World Development Sustainability 4 (2024) 100155

Contents lists available at ScienceDirect

World Development Sustainability

journal homepage: www.elsevier.com/locate/wds

Quality of urban infrastructural service accessibility and human well-being in Sub-Saharan Africa

Isaiah Maket [a,b,*], Izabella Szakálné Kanó [a], Zsófia Vas [a]

[a] Faculty of Economics and Business Administration, University of Szeged, H-6722 Szeged, Kálvária sgt 1, Hungary
[b] Department of Economics, University of Embu, P.O, Box 6-60100, Embu, Kenya

ARTICLE INFO

Keywords:
Human Well-Being
Urban infrastructural service
Panel dynamic model
Sub-Saharan Africa

ABSTRACT

Urban infrastructure critically influences how urban people carry their lives and mediates how services central to human well-being are accessed. Therefore, the main of this study is twofold: One, the study interrogates how the quality of urban infrastructural service accessibility influences human well-being, and two, how governance interactively with urban infrastructural services affects human well-being using balanced panel data from 2000 to 2020 from 22 Sub-Saharan African countries. Applying the Driscoll-Kraay and Two-Step Instrumental Variable Generalized Method of Moments (2SIV-GMM) in panel dynamic model setup, we uncover that increasing the quality of accessing urban infrastructural services results in enhanced human well-being. Interrogating the role of governance on human well-being, the findings depict a significant detrimental interactive effect between governance and urban infrastructural services on human well-being. Accounting for rapid urbanization in the Sub-Saharan African region, the results illustrate significant negative control effects of urbanization rate and aftermath urban agglomeration on human well-being. Conclusively, effective government policies that influence higher levels of human well-being in regions with large urban agglomerations are paramount. Thus, effective government investments in urban infrastructural services in Sub-Saharan Africa remain a vital sustainability policy agenda.

1. Introduction

Cities and urbanizing regions are currently home to more than half of the world's gross population. By 2050, more than two-thirds of the world population is projected to be urban, with many living in informal and unplanned settlements and growing cities in rapidly urbanizing and developing regions such as Sub-Saharan Africa (SSA) [1]. This has been particularly notable in the most recent three decades, with the urban population share doubling [2–4]. Additionally, the driving forces of the enormous urban population growth in many African cities present deleterious socioeconomic outcomes. For instance, rapid urbanization in SSA is featured by enormous slums, informal settlements, insufficient infrastructure, and rising climate change effects resulting in social inequalities in access to critical urban infrastructural services among urban residents [5,6]. Moreover, although rapid urbanization is happening in all SSA economies, the trend differs significantly across countries [7,8]. For example, Nigeria, the most populous SSA nation, has encountered a tremendous rise in urbanization from 17 % to more than 50 % between 1960 and 2020, with forecasts indicating it will be over 68 % by 2050. South Africa has a reasonably greater urbanization level than other SSA states but is accompanied by a high inequality level, specifically in urban informal settlements. Ghana and Kenya have also encountered noteworthy urbanization, pigeonholed by challenges such as inadequate urban infrastructural service provision, high unemployment rate, widening income inequality, and urban poverty [9]. Ethiopia and Uganda have relatively low urbanization levels, with 21 % and 25 % urban populations in 2020, correspondingly [4,10].

Given rapid urbanization, how the quality of urban infrastructural service provisioning in terms of the urban population share accessing water, energy, and sanitation services influences human well-being in the SSA region has received considerable political, stakeholder, and research focus in recent times [11–13]. Mainly, access to urban infrastructural services such as water, sanitation, education, energy, and healthcare, collectively contribute to the overreaching concept of evolving human well-being, environmental sustainability, and economic performance [14–16]. Therefore, human well-being remains a far-reaching construct engrained in Sen's notion of human aptitudes measured in various ways, including the human development index

* Corresponding author.
E-mail address: maket.isaiah.juma@o365.u-szeged.hu (I. Maket).

https://doi.org/10.1016/j.wds.2024.100155
Received 2 July 2023; Received in revised form 19 March 2024; Accepted 1 May 2024
Available online 7 May 2024

(HDI) [17]. Also, in the most recent, surveys that measure human well-being subjectively have emerged, defined simply in terms of positive self-reporting (evaluative) and feeling fulfilled by what urban life offers (eudemonic) [16,18,19]. With over 50 % of the world population living in urban regions presently, understanding how the quality of accessing urban infrastructural services shapes human well-being in cities and specific countries or regions is essential in propagating the sustainability ambitions as depicted in the United Nations Sustainable Development Goal 11 (SDG#11) and the New Urban Agenda (UNDESA, 2015).

Urbanization-driven socioeconomic disparities manifest in most SSA cities in several ways, most profoundly unequal access to urban infrastructural services, resulting in undesirable human well-being (UNDESA, 2015; [20,21]). Rapidly urbanizing SSA continues to face overwhelming pressure of containing urban inequalities despite numerous efforts to align with (SDG#11) and the New Urban Agenda [22]. Partly, this is due to un-procedural governance mechanisms and unattractive urban infrastructure investments [13]. Secondly, this is due to the increasing urban agglomeration, which is much faster than urban infrastructural development and economic opportunities [23,24]. Lastly, the most significant part of the looming problems of accessing urban infrastructure services is due to limited urban infrastructural investment and policy governance capacity [24]. For instance, the region must spend between $130 to $170 billion on basic urban infrastructural service needs [25]. Yet still, the area is facing a financing shortfall of between $68 to $108 billion. Ideally, two-thirds of the spending on the urban infrastructure required by 2050 is yet to be realized [25]. Thus, access to critical urban infrastructural services such as water, energy, and sanitation has continued exacerbating the social inequality in cities, resulting in undesirable levels of human well-being as most households shift to unclean energies and unsafe drinking water [22].

Despite the bewildering current urbanization-driven social inequality realties and projected urban agglomeration figures fueled by anti-urban bias, SSA has been depicted in academia and policy as a rural region [26]. This is notable in development cooperation, not only for SSA but also globally, which has been dedicated to rustic openly and is hardly cherished by city stakeholders and state governments [27]. Researchers and scientists in the SSA region emphasize the urgent attention to SSA's incredibly stirring urbanization rate, its associated social outcomes, and the extent of social transformation [9,28,29]. However, unpacking the connectedness between the quality of accessing urban infrastructural services and human well-being from a regional perspective has been challenged by measuring human well-being, given the complexities across social-ecological-infrastructural urban system attributes of cities (SEIUS) [16]. While there have been notable scientific strides in quantifying the connection between the quality of accessing urban infrastructural services and human well-being worldwide, most studies have shifted focus from a quantitative measure of human well-being to subjective well-being (SWB) measures [16]. Also, although several studies link the quality of accessing urban infrastructural services such as water, sanitation, and energy services to SWB, few studies have explored how a range of urban infrastructural services shape human well-being from an objective and regional perspective measures of human well-being.

Against this backdrop, this paper contributes to literature in three-fold ways. First, the study interrogates how the quality of access to urban infrastructural services influences human well-being in the SSA region. Most previous studies have considered urbanization's effect on human development without paying attention to objective components of human well-being [30–32]. Secondly, the paper evaluates how governance in terms of service provisioning, planning, management, and investment effectiveness interactively influences the urban infrastructural service accessibility quality and human well-being using balanced panel data from 2000 to 2020 from 22 SSA countries. Several previous studies have consistently mentioned in passing the challenges of urbanization in SSA without analyzing the missing governance link toward ensuring sustainable urbanization and better human well-being [4,33]. Additionally, this study evaluates the interactive relation between governance and the quality of urban infrastructural service accessibility to point out how local, national, and regional governments and stakeholders plan, implement, and finance urban infrastructural services in line with the sustainable development goal of making cities livable and resilient for better human well-being [34,35]. Thirdly, we evaluate the SSA regional human well-being from the objective panel perspective as informed by evolving objective measures such as HDI, which capture an urban region's overall quality of living conditions and economic resilience more robustly compared to subjective well-being measures that are context-specific and time-bound [36–38]. In this conjecture, this study seeks to fill the gap where most papers focusing on urban infrastructural service accessibility in the SSA region are case studies; hence, there is no sufficient panel analysis base. As informed by the recent United Nations Development Programme 2021 Report, SSA's HDI averages at 0.547, far below the global threshold of 0.732, with ten out of fifty-four countries featuring among the bottom countries [39]. Objectively, this study applies different estimation techniques such as Pooled OLS, Driscoll-Kraay, and Two-Step Instrumental Variable-Generalized Method of Moments (2SIV-GMM) techniques, which are robust in case of autocorrelation, cross-section dependence, regional endogeneity, and heteroscedasticity [30,40].

The remaining part of this paper is structured as follows: Section 2 presents background literature that sets off from the theoretical evaluation angle and provides empirical evidence from recent studies. The third section describes variables of interest, data type, data sources, estimation strategy, and estimation techniques. Data analysis and discussions of findings are presented in Section 4. Section 5 summarizes the study findings, makes deductive conclusions, and professes policy recommendations.

2. Background Literature

This section entails two subsections. The first section involves theoretical literature conceptualising urban infrastructural service accessibility quality and governance in conjunction with human well-being. In contrast, empirical literature provides recent research evidence that links the quality of accessing urban infrastructural services and human well-being and uncovers the existing research gaps to be filled by the study.

2.1. Theoretical literature

Conceptually, this paper is built from three theoretical perspectives: modernization, dependency, and urban bias theories. Modernizationists view urbanization as a natural process through which traditional society passes to become industrialized or modern nations [41]. This theory contends that urbanization has positive social effects and must be encouraged [42]. On the other hand, urban bias theorists do not agree with these assertions; instead, they contend that urbanization is a government policy product that systematically redirects most precious resources to urban regions, causing rural-urban disparities [43]. This leads to massive rural-urban migration, creating large agglomerations with long-term social outcomes [44]. lastly, dependency theorists are concerned with urbanization's effect on available social resources, such as land for rural-based populations [31]. They posit that urbanization causes disparities between rural and urban dwellers, scramble for limited urban infrastructural services, and urban labour market distortions due to large uncontainable agglomerations in developing regions such as Sub-Saharan Africa [31].

In line with dependency theory, urban infrastructure refers to the systems that provide energy, water, sanitation, waste management, communication, public green spaces, and affordable housing services [31,41,45]. These are vital in supporting human well-being and economic prosperity in city regions [46]. Consequently, the quality of accessing these urban infrastructural services refers to the ease and extent with which a particular share of the urban population can obtain these services, as determined by proximity and the efficiency of getting them, and quantity provided by the local government and private suppliers [47,48]. In this connection, governance has recently received much attention as it is the process by which central, local, municipal, or regional governments and stakeholders collectively determine the provision and access to social services. Governance refers to systems and processes influencing urban populations' access to infrastructural services [47,49–51].

Human well-being is made up of three words: "human," "well," and "being," and it can be interpreted as "human being well in a particular region" or a situation whereby things are generally fine among a specific region's population. Various dictionaries have defined it as a state resultant of factors such as comfort, health, happiness, and prosperity [52–54]. All these factors point out some form of positivity in human life. Researchers across different scientific subjects have been trying to define better and enhance understanding of human well-being [55–57]. Nevertheless, there is an imminent agreement in the literature that due to its nature, human well-being can be better described than defined [58]. Conventionally, the concept of human well-being stemmed from metaphysics, where traditional ancestors regularly contemplated life and its purpose [53]. The concepts of Eudaimonism and Hedonism were among the primary trials to understand human well-being. Hedonism relates to the experience of a positive emotional state and satisfaction of needs and preferences, whereas Eudaimonism corresponds to the meaning and development of an individual's potential and capabilities [59,60].

Human well-being is linked to two distinct categories: subjective (individual) and collective (society's population) in a particular region. Subjective human well-being refers to an individual's well-being [61]. On the other hand, collective human well-being is derived from the sociocultural and economic relationships shared by people in one space [62]. Earlier attempts to understand human well-being concentrated majorly on subjective notions such as individual happiness and satisfaction with one's life; however, the collective notion of human well-being is currently gaining research traction [63]. Several researchers began to compute quantitative means of subjective well-being as indicator measures of collective human well-being, leading to the development of objective measures such as the Human Development Index (HDI) and average gross domestic product [17,63–67]. A new research strand has argued that collective well-being measures substantially impact overall and regional human well-being more than subjective well-being measures [68,69].

However, the distinction between subjective and collective/objective well-being is abstruse, and though they are usually correlated, *Easterlin paradox* (i.e., following a certain level of increase in income per capita of a country does not necessarily signify enhanced citizens' happiness, suggesting that a rise in attributes of objective/collective well-being does not need necessarily to improve subjective well-being everlastingly) underscores the intricacy of their nexus [70]. This paper builds on the contemporary understanding of collective notions of well-being from an objective and regional perspective for one intriguing reason. Subjective well-being focuses on self-evaluation of life, developing abilities, realizing potential, and leading a socially impactful life at one economic level or place [71]. However, Seligman [72] describes human well-being as a combination of five key factors (PERMA): positive emotion, engagement, relationships, meaning, and accomplishment. This has been extensively supported in many theoretical and empirical studies. For instance, daily experiences in the city can affect an individual's positive emotions, and environmental surroundings can pose intrinsic values to enhance these positive emotions [73]. Others have underscored the role of interactions in augmenting the sense of human well-being as a web (personal, environment, and society) directly impacts an individual's well-being [55,56,74]. Meaning in life can generally be altruistic, and it offers people a sense that life has a greater purpose beyond an individual's self-evaluation [75–78]. Life accomplishment is the sense of attainment, mastery, and capability over what people do [58].

Collective human well-being includes objective measures calculated based on context-specific factors seen from an economic perspective, and the economic growth ideology of bringing happiness to people continues to remain popular [74]. However, the complexity of measuring regional human well-being objectively is propagated by the occasional interchangeable usage of popular and similar notions such as good health, satisfaction with life, happiness, and quality of life. Researchers have continued to point out the differences between these theoretical concepts and posited that these are subsets of human well-being [58]. Researchers have argued that though all these constituents of human well-being are essential, focusing on only one results in the deliberate omission of other significant aspects of human well-being [79]. Thus, authors have somewhat agreed that human well-being is more effective than all of its components, and one aspect cannot be used to imply human well-being [58,80]. It is thus essential to evaluate how regional human well-being comes about by centring analysis on different life events and a range of dimensions and factors that, in various combinations, determine the well-being of people in a particular region [58].

