Supplementary Information Appendix

Heterogeneity and Scale of Sustainable Development in Cities

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1. Supporting Information

1.1 Distributional Effects in Sustainability Urban Indicators
In the main text, we characterize several aspects of the heterogeneity of personal income and access to basic services as fundamental measures of sustainable development as defined by the recent *Sustainable Development Goals*. We emphasized the strong spatial and socioeconomic heterogeneity of these indicators across entire nations, and specifically within functional urban areas whose inhabitants share the same labor and real estate markets.

Here we provide a more comprehensive description of related work. In this section, we concentrate on a literature that refers to these issues in terms of so called *distributional effects*. As the term indicates distributional effects consider quantities beyond the mean, by analyzing higher statistical moments (such as the variance), inequality indices (such as the Gini coefficient) or indeed by characterizing frequency or probability distributions.

The discussion of distributional effects has become particularly relevant in the context of environmental and public goods provision policies and their differential effects on distinct segments of the population, especially when stratified by income (*1*–*3*). A pervasive concern in the literature on distributional effects is whether such policies are regressive, meaning that they impose a disproportionate burden on poorer populations, such as happens with (flat) consumption taxes (*1*, *4*–*8*). Though the problem analyzed in the main text is somewhat different – heterogeneity in *access* to services, rather than specifying policies for service revenue or taxes—we provide the reader here with a brief introduction to issues of distributional effects as they make clear that knowledge of the disaggregated impacts, whether by social and economic groups and by place, is critical for the design of urban sustainability policies.

This literature can be characterized in terms of the i) types of policies attempted, ii) the typology of the population to be served (e.g. income groups), and iii) the level of spatial aggregation in the analysis. Most past studies rely on relatively high levels of spatial aggregation within developed nations or are limited to just a few places. The results in the main text are novel with respect to our treatment of space as they produce, to the best of our knowledge, the first comprehensive analysis across all scales (neighborhood to country) in two large middle-income nations and show the way such analysis can be performed in any city or nation with similar, neighborhood level data.

One of the earliest literatures to emphasize distributional effects was focused on policies aimed at creating sustainable solutions related to air quality in the USA (*1*, *9*–*11*). It was established that poor air quality disproportionally impacted the poor (and certain other populations at risk) and, as such, that policies for improving air quality should be more targeted in order to truly affect the lives of the poor.

Similar concerns and more contemporary methods of analysis have been used to foresee or measure the impacts of other sustainable development policies. For example, Bitler and colleagues (*12*) analyzed the distributional consequences of specific welfare reforms in Connecticut, to find that policy results are more varied and more extensive then when evaluated in terms of means. Similarly, Hammer and colleagues have studied the impacts of social sector policies in Malaysia (*13*) between 1974-89, and in particular investments in education, finding that those targeted at universal primary education have had tremendous progressive consequences over the long term, while others less so. Thus, the analysis of the heterogeneity of effects as a result of policies or events provides a finer and more insightful view of processes and aids policy design and assessment.

A number of recent studies have analyzed distributional effects resulting from the privatization of services in Bolivia (*14*) and the United Kingdom (*6*), of water pricing models in São Paulo (*15*), or environmental and renewable energy policies in Germany (*16*, *17*), and of road congestion charges in the USA (*2*, *3*). Studies of household consumption, as they relate to greenhouse gas emissions, have also been analyzed in terms of their heterogeneity (*18*).

The overall conclusions from all these studies is that there is strong heterogeneity in patterns of consumption and emissions across households with different socioeconomic status, and that policies and assessments that forego distributional analyses will be unnecessarily blunt and may generate unintended consequences, such as being regressive.

Another important line of enquiry has analyzed the distributional impacts of changes in international trade and globalization on personal incomes. These studies tend to be tied to international policies, e.g. connected to World Bank Investments, World Trade Organization guidelines and others. For example, Goldberg and Pavcnik (*19*) conducted a large empirical study of measures of income inequality in developing nations (including skill wage premiums, wage and income Gini indices and other measures of heterogeneity). Garuda (*20*) performed a similar analysis of distributional effects across several nations as a result of International Monetary Fund policies to find adverse distributional effects in many cases. Such studies fit into a broader literature on progress in international policy targeted at eliminating poverty (*21*) and other sustainability goals and an increasing recognition that such effects need to be studied in greater detail across populations and places.

Most past analyses of the distributional impacts of specific development policies, however, apply to entire nations at once, without performing a scale-dependent disaggregation or emphasizing diverse urban areas, as we do here. Thus, in the main text, we establish and illustrate a systematic procedure to measure and evaluate sustainable development goals across scales, from neighborhoods to nations. In our view --supported by the results of numerous distributional effects studies -- only such systematic approaches can capture local variation and context in a way that renders the analysis general, and not merely circumstantial.

1.2. The Value and Role of Public Services for Sustainability Assessment

In this section, we discuss the importance of tracking service access as a fundamental component of sustainable development at the local level, and discuss how it gives us a window into local development beyond that provided by income assessments.

The inaccuracies introduced by ignoring non-cash income and the benefits of access to public goods and infrastructure have long been noted by economists (*22*, *23*). The neglect of non-cash sources of income when analyzing the prevalence of poverty, poverty rates and income distribution stem largely from the difficulties inherent in the measurement, valuation, and imputation of non-cash income to individual households on the basis of the data typically collected by governmental agencies (*24*).

Considering that most welfare transfers in developed countries are in the form of in-kind benefits (health insurance, education, subsided housing and other services), an excessive focus on cash income yields not only an incomplete but also misleading picture of the distribution of economic wellbeing (*25*). Measuring "extended income" (defined as the sum of disposable cash income, the value of access to public infrastructure and the value of public services received by households) leads to smaller differences in the calculated poverty rates among the developed economies but with increased heterogeneity of income inequality for households within countries (*26*).

The arguments in favor of using extensive income for analyzing poverty rates and income distribution in and among poor communities in developing economies are also compelling but the empirical challenges are even more severe. Surprisingly little is known about patterns of income distribution and poverty rates in urban areas of the developing world, especially within slums (*27*, *28*). A World Bank comparative study of slums in Dakar, Nairobi and Johannesburg based on survey data of slum dwellers socioeconomic and housing conditions, which tried to estimate "extensive income", finds much heterogeneity of poverty within slums and even that not all slums dwellers can be considered poor with respect to cash income (*29*).

There is a striking discrepancy when poverty alleviation programs for the urban poor and slum upgrading projects are discussed. Poverty is usually identified and measured on the basis of income with poverty reduction been identified with an increase in household income. Slums are identified primarily through non-income measures, the presumption being that slum dwellers have low cash (or pecuniary) incomes. But an accurate assessment of poverty in slums necessitates not only the identification of income levels (hard to do when a large proportion of a population is economically engaged in the informal sector) but also the valuation of the public services and infrastructure a slum population has access to. An important step in the right analytical direction is to measure the spatial heterogeneity of income and access to services within and across *all* neighborhoods inside a city. The main text shows how this can be done extensively for entire nations, and how distributional effect by place, income and race can be readily identified. It also shows that present policies create strong adverse distributional effects on their way to providing greater access to services.

1.3 Additional Details of the Construction of the Sustainable Development Index

While, from a purely accounting perspective, an additive form provides a possible definition of a sustainable development index, *X*, such a choice has two major disadvantages: i) it must be renormalized by the number of objectives every time a new dimension is added, and ii) it conveys a sense that different dimensions are strict substitutes for each other (e.g. electricity for sanitation), which is incorrect. A multiplicative index, instead, emphasizes the simultaneous importance of all its dimensions. Multiplicative indices are usually written as geometric means of several, such as the Human Development Index.

To construct *X* in practice, we used four different dimensions identified by slum dwellers as major priorities and available in census data: Access to improved water, improved sanitation, electricity, and permanent housing. The quantification of access to any service category in both Brazil and South Africa follows the measures identified by the Joint Monitoring Program and UN Habitat, described by Satterthwaite (*30*), as closely as is permitted by the available data:

For the case of South Africa, we defined a household as having access to an *improved water source*, if it has access to piped water inside the dwelling, through a tap inside the yard, or via a community tap less than 200m away. We define a household as having access to *improved sanitation* if its main type of toilet facility empties to a sewer system or septic tank, or is a ventilated improved pit latrine. We define the rate of *electricity access* in each sub-place as the combined maximum rate of use of electricity for heating, cooking, or lighting. Finally, we define a household as having *permanent housing* if the household lives in an apartment in a multi-unit building, in semi-detached housing such as townhouses or duplexes, or in a permanent structure on its own lot or in a back yard. All these terms correspond to *categories of access* characterized and measured by the Census of South Africa, household by household.

For Brazil, we defined a household as having access to an *improved water source* if it has access to piped water, well water, or rain water on their premises. We defined a household as having *improved sanitation* if it has access to a toilet where waste is disposed of into the municipal sewer system, a septic tank, or a pit. Sanitary sewage waste disposal via ditch or an open water body is not considered improved sanitation. *Access to electricity* and *adequacy of housing* are directly measured in the Census.

Note that in most cases these classifications do not necessarily require formal (municipal) services, and express instead the quality of the service households have access to, regardless of the manner in which the service is provided. In particular, in many cases improved services may result from informal business models or practices. This is in the spirit of a "capabilities approach" to development, which frames this work as discussed in the main text.

We note that the technology and type of infrastructure necessary to provide improved access to urban services varies substantially across different population densities. This is especially true for sanitation and fresh water access. For example, a *ventilated improved pit* is clearly an inappropriate technology for a dense urban neighborhood in a flood prone location. Similarly, a single community tap may not have the capacity to serve the entire population within a 200m radius. Better future metrics should include notions accounting for the ratio of actual population using some service to the design capacity of that service.

The issue of land tenure, which is a component of UN-Habitat "slum indices" (*31*) and is an important priority to slum dwellers, could not be evaluated as this information is not collected in either Census.

It is important to note that these measures exclude important considerations relating to safety, time use, quality of service and its durability, which are relevant to better assessing development capabilities and neighborhood resilience but are not currently reported in either Census.

