi employed three approaches to estimate monetary welfare:[3]

- Assessment of household expenditures above or below the poverty line. The enumerator calculated a household-specific poverty line based on the age and number of household members, and the respondent answered whether expenditure was above or below that threshold.

- Total household expenditures adjusted for family size (measured in adult equivalents)

- Total household income adjusted for family size (also measured in adult equivalents)

The first of these measures was judged to be most reliable and is used as the primary measure of poverty throughout this report. In Nairobi, the analysis took the 1999 poverty line as defined by the Government of Kenya and adjusted it for inflation to calculate the poverty threshold for 2004. Using this expenditure-based poverty line—defined as an expenditure of Ksh 3,174 (US$42) per adult equivalent per month, excluding rent—about 72 percent of the slum households are poor and 28 percent are nonpoor.

In Dakar, the 2004 official poverty line was 27,705 F CFA (US$53) per adult equivalent, including rent. The discrete wealth indicator suggests that about 18 percent of the individuals have expenditures above the poverty line, while about 82 percent fall below the poverty line. For Johannesburg, the survey did not have information on income; so Figure 1 uses an estimated value of about 50 percent of households under poverty line.

Education

Educational attainment varies markedly across the three cities (appendix tables 2 and 3). In Dakar, about a third of adults have a primary-level education, and fewer than 10 percent completed high school. Corresponding figures are much higher in Nairobi (79 percent have finished primary school; 31 percent high school) and Johannesburg (70 percent have completed primary; 44 percent high school).

It is worth noting the contrast between Dakar, which has low educational attainment and fairly good infrastructure, and Nairobi and Johannesburg, with their relatively high levels of educational attainment and poor infrastructure. This suggests that while human capital can certainly affect access to jobs and poverty levels, it appears to be neither necessary nor sufficient for slum households to attain decent living conditions or access to basic infrastructure services such as water and electricity.

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[3] Factor analysis based on household assets was also carried out, but slum households exhibited too little variation in assets for meaningful results.

Employment

Unemployment is widespread among Johannesburg's slum residents, where every other adult is unemployed. That compares to an unemployment level of 26 percent in Nairobi and only 6 percent in Dakar. Within households the story is much the same: a typical household in Johannesburg slums will have one-third of adult members unemployed, compared to one-fifth in Nairobi and only one-twentieth in Dakar (appendix tables 4 and 5).

At the same time, Johannesburg also has the highest proportion of regularly employed adults (28 percent) compared with 25 percent in Nairobi and only 8 percent in Dakar. Self-employment or work in household-owned microenterprises is uncommon in Johannesburg but prevalent in Nairobi and Dakar, where about one in five report that they work in their own household microenterprise. Nairobi's slum residents report the highest level (24 percent) of casual employment, followed by Johannesburg (10 percent) and Dakar (8 percent). Overall, among the three cities, slum residents in Johannesburg are the most likely to be either unemployed or regularly employed and the least likely to be working in a household microenterprise.

Living conditions

We developed two proxy indicators to arrive at an overview of living conditions and infrastructure access across slum areas in the three cities—both indicators are composites. The first indicator establishes the percentage of households with access to piped water and electricity, and the second determines the percentage of those with piped water, electricity, and permanent external walls.

On either indicator, Dakar leads by a sizable margin—76 percent of Dakar's slum households have both piped water and electricity compared with about 31 percent in Johannesburg and only about 7 percent in Nairobi. Another way to compare living conditions among the three cities is to note that only about 3 percent of Dakar's slum households have neither piped water nor electricity, but the corresponding number jumps to about 44 percent for Johannesburg and to 66 percent for Nairobi.

In terms of the second indicator, about 74 percent of Dakar's slum households have access to piped water and electricity and reside in houses constructed with permanent external walls. This is true of only 3 percent of the slum households in Nairobi. (Housing quality indicators are not available for Johannesburg.) Less than 1 percent of Dakar slum households have none of three—piped water, electricity, permanent external walls. For Nairobi, by way of contrast, the corresponding number jumps to about 63 percent. Clearly, while the study areas in all three cities can be called slums, those in Dakar offer greater access to critical infrastructure than those in either Johannesburg or Nairobi. The conditions are particularly bad in Nairobi.

In the next section, we move from coarse indicators of basic or decent living conditions to a more comprehensive framework for assessing and understanding quality of living conditions.

Assessing quality: the living conditions diamond

Although slums typically evoke images of squalor, some slums offer decent living conditions. Some have good access to water; others offer better-quality housing units, and some are physically safe. To

document and compare living conditions across cities, we use a new tool—termed "the living conditions diamond"—developed in Gulyani and Talukdar (2008).

According to this framework (represented graphically as a diamond in figure 2.2), living conditions vary in four ways: tenure, infrastructure, unit quality, and neighborhood condition and location. These four factors interact with and influence each other.

Figure 2.2   Living conditions diamonds for three cities

INFRASTRUCTURE
20% index (avg.)

TENURE
8%
own
homes

UNIT
12%
with
permanent
walls

NEIGHBORHOOD &
LOCATION
37% feel safe

NAIROBI

INFRASTRUCTURE
60% index (avg.)

TENURE
74%
own
homes

UNIT
96%
with
permanent
walls

NEIGHBORHOOD &
LOCATION
48% feel safe

DAKAR

INFRASTRUCTURE
52% index (avg.)

TENURE
89%
own
homes

UNIT
N/A

NEIGHBORHOOD &
LOCATION
N/A

JOHANNESBURG
(Shacks)

INFRASTRUCTURE
67% index (avg.)

TENURE
82%
own
homes

UNIT
62%
with
permanent
walls

NEIGHBORHOOD &
LOCATION
N/A

JOHANNESBURG
(Underserved areas)

In the rest of this section, we use the living conditions diamond to determine the quality of slum settlements in the three cities. Given data constraints regarding neighborhood conditions, we focus our discussion on the other three factors. The discussion below shows that each of the three dimensions is in

itself a composite of several factors and requires use of multiple indicators. Our selection of indicators is illustrative rather than prescriptive.

In graphing the living conditions diamond, we have simplified even further. For simplicity and ease of illustration, we have opted to plot *only one proxy indicator or an index* for each of the four dimensions. We use the following indicators in figure 2.2: the percentage of households with permanent walls (which is a proxy for unit quality); percentage who own their home (a proxy for tenure); percentage who feel safe in their neighborhood (a proxy for neighborhood conditions); and a composite infrastructure index (average access or connection rate across eight different infrastructure services).

Condition of housing units: space and quality

The mean household size in Dakar (9.6) is about three times larger than those in Nairobi (3.0) and Johannesburg (3.7). At the same time, the mean number of rooms per household is also significantly higher in Dakar (4.1) than in Nairobi (1.2) and Johannesburg (1.8). Consequently, crowding levels—the average number of persons per room—are comparable across the three slums: 2.8 in Dakar, 2.6 in Nairobi, and 2.3 in Johannesburg (appendix table 6).

The condition of the housing stock is much better in Dakar than in Nairobi. For example, about 96 percent of the houses in Dakar's slums—but only 12 percent of those in Nairobi—have external walls constructed with permanent materials (brick/stone/concrete blocks).[4] Similarly, about 32 percent of households in Nairobi's slums have dirt floors; the corresponding number in Dakar is only 10 percent.

Tenure mix and turnover rate

The tenancy mix—or, the ratio of owner-occupiers to tenants—is highly skewed in Nairobi, where only 8 percent of households own their own houses. In Dakar, about 74 percent are owner-occupiers and 26 percent tenants. Johannesburg has the highest owner-occupancy rate—89 percent; the remaining 11 percent do not own their house, but only 4 percent report that they pay rent for their accommodations.

The turnover rate among slum residents is high in Nairobi and low in Dakar. Median stays in the current house and slum settlement are three years and six years (average of five and nine years) respectively for Nairobi households, compared to 17 and 20 years (average of 19 and 21 years) respectively for Dakar households. Although the mean and median length of stay cannot be computed for Johannesburg's slum residents, 23 percent of the residents report they have stayed in their current home for more than 10 years, while 33 percent have stayed for fewer than 5 years.

Neighborhood safety and facilities

Assessing the condition of a neighborhood and its location requires the use of multiple indicators. Here we use three proxy indicators: whether slum residents feel safe in their neighborhood, and whether or not their neighborhood has health and education facilities, that is, clinics and schools. (We have these data for Nairobi and Dakar, but not for Johannesburg.)

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[4] Data on physical condition of housing are not available for Johannesburg.

The majority of slum residents in both cities report that they feel unsafe in their own settlement. Specifically, when asked if they feel safe in their settlement, 48 percent of Dakar's slum residents and 37 percent of those in Nairobi answered in the affirmative.

With respect to health infrastructure, as many as 89 percent of slum households in both Nairobi and Dakar report they have health-service facilities in their settlements. In terms of education infrastructure, we find that schools in general, and private schools in particular, are much more widely prevalent in the slums of Nairobi than in Dakar. About 88 percent of slum households in Nairobi say that they have public or private school facilities in their settlements compared with about 75 percent in Dakar. Breaking this down by type of school, about 52 percent of slum households in Nairobi say that they have public school facilities in their settlements compared with about 59 percent in Dakar. For private schools, the corresponding values are 85 percent in Nairobi and 58 percent in Dakar.

Infrastructure

Basic infrastructure services are an essential component of quality of living conditions. We examined eight services in detail: water, electricity, toilets, sewage disposal, drainage, garbage collection, public transport, and telephone services. Each of these services is discussed in the next section. (For several indicators, we restrict our comparison to Nairobi and Dakar because comparable data were unavailable for Johannesburg.)

The infrastructure polygon

By definition, slums in all three cities are poorly served. There are variations, however, among services within a given city and large differences in access among the three cities. In this section, we look more closely at access to different services, specifically focusing on the following questions: What is the infrastructure status of the slums? Are service indicators better in certain sectors? Which cities are doing better in serving their slum areas and in what types of services?

Figure 2.3 clearly shows that none of the three cities offers anything approaching universal coverage to its slum residents. In relative terms, households in Dakar's slums are systematically and significantly better off than those in either Johannesburg or Nairobi, on almost all key infrastructure services. In terms of water and electricity connection rates, Dakar leads Johannesburg by a factor of two and Nairobi by a factor of four. Regarding households with both piped water and electricity connections, Dakar's slum households still have significant advantages—76 percent compared to 31percent for Johannesburg and only 7 percent for Nairobi. Figure 3 also allows for a comparison across services; it shows, for instance, that in Nairobi about 22 percent have electricity connections but only 10 percent benefit from garbage collection services.