According to Shekhar [81], human well-being can be understood from different dimensions, summarized as the well-being wheel in human settlements. Among the dimensions of the wheel of human well-being is access, which stands for equality of chances for a population to gain access to essential, supportive, and conducive physical and social infrastructural services, social interrelationships, as well as space and capital resources required in utilizing them [14,82–85]. Simply put, the access dimension refers to the extent to which the urban population can obtain infrastructural services such as water, sanitation, health, energy, recreational places, educational places, employment, and sources of information [86]. Access incorporates a broader array of governance practices that can be directly impacted by spatial infrastructural planning provisions such as sanitation, water, energy, education, green space, recreation, health, and transportation. Research has documented that improving general access to these critical infrastructural services enhances the human well-being of a population in a particular region [86]. Moreover, the improvement in the quality of accessing infrastructural services can significantly impact different attributes of human well-being in a specific area [87–92].

In the wake of rapid urbanization, the theoretical linkage between urbanization and human development can be explored by linking it with economic performance, which affects the population's income distribution, purchasing ability, and general living standards [30,93,94]. in line with this surmise, research indicates that urbanization is significantly linked to better economic outcomes such as better incomes, living standards, and employment [95–98]. Consequently, urbanization's effect on economic performance is mediated by urban agglomeration, which brings out technological spillovers, economic efficiency, human capital accumulation, innovation, and labour specialization [99,100]. Thus, as economies grow, urbanization effects become beneficial as people can access services such as water, better income jobs, and industrial agglomeration creates a compact economic advantage for the urban populace in terms of better living [101–103].

Better access to urban infrastructural services such as energy, sanitation, and water significantly affects the population's household conditions and living standards [104]. In this connection, necessary infrastructural service provision through government spending and governance practices ensure these critical infrastructural services are accessible to the entire population at different economic levels [105]. Existing theories such as Wagner's Law and Ratchet Effect substantiate the need for state spending in an economy [105]. Fiscal transfers from the central governments through devolution and program-based budgeting help the state to close the social inequality gaps in urban infrastructural service accessibility and income levels and undo development backwardness [106]. For instance, regional urban electrification is expected to enhance human well-being by reducing the use of kerosene lamps, hence decreasing the burden of respiratory disease [106]. Evidence also shows that poor urban household populations cannot access these basic social amenities, negatively impacting their well-being [107–110]. Therefore, understanding spatial accessibility quality features of infrastructural services that directly and significantly influence human well-being from an objective and regional perspective is urgent and timely. Human settlements, especially in urban regions, are gaining more research and policy attention in climate change and well-being debates, as evidenced by the recent specific mention of cities in SDG, several IPCC, and other celebrated global reports [111,112]. This further underscores the need to empirically understand human well-being from a spatial, objective, and regional perspective. Therefore, the study follows and maintains the objective measure of regional human well-being, a new and limited but primarily growing strand of literature [113].

2.2. Empirical literature

In line with the theoretical conjectures discussed above, several empirical studies have been conducted, from case study dimension, city to city, country to country, and from the regional perspective. For instance, Adams and Vásquez [114] indicated that households in Accra City, Ghana, were more sensitive to water quality as part of their general well-being. Using urban household survey data, Cassivi et al. [115] analyzed water accessibility in Malawi descriptively. They established that degraded water quality from the point of collection and consumption poses significant health risks. If no interventional measures are adopted, it results to the detriment of human well-being. Focusing on 15 Sub-Saharan African cities, Beard and Mitlin [116] found that most urban households receive piped water intermittently, affecting water quality negatively due to privatization and infringing the well-being of low-income households. In a more recent study, Chumo et al. [117] used qualitative research approaches, where data was collected through workshops and focus group discussions to uncover financial, structural, and social quality constraints of water accessibility and human well-being in informal settlements in Nairobi City, Kenya. The study deduced that the co-creation process could enhance the inclusion and quality of accessing and owning water services, positively impacting the urban informal settlement population's well-being. Enqvist and Ziervogel [113] applied a critical policy analysis approach to analyzing water service governance and justice in Cape Town, South Africa. It observed that accounting for water source development and coordination across sectors promotes water justice and accessibility across different social groups in Cape Town city.

Focusing on urban energy infrastructural service accessibility, Salite et al. [118] evaluated electricity accessibility in Mozambique's four major cities: Maputo, Matola, Nampula, and Beira. The study conducted critical policy analysis of 207 structured interviews and observed that the cost of accessing electricity service is always politicized and is not cost-reflective due to the governance challenges, leading to unreliable, low-quality energy use and low general human well-being among urban dwellers. Similarly, Tesfamichael et al. [119] studied urban energy accessibility among households in Ethiopia. The study observed that power outages cause food spoilage, paralyze essential services such as water, cause economic losses, and disrupt household social activities such as night-time studies. Also, studies carried out in Tanzania, Kenya, and Senegal found that lack of sufficient access to energy creates low human well-being driven by night-time criminal activities and uncertainty of electricity restoration [120,121]. Dioha et al. [122–124] applied the Long-Range Energy Alternatives Planning Systems model, a quantitative approach, to investigate the welfare outcomes of energy access in Nigerian households. They observed that adequate access to clean and modern energy would increase human well-being by reducing local air pollution significantly, especially in the urban regions.

A section of the studies has also focused on the implication of urban sanitation infrastructure service accessibility on general human well-being. For instance, Yesaya and Tilley [125] concluded that the volume of safely emptied sludge was low, posing significant health risks to people in Blantyre, Malawi. Further, the study concluded that there is a need for infrastructural development and delegated governance for managing and providing sanitation services to the people, going by the projected urbanization figures. Using 15 Sub-Saharan African cities, Beard et al. [126] established that 62 per cent of urban waste was not safely managed by the metropolitan municipality, where most households engaged in unsafe sanitation practices, creating public health threats. Similarly, Berendes et al. [127] focused on sanitation and waste management infrastructural service accessibility in Accra, Ghana. The study observed that multisectoral governance and management interventions help reduce contamination, thereby enhancing the human well-being of the population. In the same node, Dirix et al. [128] conducted an action research study on coordinated faecal sludge management in Toamasina City, Madagascar. They observed that effective public-private management improves the quality of accessing sanitation services across social classes, reducing health-related burdens. Applying qualitative research methods–in-depth interviews and focused group discussions (FGS), Simiyu et al. [129] observed that on-site sanitation facilities are dominant, although very few, and shared by urban informal household members in Nakuru City, Kenya. The study also pointed out that the quality of the sanitation facilities was featured by ever-filling up, manual emptying and sludge being transported using small-scale means, posing significant health risks before reaching the central treatment site.

In sum, while the reviewed studies confirm the influence of the quality of accessing urban infrastructural services on human well-being, several research gaps must be filled. First, a more extensive section of the studies conducted in the SSA region followed subjective measures of human well-being and applied qualitative approaches in analyzing its determinants from a household perspective [113,117,128,129]. Secondly, although other studies have analyzed the influence of the quality of accessing urban infrastructural services on human well-being, their focus has been on case study scenarios of one metropolitan region [114,119,127,130]. Few studies have begun shifting focus on regional perspective analysis of human well-being as influenced by the quality of accessing urban infrastructural services and following objective measures [116,118,126]. However, analyzing the link between urban infrastructural service accessibility quality and human well-being from a panel perspective is needed because of different existing plausible inconclusive results in the literature [131–133]. The significant probable differences in sample size, data type (micro and macro), urban structure (urban agglomeration distribution), unit of analysis (case studies and cross-sectional), limited panel studies, methodological differences, and variable inclusions are vital canals of inconclusive results. Therefore, addressing these critical research gaps requires an objective measure of human well-being and analyzing the influence of the quality of various urban infrastructural services on human well-being from a regional perspective using dynamic panel model estimation methods that can take care of autocorrelation, heteroscedasticity, and cross-sectional dependence and quantitative panel data set. On the bases mentioned above, this study aimed to address two objectives: to determine the link between the quality of accessing urban infrastructural services and human well-being and to determine the interactive effect between governance and urban infrastructural service accessibility quality on human well-being using 22 SSA countries for the panel data period 2000 to 2020.

3. Research Methodology

This section describes variables, data sources, theoretical and empirical models, summary statistics description and stylized facts, correlation analysis, and relationships illustrated by scatter plots.

3.1. Variable description

The study utilized balanced panel data for 22 Sub-Saharan African countries from 2000 to 2020 to study the link between the quality of accessing urban infrastructural services and human well-being due to the limited availability of data on urban infrastructure before 2000. The dependent variable is human well-being, for which data for its measure (HDI) from UNDP is utilized. HDI was selected as a measure for human well-being as it captures different constituents that contribute to the overall well-being of people as compared to subjective or self-reporting measures, which have been regarded to convey individual satisfaction and not societal or community well-being [16,80]. The primary explanatory variable is the quality of accessing urban infrastructural services measured using three key indicators as per World Bank classification: the share of the urban population accessing improved water, the percentage of the urban population accessing improved sanitation, and the share of the urban population accessing electricity sourced from World Bank Development Indicators [4]. As indicated in the literature, the quality of accessing urban infrastructural services refers to the ease and efficiency with which a particular population can obtain them, as depicted by close proximity [86]. For instance, as more people access clean energy, improved drinking water, and managed sewage sludge, there would be reduced air pollution, reduced infant mortality rate, and environmental degradation, hence enhancing the well-being of the people in a particular economy [134–136].

For the control variables ($Z_{1,i}$ in Eqs. (1) and (2)), we start by considering the urban agglomeration as a share of the urban population. Increased urban agglomeration following rapid urbanization, compounded by rural-urban migration, increases the competition for limited urban infrastructural services, thereby leading to deterioration of the environment, increased insecurity, environmental pollution through open defecation, excessive use of solid fuels, hence jeopardizing the overall well-being of the urban population [5,137]. Secondly, we consider the urbanization rate measured as a fraction of the urban population over the total population [138,139]. The sub-Saharan African region is currently categorized as rapidly urbanizing, characterized by insufficient access to critical urban infrastructure such as drinking water, sanitation facilities, and informal housing without electricity connections. Evidence also shows that the region has a record high level of environmental degradation, air pollution, and increased infant mortality and respiratory disease infections [5,6].

Also, we controlled for urban employment as a share of people employed in urban industries. Most rural-urban migration in the SSA region is due to perceived better employment in urban industries [140]. However, the industrialization level in the region provides limited opportunities for a skilled labour force, leaving out a more significant portion, especially youths, surviving on casual and menial jobs in the city, which drives them into slums due to unaffordability of housing and basic life needs such as food [141–143]. Lastly, we controlled for governance measured as the government effectiveness index sourced from the World Governance Index compiled by the World Bank. Notably, governance comprising county governments, local leadership, municipal councils, and the help of the central government provides public urban infrastructural services through fiscal allocation, coordination, and implementation of administrative policies [138]. Studies have proved that governance determines how effectively social inequalities and threats to well-being are corrected [138]. Therefore, lousy governance may propagate further social and environmental problems, while good management, in terms of effectiveness, helps promote policies that improve the health and well-being of the population [144–148]. Table 1 lists all variables, operationalization measures and data sources.

Table 1
Variable description.

Variable name	Measure	Data source
Human well-being	Human Development Index (HDI)	UNDP/Our World in Data
Quality of urban Infrastructural Service	Share (%) of the urban population accessing drinking water, sanitation, and electricity.	World Bank Development Indicators (WDI) /UNDP
Urban Agglomeration	Urban share (%) of the population	WDI /UNDP
Governance	Government Effectiveness Index	WGI/ WDI
Urbanization rate	The ratio of the urban population to the total population	World Bank Development Indicators
Employment	Share (%) of the people employed in urban industries	World Bank Development Indicators

Note: UNDP; United Nations Development Programme; WGI; World Governance Indicators.

3.2. Theoretical model

The empirical analysis of this study focuses on the link between the quality of accessing urban infrastructural service and human well-being, following the foundations of Adams and Klobodu [138], Brülhart and Sbergami [139], Castells-Quintana [149], Henderson [150], and Frick and Rodríguez-Pose [151]. This study relies on the neoclassical theoretical framework, which considers country-specific attributes such as the human development index (HDI) as the overall measure of human well-being. HDI captures a country's GDP per capita, population's health, and economic well-being to enable heterogeneity in primary conditions that impact human well-being, illustrated as follows:

$$y_{it} = \alpha_0 + \beta_1 X_{it} + \pi Z_{it} + \varepsilon_{it}; i, \ldots, 22;\ t \ldots,\ 21 \qquad (1)$$

where y_{it} represents the HDI (a measure of human well-being) level of country i, and time t, and X_{it} illustrates the explanatory variables, Z_{it} is a vector of country-specific explaining the cross-country human well-being differences and the well-behaved error term is represented by ε_{it}. The intercept is defined by $\alpha_{0,}$ α_1 is the coefficient estimate for lagged HDI, β_1 is the slope parameter for the quality of accessing urban infrastructural services, π is the coefficient's vector for the control variables, and the random error term is ϵ_{it} [152–154]. The subscript indexes i refer to country 1,…,22, and t refer to time from 2000 to 2020.

Introducing the country-specific factor affecting human well-being at the urban level as represented by X_{it}, this study considers the quality of accessing urban infrastructure (share of the urban population accessing improved water, improved sanitation, and energy) as the urban processes that collaboratively influence the well-being of the urban populace [149,155]. Specifically, the quality of urban infrastructural services refers to the urban environment that results from various capacities of urban agglomeration economies [149,155]. The provision of public infrastructural services mainly affects resources devoted to the urban share of the population and the overall country's human well-being status [155]. In line with this argument, Bertinelli and Black [156] stylized an urban economics model that suggests empirically testable prediction that the quality of accessing urban infrastructure influences human well-being. Thus, taking this prediction into perspective, Eq. (1) extends to the following generalized empirical dynamic panel data model:

$$HDI_{it} = \alpha_0 + \beta \text{Urb\_Infr}_{it} + \pi Z_{it} + \varepsilon_{it} \qquad (2)$$

where *Urb_Infr* is the urban infrastructure capturing the specificities of the urban processes in a country.