1.4 Census of Brazil and South Africa: Assessments of quality and coverage

Both Census datasets for Brazil and South Africa are comprehensive counts of population and their living conditions and strive to account for every person, in each household and place of residence throughout their entire nations. Assessments of success of these practices, in terms of accounting for the entire population and controlling for possible biases, by place or socioeconomic characteristics, are always difficult to gauge in detail and must rely on smaller samples that test for such issues in specific places.

Data from the Census of Brazil and South Africa are highly regarded among national statistical bureaus and follow the worldwide state of the art. Their methods are based on and are very similar to those implemented by the US Census Bureau. The *Brazilian National Institute of Geography and Statistics* (IBGE), Brazils' counterpart to the United States Census Bureau, is highly respected by international agencies and itself provides technical advice to other middle and low-income nations on how to conduct population counts and surveys.

To check for accuracy and biases, the Brazilian and South African Census agencies follow the practice of the U.S. Census Bureau and conduct "post-enumeration surveys." A "post enumeration survey" (PES) is a smaller survey run a short time after a Census in order to compare counts in specific places and thus determine how many people may have been missed or counted more than once. A PES is run independently from the Census and it is intended to provide a methodologically independent assessment of the completeness of a Census. Both the IBGE an Statistics South Africa conduct PES following the guidelines provided by the *U.N. World Population and Housing Programme* (*32*). While not providing an overall margin of error for the population count, post-enumeration surveys often allow for the estimation of error margins and corrections for some specific sub-population thereby helping to validate the methodology and count accuracy of nation-wide census.

In the case of South Africa the PES conducted after the 2010 Census estimates that about as many as 16% of households and 15% of the total population were not included in the Census (*33*). For Brazil the results of the PES are not reported in a manner that allows for a succinct evaluation of accuracy but a recent study indicates that around 5% of households might have been missed in the 2010 Census (*34*). Within the caveats that no population Census (including the one conducted in the U.S.) can or is expected to be perfectly accurate, there are no serious doubts raised based on these findings for the Census of Brazil, especially regarding biases. For South Africa there has been some controversy in the media about the level of population coverage, but the post enumeration survey points to slightly better coverage in cities relative to rural areas and of black populations relative to white, for example.

For these reasons, while some undercount is likely in both Censuses , we have no reason to expect significant biases in coverage by place or socioeconomic characteristics, and can therefore expect that comparative conclusions across neighborhoods and more aggregated units of analysis are warranted in both nations.

1.5 Sensitivity Analysis for the Construction of the Sustainable Development Index

Although the multiplicative form of *X* in the main text is motivated by its mathatematical properties and well as a long history of lessons learned from the construction of the Human Development Index and others, it may be interesting to compare several possible definitions of *X*, using the same underlying data.

To illustrate this comparison, we show in Fig S13 the within-municipality standard deviation for the mean access rate for the different constituent components of the Sustainable Development Index. In addition, Fig S14A shows an index where the components have been combined into their arithmetic mean, and Fig S14B shows this manuscript's definition, where the components have been combined into their geometric mean, which is the same strategy used in the construction of the HDI.

The maps of Fig S15 refer to the Johannesburg and Tshwane Metro areas in South Africa. The left panel shows an index based on the arithmetic mean of the four urban services measures, while the right shows the geometric mean of the same services. The maps in Fig S16 refer to a small part of the city of Rio de Janeiro, again showing the arithmetic and geometric means. Figs S15A and B are quite similar because in South Africa, if an area is has low levels of service for one of the components of *X*, it is also likely to have low levels of service for the other categories. As a result, the difference between the arithmetic mean and geometric mean is small.

Fig S16A and B show much larger differences than Fig S15A and B. This occurs because in this part of Brazil the components of urban services are less likely to be provided together than they are in South Africa. As a result, the lack of substitutability between different services expressed by the geometric mean implies lower values of sustainable development.

2. Supplementary Figures

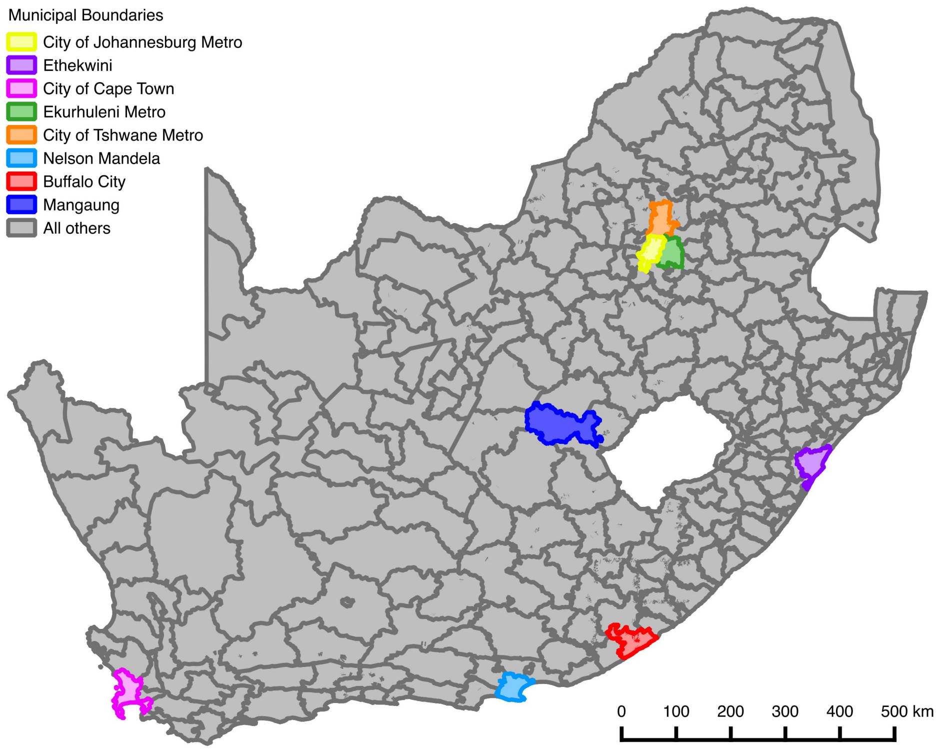


Figure S1 – A Map of South Africa showing municipal boundaries and main cities. The eight officially designated Metropolitan Areas are indicated in color (see legend). Details of their urban fabric and sustainability indices are developed in the main text and shown in Figs. S4-5, below.

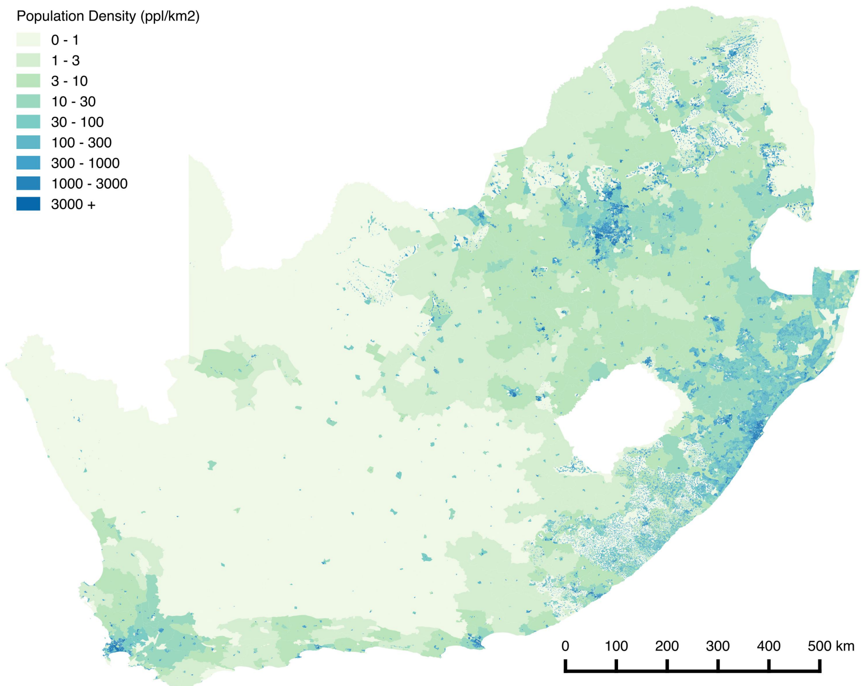


Figure S2 – Population Distribution in South Africa. Large cities clearly stand out as dense population agglomerations, compare with Figure S1. However note that there are several areas of relatively dense rural populations, especially along the Eastern Cape (southeast) and Limpopo (northeast). These have been areas of large out-migration to the largest cities in the country, especially greater Johannesburg and Cape Town.