Figure 2.3　Infrastructure polygons for three cities

NAIROBI

DAKAR

JOHANNESBURG
(Shacks)

JOHANNESBURG
(Underserved areas)
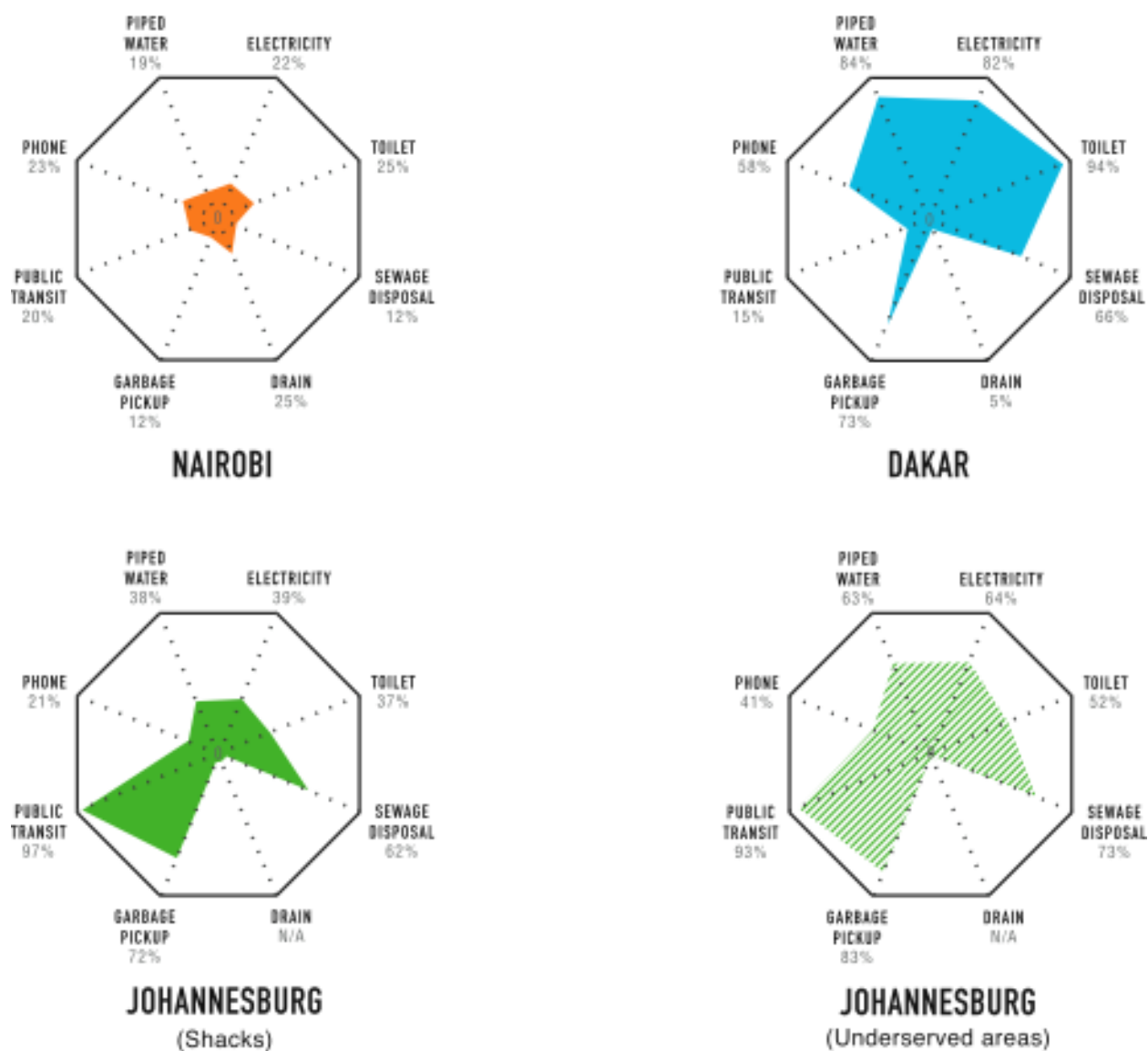
In the discussion below we highlight some of the service-specific findings, presented in appendix tables 7.1–7.5, to provide an insight, first, into the types of informal options the unserved are forced to rely on, and, second, some of the implications of poor access/service.

Water connection rates and use

Access to private, piped water connections—in-house or a yard tap—is remarkably high in Dakar (84 percent), lower in Johannesburg (38 percent), and quite low (19 percent) in Nairobi. In Dakar, the vast majority of slum residents use private piped connections as their primary source of water. In Johannesburg, communal taps are the most common source, with 42 percent of slum households relying

on them. In Nairobi's slums, given the low connection rate, water kiosks are the most prevalent primary source—64 percent of slum households buy water by the bucket (or 20-liter Jerri can) from water kiosks.

Most Johannesburg slum households are found to use a single source of water for their daily needs, while about 10 percent of Nairobi's slum households and 13 percent of those in Dakar depend on multiple sources. Further, when we analyzed those households using multiple water sources, the percentage with private piped water connections is 0 percent for Nairobi and about 68 percent for Dakar. That 68 percent for Dakar amounts to 9.5 percent of all households with private piped-water connections; presumably these households have to rely on alternate backup water sources either because of uncertainty of the private piped water supply or because they cannot afford to use piped water for activities such as washing and cleaning.

Despite the dramatic differences in the primary water sources available in Nairobi and Dakar, the per capita water use is low in both cities in absolute terms—it hovers around 20 liters per capita per day (lcd)—and it is only slightly higher in Dakar as compared to Nairobi. Specifically, median and mean values of per capita water consumption for Nairobi's slum households are 20 lcd and 23 lcd respectively, and the corresponding values for Dakar's slum households are 22 lcd and 28 lcd. The low level of use in Dakar lends further credence to the hypothesis that water prices may be high for slum residents; this is an area for further research. (We lack daily water-use data for Johannesburg.)

Electricity connection rates and street lighting

At 82 percent, electricity connection rates are high in the Dakar slums; the figures are lower in Johannesburg (39 percent) and lowest in Nairobi (22 percent). Not surprisingly, 77 percent of the slum residents in Nairobi use kerosene/paraffin as an alternate source of home lighting. This figure is 91 percent in Johannesburg; in Dakar 5 percent of slum residents use kerosene/paraffin.

In Dakar's slums, 59 percent of the households report street lights in their neighborhoods compared with only about 14 percent of households so reporting in Nairobi. (We do not have comparable data for Johannesburg.) These findings suggest that electricity supply infrastructure—transmission and distribution networks—is more established in Dakar's slums than in Nairobi's. In Section 4 we offer further analysis at the residential neighborhood level to see how household electricity connections vary across the geographic divisions within the slum settlements in each city. It allows us to gain insights into the extent to which electricity access in a city is affected by demand-side (affordability) factors versus supply-side (presence of trunk infrastructure) issues.

Telephone: mobile phones rather than landlines

Dakar's slum residents also have superior access to telecommunication services, as compared with Nairobi and Johannesburg. About 29 percent of Dakar's slum households have working landline telephones, but this service is not really an option in the other two cities—only 0.2 percent of slum residents in Nairobi and 2.1 percent of those in Johannesburg have landline telephones.

The big communications story, however, lies in the expanding use of mobile phones. By a significant margin in the three cities, access to mobile phones outstrips that to landlines. Here again, Dakar's slum residents enjoy better access—50 percent of households in Dakar have a mobile phone compared to about 20 percent in Nairobi and 22 percent in Johannesburg.

Toilets and sewage disposal services

Dakar's slum households have better access to toilet facilities, with the mean number of households sharing a toilet facility at about 1.4 compared with 19.1 and 16.2 for Nairobi and Johannesburg respectively. Even after accounting for the mean size of households (which is much higher in Dakar, at 9.6 percent, than in Nairobi and Johannesburg—3.0 and 3.7 respectively), we find that on average about 13 people use one toilet in Dakar compared with 57:1 in Nairobi and 60:1 in Johannesburg.

With 60 percent of households relying on public toilets, these are the most commonly used facility in Nairobi's slums. About 6 percent of Nairobi slum households report they have no access to toilet facilities and therefore resort to the bush or a wrap-and-throw option infamously described as "flying toilets."

A septic tank or a VIP (ventilated improved pit) latrine is the most widely used form of sewage disposal in Dakar's slums, used by about 80 percent of households. In contrast, the most widely used disposal system in Nairobi's slum is an ordinary pit latrine—64 percent of the households rely on them as their disposal system. Comparable information is not available for Johannesburg.

Solid waste/garbage disposal services

Access to solid-waste removal services is almost universal in Johannesburg, reasonably high in Dakar, and in Nairobi almost nonexistent. Specifically, about 90 percent of Johannesburg's slum households have some form of an organized garbage-disposal system, compared with 76 percent in Dakar and only 12 percent in Nairobi. Although we do not have data on specific collection systems for Johannesburg, we do for Nairobi and Dakar. Interestingly, while only 12 percent of Nairobi households have an organized collection system, private collection is a central part of that system, accounting for 11 out of those 12 percent. In contrast, for Dakar, 70 out of the total 76 percent of slum households with access to organized collection systems in fact depend on city/municipal collection systems. As for those households without any access to an organized garbage disposal system, the predominant method is "dumping in the neighborhood" in both Nairobi and Dakar.

Graywater disposal services

As we do not have data for graywater disposal services for Johannesburg, we will focus only on Nairobi and Dakar. The most prevalent method for graywater disposal in Nairobi's slums is "pouring into the drain" used by about 71 percent of households. In contrast, the most prevalent method in Dakar's slums (used by about 62 percent of households) is "pouring on the road or pavement." Different graywater disposal practices is not surprising given that about 58 percent of Nairobi slum households report some kind of drain outside their house; the figure is only about 7 percent of Dakar households.

The lack of drainage infrastructure in Dakar seriously compromises the potential gains from improvements in other services. Many neighborhoods, especially those in low-lying areas, flood extensively. This adversely affects both health and living conditions.

Construction of drains is not enough. They need to work. Of those households with drains outside their homes, only about 44 percent of slum residents in Nairobi report that such drains work properly most of the time, compared with about 75 percent in Dakar. Although Nairobi's slums certainly have a more extensive drainage network compared with Dakar, most of this network is not maintained well

enough to be in working condition—the result is that only 25 percent of Nairobi's slum residents have a working drain outside their home (the comparable figure for Dakar is 5 percent).

Access roads and internal paths

About 98 percent of slum households in Nairobi say that they have internal roads in their settlements compared to about 35 percent in Dakar. As for access roads to the settlements, the corresponding values are 98 percent in Nairobi and 56 percent in Dakar. We do not have corresponding data for Johannesburg. The findings seem to suggest that Nairobi's slums have better internal and access road infrastructure compared with those in Dakar. Because drains are often built along with roads, Nairobi's relatively better road infrastructure in slums may explain why they also have a significant drainage network.

Transportation

Only Johannesburg seems to offer public transit services used by slum residents. In Nairobi and Dakar, most slum residents walk. For the slum residents in all the three cities, walking to school and work is an important mode of transport. Walking is the primary mode of transport for majority (55 percent) of Nairobi residents; only about 20 percent use motorized public transportation. In Dakar, walking is the most common form of transport: the primary transportation mode is walking for about 40 percent of the residents, while about 16 percent use public transportation. In Johannesburg, vehicles (motorcycles and microbuses) are slightly more common forms of transportation than walking. Interestingly, almost all slum households in Johannesburg have some members who use motorcycles for transportation and 23 percent of slum households have members who use trains, which are not available at all in the other two cities. Overall, use of motorized public transportation is low and this seems to reflect a combination of constraints—financial constraints at the household level and infrastructure or service constraints at the settlement level.

Expenditure allocation for rent and basic services

Slum residents in Nairobi and Dakar reported their expenses on rent and basic services (appendix table 8). As a percentage of basic household expenditure, both Nairobi and Dakar households are found to have comparable expenditures on rent (about 12 percent and 15 percent respectively) and water (about 2 percent and 3 percent respectively). But the expenditure levels for electricity (2.5 percent) and refuse collection (0.3 percent) for Dakar households are about half of those for Nairobi slum residents—4 percent for electricity and 0.8 percent for refuse collection.

3   Inequality within slums: comparing poor and nonpoor households

In this section, we examine residents' access to infrastructure and services among households according to their welfare level. We looked for systematic differences in access between households below and above the poverty line. This approach allows us to see if slums are uniformly bad or if some residents face conditions that are worse than those of their neighbors. We use respective national governments' expenditure-based poverty lines, adjusted for household size, to categorize slum households as either poor or nonpoor. Because no data on income and poverty level for households are available in our Johannesburg survey, we restrict our discussion here to Nairobi and Dakar.

As described above and in section 1, poverty was assessed for each household (for which size and age were also determined) according to household-specific poverty lines calculated in the field. Respondents were asked if their total monthly expenditures were above or below the computed amount. Those who responded that they spent less than the poverty level were considered poor.

The development diamond

Poverty rates are high, but not everyone is poor

As noted earlier, slum settlements in both Nairobi and Dakar have high household poverty rates—72 percent and 82 percent respectively—based on respective national poverty threshold levels. But, strikingly, not all slum residents are poor. About 1 in 4 or 5 of the slum households in the two cities are above the poverty line.