The dynamic panel data model (Eq. (2)) is estimated using different panel regression techniques such as Pooled OLS, Driscoll-Kraay, and instrumental variable (IV) estimation based on the fixed effect (FE) two-step generalized method of moments (GMM) technique (2SIV-GMM). The explanation of results and deductions are based on the fixed effect

(FE) two-step generalized method of moments (GMM) technique (2SIV-GMM) approach because, by default, the Pooled OLS panel technique assumes that at least a portion of the regression estimators is similar across the panel [157]. In this case, Pooled OLS was utilized as a benchmark technique for establishing an overview of cross-country analysis of human well-being [157,158]. Specifically, the Driscoll-Kraay estimation technique was used to unravel the preliminary link between the quality of accessing urban infrastructural services and human well-being in SSA [159]. Nevertheless, this method suffers if omitted variables correlate with human well-being and urban infrastructural service quality measures, resulting in endogeneity issues [40, 160].

Given that we have $N > T$ ($N = 22$ and $T = 21$) and social welfare variables that are hard to measure, it signifies that biased estimates can be obtained. However, applying panel data models such as (FE) two-step generalized method of moments (GMM) technique (IV-GMM) helps to control state and time-invariant variables and tackle endogeneity issues [160,161]. In addition, applying Driscoll-Kraay standard errors in IV-GMM setup, probable heteroscedasticity, and cross-sectional dependence problems, which automatically exist in variables measured in panel form [30,160]. Additionally, since the IV-GMM utilize instrumental variables as part of the regressors, they enhance the performance of dynamic panel models with small N and T as it is in this study [162, 163]. Using Driscoll-Kraay standard errors helps robustly account for cross-sectional dependence [159,164]. It accounts for spatial and other forms of cross-sectional correlation results in a significant complication of empirical studies. Failure to care for spatial dependence results in spurious standard error estimates [102]. Furthermore, the Driscoll-Kraay estimator allows for autocorrelation, heteroscedasticity, and temporal and spatial dependence [159]. Although the applied panel models account for cross-sectional dependence, autocorrelation, heteroscedasticity, and endogeneity, they cannot partition the effects at different levels [30,159]. To account for this, this paper carried out robustness checks by disaggregating the impact of the quality of accessing urban infrastructural services on human well-being by separating the selected countries into high-HDI (HDI >0.5) and low-HDI (HDI <0.5) countries and estimate using 2SIV-GMM [162].

3.3. Data description and stylized facts

As mentioned above, data for the Human Development Index (HDI) are obtained from the official website of UNDP. In contrast, data for urban infrastructural service accessibility quality indicators (water, sanitation, and electricity), urbanization rate, and industrial employment are obtained from the World Development Indicators database of the World Bank [4,165] and data for governance are obtained from the Worldwide Governance Indicators database (2022). This paper considered 22 Sub-Saharan African countries for the period spanning from 2000 to 2020 due to data unavailability for the quality of accessing urban infrastructural services before 2000. Before carrying out any econometric analysis, a primary look at the quality of urban infrastructural service accessibility and regional human well-being patterns in recent decades enables us to outline some basic yet interesting stylized facts. First among these is that human well-being in several developing regions is characterized by a more extensive section of the urban population living under acute inadequate accessibility of urban infrastructural services (water, sanitation, and electricity), depicted by a lower HDI of less than 0.5. As indicated by the UNDP estimates in Appendix Fig. A1, whereas the HDI for Sub-Saharan Africa has been rising over the recent decades, the value has trailed behind other regions, with an average value of less than 0.50 between 2000 and 2021 [39].

In addition, Fig. 1 depicts the average HDI for the selected countries from 2000 to 2020. Fig. 1 shows that South Africa had the leading average HDI value of 0.68, followed by Ghana with an average value of 0.57, Congo Republic with 0.55, and Kenya with 0.54. Other countries with an average HDI value above or equal to 0.5 included Angola, Cameroon, Zambia, and Zimbabwe. On the other hand, Burkina Faso, Cote d'Ivoire, DRC, Ethiopia, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Tanzania, Togo, and Uganda.

Table 2 presents the descriptive statistics, where the average means of the HDI for the selected 22 Sub-Saharan African countries from 2000 to 2020. The average HDI value over the period is 0.4785, less than the average world value above 0.65 [166,167]. The second fundamental fact concerns urban infrastructural service accessibility. An average of 37.31 % of the urban population had access to essential sanitation

Table 2
Descriptive statistics.

Variables	N	Mean	Maximum	Minimum	Std. Dev.
Human Development Index (HDI)	462	0.4785	0.7360	0.2620	0.0857
Sanitation (SAN)	462	0.3731	0.7713	0.0957	0.1547
Water (WAT)	462	0.8233	0.9900	0.5953	0.0842
Electricity (ELEC)	462	0.6280	0.9660	0.0343	0.2190
Employment (EMPI)	462	1.0927	3.3930	0.2830	0.5835
Urban Agglomeration (URAG)	462	0.1649	0.6318	0.0335	0.1166
Governance(G)	462	−0.8289	0.6459	−1.8414	0.4397
Urbanisation Rate (UR)	462	0.3739	0.67829	0.1461	0.1474

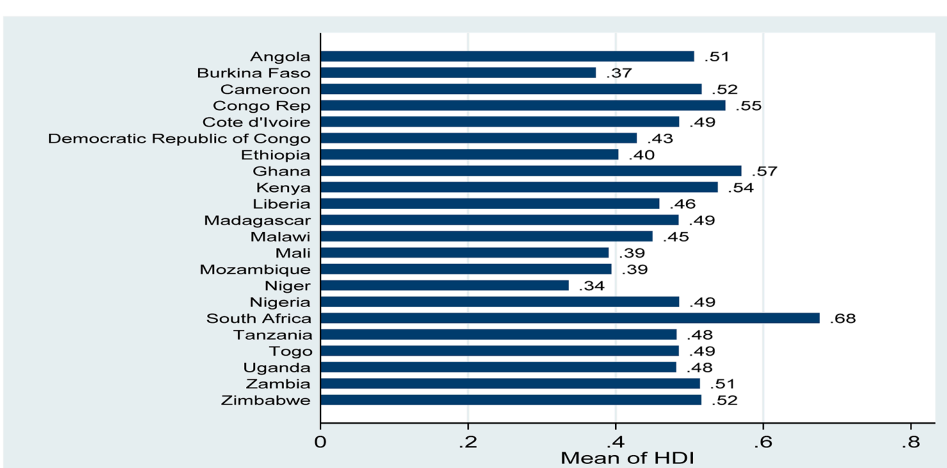

Fig. 1. The Average HDI for the Selected SSA Countries for 2000–2020.

services, 82.33 % to basic water services, and 62.80 % to electricity services. Regarding urban governance, an average government effectiveness index of −0.8289 indicates the weak effectiveness of the Sub-Saharan African governments in initiating, monitoring, and providing urban infrastructural service policies. The average urban agglomeration is 16.49 %, preceding an average galloping urbanization rate of 37.39 %.

Table 3 presents the correlation test results. As indicated, there is a significant positive correlation between the Human Development Index (HDI) and the selected variables. Specifically, a strong positive correlation exists between the Human Development Index (HDI) and the urbanization rate. In addition, there is an average positive correlation between the Human Development Index (HDI) and electricity accessibility, urban agglomeration, and water accessibility. In contrast, there is a weak positive correlation between the Human Development Index (HDI) and sanitation access and governance. Although the significant correlation between explained and explanatory variables indicates ideal regression results, it is essential to check for a multicollinearity problem as its presence results in overestimating coefficient estimate standard errors. This paper relied on the variance inflation factor (VIF) test to detect the presence of multicollinearity. Studenmund [168] posited that the rule of thumb for the VIF test is that VIF values greater than 5 and tolerance values less than 0.1 [169] indicate the presence of a multicollinearity problem, and the converse is true. The results shown in Appendix Table A1 show that the VIF and tolerance values for all selected variables are less than 5 and greater than 0.1, respectively. These collaboratively signify that including the explanatory variables together doesn't result in strong multicollinearity in the subsequent regression models.

Fig. 2 presents correlation plots between HDI and Urban Infrastructural Service Accessibility Quality measures. Specifically, Fig. 2 depicts an increasing relationship between HDI and Urban Infrastructural Service Accessibility Quality measures. This implies that SSA countries with increasing quality of accessing urban infrastructural services experience higher HDI, as elaborated by Appendix Fig. A2. Moreover, Appendix Fig. A3 shows an increasing relationship between higher quality of governance and higher HDI and urban agglomeration is associated with lower HDI.

4. Empirical Analysis and findings

4.1. Cross-Sectional dependence and panel unit root test

This paper's starting point of estimation is checking the presence of cross-sectional dependence (CD) between the cross-sectional units of analysis (countries). Due to urbanization resulting from rural-urban migration, attributed mainly to political instability and forced displacement in most SSA countries, the effect can spillover to the neighbouring countries. Additionally, most African countries are highly connected, resulting in dependence problems, especially if applied to panel data modelling. As indicated in Table 4, most variables are cross-sectionally dependent, thus rejecting the null hypothesis of panel homogeneity. However, governance and urbanization rate are cross-sectionally independent; the null hypothesis of panel heterogeneity is accepted at a 5 % significance level.

In line with the evidence of cross-sectional dependence among most of the selected variables, the next step is checking the stationarity or order of integration by carrying out second-generation unit root tests, which are ideal in addressing the presence of cross-sectional dependence in the estimated models. The study combined several panel unit root tests such as Levin et al. [170], knowns as (LLC), Im et al. [171], and known as the IPS test. These stationarity tests perform well in short panels with a small T. The validation for using panel unit root tests (IPS and LLC) instead of first-generation unit root tests (ADF and PP) is the robustness of the test, especially for short panels as it is in this study. Also, we employed augmented cross-sectional IPS (CIPS) by Pesaran [172] to account for the possibility of cross-sectional dependence in our panel data. The stationarity test findings of variables follow the underlying null hypothesis of the presence of unit root. Based on the results in Table 5, the null hypothesis is rejected under all tests for the human development index (HDI) at the first difference, $I(1)$. However, the null hypothesis of the presence of unit root is rejected for all other variables (water accessibility, electricity accessibility, sanitation accessibility, urban agglomeration, governance, urban employment, and urbanization rate) at level form, that's, $I(0)$, implying the absence of non-stationarity traits.

4.2. Dynamic panel model estimation

The main aim of this study is to determine the link between the quality of accessing urban infrastructural services and human well-being in 22 SSA countries from 2000 to 2020. The genesis point discusses the results per the estimation of the statistic panel data model form of Eq. (2) using Pooled OLS as a benchmark model and Driscoll-Kraay's estimator as the preliminary technique. Table 6 presents the results of Pooled OLS and Driscoll-Kraay's findings for the static model form of Eq. (2), where all the two models include HDI as the dependent variable, with an observation size of 462. The Pooled OLS estimates with all variables linked to regional human well-being are shown in column 1. Column 2 reports the findings following the Driscoll-Kraay technique, with all control variables, country and time-fixed effects included.

The Driscoll-Kraay findings show a significant positive relationship between urban water infrastructural service accessibility and regional human well-being at a 10 % confidence interval (see column 2). However, the findings indicated an insignificant negative effect of sanitation and a significant negative relationship between urban electricity infrastructural service accessibility and human well-being. This can be explained by the fact that most Sub-Saharan African cities lack important sanitation and electricity development capacity, negatively affecting the people's welfare in the urban regions. Further, the Discroll-Kraay Fixed Effect findings show that governance significantly positively affects regional human well-being at 1 %. This implies that as governance effectiveness in policy implementation and monitoring of urban infrastructural development programs improves, the welfare of the people improves as well. On the other hand, urban employment and urbanization have insignificantly positive and negative effects on human

Table 3
Correlation Test Results.

Variable	1	2	3	4	5	6	7	8
Human Development Index (HDI)	1.000							
Water Access	0.439*	1.000						
Sanitation Access	0.322*	0.393*	1.000					
Electricity Access	0.4938	0.479*	080*	1.000				
Urban Agglomeration	0.4768	0.178*	0.109*	0.023	1.000			
Governance	0.323*	0.270*	0.245*	0.290*	−0.207*	1.000		
Employment	0.453*	0.405*	0.225*	0.289*	0.635*	0.235*	1.000	
Urbanisation Rate	0.630*	0.172*	0.362*	0.288*	0.825*	−0.066	0.565*	1.000

Note: $**p < 0.1$.

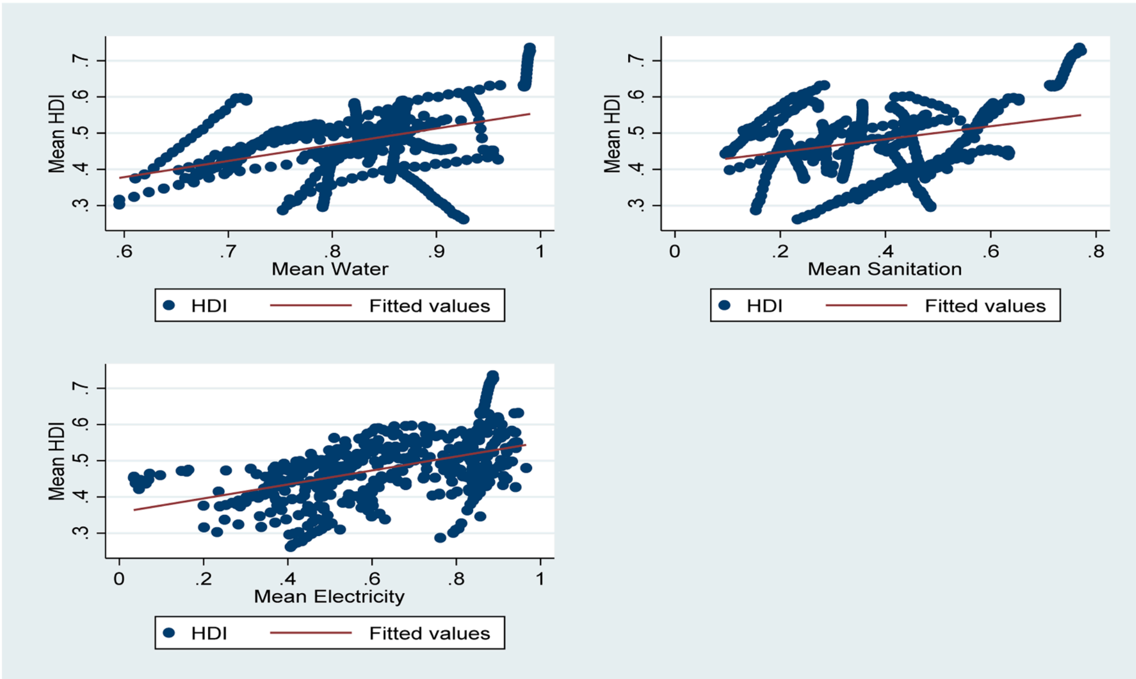

Fig. 2. Correlation Plots for HDI and Urban Infrastructural Service Accessibility Quality.