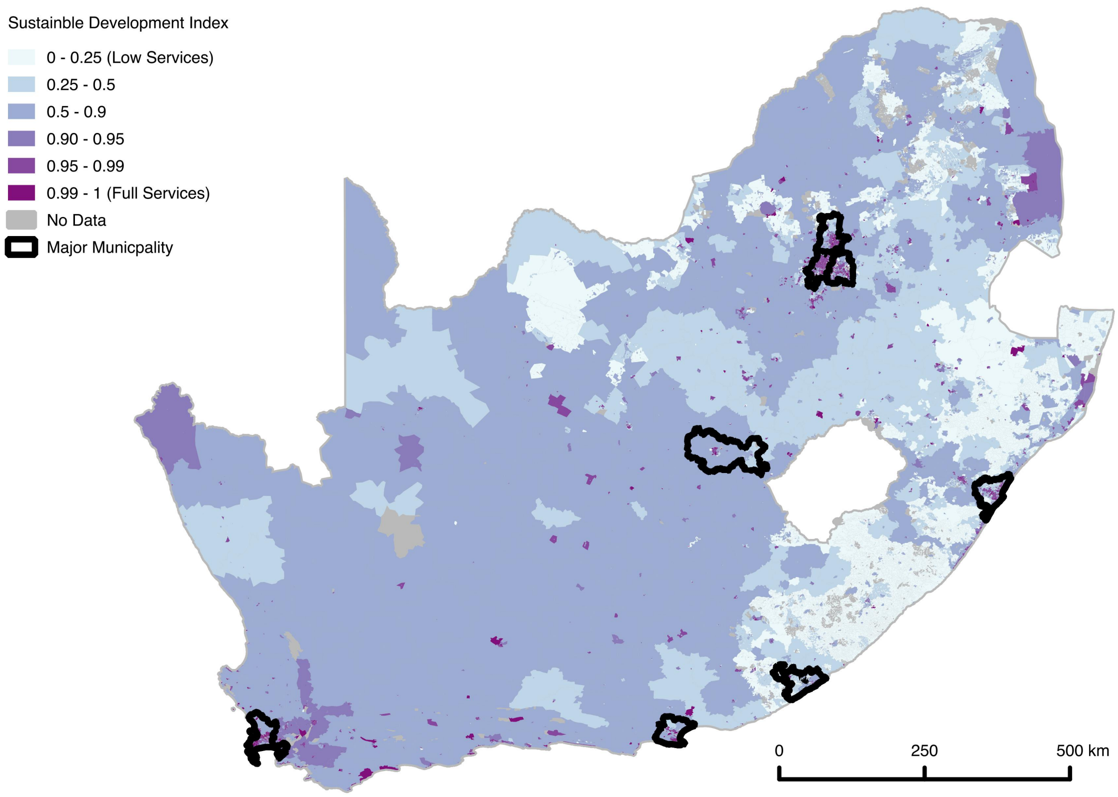


Figure S3 – A Map of South Africa showing the nationwide distribution of the Sustainability Index. Colors show the values of the Sustainable Development Index, X (see main text), which varies from the total absence of services (white) to universal access (dark purple). Note that despite their small geographic size, large cities are much more likely than rural areas to have high levels of services, see also Figures S4-5. Note, however, the role played by other small cities and by a few low density areas, especially in the North of the country.

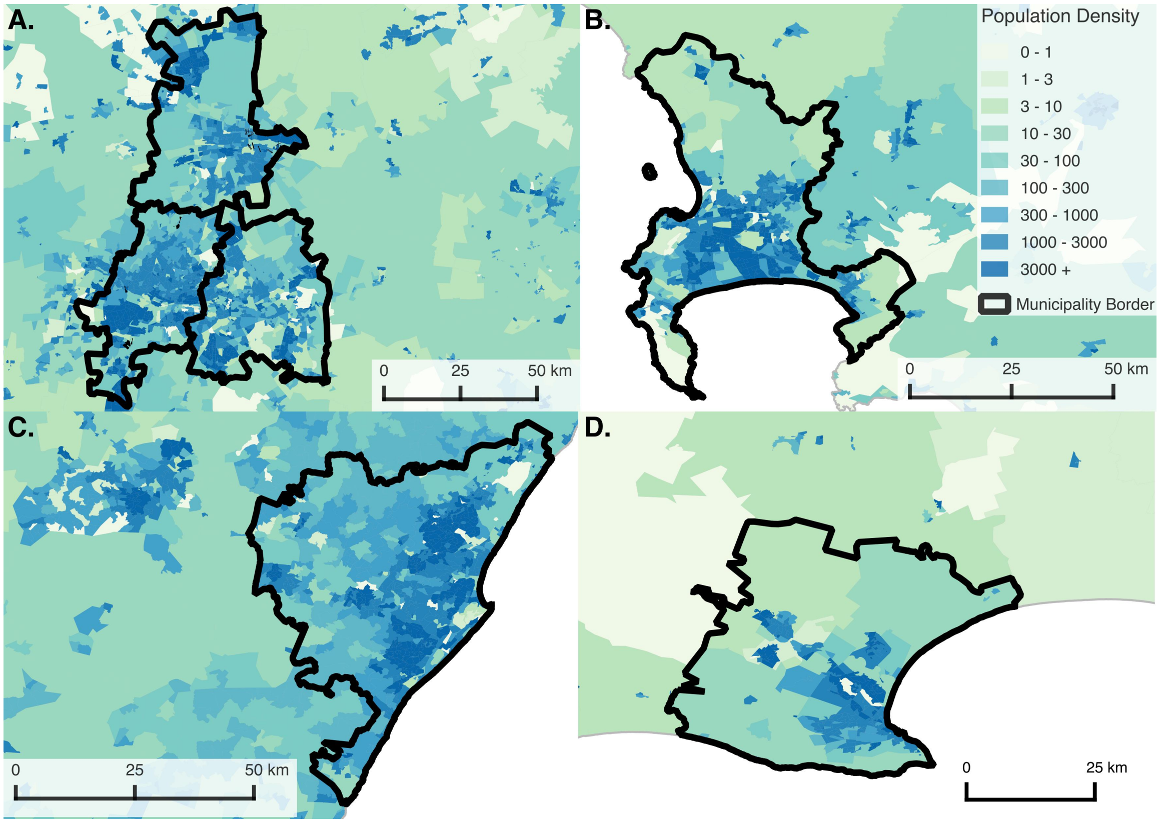
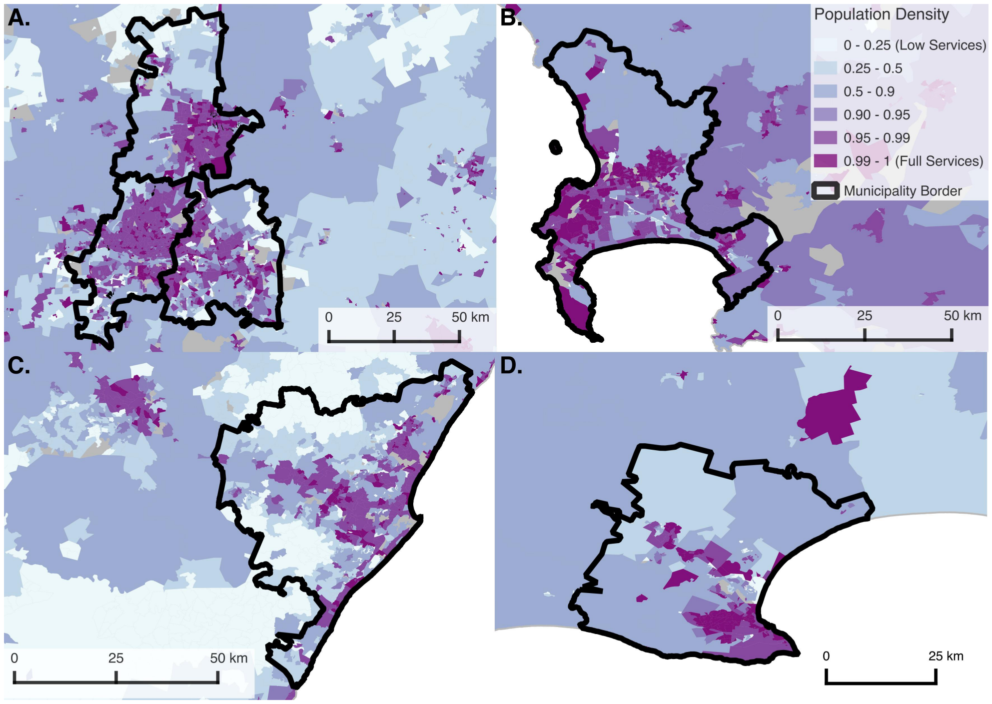


Figure S4: Population Distribution in selected South African Metropolitan Areas. In each panel, we show the estimated population density (people/km^2) at the sub-place level. Panel A shows the Greater Johannesburg area, which includes the City of Johannesburg Metropolitan area, Ekurhuleni Metropolitan area (East Rand), and the City of Tshwane Metropolitan area (Pretoria). Panel B shows the City of Cape Town Metropolitan area. Panels C and D show the Metropolitan areas for eThekwini (Durban), and Nelson Mandela (Port Elizabeth), respectively.



Figures S5: Sustainability Index Distribution in selected South African Metropolitan Areas. In each panel, we show the estimated sustainable development index, *X,* at the sub-place level. Panel A shows the broader Johannesburg area, which includes the City of Johannesburg Metropolitan area, Ekurhuleni Metropolitan area (East Rand), and the City of Tshwane Metropolitan area (Pretoria). Panel B shows the City of Cape Town Metropolitan area. Panels C and D show the Metropolitan areas for eThekwini (Durban), and Nelson Mandela (Port Elizabeth), respectively. With the exception of Cape Town, widespread access to services is generally concentrated within metropolitan areas, and in the denser more central parts of those cities. However, the correlation is not perfect and many dense poor areas remain underserviced. In informal areas (slums), some of the official census numbers are disputed by resident communities.