Poor households are larger. In both cities poor slum households are likelier to report having more household members living together than the nonpoor, and they are also less likely to be single-person households (appendix table 9). Although the proportion of female-headed households is similar among poor and nonpoor slum households in both cities, in Dakar the heads of poor households are found to be about five years older (53 versus 48 years) than those of nonpoor households.

Education: the poor are less likely to have secondary and postsecondary education

With respect to education level among individual adults living in the slum settlements, those from poor households are systematically less likely to have secondary and postsecondary level education in both cities (appendix table 10).[5] The same finding holds when we look at the highest level of education within households (appendix table 11).

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[5] We also tested whether there was any systematic difference between poor and nonpoor households in terms of access to basic public health services, using BCG immunization rates as a proxy indicator. Encouragingly, we find that almost all (about 97-98 percent) slum children of 0-14 years of age are immunized against BCG in both cities, and there is relative little difference in the immunization rates among children from poor and nonpoor households.

Employment: a welfare gap in Nairobi but not in Dakar

Regarding the employment status of adults in the two cities, interestingly, Dakar's poor and nonpoor are not very different. In Nairobi's slums, however, poor adults are less likely to be employed than their nonpoor neighbors. The same finding holds when we look at employment within households. Taken together with education levels, this suggests that while adults in nonpoor slum households are likely to have better educations than those in poor households in both cities, only in Nairobi does this systematically correlate with their chances of being employed (appendix tables 12–13).

Decent living conditions: the poor lag behind the nonpoor in Nairobi but not in Dakar

As noted in our discussion of cross-city analysis, we created a summary indicator for tabulating access to basic or decent living conditions—the percentage of households that have access to both piped water and electricity and are constructed with permanent external walls. We then examined whether this indicator differs systematically among poor and nonpoor households.

In Dakar's slums, there is no statistically significant difference between poor and nonpoor households on this composite proxy indicator. By contrast, in Nairobi's slums, poor households are systematically (statistically significant at 1 percent level) worse off compared with their nonpoor counterparts. In Nairobi (but not in Dakar), living conditions—defined in terms of access to basic utility services and housing—vary systematically with the relative economic or welfare level of a slum household. Whether such variation in utility services is purely due to demand-side/affordability differences or due to neighborhood-level supply bottlenecks is something that we further explore in the next section (Section 4). In the next two subsections, we examine quality of living conditions—and, especially, infrastructure access—in more detail.

The living conditions diamond: dwelling quality and tenure

Housing units: the poor are more cramped and, in Nairobi, their house quality is worse

As earlier noted, while the overall conditions of housing units remain dismal in both cities, we do find systematic differences in the condition of housing units occupied by poor and nonpoor households (appendix tables 14.1–14.2). For example, poor households are likely to live in more crowded conditions with the mean number of persons per room in Nairobi being 3.0 for poor households and 1.6 for nonpoor households; the corresponding figures in Dakar are 2.9 and 2.3 respectively. Regarding materials (permanent versus less permanent) used for the walls, roofs, and floors of the housing units, there is not much of a difference between poor and nonpoor households in Dakar's slums. In Nairobi's slums, however, the nonpoor are more likely to live in housing units built with permanent materials than their poor neighbors are.

Tenure: more a city-level problem rather than a poverty issue?

Poor and nonpoor households in Nairobi's slums have similar levels of land/structure ownership and tenancy rates. The turnover rate for the two groups does not differ much either—both poor and nonpoor households in Nairobi's slums have lived in their slums, on average, for similar lengths of time.

In Dakar, at first glance and somewhat erroneously, the poor seem to have better tenure indicators than the nonpoor. For instance, the poor are more likely (73.5 percent versus 59.9 percent) to own land/structure and are less likely (23.7 percent versus 36.4 percent) to be tenants than nonpoor households. Further, the poor have resided in their slum settlement for about five years longer than the nonpoor. These indicators are influenced, however, by the national government's definition of poverty— because rent is included in the government's expenditure-based poverty threshold, rent-paying tenants are more likely to rise above the poverty line than homeowners are. Additional analyses are required, therefore, to understand the links between poverty and tenure for the case of Dakar.

Among those who rent, the poor are more likely to have no agreement (at times suggesting a squatter status) and are less likely to have formal written agreement than their nonpoor counterparts in both cities. Finally, we do not find a significant difference between poor and nonpoor households in either city regarding perceptions of house tenure security.

At a broader level, it is important to test whether tenure influences (or is related to) some of the outcomes that we have been examining. We find that two sets of variables do exhibit statistically significant correlations with tenure status (that is, difference between tenant and nontenant households has a p value <0.05). First, data from Nairobi, Dakar, and Johannesburg show that homeowners have larger families (household size) and live in larger homes. Second, tenure affects infrastructure connections. When present, the effect is large in magnitude, but strikingly the sign of the effect varies across cities. In Nairobi and Dakar, owners are more likely to have electricity and water connections; in Johannesburg the opposite is true. The relationship between tenure and the likelihood of having basic infrastructure— particularly water and electricity connections—is further explored in Section 4.

Neighborhood safety and facilities: mo welfare gap

We do not find significant differences between poor and nonpoor households in either city regarding their perceptions of neighborhood safety as well as the actual incidence of crimes (personal and property).

With respect to school facilities, cross-tabulations suggest that nonpoor households are more likely to have public and private schools in their neighborhood. When controlling for other factors, using logistics regression analyses, the results are different. We find that the likelihood of a household having public or private school in its vicinity depends not on the household's poverty level but on the neighborhood; this is true in both cities.

The story regarding availability of health clinics is similar. A regression analysis shows that the likelihood of a household having a nearby health clinic, in either city, depends not on the poverty level of the household but on the neighborhood.

The infrastructure polygon: the poor are worse off

Now we turn to the fourth dimension of the living conditions diamond—infrastructure. In this section we examine six different infrastructure services and find that, compared to the nonpoor, the poor are systematically worse off (appendix tables 15.1–15.5). Although this makes intuitive sense in general, it is remarkable that these differences manifest themselves even among slum residents, who are already deprived relative to other residents. We also find that, compared with the nonpoor, poor slum households

in both cities allocate a larger share of their household budget for rent and services such as water, electricity, and refuse collection (appendix table 16).

Water: the nonpoor use more and pay higher unit prices

The distribution of primary water sources is similar between poor and nonpoor households in both cities. This suggests that nonpoor households have the same water-supply options and constraints as poor households. Nevertheless, nonpoor households consume much more water in both cities (by as much as 30–40 percent). In Nairobi, nonpoor households are also found to have slightly higher per-unit cost for water than the poor households. In Section 4 (below), we conduct further analyses at the residential neighborhood level to gain insights into how water connection rates in a city are affected by demand side (affordability) and supply side (presence of trunk infrastructure) factors.

Electricity: connection rates are higher among the nonpoor

Better-off households have better access to home electricity connections in both cities. When it comes to neighborhood street lighting, however, we do not see a statistically significant difference between nonpoor and poor households in either city. In Section 4, along with water connections, we also examine electricity connections rates at the neighborhood level to assess the extent to which electricity connection rates are affected by demand- and supply-side factors.

Telecom: access to (mobile) phones is higher among the nonpoor

The relative economic clout of nonpoor households does translate to better access to cell phone services in both cities. Specifically, about 28 percent of nonpoor households have cell phone service compared to 16 percent of poor households in Nairobi's slums. The corresponding numbers in Dakar's slums are 59 percent and 47 percent. Land-based phone services are practically nonexistent in Nairobi's slums, so the welfare gap cannot be tested. Dakar's slums do have landlines and, compared with the poor, the nonpoor are more likely to have landline phones.

Sanitation: the nonpoor are better off

As for sanitation infrastructure services, while the overall situation is dismal, nonpoor households appear to have marginally better (statistically not significant for Nairobi but significant for Dakar) services compared to the poor households in both cities. For example, in both cities, nonpoor households are more likely to have individual VIP or flush toilets as well as septic tank/soak pit for toilet sewage disposal. Specifically, about 25 percent of nonpoor households have such types of toilets compared to 22 percent of poor households in Nairobi. For Dakar, the corresponding numbers are 60 percent and 51 percent respectively.

The positive differential in favor of the nonpoor households is more pronounced for garbage disposal services, especially in Dakar's slums. In Dakar, about 84 percent of nonpoor households have organized garbage disposal services compared to 75 percent of poor households. In Nairobi, the corresponding numbers are 15 percent and 11 percent, respectively.

Roads: nonpoor report better access roads

Nonpoor households in both cities are slightly more likely to report that they have reasonable access roads in their neighborhood. With respect to the availability of internal road facilities within their neighborhoods, the nonpoor, again, have a slight advantage in Nairobi, but the situation is reversed in Dakar.

Motorized public transport?

As for the primary mode of transport to school and work, in Nairobi's slums, individuals from poor households are more likely to walk than those from nonpoor households. In Dakar, however, there is no welfare gap—individuals from poor or nonpoor households are about equally likely to walk to school and work.

4   Spatial heterogeneity in access to services

To what extent does infrastructure access vary among and within settlements in a city? What is the relative role played by supply and demand? To what extent does tenure status and its security influence access to services? Answers to such questions can help us better understand why infrastructure access or hook-up rates are low and, thereby, help us design tailored solutions for improving overall coverage. They can provide insights on whether the priority is to invest in additional trunk infrastructure, in making the service more affordable, or in dealing with insecurity of tenure.

In this section we take a closer look at differences in access to services across space—spatial heterogeneity—within each city. This serves two purposes. First, it provides an insight into the extent and nature of spatial heterogeneity, or inequality in services, within cities. Second, it provides some clues as to why some households lack services. The reasoning is simple: If none of the households surveyed within a given administrative district use a given service, then that service is probably unavailable. For example, an area that reports no households with piped water likely lacks the requisite trunk infrastructure, while a neighborhood with a small percentage of households that enjoy piped water probably has the trunk infrastructure. In the latter case we might suspect that affordability, not access, was the main barrier to household-level access.

The analysis proceeds as follows. We examine two categories of infrastructure for Nairobi and Dakar: home electricity and piped water connections. (We did not have comparable data for Johannesburg.)[6] To divide the cities spatially, we relied on divisions and enumeration areas (EAs) used to design the sampling frame. Our analysis thus covers 8 divisions and 88 constituent EAs for Nairobi, and for Dakar 10 divisions and 99 constituent EAs. For each category and for each city, we first tabulate coverage rates by division and by EA for the two selected services. This tabulation shows how the coverage varies *across* the divisions in each city and *within* each division across its constituent EAs.

Next, we investigate what might explain spatial variations in access. In this context, the variations have two possible sources: supply-side factors and demand-side factors. Supply-side factors refer to differences in access arising from the relative extent of supply trunk lines available across and within the divisions in which they reside. Demand-side factors refer to differences arising from factors such as a household's welfare status (poverty level) and tenancy status (which can in turn affect a household's ability or willingness to pay for infrastructure).

By running logistic regressions at the household level, we investigate what roles supply- and demand-side factors play in explaining the observed variations in coverage. A household's access to electricity or water is modeled as a function of indicator variables for poverty-level (poor versus nonpoor), tenancy status (tenant versus owner), and location (at the division level) of the household. Statistically significant coefficients for household poverty level and/or tenancy status in such analysis will show that demand-side factors help to explain the observed variations in access across the divisions in the given city. Similarly, statistically significant coefficients for division indicator variables will indicate that significant variation

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[6] However, we do an analogous type of analysis for Johannesburg's underserved areas (see appendix A).

in access rates across the divisions in a given city can be attributed to supply-side factors. The extent of such roles can be inferred from the estimated odds ratios of the corresponding coefficients, which show the *ceteris paribus* effects of the household's poverty level, tenancy status, and residential location on the probability that the household has access to a given infrastructure service. [7]

Electricity connections: poverty, tenancy, and location matter

Appendix tables 17 and 18 summarize how the electricity coverage varies across the divisions in each city and within each division across its constituent EAs in Nairobi and Dakar. All divisions in both cities report at least some households with electricity. This suggests that—at least at a very coarse spatial scale—the trunk infrastructure exists in all divisions. The coverage levels do, however, vary considerably across divisions. For instance, in Nairobi, the minimum division level coverage is 8 percent (Embakasi) and the maximum level is 47 percent (Dagoretti). The corresponding figures for Dakar are 27 percent (Nolivet/Barak) and 93 percent (Diokoul).