Table 4
Cross-sectional Dependence Tests.

Variable	CD-Test	*P-value*	Abs(Corr)
Human Development Index (HDI)	66.29	0.000**	0.952
Water Access	26.28	0.000**	0.995
Sanitation Access	17.58	0.000**	0.969
Electricity Access	43.93	0.000**	0.682
Urban Agglomeration	31.06	0.000**	0.824
Governance	−1.44	0.150	0.374
Employment	−1.13	0.257	0.588
Urbanisation Rate	55.10	0.000**	0.960

Note: Under the null hypothesis of cross-sectional independence. *$**p < 0.1$, $***p < 0.05$, $*p < 0.01$.*

Table 5
Panel Stationarity Unit Root Test.

Variable	LLC	IPS	CIPS	Status
Human Development Index (HDI)	−2.4905**	−1.7132**	66.2944**	I(1)
Water Access	1.1981	−2.6212**	26.2842**	I(0)
Sanitation Access	1.0723	−22.9533**	17.5843**	I(0)
Electricity Access	−4.0305**	−2.2772**	43.9284**	I(0)
Urban Agglomeration	−4.4858**	−2.6979**	31.0635**	I(0)
Governance	−2.4293**	−1.7909**	−1.4381**	I(0)
Employment	−0.2362**	2.1998	−1.1330**	I(0)
Urbanisation Rate	−1.7918**	3.3154	55.1005**	I(0)

Note: *$**p < 0.1$, $***p < 0.05$, $*p < 0.01$.*

well-being (see column 2). On the other hand, increased urban agglomeration could enhance human well-being. Rapid rural-urban migration increases agglomeration economies through sharing, matching and interaction, promoting better incomes and access to industrial employment. Nevertheless, Discroll-Kraay Fixed Effect estimates may be biased due to the endogeneity issue orchestrated by the presence of cross-sectional dependence uncovered earlier in this paper [173,174]. Therefore, we extended the analysis and presented results in the subsequent sections.

Table 6
Urban Infrastructural Services and HDI: Pooled OLS and Driscoll-Kraay Fixed Effect Results.

Dependent Variable: HDI	Pooled OLS (1)	Driscoll-Kraay FE (2)
Const.	0.560***	0.644**
	(0.046)	(0.140)
Water Access	0.216***	0.216*
	(0.043)	(0.110)
Sanitation Access	−0.041**	−0.041
	(0.019)	(0.052)
Electricity Access	−0.048***	−0.048**
	(0.013)	(0.020)
Urban Agglomeration	0.318**	0.318**
	(0.073)	(0.152)
Governance	0.034***	0.034***
	(0.006)	(0.011)
Urban Employment	0.008*	0.008
	(0.004)	(0.006)
Urbanisation Rate	−0.457***	−0.457
	(0.103)	(0.295)
Country/Year FE	YES	YES
Adjusted/Within Adjusted R^2	0.973	0.964
Observations	462	462
Number of Countries	22	22
F-stat, *p*-value	0.000	0.000

Note: All variables are measured at the beginning of the period. The time spans from 2000 to 2020. Standard errors are enclosed in parentheses. The Driscoll-Kraay nonparametric covariance matrix estimator produces the standard errors in the Fixed Effect model. Dummies for country and time effects are included to control fixed effects.
$*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

As a corrective robust measure of the endogeneity bias, the dynamic panel model specified in Eq. (2) was re-estimated using the Two-step Instrumental Variable-Generalized Method of Moments (2SIV-GMM) estimation technique (with the Discroll-Kraay standard errors). The 2SIV-GMM utilizes the orthogonality condition to produce efficient coefficient estimates in the presence of autocorrelation, cross-sectional dependence, variable omission, measurement error, endogeneity, and heteroskedasticity of unknown form [175]. Conceptually, we anticipate the correlation between explained, explanatory, and instruments to exist [176,177]. This paper assumed that the quality measures of accessing urban infrastructural services (main regressors) are endogenous except for the year. Thus, we utilized a maximum of three-year lags of the main regressors as instruments and included urban agglomeration and second differenced governance as external instruments of the estimation. Mainly, governance captures the effectiveness of government policies influencing urbanization and urban agglomeration-related welfare. Using lag structure enables the instruments and endogenous explanatory variables to be strongly associated [178]. Additionally, by following Amponsah et al. [40] and Sovey and Green [179], we tested the statistical validity of the selected instruments' validity to minimize the probable bias, especially in the presence of heteroscedasticity. We considered standard errors and Kernel (Bartlett) band-with to account for the potential in the model estimations [40,179]. Moreover, we performed instruments' validity, under-identification, over-identification, and weak identification tests using the Hansen J test, Kleibergen-Paap rk LM tests, and Cragg-Donald Wald F-statistics.

Table 7 provides the 2SIV-GMM regression estimated results. Looking at the model reliability tests, the findings show a significant Kleibergen-Paap rk LM ($p = 0067 < 0.05$) and an insignificant Hansen J-statistic value of 6.716. Empirically, a significant Kleibergen-Paap rk LM test [180] resulted in the rejection of the null hypothesis of under-identification and weak instruments, signifying the appropriateness of the instruments. Additionally, an insignificant Hansen J-statistic value indicated that we do not reject the null hypothesis (instruments are valid) and deduce that the selected instruments are valid. This further implies that the instruments excluded are independently distributed in the error process [176]. it is also important to mention that 2SIV-GMM corrects for the endogeneity problem by including regressors as both exogenous and endogenous variables in the model estimation [181].

The findings in Table 7 show the coefficient of sanitation and electricity urban infrastructural service accessibility to significantly and positively affect human well-being. This signifies that holding all other factors constant, as the quality of access to sanitation and electricity infrastructure improves in the sampled countries, the human well-being of the people is enhanced by increasing the HDI. These findings align with the previous studies, which observed that increased accessibility of sanitation services such as sludge management, emptying of solid waste, and electrification services improves the welfare of the people by reducing environmental pollution, diarrheal disease, infant mortality rate and enhances security certainty of the people [134–136,182]. Additionally, improving the quality of access to urban sanitation improves human well-being by reducing air pollution and enhancing human productivity, economic well-being, and social dignity [183–185]. On the other hand, the findings indicate the coefficient estimate of water service accessibility quality significantly negatively affects human well-being. This can be described by the fact that most cities in Sub-Saharan Africa lack essential drinking and domestic water, thereby detriment to human well-being (Ahmed, 2021; [186]). Collaboratively, this aligns with the observations made by [187] that there exist significant health inequalities in cities, such as differences in life expectancy due to inadequate water services for drinking.

Regarding the effect of governance in terms of the effectiveness of incepting, implementing, and monitoring social welfare policies, the findings indicate governance has a significant negative impact on human well-being. This implies that holding all other factors constant, an increase in governance ineffectiveness deters human well-being by reducing HDI. This holds water for the case at hand in many ways. First, as indicated by the negative governance effectiveness index, the majority of the Sub-Saharan African countries exhibit detrimental urban governance policies, including inadequate enforcement of contracts and failure to guarantee property rights that promote inclusive economic growth, which affects human well-being negatively [188,189]. Secondly, research studies such as Fisayo et al. [190] have indicated the governance challenges associated with human well-being in the SSA region. Studies have shown that Africa's governance and institutional environment for social welfare have been weak and unchanged in recent decades [191,192]. However, as observed in Table 7, it is unexpected for a higher governance level to result in reduced human well-being; we extended the analysis by including governance and its interaction term in the dynamic panel model and estimated it robustly in Table 8, where the findings pointed out that higher government effectiveness enhances human well-being.

Regarding the control variables in Table 7, the urbanization rate is significantly and negatively linked with human well-being. Indeed, the SSA region is characterized by rapid urbanization, which presents governance pressure of managing large agglomerations and providing vital social amenities such as water, sanitation, and electricity services, which are crucial to the well-being of the urban population [5,6,142]. On the other hand, urban industrial employment is insignificantly linked to human well-being. This can be attributed to the SSA region being an agricultural-based economy that produces primary goods. Hence, urban industrial employment has an insignificant influence on human well-being [193]. Also, excessive state interference and poorly designed industrial investment policies contribute to shrinking SSA's urban industrial performance [193,194].

Table 7
2SIV-GMM Regression Findings.

Dependent Variable: HDI	2SIV-GMM
Const.	0.253***
	(0.050)
Water Access	−0.198***
	(0.060)
Sanitation Access	0.056**
	(0.021)
Electricity Access	0.079**
	(0.017)
Urban Agglomeration	0.162
	(0.049)
Governance	−0.075**
	(0.009)
Urban Employment	0.031
	(0.0007)
Urbanisation Rate	−0.292***
	(0.044)
Country/Year FE	YES
Observations	396
Number of Countries	22
F-stat, P-value	0.000
Kleibergen-Paap rk LM P-value	0.0067
Hansen's J-stat	6.716

Note: Standard errors are enclosed in parentheses. The Driscoll-Kraay nonparametric covariance matrix estimator is used to produce the standard errors. Dummies for year and country effects are included to control fixed effects.
$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

4.3. Robustness checks

This section presents detailed robustness checks regarding the connection between the quality of accessing urban infrastructural services and human well-being. Given the varied human well-being indicated by different HDIs, the probable effect of the quality of accessing urban infrastructural services on human well-being varies in different model specifications. This paper pays a deeper robustness focus to the Sub-Saharan African context for two main reasons. One resides in the identified positive differential impact of the quality of accessing urban infrastructural services and urban governance on human well-being, as shown in Table 8. The second reason is the methodological deficiencies of Pooled OLS and the different HDI values of the selected countries. As mentioned, the 2SIV-GMM estimation technique addresses endogeneity problems and enhances estimation efficiency. Nevertheless, 2SIV-GMM

Table 8
2SIV-GMM Robustness Checks: Quality of Accessing Urban Infrastructure and Human Well-being.

Dependent Variable	Drisc-Kraay FE (1) HDI	2SIV-GMM (2) HDI	2SIV-GMM (3) Electricity	2SIV-GMM (4) Governance	2SIV-GMM (5) Agglomeration
Const.	0.105**	0.245***	0.548***	−0.722***	0.100***
	(0.043)	(0.051)	(0.029)	(0.080)	(0.025)
Water Access	−0.160**	−0.208**		−0.240	0.066
	(0.043)	(0.063)		(0.095)	(0.029)
Sanitation Access	0.026	0.075*		0.225**	−0.121***
	(0.029)	(0.022)		(0.041)	(0.017)
Electricity Access	0.174**	0.084*		1.342**	−0.244***
	(0.031)	(0.047)		(0.058)	(0.018)
Urban agglomeration	0.258**	0.129**	−0.774***	−0.028***	
	(0.110)	(0.104)	(0.252)	(0.157)	
Governance	0.005**	0.005**	0.459**		
	(0.011)	(0.023)	(0.057)		
Elect*Governance	−0.038**	−0.088**	−0.666***	1.279***	
	(0.018)	(0.032)	(0.063)	(0.022)	
Elect*Urban Agglomeration	−0.466**	−0.488***	0.905***		1.232***
	(0.111)	(0.146)	(0.365)		(0.070)
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	462	396	396	441	396
Number of countries	22	22	22	22	22
Centered/Within R^2	0.7060	0.989	0.892	0.942	0.944
F-test *p*-value	0.000	0.000	0.000	0.000	0.0000
Kleibergen-Paap rk LM		15.781**	20.873**	15.644**	16.584**
Hansen's J-statistic		5.265	5.210	2.825	12.465

Note: Controls comprise urbanization, industrial employment, urban agglomeration, and urban governance. The time frame spans from 2000 to 2020. The Driscoll-Kraay nonparametric covariance matrix estimator is used to produce the standard errors. Dummies for year and country effects are included to control fixed effects. **p < 0.1; **p < 0.05; ***p < 0.01.*

estimation relies on adjustments to internal and external instruments, such as lagging and variable transformations [195]. Therefore, ideal external instruments for regional human well-being from the quality of urban infrastructural service accessibility are complex to find.

Still, literature has pointed out urban agglomeration and urban governance as reliable external instruments for regional human well-being in Sub-Saharan Africa [138,149]. Higher levels of urban agglomeration are anticipated to negatively impact urban infrastructural service accessibility. Also, the weak effectiveness of governance in initiating and implementing urban population policies jeopardizes the overall living standard of the urban population [138, 149]. In this effect, we used urban agglomeration and urban governance along with their squared values as the exogenous and instrumental variables along with the interactive term of these instrumental variables, with the electricity access as a proxy for quality urban infrastructure accessibility having been identified as significantly positive in pooled OLS, Driscoll-Kraay and 2SIV-GGMM models in Tables 6 and 7. Using these instrumental variables as part of exogenous variables and electricity accessibility allows us to control for simultaneity bias and feedback effect ([138]; Castells-Quintana & Royuela, 2015; [149]; Wooldridge, 2010). The strategy here entails regressing electricity access (a proxy for quality of accessing urban infrastructural services), an urban agglomeration, and urban governance, their squared terms along with the interactive terms on regional human well-being using 2SIV-GGMM technique (see models in Appendix Eqs. (3) and (4)).