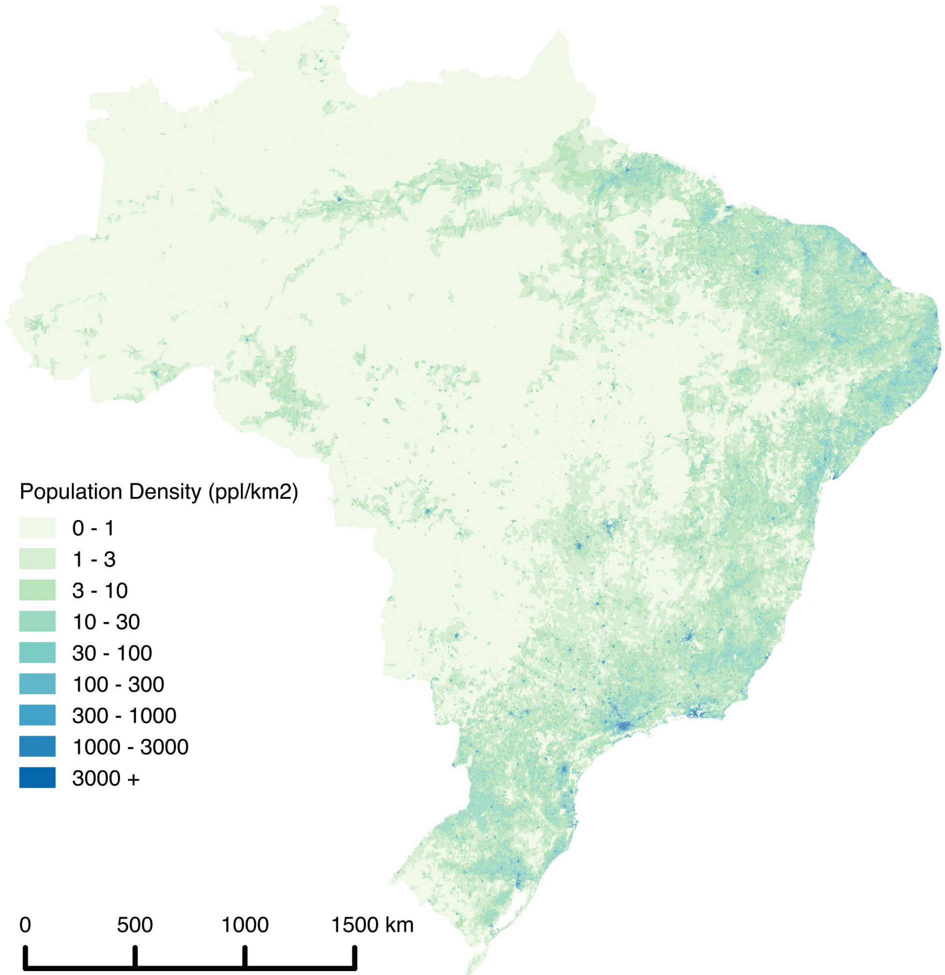


Figure S6: Population Distribution in Brazil. Brazil's population is clearly concentrated towards the coast, with the interior and Amazon very sparsely populated. Brazil's large cities, such as São Paulo and Rio de Janeiro, are visible through their large population density, but their area is small relative to the country as a whole.

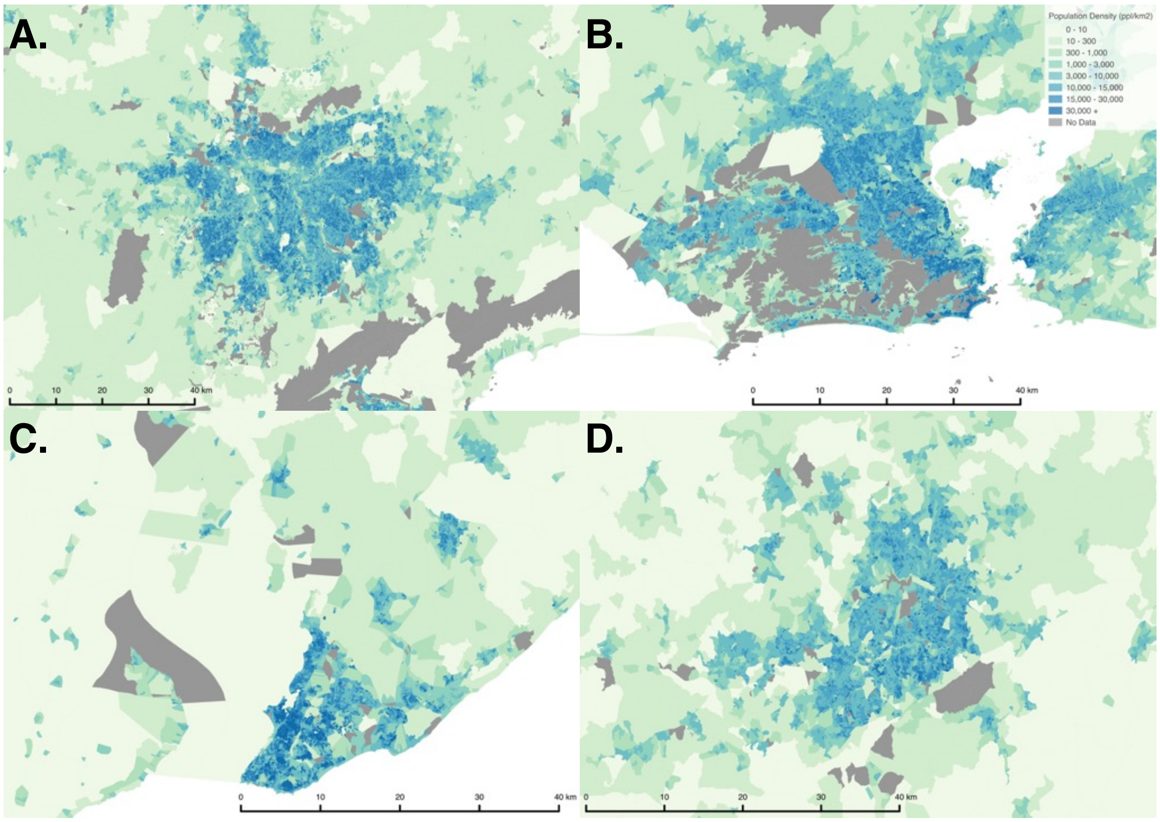


Figure S7: Population Distribution in selected Brazilian Metropolitan Areas. In each panel, we show the estimated population density (in people/km^2) at the *setor* level. Note the color scale used to show population density for urban environments breaks out much higher population densities than the color scale used at the national level in Figure S6. Panel A shows São Paulo. Panel B shows Rio de Janeiro. Panels C and D show Salvador and Belo Horizonte, respectively.

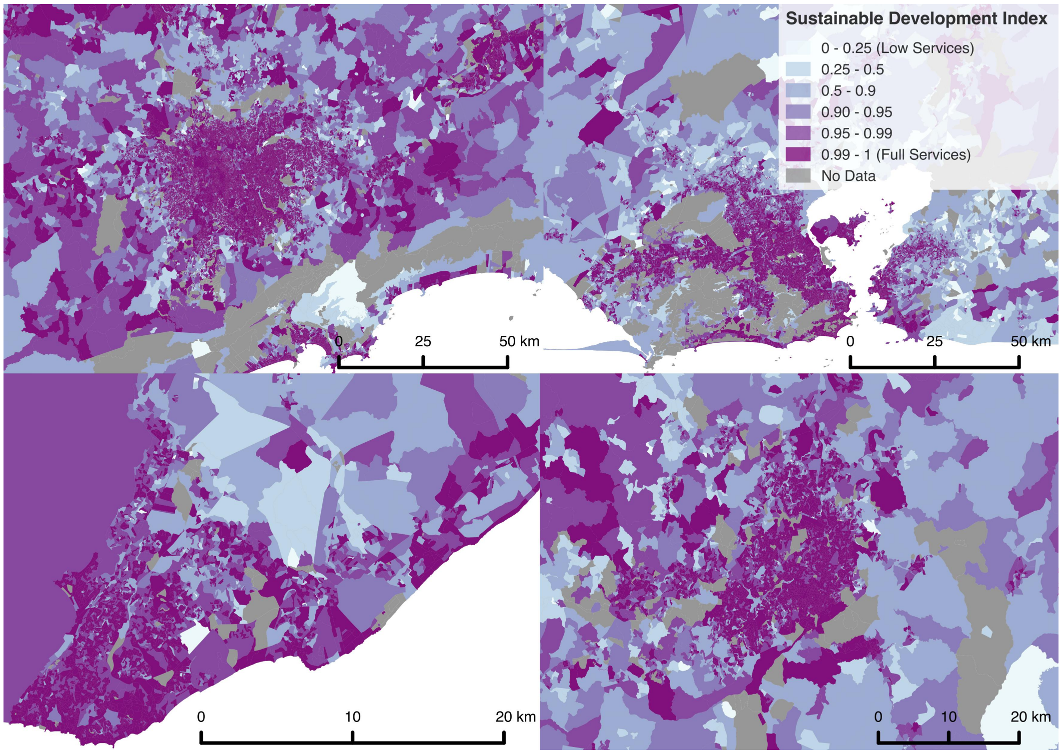


Figure S8: Sustainability Index Distribution in selected Brazilian Metropolitan Areas. In each panel, we show the estimated sustainable development index, *X,* at the *setor* level. Panel A shows São Paulo. Panel B shows Rio de Janeiro. Panels C and D show Salvador and Belo Horizonte, respectively. We observe that, relative to South African cities, Brazilian Metropolitan Areas have higher overall levels of services, which is particularly visible for São Paulo, the nation's largest Metropolitan Area.

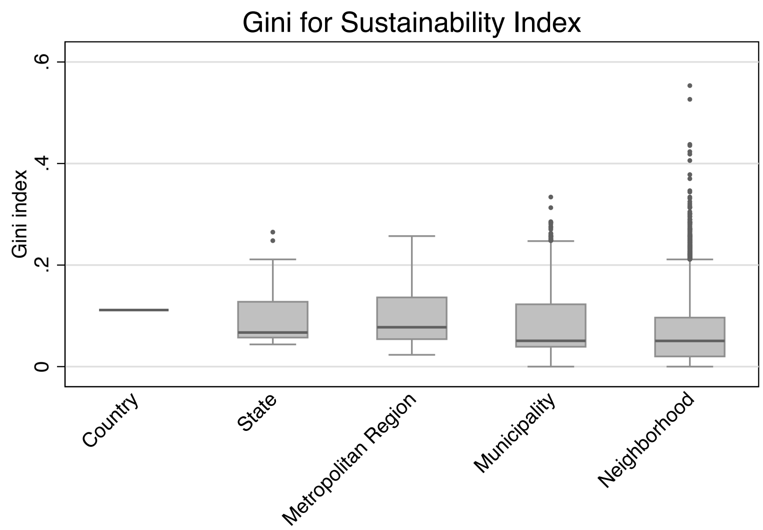


Figure S9: The Gini coefficient for the sustainable development index, *X*, at the neighborhood (*bairro*), municipality, metropolitan region, state, and national level for Brazil. The population weighted median across all units of analysis within a class is shown by a horizontal black line, with the 25th to 75th percentiles shown by the grey box. Whiskers reach to the most extreme data point that is less than 1.5 times the distance between the 25th and 75th percentiles from the grey box. Any remaining outlying points are plotted individually. We see that, in analogy to Fig. 1B, the spread in inequality across neighborhoods is greater than the spread in inequality across cities and larger areas. Metropolitan regions show level of services inequality that are consistent with the nation at large and are greatest for an integrated labor and real estate market.