At the EA level, the story appears to be quite contrasting between the two cities. While both cities report EAs that completely lack access, in Nairobi we find that 75 percent (6 out of 8) of the divisions have at least one or more EAs that completely lack access to electricity and about 25 percent (21 out of 88) of all EAs have no access. But only 10 percent of the divisions in Dakar have at least one or more EAs that completely lack access, and just about 1 percent of all EAs have no access. Although Dakar exhibits a significantly higher access level for electricity throughout its slum settlements, the access level is much lower in Nairobi, and that too is concentrated in about 75 percent of its slum settlements.

Appendix tables 19 and 20 present the results from the household-level logistic regression results that shed insight into the extent to which tenancy, demand, and supply help to explain the observed spatial differences in coverage levels in the two cities. The results show (at 10 percent significance) that in each city the likelihood of a household's access to electricity is affected by all three factors. That is, households' access to electricity is affected by their poverty level, their residential location, and also their tenancy status (with tenants being worse off relative to homeowners).

Specifically, the likelihood of a *poor household* having access to electricity is reduced to only 57 percent and 54 percent of that of a nonpoor household in Nairobi and Dakar respectively. Similarly, the likelihood of a *tenant household* having access to electricity is reduced to only 37 percent and 40 percent of that of a non-tenant household in Nairobi and Dakar respectively. As the results also show, *several locations* have odds ratios that are statistically significant in each city. This indicates that, after controlling for both tenancy and poverty/affordability, residential location also matters greatly in determining access—a likely reflection of differences in supply-side bottlenecks. For example, the likelihood that a resident of Kibera in Nairobi will have an electricity connection is only 33 percent of that of a slum resident in Nairobi's Central division. Similarly, the likelihood of households in Dakar's Dalifort neighborhood of having access to electricity is only 31 percent of those residing in the city's Arafat settlement.

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[7] We also use a heuristic computational approach developed in the study by Foster and Araujo (2004) to investigate the relative roles of demand and supply side factors in explaining the variation in coverage rates across divisions in each city for electricity and piped water. The approach and results from that analysis are discussed in appendix B.

Piped water: tenancy and location matter, but poverty does not

Appendix tables 21 and 22 summarize the spatial variation in piped water coverage in the two cities. As with electricity, all divisions in both cities report at least some households with private piped water connections, indicating that the trunk infrastructure extends to all the divisions. The variation in coverage levels across divisions within Nairobi is higher (s.d.: 22 percent) than in Dakar (s.d.: 16 percent). For Nairobi, the minimum division level coverage is 8 percent (Embakasi) and the maximum level is 38 percent (Westlands). The corresponding figures for Dakar are 59 percent (Dalifort) and full coverage at 100 percent (Nolivet/Barak).

As with electricity, the access to piped water connections also differs significantly in the two cities. In Nairobi, we find that 75 percent (6 out of 8) of the divisions have at least one or more EAs that completely lack private piped water connections and about 31 percent (27 out of 88) of all EAs have no access. In stark contrast, none of the 10 divisions in Dakar have an EA that completely lacks access to piped water connections. So, for both electricity and piped water, we find that Nairobi exhibits a significantly lower access level than Dakar all through its slum settlements, and its spatial access is concentrated in about 70–75 percent of its slum settlements.

Appendix tables 23 and 24 present the results from the household level logistic regression results. In contrast to our findings for electricity, the results show (at 10 percent significance level or less) that poverty level does not play much of a role in a household's access to a piped water connection in either city. The tenancy status matters in Dakar but not in Nairobi. Specifically, the likelihood of a tenant household having access to piped water is reduced to about half (46 percent) that of a nontenant household in Dakar. As with electricity, the results again show that, after controlling for demand side factors, residential location also matters in determining access to piped water. Overall, the results indicate that a household's access to piped water is affected essentially only by supply side factors in Nairobi, but both tenancy status and supply side factors play a role in Dakar. Unlike the case of electricity, water connections are not influenced by a household's poverty level in either city.

5   Conclusions

The preceding analysis shows that much can be learned from a comparative study of African cities. Here we underscore what we consider to be three salient conclusions. A first key finding of our work is that, within the admittedly small sample of cities that we examined, neither human capital nor income appears to fully explain the observed variation in infrastructure access. This finding, if borne out by additional work, presents a substantial puzzle—and challenges the idea that reduction in income poverty is sufficient to improve the lives of slum residents.

A second key insight from this work is that the challenges facing slum residents vary considerably from neighborhood to neighborhood, and still more from city to city. This heterogeneity raises an important set of social science questions: How do variations in poverty and human capital relate to variations in urban infrastructure? What institutions mediate this relationship? What lessons do better-served places offer to places still struggling to meet basic needs? The remarkable variation in the data also suggests an important lesson for policymakers: Interventions must be adapted to local conditions.

The third lesson is primarily methodological. The current paper shows how a multisectoral approach reveals insights that sector-specific studies would almost certainly miss. Efforts to understand urban poverty must recognize multiple dimensions. We show how visual presentations of carefully chosen indicators—grouped into what we term the development diamond, the living conditions diamond, and the infrastructure polygon—can provide a simple yet powerful tool for comparative analysis.

Demographic data from Africa (and from around the world) show that future generations will live mostly in cities. But under what living conditions? This remains unclear. If we are to chart a course to a prosperous, sustainable urban future, then we need to understand clearly where we are today, and the play of forces that got us here. The research described here points to a rich set of issues for additional research. Priorities include:

- *Better data*. The power of comparative analysis proceeds from good data drawn from many different cities. Furthermore, scholars require longitudinal (panel) data in order to draw conclusions regarding urban outcomes and their underlying causes. Data that sheds light specifically on informal sources of income will be particularly useful.

- *Better theory.* One line of investigation that seems ripe is the institutional context of improvements in slum conditions. How do the key institutional players and the rules of the game vary from city to city? Are there important success stories that can help ground a theory of the institutional antecedents for systematic improvements in slum conditions?

- *Better analytical frameworks.* These will help us arrive at better interpretations of multisectoral and multidimensional data on living conditions and poverty, to translate such data into well-tailored urban interventions, and to assist in communicating the justification for selected interventions.

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Tablular appendix

As a general note to the tables in this annex, all household-level data analysis is based on sampling weights used in the survey; individual level data analysis is not.

Table 1. Demographics, household size, and composition

	Nairobi		Dakar		Johannesburg	
	N	% of total	N	% of total	N	% of total
Households	1,755	100	1,960	100%	1,618	31.7%
Household size	2.97		9.58		3.69	
Single-person households	482	27.6	34	1.7%	148	9.2 %
Female-headed households	304	17.3	400	22.0%		
Mean age of household head (yrs)	34.8		52.4			
Median age: household head (yrs)	32.0		52			
Age profile	N		N			
Age 0-4	825	15.7	2,315	12.3		
Age 5–14 (school age children)	976	18.6	4,361	23.1		
Age 15+ ("adults")	3455	65.7	12,213	64.7		
Age 0–10					1481	24.4
Age 11–20					1075	17.7
Age 21–40					2474	40.7
Age 41–65					971	16.0
> 65					79	1.3
Total no. of individuals	5256	100.0%	18,889	100.0	6080	100.0%
Gender ratio, male: female	Ratio (N)	Ratio (%)	Ratio (N)	Ratio (%)	Ratio (N)	Ratio (%)
All individuals	2899: 2357	55: 45	9470:9419	50:50	3019: 3061	50:50

Table 2. Educational attainment across individuals

Individuals 15 years of age or older

	Nairobi		Dakar		Johannesburg (slum)	
	N	%	N	%	N	%
None	786	20.6	7,721	64	937	26.4
Primary	1,849	48.4	3,296	27.3	933	26.3
Secondary	1,162	30.4	820	6.8	1,000	28
Postsecondary (including vocational/technical)	22	0.6	220	1.8	564	15.9
Don't know/other	—	-	-	-	119	3.4
Total	3819	100	12057	100	3434	100

Table 3. Within households

Attainment of the most educated member of the household; individuals 15 years of age or more

	Nairobi		Dakar		Johannesburg	
	N	%	N	%	N	%
None	223	12.7	466	24.7	239	14.1
Primary	833	46.8	848	43.3	337	21.4
Secondary	686	39.8	472	23.6	574	36.1
Postsecondary (including vocational/technical)	13	0.7	174	8.4	436	28.4
Total	1755	100	1960	100	1586	100

Table 4. Employment status across individual adults

Individuals 15 years of age or more)

	Nairobi		Dakar		Johannesburg	
	N	Percent	N	Percent	N	Percent
Unemployed	1,008	26.3	690	5.7	1,813	51.0
Self-employed (nonfarm)	726	19.0	2,782	23.1	5	0.1
Self-employed (farm)	0	0.0	0	0.0	10	0.3
Regular employee	954	24.9	944	7.8	1,007	28.3
Casual employee	913	23.9	1,018	8.4	354	10.0
Nonpaid family worker[1]	14	0.4	3,043	25.2	114	3.2
Student/apprentice	172	4.5	2,052	17.0	27	0.8
Others[2]/Don't know	40	1.1	1,532	12.7	223	6.3
Total	3,827	100	12,061	100	3,553	100

[1] Includes housewife/homemaker

[2] Includes pensioner/retired persons and disabled persons

Table 5. Employment status within households

	Nairobi		Dakar		Johannesburg	
	N	Percent	N	Percent	N	Percent
Self-employed	1,755	19.5	1,763	18.94	1,591	0.20
Casual employed	1,755	27.8	1,763	6.53	1,591	7.95
Regular employed	1,755	27.1	1,763	6.31	1,591	21.24
Unemployed	1,755	21.3	1,763	4.60	1,591	34.10

Table 6. Housing unit and tenure conditions: neighborhood safety

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
HOUSING UNIT CONDITION						
Mean household size	1,755	3.0	1,960	9.6	1,618	3.7
Mean number of rooms per household	1,755	1.2	1,956	4.1	1,609	1.8
Mean number of persons per room	1,755	2.6	1,956	2.8	1,609	2.3
Housing Structure—External Walls:	*1,755*		*1,951*			
Brick/stone/block		12.0		89.3		
Concrete (permanent)				6.6		
Mud/wood or mud/cement		37.2				
Mud only				0.5		
Wood only		6.0		3.0		
Tin or corrugated iron sheet (zinc)		44.6		0.5		
All others		0.2				
Housing Structure—Material for Floor:	*1,755*		*1,950*			
Earth/clay		31.9		9.5		
Tiles				13.0		
Cement		67.9		76.4		
All others		0.2		1.1		
TENURE CONDITIONS						
Home/land ownership (% of HHs):	*1,755*		*1,960*		*1,618*	
Own both land and structure		6.0		57.6		19.5
Own the structure but not the land		2.1		13.7		68.9
Tenants		91.9		25.8		11.3
Others		0.0		2.9		0.3
Type of tenancy agreement (% of HHs):	*1,613*		*918*			
Written formal tenancy agreement		3.5		5.9		
Verbal agreement		96.0		49.9		
No agreement (squatter)		0.5		44.2		
% of households who feel they have secure tenure	1,755	50.6	1,803	71.3		
Mean time in years lived in the current house	1,755	4.9	1,954	18.7		
Median time in years lived in the current house	1,755	3.0	1,954	17.0	1,618	5 to 9
Mean time in years lived in the settlement	1,755	8.8	1,953	20.8		
Median time in years lived in the settlement	1,755	6.0	1,953	20.0		
CRIMINAL LAW & ORDER						
% of households which has been a victim of crime in the past year	1,755	27.3	1,955	19.1	1,618	27.9
% of households who feel safe in their settlements	1,755	36.5	1,955	51.9		