Appendix Table A2 presents the first-stage OLS and Driscoll-Kraay FE estimations for Eqs. (3)-(5). Urban agglomeration and urban governance, along with their squares, appear statistically significant in explaining the variation in the human well-being of the urban population in Sub-Saharan Africa, as depicted in literature. We further utilize Driscoll-Kraay FE and 2SIV-GGMM techniques to estimate the model presented in Eq. (5). In this case, urban agglomeration and governance are used as basic instruments, and their interactive terms with urban infrastructural services (proxied by electricity access) are used as additional regressors. Before evaluating the results presented in Table 8, we check the validity of electricity access (a proxy for urban infrastructure) and urban agglomeration and governance as instruments for human well-being following the first-stage OLS approach. For these variables to be valid instruments, they should explain the variation of human well-being and influence the quality of urban infrastructural services and urban agglomeration via human well-being (exclusion procedure). The F-statistic test is carried out to further evaluate the exogeneity and relevance of urban agglomeration and governance, along with their squares (see Appendix Table A2). As seen in Appendix Table A2, the selected variables significantly affect the variation of human well-being and impact the urban infrastructure and urban agglomeration (see columns 2 and 3).

Table 8 presents the robustness checks by 2SIV-GGMM estimates of the HDI model for SSA. In alignment with the findings observed in Table 8, 2SIV-GGMM results show a significant positive effect of the quality of access to sanitation and electricity urban infrastructural services on human well-being (see Column 2). Still, the significant negative effect of water urban infrastructural service is sustained. However, it turns out to be significantly positive if the country's HDI level disaggregates the estimation (see column 2 of Appendix Table A3). Additionally, suppose a composite measure of the quality of accessing urban infrastructural services (mean summated share of the population accessing improved sanitation, modern energy, and clean drinking water) is considered; it becomes significantly positive (see column 5 in Appendix Table A2). In that case, it has a significantly positive effect on human well-being. This implies that enhanced quality of accessing urban infrastructural services such as water, sanitation, and electricity improves the well-being of a country's population through reduced health-related risks, increased productivity, and reduced environmental pollution (Field & Kremer, 2006; [30]; Riva et al., 2018).

Regarding the role of governance on human well-being, the 2SIV-GGMM findings indicate a significant positive effect of governance and a negative interactive effect with the urban infrastructure (proxied by electricity) (see column 2 of Table 8). Further, the findings confirm a significant positive effect of urban agglomeration and a negative interactive impact with electricity accessibility (a proxy for urban infrastructural service accessibility) on human well-being, aligning with the results in Table 7. This signifies that the increased urbanization rate pushes more people to concentrate (urban agglomeration) in urban regions, thereby increasing energy needs for education and production and affecting the urban population's welfare (Byaro & Mmbagga, 2023). However, the findings show a significant positive interactive effect between urban agglomeration and electricity accessibility on electricity infrastructural services (see column 3 of Table 8), meaning as urban agglomeration as an outcome of continuous urbanization increases, the government, through local authorities, enhances the quality of accessing urban infrastructural services, thereby improving the welfare of the urban people [30]. Increased urban productivity and governance enable more households to have sufficient disposable income to purchase home appliances such as electric cookers, TV sets, electric radios, kettles, and iron boxes, which depend on electricity use, all meant to make life enjoyable [29,192,196].

Regarding the influence of governance on urban infrastructural service accessibility quality, results depict a significant positive effect (see column 3 of Table 8). This signifies that enacting sound urban development and demographic-transition policies, such as decentralization of urban industries and agricultural mechanization, reduces urban concentration and encourage a particular share of population to back to the rural, hence enhancing equitable access to urban infrastructural services such as electricity ([197–199]. This reduces competition and pressure exerted on urban infrastructural services, enhancing the remaining urban population's quality, usability, livability, and general human well-being [29,200,201]. On the other hand, the interactive term between governance and access to urban infrastructure is negative (see columns 2 and 3 of Table 8), signifying that persistence in weak governance effectiveness results in the deterioration of the quality of accessing urban infrastructural services, hence reduced human well-being [202,203]. A case of SSA region is that of continuous concentration of people in the city regions, driven by massive rural-urban migration and natural births, which has been touted to be growing much faster than the urban infrastructural development and governance capacity [204]. The aftermath of the SSA region's increasing urban glomeration is insufficient government provision of critical urban infrastructural services such as water, sanitation, and energy services, and exacerbated environmental deterioration [205].

4.2. Summary of the findings

In sum, the statistical evidence provided by development organizations such as the World Bank and UNDP regarding developing regions such as SSA provides the dire situation of the quality of accessing urban infrastructural services such as water, energy, and sanitation. Partly, this is attributed to the constrained economic opportunities for the rural population orchestrated by the dwindling agricultural sector and forced migration to cities. Also, the limited accessibility to urban infrastructural services is attributable to the bursting urban population and government mishaps. Indeed, due to the worst quality of accessing essential social amenities, resulting from government ineffectiveness in initiating and adopting development policies geared toward achieving better accessibility of social services.

The findings from this study, in many ways, confirm these assertions. First, the results depict SSA's general human well-being standard trailing behind other regions. This observation is confirmed by previous studies such as Castells-Quintana [149], who observed that the quality of urban infrastructural services in SSA is significantly lower than in counterpart rapidly urbanized regions such as East Asia. The disparity in the quality of accessing urban infrastructural services also differs across SSA countries and cities and between genders [206]. This can be justified by the fact that informal settlement in the SSA region houses over 50 % of the urban population, living in dilapidated housing conditions without adequate access to improved water, sanitation facilities, and connection to the electricity grid [207]. The estimated results showed a significant positive link between the quality of accessing urban infrastructural services and human well-being in SSA, implying that better quality of accessing critical services enhances the general human well-being of the urban population. These results confirm the observations made by previous studies that adequate access to essential urban infrastructural services results in significant improvement in human well-being by significantly reducing several social problems in SSA, ranging from diarrheal diseases and respiratory disease to reduced household healthcare expenditure, energy poverty and social inequalities [30,129].

Second, the study indicated an increasing urban agglomeration that does not match the available urban infrastructural services. Particularly, the results suggest that countries like Democratic Republic of Congo and South Africa with sizeable urban agglomeration experience declining human well-being compared to countries like Burkina Faso and Niger with smaller urban agglomerations. This is because large agglomerations in SSA encounter severe pressure to accommodate ever-increasing population as the majority of the cities in the region are characterized by limited employment opportunities, inadequate housing facilities, water, sanitation, healthcare facilities, waste management systems, and rising effects of climatic changes and environmental degradation, increase in non-communicable and water-borne diseases [30,129]. These findings are confirmed by Nyika [208], who identified rapid urbanization and urban population growth as the major factors of urban water scarcity and stress in most SSA urban regions.

In terms of the government's role, the findings show that SSA governments have been ineffective in incepting, implementing, and monitoring social development policies in recent decades. Specifically, a few countries like Zambia, South Africa, Madagascar, Kenya, and Niger, with perceived fair governance as indicated by positive governance index effectiveness, experience slightly better human well-being as compared with countries like Nigeria, with higher levels of corruption. The results imply that enhanced governance results in an improvement in human well-being. For instance, coordinated waste and sludge management leads to declined diarrheal diseases and mortality rates in urban informal settlements and promotes sustainability and waste management culture [209]. These findings are confirmed by Branchet et al. [210], who established that reclaimed urban water resources and moves by local authorities to protect urban water resources and safe disposal of wastes enhance the health of the urban population and environmental quality in SSA. In addition, Ndam et al. [209] observed that coordinated urban household waste management is a gateway to cities' new well-being, reflecting long-term collective infrastructural development actions defined by local authority in SSA. In general, an increase in urban agglomeration in SSA increases urban infrastructural needs, negatively impacting human well-being, resulting from insufficient accessibility and compromised quality of services. Therefore, it calls for collective infrastructural development and refocused urban governance in initiating and implementing urban policies targeting different social clusters of people confronted by different livability needs.

Although the study covered several aspects of the quality of accessing urban infrastructural services and how it influences human well-being, it suffers from some limitations. First, the study excluded urban green infrastructure's influence due to the unavailability of panel data. Therefore, further studies can include the impact of urban green infrastructure in assessing how it impacts the well-being of the people. Secondly, the paper used the urban share of the population to measure the quality of accessing urban infrastructural services. However, future studies can interrogate the quality of accessing urban infrastructural services using daily water intake, daily volume of emptied waste, and daily hours of power outage. Thirdly, future studies can focus on quantitative case studies to provide new insight from a specific contextual perspective. These will help in enlarging the urban economics literature and provide a basis for further quantitative research on urban demographic transitions, which can be of great value to understanding better the link between urban infrastructure and human well-being, a relevant issue for developing regions presently. Lastly, the selected quality of accessing urban infrastructural services and HDI are not the only indicators of urban infrastructural services and human well-being from a population dynamic perspective. Future studies can focus on more in-depth indicators such as quality of life, urban livability index, inequality, and happiness index that can be computed using micro or survey-based data, widely recognized in the literature as robust measures of human well-being.

5. Conclusion and policy recommendations

The quality of accessing urban infrastructural services such as water, energy, and sanitation plays a pivotal role in enhancing the human well-being of the urban population and the entire economy, as confirmed by literature and results. However, significant heterogeneities across nations, cities, and regions are orchestrated by urbanization processes and quality of governance. In addition, investigating the connection between the quality of accessing urban infrastructural services and human well-being has been identified in the literature as daunting due to the revolving measures of human well-being, from subjective to objective measures. Several studies covering this topical issue in the SSA region have focused heavily on case studies, and little evidence is available regarding the panel data model estimation. Furthermore, most studies have covered urban infrastructural services and human well-being from a subjective point of view without including the role played by governance in ensuring quality accessibility of urban infrastructural services. Against these gaps, this paper explored the link between the quality of accessing urban infrastructural services and the interactive effect of governance on human well-being using panel data from 2000 to 2020 for 22 countries. Utilizing Pooled OLS, Driscoll-Kraay, and 2SIV-GMM techniques, the paper uncovered the following findings: The quality of accessing urban infrastructural services enhances human well-being by way of increasing HDI; The interactive term between urban infrastructural services and governance and urban agglomeration has negative effects on human well-being. Also, governance significantly and positively influences human well-being and urban infrastructural services. Lastly, urbanization and subsequent urban agglomeration are detrimental to human well-being through increased governance ineffectiveness.

In line with these findings, this paper uncovers significant avenues through which the quality of accessing urban infrastructural services enhances human well-being. First, increasing urbanization acts as an ecosystem of inclusive economic growth from foreign development and concerted development frameworks such as sustainable urbanization and conservation measures; however, in regions such as SSA where urbanization is not typical, due to forced displacement and political hostility, governance challenges attributed to bursting urban agglomeration from rural-migration of the active population present dire quality of accessing urban infrastructural services such as water, sanitation, waste management, and electricity. In this regard, it has been argued that the low quality of access to urban infrastructural services due to high agglomeration is attributable to poor governance effectiveness arising from stirring urbanization challenges in SSA. Access to water, electricity, and sanitation is deficient, hampering positive structural change and benefits from the active population flooding urban regions.

In tandem with these arguments, the *Malthusian* trap might be the ideal reality, as the pace of urbanization supersedes the government's provision of urban infrastructural services vital for human well-being in SSA. Previous studies have suggested that when urban agglomeration is due to forced displacement rather than regular rural-urban migration, the government's effectiveness in investments in urban infrastructural service provisioning becomes highly fundamental. The quality of accessing urban infrastructural services is not desirable in terms of the quality of life of the urban population but also the general human well-being at the regional level. Therefore, the study findings point to the fact that the government's investment and policy effectiveness that raises the quality of accessing urban infrastructural services such as water, energy, and sanitation, can influence the higher levels of human well-being significantly, especially in regions with largest urban agglomerations such as SSA—subsequently, certifying that better quality of accessing urban infrastructural services in these large agglomerations keeps pace with the stirring urbanization not only enhancing the general well-being but also stripping the region from Malthusian trap.

Based on the findings and deductions, the study suggested several policy implications and strategies that can be adopted to enhance the quality of access to urban infrastructure services and result in human well-being. First, the paper recommends that improving the quality of access to urban infrastructure services is a collective action defined by local authorities, central governments, and development agencies. Therefore, the government, through the local authorities such as municipal council and community leaders, should enact pro-poor targeting urban infrastructural development policies such as community-led waste management and reclamation of water resources, women empowerment, and intensified urban electrification championed by community leaders will not only help in boosting the road toward sustainable urbanization but also controlled environmental degradation and human capital development in the SSA urban regions [211]. Secondly, governance policies such as urban decongestion through agricultural mechanization and rural-urban transport infrastructural development will help in containing detrimental urbanization effects and create a social culture of interdependency between rural and urban households, hence helping in easing urban infrastructural service accessibility pressure [30]. Thirdly, Sustainable accessibility of urban infrastructural services, compounded with easy industrial linkage to the rural regions through the development of multimodal transport systems, should be given urgent priority as these will help in overcoming the negative externalities of urban agglomeration, thereby reducing the cost of urban industrial employment which act as the pull factor of urbanization [212].

Funding

We acknowledge the funding received from the African Economic Research Consortium (AERC) under the Human Capital Development Theme 2022 Edition (REF: pHPH/ST/23–049 (award –2334)).

CRediT authorship contribution statement

Isaiah Maket: Writing – review & editing, Writing – original draft, Visualization, Software, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Izabella Szakálné Kanó:** Writing – review & editing, Writing – original draft, Supervision, Software, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Zsófia Vas:** Writing – review & editing, Writing – original draft, Validation, Supervision, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

Authors declare no competing interests.

Appendix

This section entails supporting evidence and estimations. The section consists of Fig. A1, which shows the comparative HDI for SSA with other regions; Table A1 shows the VIF results for the multicollinearity test; Fig. A2 shows the correlation between HDI and urban infrastructural services; Fig. A3 shows correlation between HDI and urban agglomeration and governance in the selected countries, Equation A1 shows the additional equations for robustness checks, Table A2 shows the first-stage least squares estimates along FE-DK, and Table A3 shows IV-GMM Regression by HDI Country Difference.