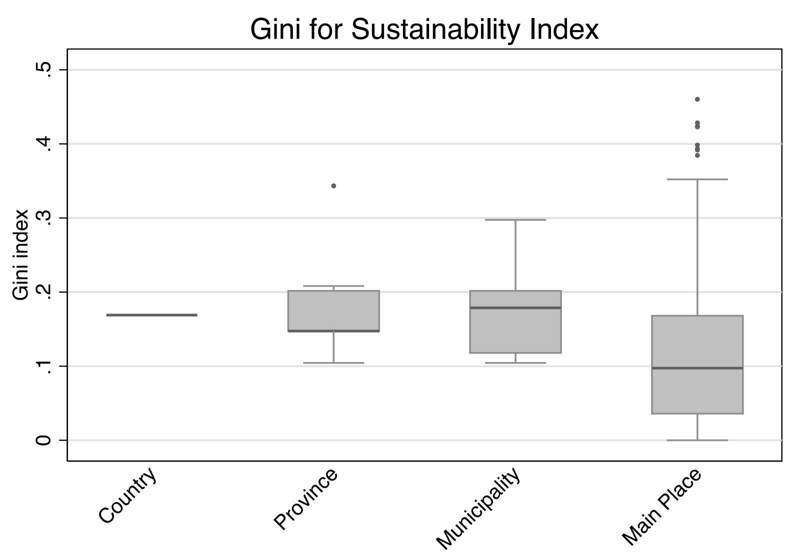


Figure S10: The Gini coefficient for Sustainable Development Index at the main-place, municipality, province and national level for South Africa. The population weighted median across all units of analysis within a class is shown by a horizontal black line, with the 25th to 75th percentiles shown by the grey box. Whiskers reach to the most extreme data point that is less than 1.5 times the distance between the 25th and 75th percentiles from the grey box. Any remaining outlying points are plotted individually. We see that inequality is somewhat lower within "Main Places" than it is at spatial scales of the municipality or larger.

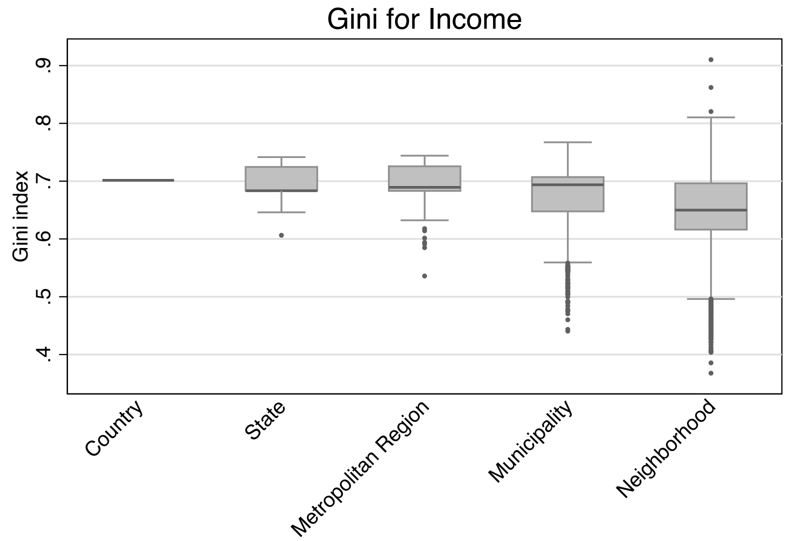


Figure S11: The Gini coefficient for personal income at the neighborhood, Municipality, Metropolitan, State, and national level for Brazil. The population weighted median across all units of analysis within a spatial class is shown by the horizontal dark line. The 25th to 75th percentiles are bounded by the grey box. Whiskers reach to the most extreme data point that is less than 1.5 times the distance between the 25th and 75th percentiles from the grey box. Any remaining outlying points are plotted individually. Similarly to the Sustainable development index, *X*, we find levels of inequality at the city level similar to the nation, but see somewhat lower inequality for neighborhoods (though still high by international standards), with larger variations. Thus, cities show the highest level of inequality within units that are integrated labor markets**.** Note that the Gini coefficients at all scales for both Brazil **and South Africa is very high**, around 0.7.

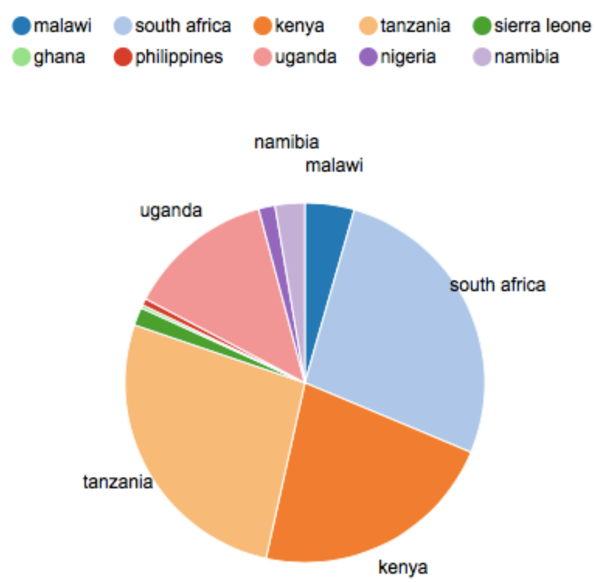


Figure S12: National breakdown of slum upgrading priority surveys. The pie chart gives a visual depiction of the fraction of neighborhoods surveyed by nation in Table 1 and Fig. 1C**.**

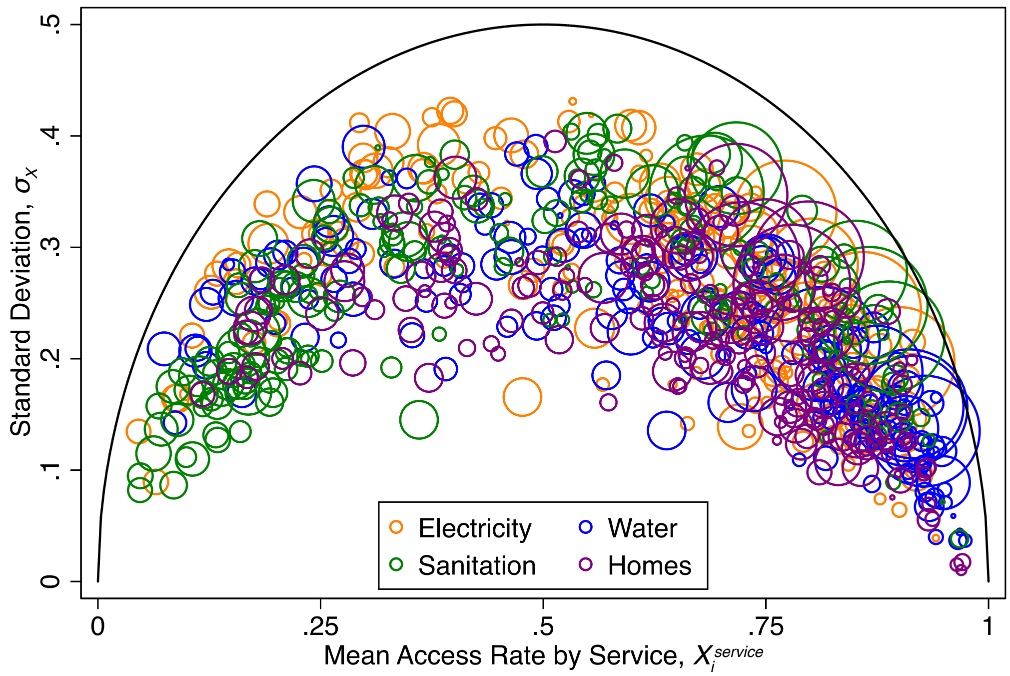


Figure S13: The mean access rate within Municipalities against the standard deviation in access rate for that service within a municipality for each of the four services for South African Municipalities. This is also shown in Fig S18A, right panel.

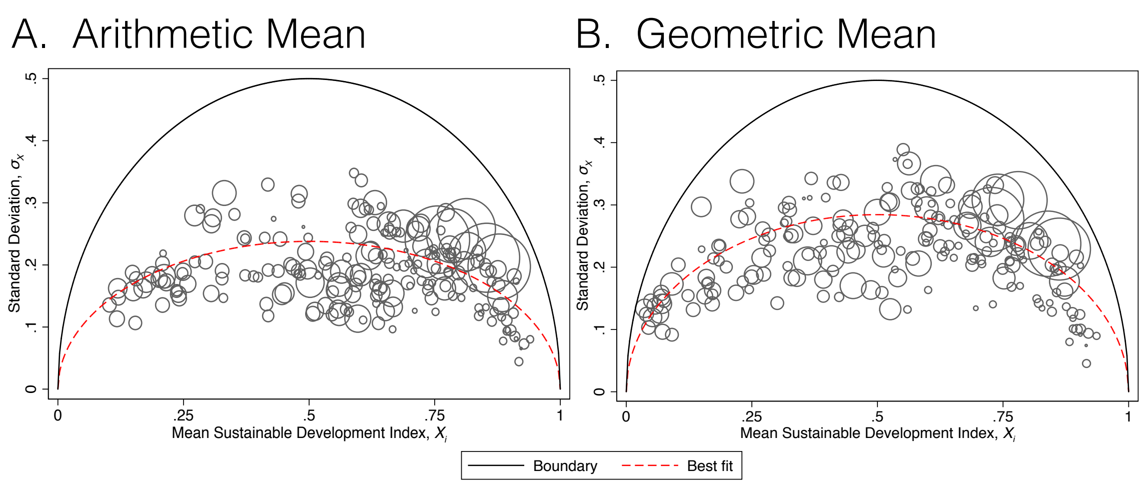


Figure S14 Comparison between multiplicative and additive forms o the Sustainability Index, X. Panel A shows the arithmetic mean for the data shown in Fig S13. Panel B shows the geometric mean for the same data.