Table 7-1. Infrastructure and services

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
Water use and unit cost						
Mean per capita water consumption in litres per day	1,750	23.4	1464	28.2		
Median value: per capita water consumption in liters per day		20.0		21.9		
Mean unit water cost in Ksh/Jerri can for those without connections	1,719	2.60				
Median value: unit water cost in Ksh/Jerri can		2.00				
Mean unit water cost in Ksh/Jerri can for those with connections	31	1.86				
Median value: unit water cost in Ksh/Jerri can		1.38				
Mean unit water cost in xx/liter for those without connections			813	0.10		
Median value: unit water cost in xx/liter for those without connections				0		
Mean unit water cost in xx/liter can for those with connections			1007	1.1		
Median value: unit water cost in xx/liter can for those with connections				0.56		
Primary sources of water (%)						
Piped in house/on-site: formal connection	67	4	1345	69	6	0
Piped in house/on-site: informal connection					36	2
Yard tap	240	15	274	15	589	36
Water kiosk	1,129	64				
Water vendors	33	2				
Private/public well			7	0		
Neighbor	17	1	57	3	149	10
Street/communal taps/standpipes					708	42
Ground tanks next to house					44	3
Borehole/rainwater/well					0	0
Groundwater/natural sources	87	5				
Other			6	0	86	7
More than one source	15	1	11	1		
No single primary water source	167	9	260	12		
TOTAL	1,755	100	1,960	100	1,618	100

Table 7-2. Infrastructure and services (cont'd)

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
Connections to electricity (% of households)						
Households with their homes connected to electricity	1,755	21.6	1960	81.9	1618	38.6
Primary source of home lighting (% of households)1 :	1,755		1958		1618	
Electricity		22.0		82.1		38.6
Kerosene/paraffin		77.1		4.8		90.8
Bougie				12.9		
Battery						17.0
Candle						85.1
Solar/other		0.9		0.2		
Street lighting (%)						
Households who say street light services exist in their settlements	1,755	14.3	1953	58.7		
Telephone access (%)						
Land telephone with service	1,755	0.2	1960	28.8	1618	2.1
Cell/mobile phone with service	1,755	19.7	1960	49.4	1618	22.2

Note: For Johannesburg, the data across households are not mutually exclusive, as in that survey each household was asked to give multiple (as opposed to only the "primary") sources used.

Table 7-3. Infrastructure and services

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
Toilet Facilities						
Type—% of households who use:	1,755		1,957		1,618	
No facility/flying toilets		5.9				
Neighbor's facilities				2.7		
Individual latrine with tank				38.4		8.9
Individual ordinary pit latrine		1.5				33.1
Individual VIP latrine		0.4		33.0		1.7
Flush toilet/water closet		22.9		19.8		16.2
Traditional latrine				3.2		
Chemical toilet						36.8
Public/shared latrine		59.4		2.2		
Public/shared VIP latrine		8.4				
Other		1.6		0.7		3.4
Average number of households sharing a toilet facility	1,615	19.1	1,658	1.4	1,329	16.2
Excreta disposal system (incl. sewerage) (%)	1,755		1,960			
Formal connection public sewer		11.8		7.7		
Informal connection to public sewer		17.2				
Septic tank/soak pit		0.8		58.5		
VIP latrine with tank				22.2		
Pit latrine		63.9				
Others				8.9		
NA/don't know		6.3		2.7		

Table 7-4. Infrastructure and services (cont'd)

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
Garbage disposal system (%)	1,755		1,958		1,618	
No organized system		87.7		23.7		9.5
Dumping in own neighborhood		78.1		22.9		
Burning/burying in own compound		9.6		0.8		
Organized system		12.3		76.3		90.5
Private collection system		10.9		3.9		
City/Municipal collection system		0.9		69.3		
Others		0.5		3.1		
Graywater disposal/drainage						
% of households with the following graywater disposal system:	1,755		1,960			
Pour into the drain		70.7		6.5		
Pour into the road or pavement		18.7		62.2		
Pour into pit latrine		1.0				
In a septic tank				2.5		
Puisard				6.7		
In an old well				1.5		
Caniveaux				3.5		
Other		9.6		17.1		
% of households with a drain outside their house	1,755	57.6	1,960	6.7		
% of households whose drain works properly most of the time	1,011	43.7	154	75.3		

Table 7-5. Infrastructure and services (cont'd)

Indicator	Nairobi		Dakar		Johannesburg	
	N	Value	N	Value	N	Value
Health services						
% of 0–14 year old immunized against BCG (tuberculosis)1	1,801	97.7	6,384	98.9		
% of households who say health services exist in their settlements	1,755	88.8	1,960	88.9		
% of households who say quality of health services is at least "satisfactory"					1,618	73.7
School facilities						
% of households who say public school services exist in their settlements	1,755	51.8	1,960	59.3		
% of households who say private school services exist in their settlements	1,755	85.2	1,960	58.1		
% of households whose children need to travel 30 min. or less to school					1,388	69.8
Roads						
% of households who say internal road systems exist within their settlements	1,755	97.6	1,960	35.0		
% of households who say access road services to their settlements exist	1,755	98.3	1,960	55.5		
Mode of transportation to school and work by individuals (%) [1,2]						
By foot	2,680	55.0	5,949	39.5		84.0
Bike	64	1.3	36	0.2		0.7
Motorbike						99.8
Private car	6	0.1	240	1.6		1.6
Shared taxi / gypsy taxi	3	0.1	100	0.7		
Taxi	2	0.0	36	0.2		0.5
Microbus/matatu	962	19.8	89	0.6		93.0
Bus regular	16	0.3	2,230	14.8		7.5
Train						21.3
Other	58	1.2	261	1.7		0.4
NA	1,033	21.2	5,575	37.0		
No response	47	1.0	1	0.0		
Do not know			542	3.6		
TOTAL	4,871	100	15,059	100	1,618	
Selective overall infrastructure access						
% of households who have neither piped water or electricity	1,755	66.0	1,960	2.8	1,618	44.3
% of households who have both piped water and electricity	1,755	6.5	1,960	75.7	1,618	30.7
% of households who have no piped water or electricity or permanent wall	1,755	62.8	1,951	0.5		
% of households who have piped water and electricity and permanent wall	1,755	3.4	1,951	74.3		

[1] Based on individual level survey data that is not weighted since the available sampling weight information is at the household unit level.

[2] For Johannesburg, the data is collected at the household level and are not mutually exclusive, as in that survey each household was asked to give multiple modes (instead of the primary mode) used by household members.

Table 8. Share of major expenditures in total monthly income and expenses

Percent

	Nairobi			Dakar		
	N	Mean	Median	N	Mean	Median
As percentage of basic HH expenditure in a typical month						
Rent	1,601	17.0	14.6	474	82.5	12.0
Food	1,754	58.8	52.9	1,832	n.a.	n.a.
Transport	1,753	11.4	6.7	1,427	n.a.	n.a.
Water (All households (HH))	1,753	4.4	3.6		n.a.	n.a.
Water (HH with connection)				1,380	9.6	2.2
Water (HH without connection)				937	3.1	0.0
Electricity	362	4.7	4.0	1,480	36.5	2.5
Refuse collection	161	1.0	0.8	64	8.4	0.3
As percentage of monthly HH income						
Rent	1,282	11.7	10.0	329	22.4	15.8
Food	1,400	41.2	37.5	1,171	n.a.	n.a.
Transport	1,399	7.7	4.3	935	n.a.	n.a.
Water (All HHs)	1,400	3.1	2.6		n.a.	n.a.
Water (HH with connection)				899	5.2	3.2
Water (HH without connection)				616	0.9	0.0
Electricity	253	3.5	2.9	944	7.7	3.3
Refuse collection	129	0.7	0.6	37	0.6	0.4

Table 9. Demographics, household size, and composition

	Nairobi				Dakar			
	Poor		Nonpoor		Poor		Nonpoor	
	N	Percent of total	N	Percent of total	N	Percent of total	N	Percent of total
Households	1,282	72.5	473	27.5	1615	82.4	345	17.6
Household size *a, d*	3.38		1.88		10.06		7.25	
Single-person households a	199	15.2	283	60.1	13	0.8	21	6.1
Female-headed households c	238	18.5	66	14.0	333	22.0	67	22.0
Mean age of household head (yrs) d	34.8		34.6		53.2		48.1	
Median age: household head (yrs)	32.0		32.0		53		47	
Age profile	N	Percent	N	Percent	N	Percent	N	Percent
Age 0–4	717	16.5	108	11.9	1,968	12.0	347	13.8
Age 5–14 (school age children)	877	20.2	99	10.9	3,799	23.2	562	22.3
Age 15+ ("adults")	2,751	63.3	704	77.3	10,601	64.8	1,612	63.9
Total no. of individuals	4,345	100.0	911	100.0	16,368	100.0	2,521	100.0
Gender ratio, male: female	Ratio (N)	Ratio (%)	Ratio (N)	Ratio (%)	Ratio (N)	Ratio (%)	Ratio (N)	Ratio (%)
All individuals	2,320: 2,025	53: 47	579: 332	64: 36	8,203: 8,165	50:50	1,267: 1,254	50:50

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 10. Education level across individual adults

Individuals 15 years of age or older

	Nairobi				Dakar			
	Poor		Nonpoor		Poor		Nonpoor	
Education level	N	%	N	%	N	%	N	%
Less than primary education	669	22.6	117	13.6	6,814	65.2	907	56.7
Completed primary education	1,494	50.5	355	41.2	2,809	26.9	487	30.5
Some/completed secondary education	790	26.7	372	43.2	664	6.4	156	9.8
Postsecondary training	5	0.2	17	2.0	171	1.6	49	3.1
Total	2,958	100	861	100	10,458	100	1,599	100

Table 11. Highest education level within households

| | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
Education level	N	%	N	%	N	%	N	%
Less than primary education	164	12.8	59	12.3	379	24.5	87	25.6
Completed primary education	628	48.2	205	43.3	725	44.9	123	35.2
Some/completed secondary education	486	38.7	200	42.5	376	22.7	96	28.0
Postsecondary training	4	0.3	9	1.9	135	7.9	39	11.2
Total	1,282	100	473	100	1,615	100	345	100

Note: Difference between P-NP household is significant at 1% level for both cities.