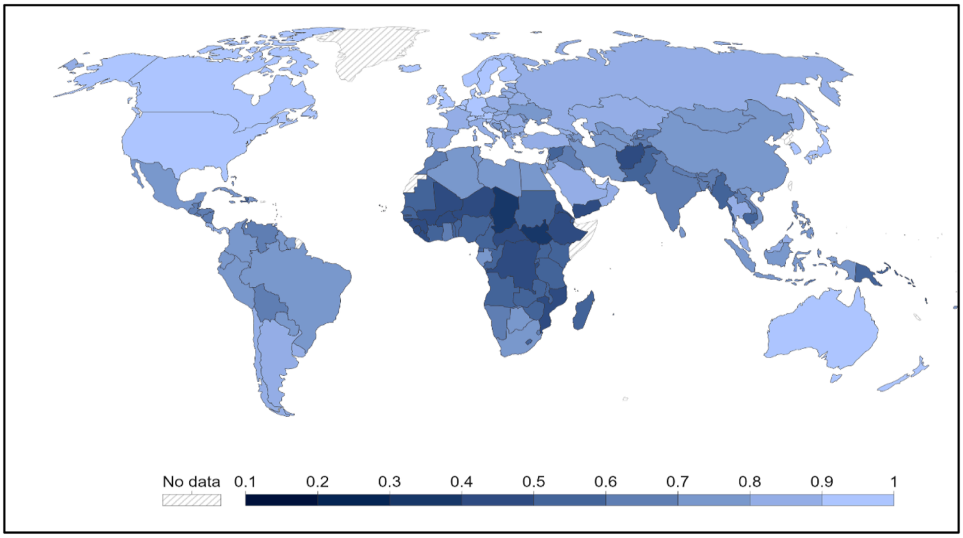

Fig. A1. Human Development Index in SSA.

Table A1
VIF Test Results.

]	Human Development Index (HDI)	
	VIF	1/VIF
Water Access	1.60	0.6239
Sanitation Access	1.44	0.6929
Electricity Access	1.46	0.6827
Urban Agglomeration	1.06	0.9405
Governance	1.30	0.7715
Employment	1.89	0.5299
Urbanisation Rate	1.92	0.5203
Mean VIF	1.53	

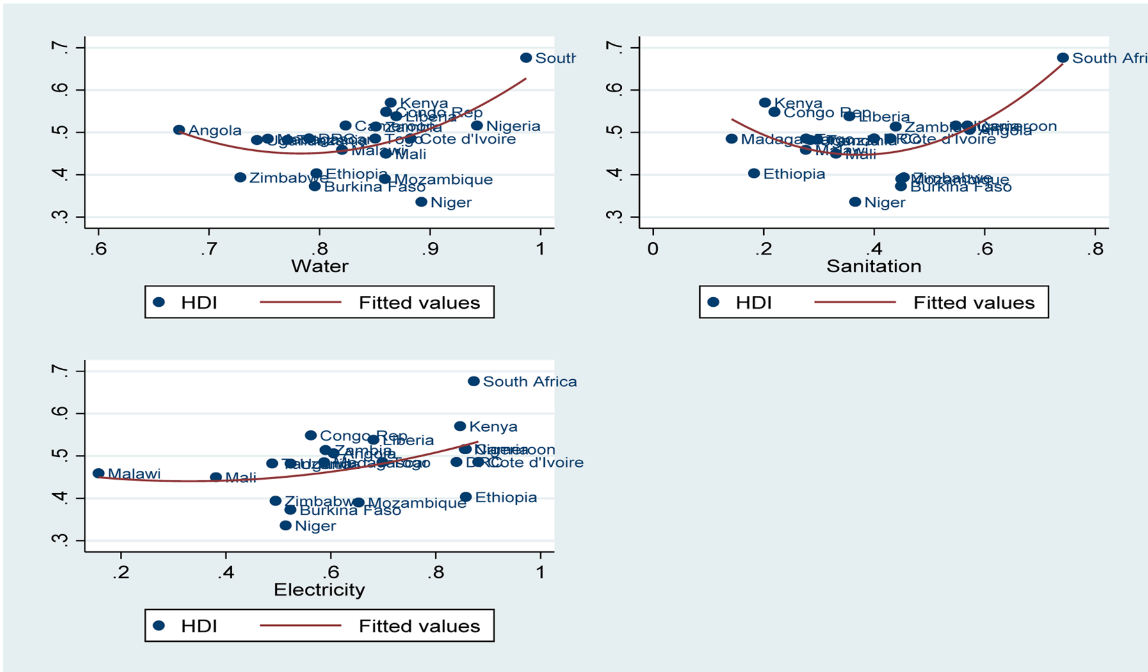

Fig. A2. Correlation between HDI and Quality of Urban Infrastructural Services by Country.

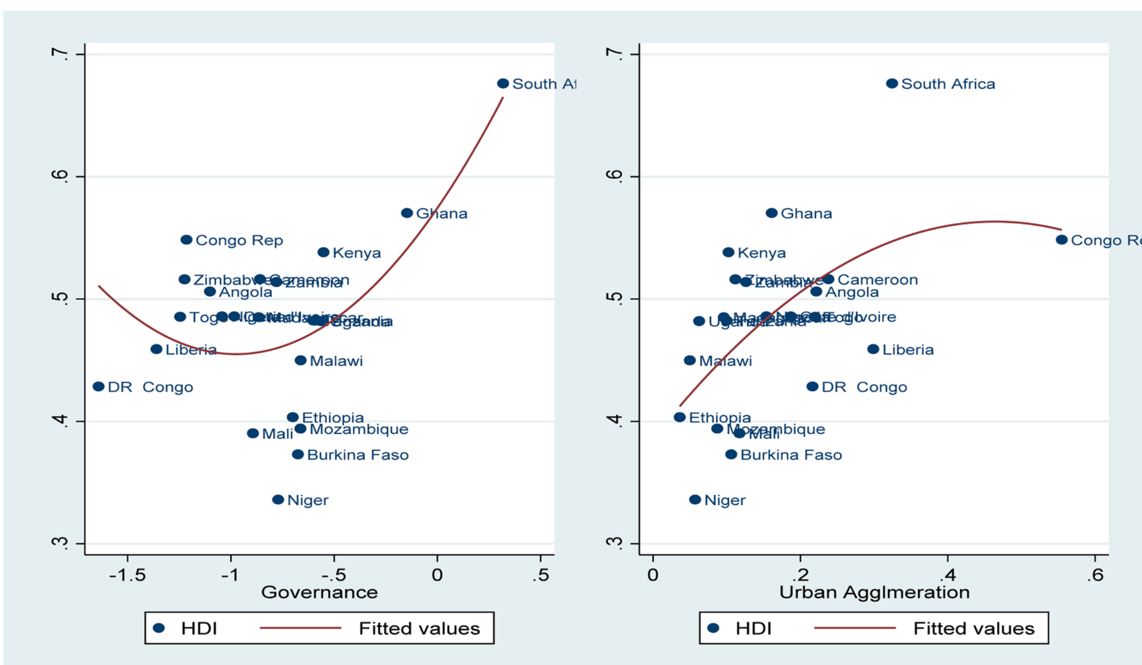

Fig. A3. Correlation between HDI and Governance and Urban Agglomeration.

Equation A1: Robustness Checks Equations

$$\text{Electricity Access}_{\text{it}} = \rho_1\left(\Delta y_{it-1,t}\right) + \alpha_i + b_t + \mu_{it} \tag{3}$$

$$\text{Urban Agglomeration}_{\text{it}} = \rho_2\left(\Delta y_{it-1,t}\right) + \alpha_i + b_t + \mu_{it} \tag{4}$$

$$HDI_{it} = \alpha_0 + \beta_1 \text{Urb\_Infr}_{it} + \beta_2 \text{Gov} * Elect + \beta_3 \text{UrAg} * Elec + \pi Z_{it} + \varepsilon_{it} \tag{5}$$

where α_i represents the country-specific fixed effects and b_t represent the year-fixed effects. The interactive term between urban infrastructural services (proxied by electricity) and governance is denoted by $Gov * Elect$, and that of urban infrastructural services and urban agglomeration is denoted by $UrAg * Elec$. Introducing the country-specific fixed effects lets us control for time-invariant country-specific omitted variables. In addition, introducing year-fixed effects helps control regional effects.

Table A2
First Stage OLS and Driscoll-Kraay FE.

Dependent Variable	Pooled OLS HDI (1)	Driscoll-Kraay FE HDI (2)	Driscoll-Kraay FE Electricity (3)	Driscoll-Kraay FE Agglomeration (4)	Driscoll-Kraay FE G-service (5)
Urban Agglomeration	0.9330***	2.8587***	1.4737**		
	(0.0785)	(0.2052)	(0.5528)		
Urban Governance	0.0896**	−0.0309**	0.0399		
	(0.0069)	(0.0135)	(0.0362)		
Urban Agglomeration. SQ	−0.9685***	−2.5244*	−1.9726***		
	(0.1368)	(0.2216)	(0.4232)		
Urban Governance. SQ	0.0386***	−0.0317***	0.0532**		
	(0.0152)	(0.0065)	(0.0233)		
HDI			1.4459***	0.2052***	0.8673***
			(0.0760)	(0.0107)	(0.0377)
Const.	0.4417***	0.1398***	−0.2304***	0.0667***	0.1931**
	(0.0094)	(0.0321)	(0.0423)	(0.0051)	(0.0171)
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Observations	440	440	440	440	440
N. of countries	22	22	22	22	22
Adjusted/Within R^2	0.4698	0.3794	0.4796	0.2625	0.4815
F-stat *P-value*	0.000	0.000	0.000	0.000	0.000

Note: Standard errors are enclosed in parentheses. The Driscoll-Kraay nonparametric covariance matrix estimator is used to produce the standard errors. Dummies for year and country effects are included to control fixed effects.
$*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

Table A3
IV-GMM Regression by HDI Country Difference.

Dependent Variable: HDI	IV- SysGMM HDI≤0.5	IV- SysGMM HDI>0.5
Const.	0.0339***	0.0130
	(0.0052)	(0.0083)
Water Access	−0.0275***	0.0443**
	(0.0048)	(0.0131)
Sanitation Access	0.0068	0.0090**
	(0.0044)	(0.0034)
Electricity Access	0.0018	−0.0042
	(0.0021)	(0.0033)
Urban Agglomeration	−0.0076	−0.0055
	(0.0178)	(0.0084)
Governance	−0.0010	0.0018
	(0.0022)	(0.0018)
Urban Employment	−0.0002	−0.0027
	(0.0009)	(0.0027)
Urbanisation Rate	−0.0115	0.0242**
	(0.0097)	(0.0070)
Year FE	YES	YES
Country FE	YES	YES
Observations	224	172
Number of Countries	22	22
Centered R^2	0.9911	0.9920
F-stat, *P*-value	0.000	0.000
Kleibergen-Paap rk LM	34.340**	31.409**
Hansen's J-stat	0.1828	0.2608

Note: Standard errors are enclosed in parentheses. The Driscoll-Kraay nonparametric covariance matrix estimator is used to produce the standard errors. Dummies for year and country effects are included to control fixed effects.
$*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

References

[1] UNDESA, Revision of World Urbanization Prospects, United Nations Department of Economic and Social Affairs, 2018 (Accessed on 9 October 2022), https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html.
[2] G. Duranton, Growing through cities in developing countries, World Bank Res. Obs. 30 (1) (2015) 39–73.
[3] K. Farrell, The rapid urban growth triad: a new conceptual framework for examining the urban transition in developing countries, Sustainability 9 (8) (2017) 1407.
[4] World Bank. (2022). *Poverty and Shared Prosperity 2022: Correcting course*. The World Bank. Available on: https://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-1893-6. Retrieved on November 8, 2023.
[5] S. de Bruin, J. Dengerink, J. van Vliet, Urbanization as a driver of food system transformation and opportunities for rural livelihoods, Food Secur 13 (4) (2021) 781–798.
[6] J. van Vliet, T. Birch-Thomsen, M. Gallardo, L.M. Hemerijckx, A.M. Hersperger, M. Li, A. Van Rompaey, Bridging the rural-urban dichotomy in land use science, J. Land. Use Sci. 15 (5) (2020) 585–591.