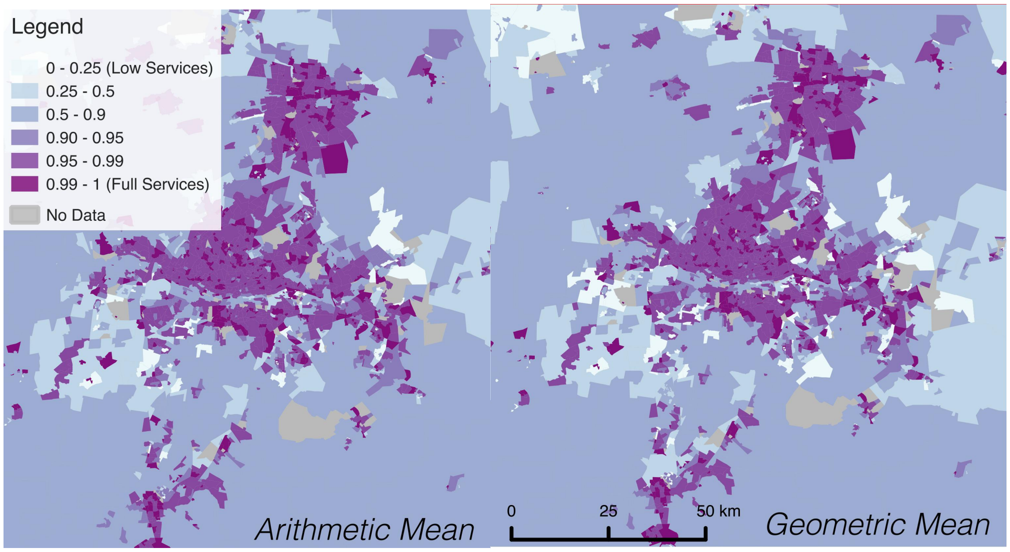


Figure S15: Map comparison between multiplicative and additive forms o the Sustainability Index, X in South Africa. These maps show the combined City of Johannesburg, City of Tshwane Metro, and Ekurhuleni Metro areas. Panel A shows the arithmetic mean of the four components of the Sustainable Development Index. Panel B shows the geometric mean of the same data.

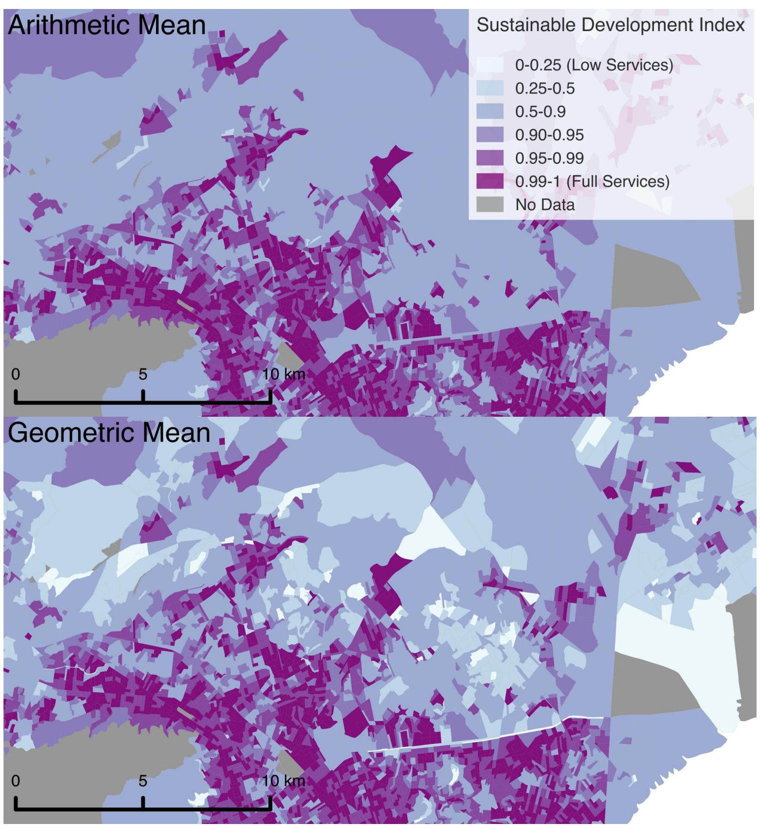


Figure S16: Map comparison between multiplicative and additive forms o the Sustainability Index, X in Brazil. These maps show a small, northern part of the city of Rio de Janeiro. Panel A shows the arithmetic mean of the four components of the Sustainable Development Index. Panel B shows the geometric mean of the same data.

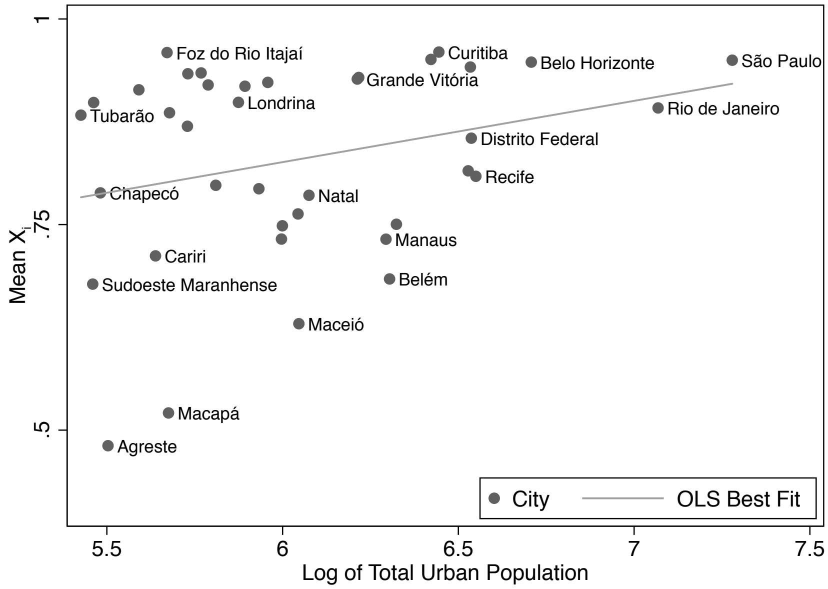


Figure S17: The mean sustainability Index, X_i versus total metropolitan population for Brazilian Metropolitan Areas. There is a slight correlation (slope= 0.075, R^2 =0.051) indicating that larger cities tend to provide greater access to services to their residents. Importantly some smaller cities in Brazil's richest regions are performing well in service provision, such as Curitiba, Tubarão or Londrina.

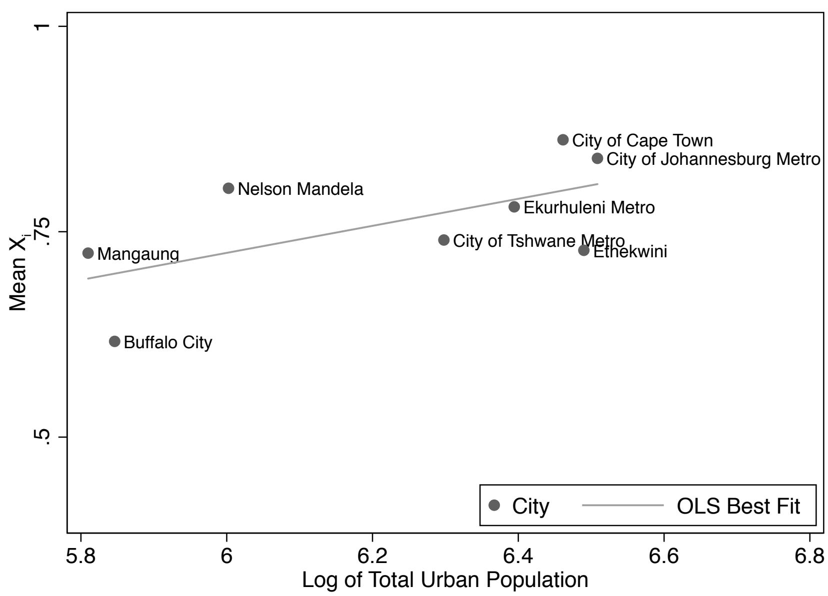


Figure S18: The mean sustainability Index, X_i versus total metropolitan population for South African Metropolitan Municipalities. The line indicates a significant correlation between city size and improved service provision (slope=0.164, , R^2 =0.29).

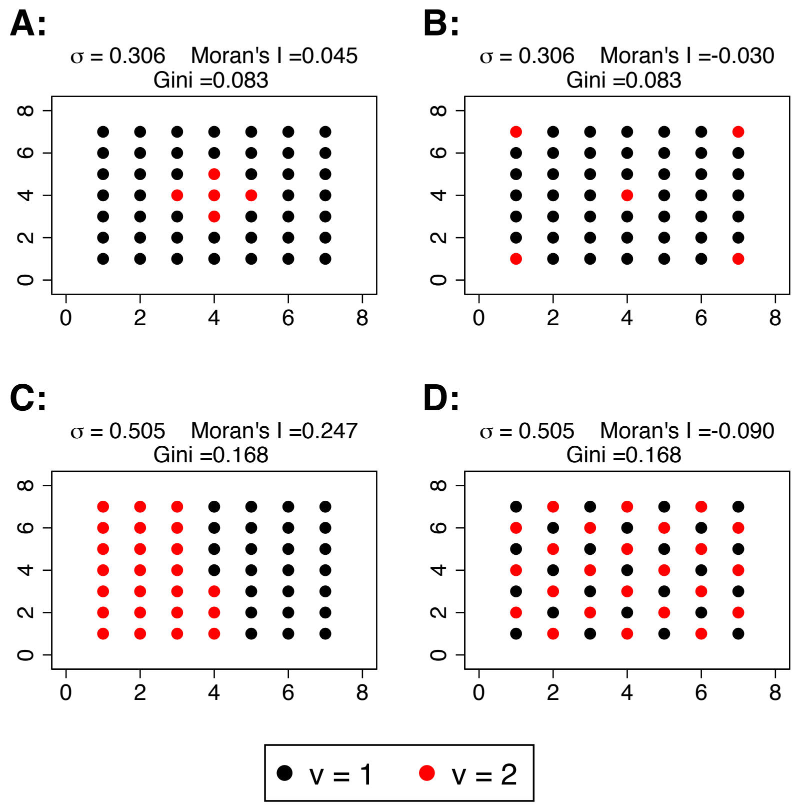


Figure S19: Simple schematic situations illustrating the relationships between the standard deviation, the Gini coefficient and Moran's I. Only Moran's I is sensitive to the spatial configuration of different colors, while the other quantities express how much mixing there is overall. Note that σ and Moran's I are unchanged by linear transformations of the quantities of red and black dots, but the Gini coefficient is not. For example, using the same spatial layout as panel D; with black = 100 and red = 101 yields σ = 0.505; Moran's I = -0.090 and Gini =0.002.