Table 12. Employment status across individual adults (>15 years of age)

| | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
	N	Percent	N	Percent	N	Percent	N	Percent
Unemployed	873	29.4	135	15.7	592	5.7	98	6.1
Self-employed (non-farm)	544	18.3	182	21.1	2,418	23.1	364	22.7
Regular employee	646	21.8	308	35.8	798	7.6	146	9.1
Casual employee	716	24.1	197	22.9	878	8.4	140	8.7
Nonpaid family worker[1]	13	0.4	1	0.1	2,611	25.0	432	27.0
Student/apprentice	144	4.9	28	3.3	1,807	17.3	245	15.3
Others[2]/Don't know	30	1.0	10	1.2	1,354	13.0	178	11.1
Total	2,966	100	861	100	10,458	100	1,603	100

[1] Includes housewife/homemaker

[2] Includes pensioner/retired persons and disabled persons

Table 13. Employment status within households

| | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
	N	Percent	N	Percent	N	Percent	N	Percent
Self employed a	1,282	18.6	473	22.0	1,442	18.5	321	20.8
Casual employed	1,282	27.8	473	27.9	1,442	6.2	321	8.1
Regular employed a, d	1,282	23.4	473	36.8	1,442	5.8	321	8.8
Unemployed a	1,282	25.4	473	10.5	1,442	4.7	321	4.2

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 14-1. Housing unit and tenure conditions: neighborhood safety

| Indicator | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
	N	Value	N	Value	N	Value	N	Value
HOUSING UNIT CONDITION								
Mean household size *a, d*	1,282	3.38	473	1.88	1,615	10.1	345	7.3
Mean number of rooms per household *d*	1,282	1.2	473	1.2	1,613	4.1	343	3.7
Mean number of persons per room *a, d*	1,282	3.0	473	1.6	1,613	2.9	343	2.3
Housing structure—material for external walls: *c, d*	1,282		473		1,607		344	
Brick/stone/block		9.3		19.0		91.4		79.1
Concrete (permanent)						4.6		16.1
Mud/wood or mud/cement		40.2		29.1				
Mud only						0.4		1.0
Wood only		6.3		5.2		2.9		3.8
Tin or corrugated iron sheet (zinc)		44.0		46.5		0.7		0.0
All others		0.2		0.2				
Housing Structure- Material for Floor: *d*	1,282		473		1,606		344	
Earth/clay		33.7		27.3		10.5		4.8
Tiles						10.3		25.8
Cement		66.1		72.7		78.4		66.7
All others		0.2		0.0		0.8		2.7

Note: Statistical significance for difference in the corresponding indicator value between poor and nonpoor households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 14-2. Housing unit and tenure conditions; neighborhood safety (cont'd)

	Nairobi				Dakar			
	Poor		Nonpoor		Poor		Nonpoor	
Indicator	N	Value	N	Value	N	Value	N	Value
TENURE CONDITIONS								
Home/land ownership composition (% of HHs): *d*	1,282		473		1,615		345	
Own both land and structure		5.8		6.8		59.1		49.9
Own the structure but not the land		2.1		2.0		14.4		10.0
Tenants		92.1		91.2		23.7		36.4
Others		0.0		0.0		2.8		3.7
Type of tenancy agreement (% of HHs): e	1,182		431		720		198	
Written formal tenancy agreement		2.9		5.2		4.7		10.2
Verbal agreement		96.5		94.4		49.0		53.3
No agreement (squatter)		0.6		0.5		46.2		36.5
% of households who feel they have secure tenure	1,282	49.6	473	53.5	1,478	71.3	325	71.2
Mean time in years lived in the current house: *b, d*	1,282	5.1	473	4.4	1,610	19.6	344	14.7
Median time in years lived in the current house	1,282	3.0	473	3.0	1,610	18.0	344	10.0
Mean time in years lived in the settlement: *d*	1,282	8.6	473	9.1	1,609	21.4	344	17.7
Median time in years lived in the settlement	1,282	6.0	473	6.0	1,609	20.0	344	15.0
CRIMINAL LAW & ORDER								
% of households which has been a victim of crime in the past year	1,282	26.1	473	30.5	1,610	19.3	345	17.9
% of households who feel safe in their settlements: *f*	1,282	37.7	473	33.1	1,614	50.9	341	56.8

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

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Table 15-1. Infrastructure and services

	Nairobi				Dakar			
	Poor		Nonpoor		Poor		Nonpoor	
Indicator	N	Value	N	Value	N	Value	N	Value
Water use and unit cost								
Mean per capita water consumption in liters per day *a, d*	1,277	21.0	473	29.8	1,215	26.8	249	34.9
Median value: per capita water consumption in L/day		20.0		20.0		20.9		25.0
Mean unit water cost in Ksh/Jerri can for those without connections b	1,257	2.55	462	2.74				
Median value: unit water cost in Ksh/Jerri can		2.00		3.00				
Mean unit water cost in Ksh/Jerri can for those with connections	20	1.77	11	2.03				
Median value: unit water cost in Ksh/Jerri can		1.25		1.48				
Mean unit water cost in XOF/liter for those without connections					665	0.10	148	0.11
Median value: unit water cost in XOF/liter for those without connections						0.02		0.55
Mean unit water cost in XOF/liter can for those with connections					827	1.1	180	1.1
Median value: unit water cost in XOF/liter can for those with connections						0.55		0.67
Primary sources of water (%)								
Private piped	48	4	19	4	1102	68	243	70
Piped in house/on-site: informal connection								
Yard tap	164	14	76	17	238	16	36	11
Water kiosk	835	65	294	61				
Water vendors	26	2	7	2				
Private/public well					6	0	1	0
Neighbor	15	1	2	0	46	3	11	3
Street/communal taps/standpipes								
Ground tanks next to house								
Borehole/rainwater/well								
Groundwater/natural sources	49	4	38	8				
Other					6	0	0	0
More than one source	14	1	1	0	11	1	0	0
No single primary water source	131	10	36	8	206	11	54	15
TOTAL	1,282	100	473	100	1,615	100	345	100

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 15-2. Infrastructure and services (cont'd)

| | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
Indicator	N	Value	N	Value	N	Value	N	Value
Connections to electricity								
% of households with their homes connected to electricity: *a, e*	1,282	18.2	473	30.5	1,615	80.9	345	86.4
Primary source of home lighting (% of households) : *a*	1,282		473		1,613		345	
Electricity		19.1		29.6		81.2		86.1
Kerosene/paraffin		80.0		69.5		5.2		3.0
Bougie						13.3		10.9
Solar/other		0.9		0.9		0.3		0.0
Street lighting (%)								
Households who say street light services exist in their settlements	1,282	14.4	473	13.9	1,608	57.9	345	62.7
Telephone access (%)	1,282		473		1,615		345	
Land telephone with service d		0.2		0.2		26.9		38.0
Cell/mobile phone with service *a, d*		16.4		28.4		47.3		59.3

Note: Statistical significance for difference in the corresponding indicator value between poor and nonpoor households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 15-3. Infrastructure and services (cont'd)

| | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
Indicator	N	Value	N	Value	N	Value	N	Value
Toilet facilities								
Type—% of households who use:	1,282		473		1,612		345	
No facility/flying toilets		5.8		6.1				
Neighbor's facilities						2.81		2.37
Individual latrine with tank						39.63		32.48
Individual ordinary pit latrine		1.8		0.5				
Individual VIP latrine		0.4		0.4		32.70		34.29
Flush toilet/water closet		22.1		24.9		18.51		26.15
Traditional latrine						3.30		2.66
Public/shared latrine		60.5		56.4		2.27		1.63
Public/shared VIP latrine		7.7		10.4				
Other		1.6		1.3		0.79		0.43
Average number of households sharing a toilet facility *e*	1,180	19.4	435	18.5	1,398	1.4	260	1.8
Excreta disposal system (incl. sewage) (%) *c, e*	1,282		473		1,615		345	
Formal connection public sewer		11.0		14.0		7.7		7.7
Informal connection to public sewer		18.3		14.2				
Septic tank/soak pit		0.4		1.6		56.8		66.7
VIP Latrine with tank						23.0		18.1
Pit latrine		64.2		63.2				
Others						9.4		6.2
NA/Don't know		6.1		6.9		3.1		1.2

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 15-4. Infrastructure and services (cont'd)

| Indicator | Nairobi | | | | Dakar | | | |
| | Poor | | Nonpoor | | Poor | | Nonpoor | |
	N	Value	N	Value	N	Value	N	Value
Garbage disposal system (% of households) d	1,282		473		1,613		345	
No organized system		88.8		84.9		25.4		15.7
Dumping in own neighborhood		79.0		75.7		24.7		14.5
Burning/burying in own compound		9.8		9.2		0.7		1.2
Organized system		11.2		15.1		74.6		84.3
Private collection system		10.1		13.1		67.3		79.2
City/Municipal collection system		0.7		1.4		4.0		3.3
Others		0.4		0.6		3.3		1.8
Graywater disposal/drainage								
% of households with the following "graywater" disposal system: d	1,282		473		1,615		345	
Pour into the drain		71.0		70.0		6.50		6.62
Pour into the road or pavement		19.4		16.8		63.03		57.90
Pour into pit latrine		1.0		0.7				
In a septic tank						1.86		5.55
Puisard						5.98		10.11
In an old well						1.33		2.15
Caniveaux						3.61		3.18
Other		8.5		12.5		17.68		14.49
% of households with drain outside house	1,282	56.4	473	60.5	1,615	6.4	345	8.4
% of households whose drain works most of the time	1,282	25.0	473	25.7	122	73.8	32	80.9

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

Table 15-5. Infrastructure and services (cont'd)

Percent

Indicator	Nairobi				Dakar			
	Poor		Nonpoor		Poor		Nonpoor	
	N	Value	N	Value	N	Value	N	Value
Health services								
% of 0–14-year-olds immunized against BCG (tuberculosis)[1]	1,559	97.8	207	96.6	5,509	99.0	875	98.3
% of households who say health services exist in their settlements *b, f*	1,282	87.4	473	92.3	1,615	89.6	345	85.5
School facilities								
% of HHs who say public school services exist in their settlements *f*	1,282	50.9	473	54.4	1,615	59.7	345	57.6
% of HHs who say private school services exist in their settlements *a*	1,282	84.0	473	88.4	1,615	57.9	345	59.3
Road facilities								
% of HHs who say internal road systems exist within their settlements *f*	1,282	97.4	473	98.0	1,615	36.2	345	29.0
% of HHs who say access road services to their settlements exist c	1,282	98.0	473	98.9	1,615	54.5	345	60.2
Primary mode of transportation to school and work by individuals (%)								
By foot	2,259	58.1	421	42.9	5,111	39.1	838	42.2
Bike	47	1.2	17	1.7	29	0.2	7	0.4
Private car	1	0.0	5	0.5	188	1.4	52	2.6
Shared taxi / Gypsy taxi	3	0.1	0	0.0	84	0.6	16	0.8
Taxi	0	0.0	2	0.2	20	0.2	16	0.8
Microbus/matatu	595	15.3	367	37.4	80	0.6	9	0.5
Bus regular	13	0.3	3	0.3	1,921	14.7	309	15.6
Other	40	1.0	18	1.8	227	1.7	34	1.7
NA	896	23.0	137	14.0	4,933	37.7	0	0.0
No response/ Do not Know	36	0.9	11	1.1	480	3.8	705	35.5
TOTAL	3,890	100	981	100	13,073	100	1,986	100
Selective overall infrastructure access								
% of households who has neither piped water or electricity a	1,282	68.6	473	59.1	1,615	2.7	345	2.9
% of households who has both piped water and electricity a	1,282	4.8	473	10.9	1,615	74.9	345	79.5
% of households who has no piped water or electricity or permanent wall a	1,282	65.2	473	56.3	1,615	0.3	345	1.1
% of households who has piped water and electricity and permanent wall a	1,282	2.0	473	7.1	1,615	73.7	345	76.9

Note: Statistical significance for difference in the corresponding indicator value between "poor" and "nonpoor" households: (1) In Nairobi: "a"—1% level; "b"—5% level; "c"—10% level; (2) In Dakar: "d"—1% level; "e"—5% level; "f"—10% level.

[1] Based on individual level survey data that is not weighted since the available sampling weight information is at the household unit level.