[7] A.O. Acheampong, M.O. Erdiaw-Kwasie, M. Abunyewah, Does energy accessibility improve human development? Evidence from energy-poor regions, Energy Econ 96 (2021) 105165.
[8] S.M. Nguea, U.V.E. Kaguendo, I. Noumba, Are growth effects of foreign capital significant for increasing access to electricity in Africa? Energy Policy 168 (2022) 113129.
[9] I.J. Maket, I.S. Kano, Z.B. Vas, Reverse causal nexus between pro-poor policies and income inequality in Kenya, Region. Sci. Policy Practice 15 (6) (2023) 1163–1181.
[10] T.G. Sakketa, Urbanization and rural development in sub-Saharan Africa: a review of pathways and impacts, Research in Globalization (2023) 100133.
[11] M.A. Kuddus, E. Tynan, E. McBryde, Urbanization: a problem for the rich and the poor? Public Health Rev. 41 (2020) 1–4.
[12] H. Nagendra, X. Bai, E.S. Brondizio, S. Lwasa, The urban South and the predicament of global sustainability, Nat Sustain 1 (7) (2018) 341–349.
[13] L. Shi, Promise and paradox of metropolitan regional climate adaptation, Environ. Sci. Policy 92 (2019) 262–274.
[14] D.W. O'Neill, A.L. Fanning, W.F. Lamb, J.K. Steinberger, A good life for all within planetary boundaries, Nat Sustain 1 (2) (2018) 88–95.
[15] B. Quito, M.D.L.C. del Río, J. Álvarez-García, F.V. Bekun, Spatiotemporal influencing factors of energy efficiency in 43 European countries: a spatial econometric analysis, Renew. Sustain. Energy Rev. 182 (2023) 113340.
[16] A. Ramaswami, Unpacking the urban infrastructure nexus with the environment, health, livability, well-being, and equity, One Earth 2 (2) (2020) 120–124.
[17] E.A. Stanton, The human development index: a history (Working, Paper series, Number 127) (2007). http://www.peri.umass.edu.
[18] CDCP (2018). Well-being concepts. centre for disease control and prevention, Atlanta. Available on: https://cdc.gov/hrqol/wellbeing.htm. Retrieved on 9 October 2022.
[19] J.F. Helliwell, R. Layard, J. Sachs, J.E. De Neve, World Happiness Report 2020, 2020. Available at: https://happiness-reports3amazonaws.com/2020/WHR20.pdf. Retrieved on September 25, 2023.
[20] L.P. Clark, S. Tabory, K. Tong, J.L. Servadio, K. Kappler, C.K. Xu, A. Ramaswami, A data framework for assessing social inequality and equity in multi-sector social, ecological, infrastructural urban systems: focus on fine-spatial scales, J. Ind. Ecol. 26 (1) (2022) 145–163.
[21] I.J. Maket, I. Szakálné Kanó, Z.B. Vas, Estimations of pooled dynamic panel data model with time-space dependence of selected Sub-Saharan African urban agglomerations, 2000-2020, Region. Stat. 13 (4) (2023) 651–673.
[22] C. Tuholske, K. Andam, J. Blekking, T. Evans, K. Caylor, Comparing measures of urban food security in Accra, Ghana, Food Secur. 12 (2) (2020) 417–431.
[23] T. Goodfellow, Finance, infrastructure, and urban capital: the political economy of African 'gap-filling, Rev. Afr. Polit. Econ. 47 (164) (2020) 256–274.
[24] M. Lawhon, D. Nilsson, J. Silver, H. Ernstson, S. Lwasa, Thinking through heterogeneous infrastructure configurations, Urban Studies 55 (4) (2018) 720–732.
[25] World Economic Forum (2018). African Cities Will Double in Population by 2050. World Economic Forum, Cologny. Available on:https://www.weforum.org/agenda/2018/06/Africa-urbanization-cities-double-population-2050-4%20ways-thrive/. (Retrieved on 9 October 2022).
[26] S. Parnell, R. Walawege, Sub-Saharan African urbanization and global environmental change, Glob. Environ. Change 21 (2011) 12–20.
[27] D. Satterthwaite, G. McGranahan, C. Tacoli, Urbanization and its implications for food and farming, Philos. Trans. R. Soc. B: Biol. Sci. 365 (1554) (2010) 2809–2820.
[28] D.E. Pieterse, S. Parnell, Africa's Urban Revolution, Bloomsbury Publishing, 2014.
[29] I. Maket, Analysis of Incidence, Intensity, and Gender Perspective of Multidimensional Urban Poverty in Kenya, Heliyon (2024).
[30] S.M. Nguea, Improving human development through urbanization, demographic dividend, and biomass energy consumption, Sustain. Dev. (2023) 1–19.
[31] A.J. Njoh, Urbanization and development in sub-Saharan Africa, Cities 20 (3) (2003) 167–174.
[32] N. Vasher, Urbanization and human development in Sub-Saharan Africa, J. Res. Natl. Dev. 9 (2) (2011) 333–341.
[33] I.J. Maket, Population dynamics and economic growth in Kenya, Hungarian Stat. Rev. 4 (2) (2021) 18–33.
[34] F.V. Bekun, Mitigating emissions in India: accounting for the role of real income, renewable energy consumption, and energy investment, Int. J. Energy Econ. Policy (2022).
[35] D. Satterthwaite, Successful, safe and sustainable cities: towards a New Urban Agenda, Commonwealth J. Local Governance (19) (2016) 3–18.
[36] K. Das, A. Ramaswami, Y. Fan, J. Cao, Connecting the dots between urban infrastructure, well-being, livability, and equity: a data-driven approach, Environ. Res.: Infrastruct. Sustainab. 2 (3) (2022) 035004.
[37] S. Mavoa, M. Davern, M. Breed, A. Hahs, Higher levels of greenness and biodiversity are associated with greater subjective well-being in adults living in Melbourne, Australia, Health Place 57 (2019) 321–329.
[38] UNDP, Human Development Index For Sub-Saharan Africa in 2020, United Nations Development Programme, New York, 2023. URL: (Accessed on April 16, 2023), https://www.hdr.undp.org/data-center/human-development-index#/indicies/HDI.
[39] UNDP, Human Development Index (HDI), UNDP, New York, 2021. Available online at: http://www.hdr.undp.org/en/content/human-development-index-hdi. Retrieved on November 8, 2023.
[40] M. Amponsah, F.W. Agbola, A. Mahmood, The relationship between poverty, income inequality and inclusive growth in Sub-Saharan Africa, Econ. Model. 126 (2023) 106415.
[41] Y.W. Bradshaw, R Noonan, Urbanization, economic growth, and women's labour-force participation: a theoretical and empirical reassessment. Cities in the Developing World: Issues, Theory, and Policy, Oxford University Press, Oxford, 1997. J Gulger.
[42] R. Dumont, M.-F Mottin, Stranglehold on Africa, Andre' Deutch, London, 1983.
[43] M. Lipton, Why Poor People Stay Poor: The Urban Bias in World Development, Harvard University Press, Cambridge, MA, 1977.
[44] R. Stren, Urban Inequality and Housing Policy in Tanzania: The Problem of Squatting, Institute of International Studies, of California, Berkeley, CA, 1975.
[45] K. Lynch, Good City Form, Massachusetts Information Technology Press, Cambridge, 1984.
[46] A. Ramaswami, C. Weible, D. Main, T. Heikkila, S. Siddiki, A. Duvall, M. Bernard, A social-ecological-infrastructural systems framework for the interdisciplinary study of sustainable city systems: an integrative curriculum across seven significant disciplines, J. Ind. Ecol. 16 (6) (2012) 801–813.
[47] Y. Dewita, M. Burke, B.T. Yen, The relationship between transport, housing, and urban form: affordability of transportation and housing in Indonesia, Case Stud. Transp. Policy 8 (1) (2020) 252–262.
[48] P. Rode, C. Heeckt, N.F. da Cruz, National Transport Policy and Cities: key policy interventions to drive compact and connected urban growth. Coalition for Urban Transitions: London and Washington, DC, 2019.
[49] S.S. Lim, T. Vos, A.D. Flaxman, G. Danaei, K. Shibuya, H. Adair-Rohani, P. M. Pelizzari, A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a Systematic Analysis for the Global Burden of Disease Study 2010, in: The Lancet, 380, 2012, pp. 2224–2260.
[50] A. Marques Arsénio, I. Câmara Salim, M. Hu, N. Pedro Matsinhe, R. Scheidegger, L Rietveld, Mitigation potential of sanitation infrastructure on groundwater contamination by nitrate in Maputo, Sustainability 10 (3) (2018) 858–876.
[51] T. McPhearson, et al., Urban ecosystems and biodiversity. Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network, Cambridge University Press, Cambridge, 2018, pp. 257–318 [Rosenzweig, C. et al. (ed.)].
[52] Cambridge University Press (2016). Well-being Definition. Available at: http://dictionary.cambridge.org/dictionary/English/well-being. Retrieved on September 25, 2023.
[53] Merriam-Webster (2016). Merriam-Webster dictionary definition of well-being. Available at: http://www.merriam-webster.com/dictionary/wellbeing. Retrieved on September 25, 2023.
[54] Oxford University Press (2016). Oxford dictionary definition of well-being. Available: https://www.en.oxforddictionaries.com/definition/well-being. Retrieved on September 25, 2023.
[55] A.S. Nagpure, M. Reiner, A. Ramaswami, Resource requirements of inclusive urban development in India: insights from ten cities, Environ. Res. Lett. 13 (2) (2018) 025010–025024.
[56] G.Z. Nkemgha, T.N. Nchofoung, F. Sundjo, Financial development and human capital thresholds for the infrastructure development-industrialization nexus in Africa, Cities 132 (2023) 104108.
[57] D.M. Nzengya, Improving water service to the urban poor through delegated management: lessons from Kisumu, Kenya, Dev. Policy Rev. 36 (2) (2018) 190–202.
[58] Rachel Dodge, Annette P. Daly, Huyton Jan, Lalage D Sanders, The challenges of defining wellbeing, Int. J. Wellbeing 2 (3) (2012) 222–235.
[59] D.J. Disabato, F.R. Goodman, T.B. Kashdan, J.L. Short, A. Jarden, Different types of well-being? A cross-cultural examination of hedonic and eudaimonic well-being, Psychol. Assess. 28 (5) (2016) 471.
[60] R. Kraut, Summer 2018, in: Edward N. Zalta (Ed.), Aristotle's Ethics in the Stanford Encyclopedia of Philosophy., Metaphysics Research Lab, Stanford University. Available at, 2018. https://plato.stanford.edu/archives/sum2018/entries/aristotle-ethics/. Retrieved on September 25, 2023.
[61] E. Diener, K. Ryan, Subjective well-being: a general overview, South Afric. J. Psychol. 39 (4) (2009) 391–406.
[62] S.J. Lee, Y. Kim, Searching for the meaning of community well-being. Community Well-Being and Community Development: Conceptions and Applications, 2015, pp. 9–23.
[63] Y. Uchida, S. Oishi, The happiness of individuals and the collective, Japanese Psychol. Res. 58 (1) (2016) 125–141.
[64] E. Diener, M. Diener, C. Diener, Factors predicting the subjective well-being of nations, J. Pers. Soc. Psychol. 69 (5) (1995) 851.
[65] Oguz, S., Merad, S., & Snape, D. (2013). Measuring National Well-being-what matters most to personal well-being?
[66] A. Ramaswami, A.G. Russell, P.J. Culligan, K.R. Sharma, E. Kumar, Meta-principles for developing smart, sustainable, and healthy cities, Science 352 (6288) (2016) 940–943.
[67] D. Satterthwaite, D. Mitlin, S. Bartlett, Is it possible to reach low-income urban dwellers with good-quality sanitation? Environ. Urban 27 (1) (2015) 3–18.
[68] Oxfam, Oxfam Humankind Index New Measure of Scotland's prosperity Second results. Research report, 2013, 2013.
[69] K. Trebeck, Is Well-being collective or individual?. Some Answers from Scotland. Available at, 2012. https://oxfamblogs.org/fp2p/is-wellbeing-collective-or-individual-someanswers-from-Scotland/. Retrieved on September 26, 2023.