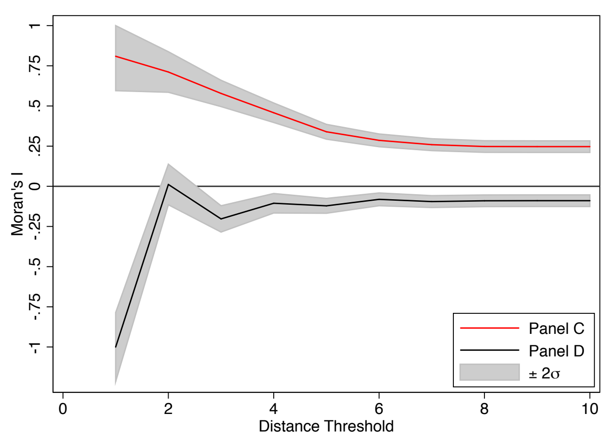


Figure S20: The estimated Moran's I value for illustrative spatial arrangements. The curves correspond to the values of Moran's I, similar to the inset in Fig 2D and Fig S22, for the spatial arrangements shown in Panel C and D of Fig. S15.

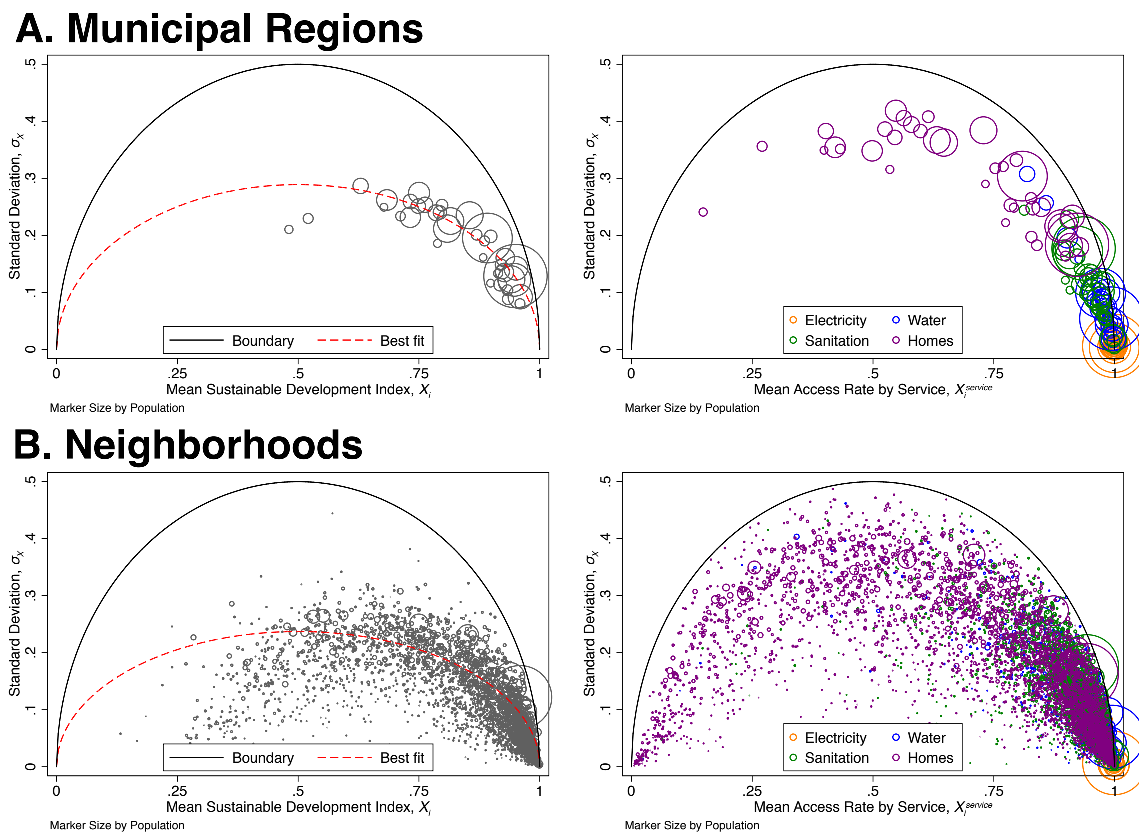


Figure S21: Infrastructure Access rates and inequality in Brazil. Panel A shows the mean and standard deviation of X for the 38 Metropolitan Areas in Brazil. These values are estimated using X_i for all urban *setor*s in each city. The colors show how permanent housing remains a greater challenge in these cities, followed by issues of water and sanitation. Access to electricity is comparatively a solved problem. Panel B shows the same estimates, but aggregated at the neighborhood level rather than the city level. The right column in both panels shows the four individual components of X_i: $X_i^{electricity}$, X_i^{water}, $X_i^{sanitation}$, and X_i^{homes} against their standard deviation.

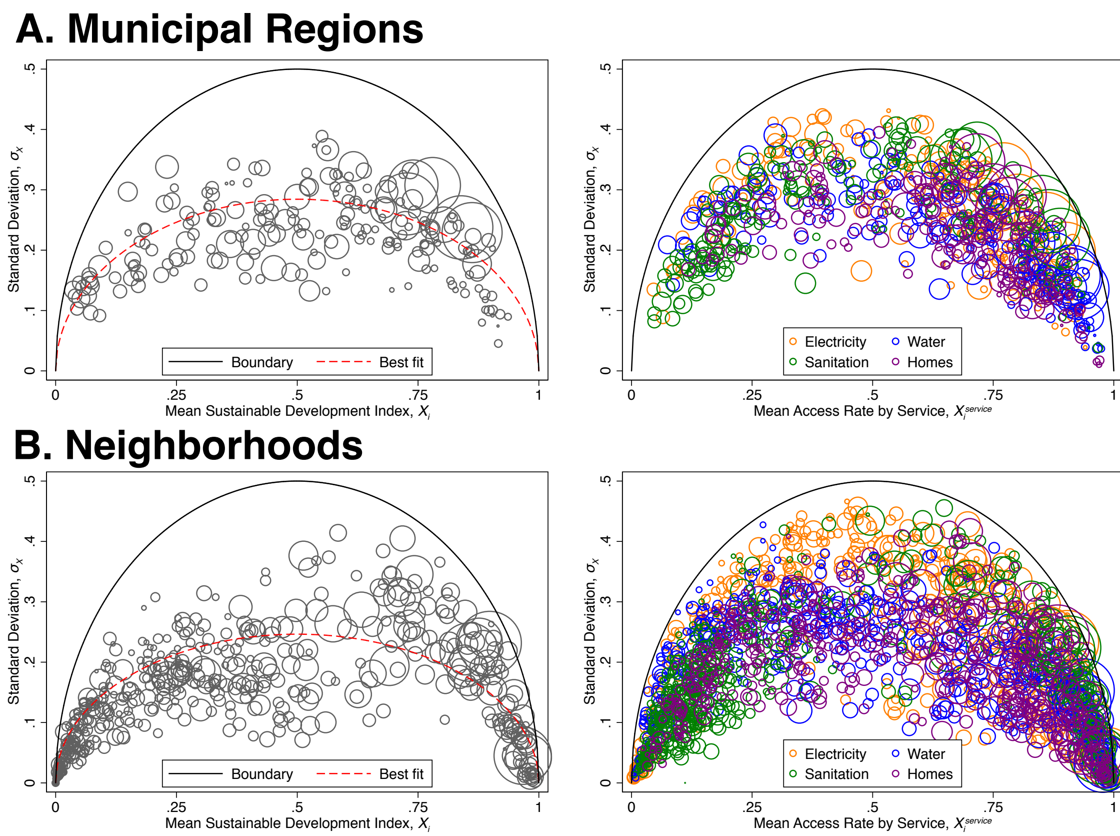


Figure S22: Infrastructure access rates and inequality in South Africa. Panel A shows the mean versus standard deviation of the sustainable development, *X,* for each of the 248 municipalities (metropolitan and not) in South Africa. These values are estimated using X_i for all sub-places in each unit. Issues of sanitation (green) tend to be the most difficult and of water (blue) and housing (purple) less so, but there is also a considerable mix of issues across municipalities. Panel B shows the same estimates, but aggregated at the main-place level rather than the municipal level. The right column in both panels shows the four individual components of X_i: $X_i^{electricity}$, X_i^{water}, $X_i^{sanitation}$, and X_i^{homes} against the standard deviation of each component.