Table 16. Share of major expenditures in total monthly income and expenses

Percent

	Nairobi						Dakar					
	Poor			Nonpoor			Poor			Nonpoor		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
As percentage of basic HH expenditure in a typical month												
Rent	1,173	17.0	15.0	428	16.9	13.9	359	101.3	12.5	115	23.9	10.0
Food	1,281	60.3	54.5	473	54.8	48.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Transport	1,280	9.7	0.0	473	15.8	13.3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Water (all HHs)	1,280	4.8	4.0	473	3.4	2.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Water (HH with connection)							1117	10.8	2.3	263	4.7	2.1
Water (HH without connection)							755	3.8	0.0	182	0.1	0.0
Electricity	218	5.4	4.2	144	3.7	3.1	1,200	43.9	2.8	280	4.5	1.7
Refuse collection	117	1.0	0.8	44	1.0	0.6	54	9.9	0.3	10	0.2	0.2
As percentage of monthly HH income												
Rent	927	11.9	10.6	355	11.3	10.0	241	23.2	16.7	88	20.4	12.5
Food	1,011	43.1	40.0	389	36.5	35.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Transport	1,010	6.6	0.0	389	10.3	10.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Water (All HHs)	1,011	3.4	3.0	389	2.3	1.8						
Water (HH with connection)							714	5.5	3.3	185	4.3	2.7
Water (HH without connection)							488	1.0	0.0	128	0.4	0.0
Electricity	151	4.0	3.3	102	2.7	2.5	746	8.1	3.6	198	6.2	2.5
Refuse Collection	94	0.8	0.6	35	0.6	0.4	31	0.7	0.5	6	0.4	0.3

Table 17. Nairobi home electricity: coverage insights

				Coverage (percentage of households with access)					
		# of EAs with no electricity			Across constituent EAs				
Division	Number of EAs		Number of HHs	Across divisions	min	max	med	mean	sd
1. Central	10	0	198	28	5	90	18	28	28
2. Makadara	9	1	175	10	0	21	10	10	6
3. Kasarani	10	2	198	11	0	30	10	11	9
4. Embakasi	9	5	179	8	0	35	0	8	12
5. Pumwani	6	1	120	35	0	85	30	35	33
6. Westlands	3	0	60	27	10	60	10	27	29
7. Dagoretti	17	2	331	47	0	100	40	47	32
8. Kibera	24	10	494	12	0	85	8	13	19
ALL	88	21	1,755	22	0	100	11	22	26

Table 18. Dakar home electricity: coverage insights

Division	Number of EAs	# of EAs with no electricity	Number of HHs	Coverage (percentage of households with access)					
				Across divisions	Across constituent EAs				
					min	max	med	mean	sd
Nolivet/Barak	4	1	40	27	0	73	17	27	32
Arafat	11	0	200	87	65	100	89	87	11
Hann	12	0	250	86	75	96	88	86	8
Dalifort	4	0	60	70	60	75	72	70	7
Santiaba	4	0	80	81	70	100	76	81	13
Taïf	10	0	200	79	65	90	83	79	9
Guinaw	16	0	400	85	73	95	88	85	9
Médina	16	0	300	80	60	100	80	80	12
Wakhinane	9	0	180	83	75	95	80	83	7
Diokoul	13	0	250	93	75	100	95	93	8
ALL	99	1	1960	82	0	100	85	82	16

Table 19. Nairobi home electricity: logistic regression results for household access

Variable	Odds-ratio	Standard error	p-value
Poor	0.574	0.096	0.001
Tenant	0.371	0.111	0.001
Locations			
1. Central (base)			
2. Makadara	0.305	0.132	0.008
3. Kasarani	0.325	0.141	0.011
4. Embakasi	0.219	0.134	0.015
5. Pumwani	1.497	0.986	0.542
6. Westlands	0.769	0.594	0.735
7. Dagoretti	2.032	0.953	0.134
8. Kibera	0.330	0.161	0.026
N 1,755			
U2 0.14			

Table 20. Dakar home electricity: logistic regression results for household access

Variable	Odds-Ratio	Standard error	p-value
Poor	0.544	0.104	0.002
Tenant	0.399	0.061	0.000
Locations			
1. Nolivet/Barak	0.052	0.043	0.001
2. Arafat (base)			
3. Hann	0.815	0.280	0.553
4. Dalifort	0.313	0.090	0.000
5. Santiaba	0.418	0.175	0.041
6. Taïf	0.505	0.160	0.034
7. Guinaw	0.709	0.234	0.300
8. Médina	0.475	0.144	0.016
9. Wakhinane	0.670	0.210	0.204
10. Diokoul	1.355	0.546	0.454
N	1,960		
U2	0.07		

Table 21. Nairobi piped drinking water: coverage insights

Division	Number of EAs	# of EAs with no piped water	Number of HHs	Coverage (percentage of households with access)					
				Across divisions	Across constituent EAs				
					min	max	med	mean	sd
1. Central	10	4	198	24	0	75	23	24	25
2. Makadara	9	3	175	13	0	72	5	13	23
3. Kasarani	10	0	198	23	5	70	18	23	21
4. Embakasi	9	5	179	8	0	45	0	8	15
5. Pumwani	6	0	120	24	5	85	13	24	31
6. Westlands	3	1	60	38	0	85	30	38	43
7. Dagoretti	17	7	331	21	0	70	20	21	23
8. Kibera	24	7	494	11	0	76	5	11	17
ALL	88	27	1755	19	0	85	10	18	22

Table 22. Dakar piped drinking water: coverage insights

Division	Number of EAs	# of EAs with no piped water	Number of HHs	Coverage (percentage of households with access)					
				Across divisions	Across constituent EAs				
					min	max	med	mean	sd
Nolivet/Barak	4	0	40	100	100	100	100	100	0
Arafat	11	0	200	93	80	100	95	93	6
Hann	12	0	250	91	75	100	93	91	7
Dalifort	4	0	60	59	18	93	63	59	31
Santiaba	4	0	80	99	96	100	100	99	2
Taif	10	0	200	93	75	100	95	93	9
Guinaw	16	0	400	93	75	100	95	93	7
Médina	16	0	300	95	80	100	96	95	6
Wakhinane	9	0	180	64	5	90	75	64	27
Diokoul	13	0	250	97	90	100	100	97	4
ALL	99	0	1960	90	5	100	95	90	16

Table 23. Nairobi piped water: logistic regression results for household access

Variable	Odds-ratio	Standard error	p-value
Poor	0.803	0.137	0.202
Tenant	0.782	0.235	0.417
Locations			
1. Central (base)			
2. Makadara	1.083	0.964	0.929
3. Kasarani	1.294	0.725	0.647
4. Embakasi	0.239	0.176	0.055
5. Pumwani	1.271	0.998	0.761
6. Westlands	3.406	3.234	0.200
7. Dagoretti	1.007	0.546	0.990
8. Kibera	0.530	0.296	0.259
N	1,755		
U2	0.04		

Table 24. Dakar piped water: logistic regression results for household

Variable	Odds-ratio	Standard error	p-value
Poor	0.715	0.156	0.129
Tenant	0.460	0.072	0.000
Locations			
1. Nolivet/Barak*			
2. Arafat (base)			
3. Hann	0.686	0.244	0.293
4. Dalifort	0.113	0.061	0.000
5. Santiaba	4.772	4.152	0.076
6. Taïf	0.859	0.396	0.744
7. Guinaw	1.067	0.411	0.866
8. Médina	1.172	0.485	0.702
9. Wakhinane	0.118	0.053	0.000
10. Diokoul	1.765	0.730	0.173
N	1,920		
U2	0.15		

* Dropped because all the 40 sample households in this location have access to piped drinking water.

Appendix A   Spatial heterogeneity in service access in Johannesburg

This section examines differences in access across space within Johannesburg. As noted earlier in Section 4 in the paper, we discuss this analysis for Johannesburg separately from that of Nairobi and Dakar because of lack of comparable underlying data in two ways. First, unlike for Nairobi and Dakar, the data for Johannesburg are not exclusively for slum settlement but for selected underserved urban areas. Second, we do not have a household poverty-level measure for Johannesburg, as we do for Nairobi and Dakar. We still wanted to glean some insights, however, from the spatial heterogeneity in infrastructure access within Johannesburg based on an analogous type of analysis.

Accordingly, here we rely on the 11 divisions and 253 constituent enumeration areas (EAs) that were used to design the sampling frame for Johannesburg underserved areas. We examine the same two categories of infrastructure: home electricity and piped-water connections as we did for Nairobi and Dakar. As for the logistic regressions at the household level to investigate whether the supply and demand side factors do play roles in explaining the observed variations in coverage levels of these two types of infrastructure, we use whether a household resides in a shack-type dwelling or not as the relative measure of household poverty level in absence of direct data on poverty level. In all other respects, the analysis here follows the same approach as we used for Nairobi and Dakar. The results are discussed below.

Electricity connections

Table A1a summarizes how the electricity coverage varies *across* the 11 divisions in the city and *within* each division across its constituent EAs. All the divisions report at least some households with electricity suggesting the presence of trunk infrastructure in all divisions. However, the coverage levels do vary considerably across divisions with a mean of 71 percent and s.d. of 39. The minimum level coverage is 49 percent (Johannesburg South) and the maximum level is 94 percent (Sandton/Rosebank). We also find that 64 percent (7 out of 11) of the divisions have at least one or more EAs that completely lack access to electricity and about 16 percent (41 out of 253) of all EAs have no access.

Table A1b presents the results from the household-level logistic regression results that shed insight into the extent of roles by demand and supply side factors in explaining the observed spatial differences in electricity coverage levels within the city. The results show (at 10 percent significance level or less) that tenancy status does not play much of a role in terms of a household's access to electricity. However, in terms of whether the household lives in a shack or not, it does appear to affect the probability of access. Specifically, the likelihood of a shack household having access to electricity is only about 14 percent of that of a nonshack household. We also find that several location odds ratios are statistically significant. That indicates that, after controlling for demand side factors, residential location also matters greatly in determining access—a likely reflection of differences in supply side bottlenecks across locations. For example, the likelihood of households residing in Roodepoort of having access to electricity is only 10 percent of those residing in Alexandra division.

Table A1a. Johannesburg home electricity: coverage insights

Division	Number of EAs	# of EAs with no electricity	Number of HHs	Coverage (percentage of households with access)					
				Across divisions	Across constituent EAs				
					min	max	med	mean	sd
Alexandra	35	0	738	80	30	100	88	80	20
Central region	17	0	332	87	20	100	100	87	23
Diepkloof / meadowlands	27	8	545	57	0	100	90	57	46
Diepsloot	16	4	321	67	0	100	95	67	46
Doornkop / soweto	45	12	941	55	0	100	85	55	46
Ennerdale / orange farm	58	10	1,158	75	0	100	95	75	40
Johannesburg south	4	1	81	49	0	95	51	49	39
Midrand / ivory park	31	0	568	87	7	100	95	87	24
Northcliff	3	1	59	67	0	100	100	67	58
Roodepoort	11	5	216	55	0	100	100	55	52
Sandton / rosebank	6	0	139	94	80	100	100	94	9
All	253	41	5098	71	0	100	95	71	39

Table A1b. Johannesburg home electricity: logistic regression results for household access

Variable	Odds ratio	Standard error	p-value
Shack	0.142	0.029	0.000
Tenant	1.312	0.216	0.101
Locations			
1. Alexandra ("base")			
2. Central region	1.155	0.628	0.791
3. Diepkloof / Meadowlands	0.199	0.112	0.005
4. Diepsloot	0.694	0.626	0.686
5. Doornkop / Soweto	0.474	0.222	0.113
6. Ennerdale / Orange Farm	1.270	0.550	0.581
7. Johannesburg south	0.216	0.233	0.157
8. Midrand / Ivory Park	1.426	0.737	0.493
9. Northcliff	0.078	0.085	0.021
10. Roodepoort	0.103	0.083	0.005
11. Sandton / Rosebank	2.706	1.378	0.053
N	5098		
U^2	0.22		

Piped water connections

Table A2a shows the spatial variation of the piped water coverage. As with electricity, we find that all the divisions report at least some households with piped water access suggesting the presence of trunk infrastructure in all divisions. The coverage levels do vary considerably across divisions with a mean of 75 percent and s.d. of 37. The minimum level coverage is 53 percent (Diepkloof/Meadowlands) and the maximum level is the full 100 percent coverage (Sandton/Rosebank). We also find that 55 percent (6 out of 11) of the divisions have at least one or more EAs that completely lack access to piped water and about 9 percent (23 out of 253) of all EAs have no access.

Table A2a. Johannesburg piped drinking water: coverage insights

Division	Number of EAs	# of EAs with no piped water	Number of HHs	Coverage (percentage of households with access)					
				Across divisions	Across constituent EAs				
					min	max	med	mean	sd
Alexandra	35	0	738	93	45	100	100	93	16
Central region	17	0	332	94	5	100	100	94	23
Diepkloof / Meadowlands	27	5	545	53	0	100	48	53	44
Diepsloot	16	4	321	63	0	100	100	63	47
Doornkop / Soweto	45	4	941	67	0	100	85	67	38
Ennerdale / Orange Farm	58	6	1,158	67	0	100	95	67	40
Johannesburg South	4	1	81	69	0	100	88	69	47
Midrand / Ivory Park	31	0	568	94	21	100	100	94	17
Northcliff	3	0	59	68	5	100	100	68	55
Roodepoort	11	3	216	64	0	100	100	64	50
Sandton / Rosebank	6	0	139	100	100	100	100	100	0
All	253	23	5098	75	0	100	100	75	37

Table A2b presents the results from the household level logistic regression results for piped water access. As in the case of electricity, we again find that (at 10 percent significance level or less) tenancy status does not play much of a role in terms of a household's access to piped water, but whether the household lives in a shack or not does. Specifically, the likelihood of a shack household having access to piped water is only about 16 percent of that of a non-shack household. We also find that, after controlling for demand side factors, residential location also matters greatly in determining access. For example, the likelihood of households residing in Roodepoort of having access to electricity is only 7 percent of those residing in Alexandra division.