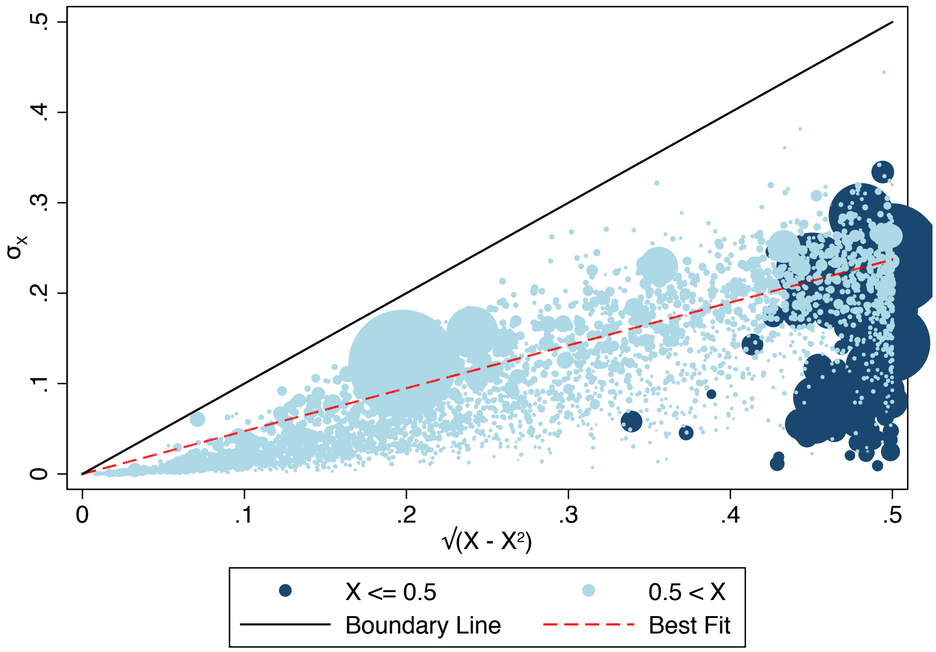


Figure S23: Estimating of the heterogeneity index, *b,* for neighborhood in Brazil. Dark blue denotes places with $\boldsymbol{X \leq 0.5}$, and light blue denotes $\boldsymbol{X \geq 0.5}$, and both sets of X values are plotted at their position under the transformation $\sqrt{(\mathbf{1}-\boldsymbol{X})\boldsymbol{X}}$ to generate a linear dependence on this variable of the standard deviation, with slope *b*. The black boundary line shows the maximum possible σ_X for each X value, while the dashed red line shows the OLS best fit line for $\boldsymbol{\sigma_X = b\sqrt{(1-X)X}}$. We estimate *b* using a standard population weighted OLS regression on the transformed data with White standard errors to account for heteroskedasticity in the errors.

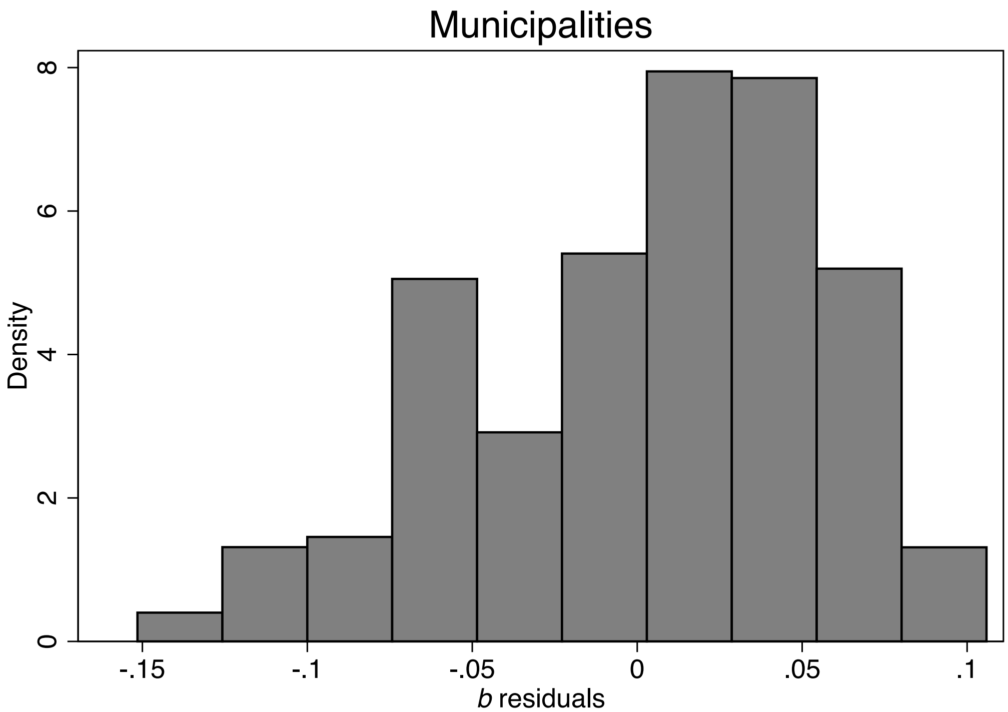


Figure S24: The residuals of the heterogeneity index, *b,* for Brazil's 38 Metropolitan Areas. We see that these values have a small dispersion around the mean, and that their values are somewhat left skewed, so that in some cases considerably less unequal outcomes are possible.

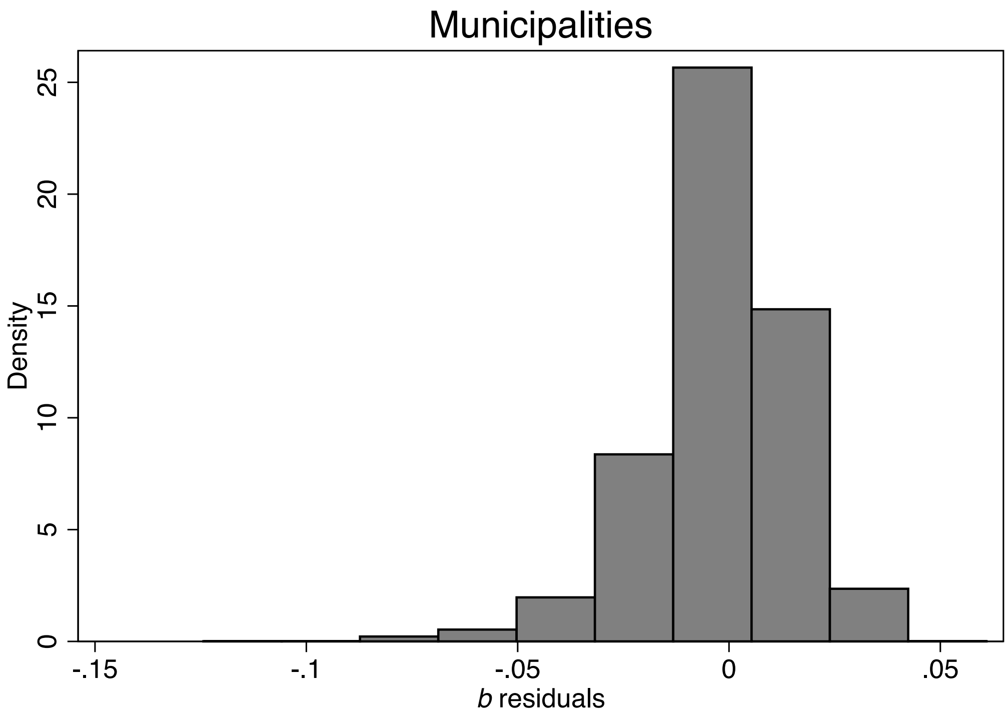


Figure S25: The residuals of the heterogeneity index, *b,* for all of South Africa's municipalities (N=248). Analogously to Brazil, Fig. S24, the distribution is relatively narrow and left skewed, meaning that development trajectories can be characterized by lower heterogeneity than observed on average.

Moran's I Sensitivity Analysis to distance threshold

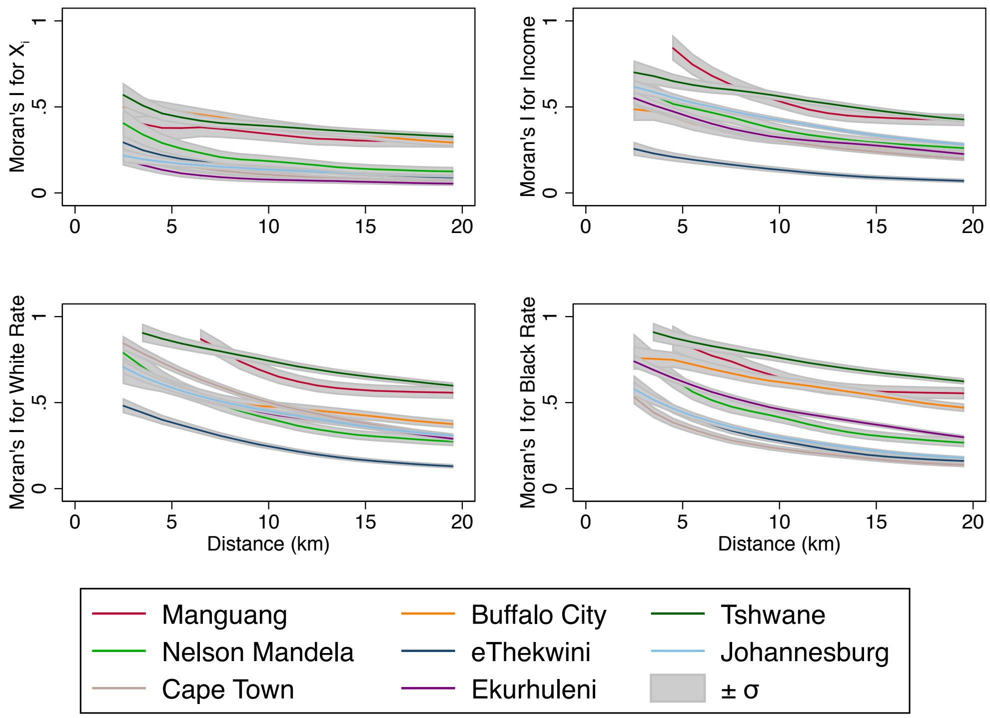


Figure S26: The normalized spatial correlation between neighborhoods in South Africa as a function of the distance threshold, see main text**.** Different panels show distinct quantities, specifically A. The Sustainability Index, *X*, B. Personal Income, C. Percent White Population (race), D. Percent Black population (race). Different metropolitan regions are shown in different colors.

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