Table A2b. Johannesburg piped drinking water: logistic regression results for household access

Variable	Odds ratio	Standard error	p-value
Shack	0.157	0.040	0.000
Tenant	1.100	0.238	0.660
Locations			
1. Alexandra (base)			
2. Central Region	0.524	0.535	0.528
3. Diepkloof / Meadowlands	0.064	0.033	0.000
4. Diepsloot	0.174	0.158	0.057
5. Doornkop / Soweto	0.328	0.183	0.048
6. Ennerdale / Orange Farm	0.194	0.125	0.012
7. Johannesburg South	0.131	0.193	0.170
8. Midrand / Ivory Park	1.269	0.944	0.749
9. Northcliff	0.035	0.027	0.000
10. Roodepoort	0.073	0.076	0.013
11. Sandton / Rosebank*			
N	4,959		
U^2	0.23		

* Dropped because all the 139 sample households in this location have access to piped drinking water.

Appendix B   Supply-side vs. demand-side determinants of infrastructure access

This appendix first discusses a heuristic computational approach developed in the study by Foster and Arauju (2004) to investigate to what extent demand and supply side factors might explain any observed spatial variations in access across neighborhoods (EAs) within a city. We present and discuss results based on this approach for Nairobi, Dakar and Johannesburg slum/underserved settlements.

The heuristic computational approach

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 that 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:

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

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:

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

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.

Application of the approach to our data for the three cities

We applied the aforesaid approach to our data for the three cities with respect to the two types of infrastructure: electricity and piped water. The results for electricity are presented in Tables B1a-c and for piped water in Tables B2a-c. A household is deemed to have access to piped water or electricity if the household lives in an EA (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 averages across the 3 cities for each of the two selected infrastructures. All averages are provided both with sample population weights and without weights. Since the results are quite similar, we discuss the results with respect non-weighted averages for the 3 cities. (See tables B1a-c and tables B2a-c.)

Electricity

The results suggest that access at the neighborhood (EA) level is fairly widespread in all the three cities: 80, 98 and 82 percent for Nairobi, Dakar and Johannesburg respectively. However, take-up rates are especially lower in Nairobi at 27 percent compared to 78 percent and 86 percent in Dakar and Johannesburg respectively. This means that the coverage rate for electricity in Nairobi is only 22 percent compared to 77 percent and 70 percent in Dakar and Johannesburg respectively. The proportion of the deficit in coverage attributable to demand-side factors is 76 percent for Nairobi compared to 97 percent and 52 percent in Dakar and Johannesburg respectively. On the other hand, the proportion of the deficit in coverage that is attributable only to supply-side factors is 6 percent for Nairobi compared to 1 percent and 42 percent in Dakar and Johannesburg respectively. The combined demand and supply-side problems account for 18 percent in Nairobi, 2 percent in Dakar and 5 percent in Johannesburg. Clearly, these results suggest that demand-side factors may be larger than supply-side factors in explaining lack of electricity infrastructure coverage in the 3 cities.

Piped water

As with electricity, the results for piped water suggest that access at the neighborhood (EA) level is fairly widespread in all the 3 cities: 71 percent, 100 percent and 90 percent for Nairobi, Dakar and Johannesburg respectively. However, again take-up rates are especially lower in Nairobi at 29 percent compared to 88 percent and 84 percent in Dakar and Johannesburg respectively. This means that the coverage rate for piped water in Nairobi is only 20 percent compared to 88 percent and 76 percent in Dakar and Johannesburg respectively. The proportion of the deficit in coverage attributable to demand-side factors is 64 percent for Nairobi compared to 100 percent and 68 percent in Dakar and Johannesburg respectively. On the other hand, the proportion of the deficit in coverage that is attributable only to supply-side factors is 12 percent for Nairobi compared to 0 percent and 27 percent in Dakar and Johannesburg respectively. The combined demand and supply-side problems account for 25 percent in Nairobi, 0 percent in Dakar and 6 percent in Johannesburg. Again, as with electricity, clearly these results based on the heuristic approach suggest that demand-side factors may be larger than supply-side factors in explaining lack of piped water infrastructure coverage in the three cities.

Table B1a. Nairobi home electricity

Percent

Division	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
Central	100	28	28	72	72	0	0	0	100	0	0
Makadara	89	11	10	90	79	11	1	10	88	1	11
Kasarani	80	14	11	89	69	20	3	17	78	3	19
Embakasi	44	18	8	92	36	56	10	46	40	11	50
Pumwani	83	42	35	65	48	17	7	10	74	11	15
Westlands	100	27	27	73	73	0	0	0	100	0	0
Dagoretti	88	53	47	53	41	12	6	5	78	12	10
Kibera	58	21	12	88	46	42	9	33	53	10	38
Simple average	80	27	22	78	58	20	4	15	76	6	18
Weighted average	76	27	22	78	54	24	6	19	71	7	22

Table B1b. Dakar home electricity

Percent

Division	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
Nolivet/Barak	75	36	27	73	48	25	9	16	66	12	22
Arafat	100	87	87	13	13	0	0	0	100	0	0
Hann	100	86	86	14	14	0	0	0	100	0	0
Dalifort	100	70	70	30	30	0	0	0	100	0	0
Santiaba	100	81	81	19	19	0	0	0	100	0	0
Taïf	100	79	79	21	21	0	0	0	100	0	0
Guinaw	100	85	85	15	15	0	0	0	100	0	0
Médina	100	80	80	20	20	0	0	0	100	0	0
Wakhinane	100	83	83	17	17	0	0	0	100	0	0
Diokoul	100	93	93	7	7	0	0	0	100	0	0
Simple average	98	78	77	23	20	3	1	2	97	1	2
Weighted average	99	82	82	17	16	1	0	0	98	0	0

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Table B1c. Johannesburg home electricity

Percent

Division	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
Alexandra	100	80	80	20	20	0	0	0	100	0	0
Central Region	100	87	87	13	13	0	0	0	100	0	0
Diepkloof / Meadowlands	70	81	57	43	13	30	24	6	30	57	13
Diepsloot	75	89	67	33	8	25	22	3	24	67	8
Doornkop / Soweto	73	75	55	45	18	27	20	7	40	45	15
Ennerdale / Orange Farm	83	90	75	25	8	17	15	2	32	61	7
Johannesburg South	75	65	49	51	26	25	16	9	51	32	17
Midrand / Ivory Park	100	87	87	13	13	0	0	0	100	0	0
Northcliff	67	100	67	33	0	33	33	0	0	100	0
Roodepoort	55	100	55	45	0	45	45	0	0	100	0
Sandton / Rosebank	100	94	94	6	6	0	0	0	100	0	0
Simple average	82	86	70	30	11	18	16	2	52	42	5
Weighted average	84	84	71	29	13	16	13	3	55	38	7

Table B2a. Nairobi piped water

Percent

Division	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
Central	60	40	24	76	36	40	16	24	47	21	32
Makadara	67	20	13	87	54	33	7	27	62	7	31
Kasarani	100	23	23	77	77	0	0	0	100	0	0
Embakasi	44	18	8	92	36	56	10	46	40	11	50
Pumwani	100	24	24	76	76	0	0	0	100	0	0
Westlands	67	57	38	62	29	33	19	14	46	31	23
Dagoretti	59	36	21	79	38	41	15	26	48	19	34
Kibera	71	16	11	89	60	29	5	25	67	5	28
Simple average	71	29	20	80	51	29	9	20	64	12	25
Weighted average	69	26	17	83	52	31	8	22	63	10	27

Table B2b. Dakar piped water

Percent

Division	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
Nolivet/Barak	100	100	100	0	0	0	0	0	—	—	—
Arafat	100	93	93	7	7	0	0	0	100	0	0
Hann	100	91	91	9	9	0	0	0	100	0	0
Dalifort	100	59	59	41	41	0	0	0	100	0	0
Santiaba	100	99	99	1	1	0	0	0	100	0	0
Taïf	100	93	93	7	7	0	0	0	100	0	0
Guinaw	100	93	93	7	7	0	0	0	100	0	0
Médina	100	95	95	5	5	0	0	0	100	0	0
Wakhinane	100	64	64	36	36	0	0	0	100	0	0
Diokoul	100	97	97	3	3	0	0	0	100	0	0
Simple average	100	88	88	12	12	0	0	0	100	0	0
Weighted average	99	89	89	10	10	0	0	0	97	0	0

Table B2c. Johannesburg piped water

Percent

Division	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
Alexandra	100	93	93	7	7	0	0	0	100	0	0
Central Region	100	94	94	6	6	0	0	0	100	0	0
Diepkloof / Meadowlands	81	65	53	47	28	19	12	7	60	26	14
Diepsloot	75	84	63	37	12	25	21	4	32	57	11
Doornkop / Soweto	91	74	67	33	24	9	7	2	73	20	7
Ennerdale / Orange Farm	90	74	67	33	23	10	7	3	70	22	8
Johannesburg South	75	92	69	31	6	25	23	2	19	74	6
Midrand / Ivory Park	100	94	94	6	6	0	0	0	100	0	0
Northcliff	100	68	68	32	32	0	0	0	100	0	0
Roodepoort	73	88	64	36	9	27	24	3	25	66	9
Sandton / Rosebank	100	100	100	0	0	0	0	0	—	—	—
Simple average	90	84	76	24	14	10	9	2	68	27	6
Weighted average	91	82	75	25	16	9	7	2	72	19	6

# About AICD

This study is a product of the Africa Infrastructure Country Diagnostic (AICD), a project designed to expand the world's knowledge of physical infrastructure in Africa. AICD will provide a baseline against which future improvements in infrastructure services can be measured, making it possible to monitor the results achieved from donor support. It should also provide a better empirical foundation for prioritizing investments and designing policy reforms in Africa's infrastructure sectors.

AICD is based on an unprecedented effort to collect detailed economic and technical data on African infrastructure. The project has produced a series of reports (such as this one) on public expenditure, spending needs, and sector performance in each of the main infrastructure sectors—energy, information and communication technologies, irrigation, transport, and water and sanitation. *Africa's Infrastructure—A Time for Transformation*, published by the World Bank in November 2009, synthesizes the most significant findings of those reports.

AICD was commissioned by the Infrastructure Consortium for Africa after the 2005 G-8 summit at Gleneagles, which recognized the importance of scaling up donor finance for infrastructure in support of Africa's development.

The first phase of AICD focused on 24 countries that together account for 85 percent of the gross domestic product, population, and infrastructure aid flows of Sub-Saharan Africa. The countries are: Benin, Burkina Faso, Cape Verde, Cameroon, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and Zambia. Under a second phase of the project, coverage is expanding to include as many other African countries as possible.

Consistent with the genesis of the project, the main focus is on the 48 countries south of the Sahara that face the most severe infrastructure challenges. Some components of the study also cover North African countries so as to provide a broader point of reference.

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The World Bank is implementing AICD with the guidance of a steering committee that represents the African Union, the New Partnership for Africa's Development (NEPAD), Africa's regional economic communities, the African Development Bank, the Development Bank of Southern Africa, and major infrastructure donors.

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The data underlying AICD's reports, as well as the reports themselves, are available to the public through an interactive Web site, www.infrastructureafrica.org, that allows users to download customized data reports and perform various simulations. Inquiries concerning the availability of data sets should be directed to the editors at the World Bank in Washington, DC.