[70] ESRC (2018). The Easterlin paradox - economic and social research Council. Available at: https://esrc.ukri.org/about-us/50-years-of-esrc/50-achievements/the-easterlin-paradox/. Retrieved on September 26, 2023.
[71] E. Diener, E. Suh, Measuring quality of life: economic, social, and subjective indicators, Soc. Indic. Res. 40 (1997) 189–216.
[72] Martin Seligman, Flourish, Free Press, New York, 2011.
[73] M. Lalli, Urban-related identity: theory, measurement, and empirical findings, J. Environ. Psychol. 12 (4) (1992) 285–303.
[74] Tom Rath, Jim Harter, Wellbeing - Five Essential Elements, Gallup Press, 2010.
[75] Martin Seligman, Building the State of Wellbeing Department of the Premier and Cabinet, 10, Government of South Australia, Adelaide, 2013.
[76] S. Thacker, D. Adshead, M. Fay, S. Hallegatte, M. Harvey, H. Meller, J.W. Hall, Infrastructure for sustainable development, Nat Sustain 2 (4) (2019) 324–331.
[77] L. Tincani, I. Ross, R. Zaman, P. Burr, A. Mujica, J. Ensink, B. Evans, It Improves Value for Money and Sustainability in WASH Programs (VFM-WASH), Oxford Publishers, 2015.
[78] Y. Truelove, Grey Zones: the Everyday Practices and Governance of Water beyond the Network, Ann. Am. Assoc. Geogr. 109 (6) (2019) 1758–1774.
[79] M.J. Forgeard, E. Jayawickreme, M.L. Kern, M.E. Seligman, Doing the right thing: measuring wellbeing for public policy, Int. J. Wellbeing 1 (1) (2011).
[80] C.D. Ryff, B.H. Singer, Know thyself and become what you are: a eudaimonic approach to psychological well-being, J. Happiness Stud. 9 (2008) 13–39.
[81] Himanshu Shekhar, Urban Identity As a Complementary Tool to Urban Wellbeing, Universitat Duisburg-Essen, Essen, 2017. PhD dissertation.
[82] S. Andrei, B. Antonescu, M. Boldeanu, L. Mărmureanu, C.A. Marin, J. Vasilescu, D. Ene, An exceptional case of freezing rain in Bucharest (Romania), Atmosphere (Basel) 10 (11) (2019) 673–687.
[83] B Carter, Political Economy Constraints For Urban Development (GSDRC Helpdesk Research Report 1207), GSDRC, University of Birmingham, Birmingham, UK, 2015.
[84] K.C. Seto, S.J. Davis, R.B. Mitchell, E.C. Stokes, G. Unruh, D. Ürge-Vorsatz, Carbon lock-in: types, causes, and policy implications, Annu. Rev. Environ. Resour. 41 (1) (2016) 425–452.
[85] L. Strande, D. Brdjanovic, Faecal Sludge Management: Systems approach for Implementation and Operation, IWA Publishing, London, 2014.
[86] R.W. Cave, F.W. Wagner, Livable Cities from a Global Perspective, Routledge, London, UK, 2018.
[87] E. Bisung, S.J. Elliott, Psychosocial impacts of the lack of access to water and sanitation in low-and middle-income countries: a scoping review, J. Water Health 15 (1) (2017) 17–30.
[88] Carol Graham, Milena Nikolova, Does Access to Information Technology Make People happier? The Brookings Institution, Washington D.C, 2012. Working paper 53Available at: https://www.brookings.edu/wp-content/uploads/2016/06/12-information-technologyhappiness-graham.pdf. Retrieved on September 26, 2023.
[89] IOM, & Institute of Medicine (US) Committee on Assessing, in: D.G. Blazer, L. M. Hernandez (Eds.), Genes, Behaviour, and the Social Environment: Moving beyond the Nature/Nurture Debate, National Academies Press (US), Washington D:C, 2006. Available at, https://www.ncbi.nlm.nih.gov/books/NBK19924/. Retrieved on September 26, 2023.
[90] Nazrul Islam, John Winkel, Climate Change and Social inequality. DESA Working Paper No. 152, Department of Economic & Social Affairs, New York, 2017. United Nations.
[91] J.W. Senterfitt, A. Long, M. Shih, S.M. Teutsch, Ow Social and Economic Factors Affect Health. Social Determinants of Health, Los Angeles County Department of Public Health, Los Angeles, 2013. Available at: http://www.publichealth.lacounty.gov/epi. Retrieved on September 26, 2023.
[92] G.R. Swain, How does economic and social disadvantage affect health, Focus (Madison) 33 (1) (2016) 1–6.
[93] Y. Li, Y.-H. Chiu, T.-Y Lin, Economic growth and air pollution impact public health in 31 Chinese cities, Int. J. Environ. Res. Public Health 16 (3) (2019) 1–26.
[94] B. Liddle, G. Messinis, Which comes first–urbanization or economic growth? Evidence from heterogeneous panel causality tests, Appl. Econ. Lett. 22 (5) (2015) 349–355.
[95] R.E. Baldwin, P. Martin, Agglomeration and regional growth, in: *Handbook of Regional and Urban Economics*, 4, Elsevier, 2004, pp. 2671–2711.
[96] M. Fujita, J.-F. Thisse, Economics of agglomeration: Cities, Industrial location, and Regional Growth, Cambridge University Press, 2002.
[97] S. Grafakos, K. Trigg, M. Landauer, L. Chelleri, S. Dhakal, An analytical framework to evaluate the level of integration of climate adaptation and mitigation in cities, Climatic Cange 154 (1) (2019) 87–106.
[98] S. Tripathi, Do large agglomerations lead to economic growth? Evidence from urban India, in: Review of Urban & Regional Development Studies: Journal of the Applied Regional Science Conference 25, 2013, pp. 176–200.
[99] G. Duranton, D. Puga, Micro-foundations of urban agglomeration economies, in: Handbook of Regional and Urban Economics, 4, Elsevier, 2004, pp. 2063–2117.
[100] M. Maiti, Urbanization and inequalities in China and India. Overview and comparative study, Theoretic. Appl. Econ. 24 (613) (2017) 121–136.
[101] M. Anisujjaman, Urbanization and human development: a study of West Bengal, Int. J. Human. Soc. Sci. Invent. 4 (7) (2015) 1–8.
[102] I. Maket, I.S. Kanó, Z. Vas, Urban agglomeration and income inequality: is kuznets hypothesis valid for Sub-Saharan Africa? Soc. Indic. Res. (2023) 1–21.
[103] Z. Wang, Z. Ahmed, B. Zhang, B. Wang, The nexus between urbanization, road infrastructure, and transport energy demand: empirical evidence from Pakistan, Environ. Sci. Pollut. Res. 26 (2019) 34884–34895.
[104] P.A. Lewin, P. Watson, A. Brown, Surviving the Great Recession: the influence of income inequality in US urban counties, Reg. Stud. 52 (6) (2018) 781–792.
[105] J.K. Nair, P. Mishra, Household basic amenities and female educational outcome: an exploration of complementarities in rural India, J. Clean. Prod. (2023) 137439.
[106] S. Gupta, A.K. Sharma, Evolution of infrastructure as an asset class: a systematic literature review and thematic analysis, J. Asset Manag. 23 (3) (2022) 173–200.
[107] V. Dunaeva, New approaches in social well-being studies, People Int. J. Soc. Sci. 4 (3) (2018) 566–573.
[108] S.H. Eriksen, A.J. Nightingale, H. Eakin, Reframing adaptation: the political nature of climate change adaptation, Glob. Environ. Change 35 (2015) 523–533.
[109] P.C. Ferreira, A. Monge-Naranjo, L.T. Pereira, Of Cities and Slums, Federal Reserve Bank of St. Louis, 2016. Working Paper 2016-022A.
[110] M. Shrestha, Get rich or die tryin': perceived earnings, perceived mortality rates, and migration decisions of potential work migrants from Nepal, World Bank Econ. Rev. 34 (1) (2020) 1–27.
[111] IPCC (2018). Global warming of 1.5°C - SR15. summary for policymakers, IPCC. Available at: https://www.ipcc.ch/report/sr15/. Retrieved on September 26, 2023.
[112] WBGU, Humanity on the move: unlocking the transformative power of cities, Summary 3 (2016).
[113] J.P. Enqvist, G. Ziervogel, Water governance and justice in Cape Town: an overview, Wiley Interdiscip. Rev.: Water 6 (4) (2019) e1354.
[114] E.A. Adams, W.F. Vasquez, Does the urban poor want household taps? Community preferences and willingness to pay for household taps in Accra, Ghana, in: J. Environ. Manage., 247, 2019, pp. 570–579.
[115] A. Cassivi, E. Tilley, E.O.D. Waygood, C. Dorea, Household practices in accessing drinking water and post collection contamination: a seasonal cohort study in Malawi, Water Res. 189 (2021) 116607.
[116] V.A. Beard, D. Mitlin, Water access in South global cities: the challenges of intermittency and affordability, World Dev. 147 (2021) 105625.
[117] I. Chumo, C. Kabaria, K. Muindi, H. Elsey, P.A. Phillips-Howard, B. Mberu, Informal social accountability mechanisms for water sanitation and hygiene (WASH) in childcare centres in Nairobi City County's informal settlements, Urban Governance 2 (2) (2022) 259–269.
[118] D. Salite, J. Kirshner, M. Cotton, L. Howe, B. Cuamba, J. Feijó, A.Z. Macome, Electricity access in Mozambique: a critical policy analysis of investment, service reliability, and social sustainability, Energy Res Soc Sci 78 (2021) 102123.
[119] M. Tesfamichael, Y. Mulugetta, A.D. Beyene, S. Sebsibie, Counting the cost: coping with tariff increases amidst power supply shortfalls in urban households in Ethiopia, Energy Res. Soc. Sci. 71 (2021) 101860.
[120] M. De Fatima, S.R. Arthur, A. Cockerill, The roles of government and the public utility in achieving universal access to electricity, Econ. Energy Environ. Policy 8 (1) (2019) 103–118.
[121] J. Gregory, B.K. Sovacool, The financial risks and barriers to electricity infrastructure in Kenya, Tanzania, and Mozambique: a critical and systematic academic literature review, Energy Policy 125 (2019) 145–153.
[122] M.O. Dioha, N.V. Emodi, Investigating the impacts of energy access scenarios in the Nigerian household sector by 2030, Resources 8 (3) (2019) 127.
[123] A. Kovacs-Györi, P. Cabrera-Barona, B. Resch, M. Mehaffy, T. Blaschke, They assess and represent livability by analyzing residential preference, Sustainability 11 (18) (2019) 4934–4957.
[124] P. Kumari, R. Shekhar, Measuring liveability: a critique, Sree J. Spat. Perspect. 2 (1) (2018) 35–40.
[125] M. Yesaya, E. Tilley, Sludge bomb: blantyre, Malawi's impending sludge emptying and treatment crisis, J. Environ. Manage. 277 (2021) 111474.
[126] V.A. Beard, D. Satterthwaite, D. Mitlin, J. Du, Out of sight, out of mind: understanding the sanitation crisis in South global cities, J. Environ. Manage. 306 (2022) 114285.
[127] D.M. Berendes, L. de Mondesert, A.E. Kirby, H. Yakubu, L. Adomako, J. Michiel, C.L. Moe, Variation in E. coli concentrations in open drains across neighbourhoods in Accra, Ghana: the influence of onsite sanitation coverage and interconnectedness of urban environments, Int. J. Hyg. Environ. Health 224 (2020) 113433.
[128] D. Dirix, F. Rossi, H. van der Hoek, Fecal sludge management in Toamasina, Madagascar: emptying–Transport–Treatment, J. Environ. Manage. 281 (2021) 111808.
[129] S. Simiyu, I. Chumo, B. Mberu, Faecal sludge management in Low-Income settlements: nakuru, Kenya Case study, Front. Public Health 9 (2021) 750309.
[130] R.P. Pradhan, M.B. Arvin, M. Nair, Urbanization, transportation infrastructure, ICT, and economic growth: a temporal causal analysis, Cities 2 (2) (2021) 115–134.
[131] L. Velzeboer, M. Hordijk, K. Schwartz, Water is life in life without water: power and everyday water practices in Lilongwe, Malawi, Habitat. Int. 73 (2018) 119–128.
[132] E. Wamuchiru, F. Moulaert, Thinking through ALMOLIN: the community bio-centre approach in water and sewerage service provision in Nairobi's informal settlements, J. Environ. Plann. Manag. 61 (12) (2018) 2166–2185.
[133] D. Zhan, M.P. Kwan, W. Zhang, J. Fan, J. Yu, Y. Dang, Assessment and determinants of satisfaction with urban livability in China, Cities 79 (2018) 92–101.
[134] H.D. Enyew, S.T. Mereta, A.B. Hailu, Biomass fuel use and acute respiratory infection among children younger than 5 years in Ethiopia: a systematic review and meta-analysis, Public Health 193 (2021) 29–40.
[135] E. Nano, Electrifying Nigeria: the household-level impact of access to electricity on consumption, education and employment, in: Energy, COVID, and Climate

Change, 1st IAEE Online Conference, June 7–9, 2021, International Association for Energy Economics, 2021.
[136] O.A. Shobande, The effects of energy use on infant mortality rates in Africa, Environ. Sustain. Indicator. 5 (2020) 100015.
[137] A.I. Tiotiu, P. Novakova, D. Nedeva, H.J. Chong-Neto, S. Novakova, P. Steiropoulos, K. Kowal, Impact of air pollution on asthma outcomes, Int. J. Environ. Res. Public Health 17 (17) (2020) 6212.
[138] S. Adams, E.K.M. Klobodu, Urbanization, economic structure, political regime, and income inequality, Soc. Indic. Res. 142 (3) (2019) 971–995.
[139] M. Brülhart, F. Sbergami, Agglomeration and growth: cross-country evidence, J. Urban. Econ. 65 (1) (2009) 48–63.
[140] Y. Altunbaş, J. Thornton, The impact of financial development on income inequality: a quantile regression approach, Econ. Lett. 175 (3) (2019) 51–56.
[141] D.E. Bloom, E. Cafiero, E. Jané-Llopis, S. Abrahams-Gessel, L.R. Bloom, S. Fathima, A.B. Feigl, T. Gaziano, A. Hamandi, M. Mowafi, D. O'Farrell, The Global Economic Burden of Non-Communicable Diseases, World Economic Forum, Geneva, 2012. Available at: http://www3.weforum.org/docs/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf. Retrieved on September 27, 2023.
[142] D. Castells-Quintana, H. Wenban-Smith, Population dynamics, urbanization without growth, and the rise of megacities, J. Dev. Stud. 56 (9) (2020) 1663–1682.
[143] C.W. Kabiru, C.O. Izugbara, D. Beguy, The health and wellbeing of young people in sub-Saharan Africa: an under-researched area? BMC Int. Health Hum. Rights 13 (2013) 1–7.
[144] Healthy Cities, Good Health is Good Politics: A Toolkit for Local Governments to Support Healthy Urban Development, 27, World Health Organization Regional Office for the Western Pacific, Manila, 2015, p. 2023. Available at: https://www.who.int/publications/i/item/WPR-2015-DNH-004. Retrieved on September.
[145] G. Laverack, Improving health outcomes through community empowerment: a review of the literature, J. Health Popul. Nutr. (2006) 113–120.
[146] R.S. Weiss, S.A. Bass, H.K. Heimovitz, M. Oka, Japan's silver human resource centres and participant well-being, J. Cross. Cult. Gerontol. 20 (2005) 47–66.
[147] T.G. Weiss, Governance, good governance, and global governance: conceptual and actual challenges. Thinking About Global Governance, 2012, pp. 168–189. Routledge.
[148] P. Zientara, A. Zamojska, G.T. Cirella, Participatory urban governance: multilevel study, PLoS ONE 15 (2) (2020) e0229095.
[149] D. Castells-Quintana, Malthus living in a slum: urban concentration, infrastructure, and economic growth, J. Urban Econ. 98 (2017) 158–173.
[150] V. Henderson, The urbanization process and economic growth: the so-what question, Journal of Economic Growth 8 (2003) 47–71.
[151] S.A. Frick, A. Rodríguez-Pose, Change in urban concentration and economic growth, World Dev. 105 (2018) 156–170.
[152] S.R. Bond, Dynamic panel data models: a guide to micro data methods and practice, Portuguese Econ. J. 1 (2) (2002) 141–162.
[153] V.A. Dang, M. Kim, Y. Shin, Searching robust methods for dynamic panel data models in empirical corporate finance, J. Bank Financ. 53 (1) (2015) 84–98.
[154] C. Hsiao, M.H. Pesaran, A.K. Tahmiscioglu, Maximum likelihood estimation of fixed effects dynamic panel data models covering short periods, J. Econom. 109 (1) (2002) 107–150.
[155] J.Vernon Henderson, "Urbanization and Growth," handbook of economic growth, Philippe Aghion & Steven Durlauf. Handbook of Economic Growth, 2005, pp. 1543–1591. edition 1, *1(24)*.
[156] L. Bertinelli, D. Black, Urbanization and growth, J. Urban Econ. 56 (1) (2004) 80–96.
[157] M. Arellano, S. Bond, Some tests of specification for panel data: monte Carlo evidence and an application to employment equations, Rev. Econ. Stud. 58 (2) (1991) 277–297.
[158] R. Blundell, S. Bond, Initial conditions and moment restrictions in dynamic panel data models, J. Econom. 87 (1) (1998) 115–143.
[159] D. Hoechle, Robust standard errors for panel regressions with cross-sectional dependence, Stata J. 7 (3) (2007) 281–312.
[160] H.K. Fotio, S.M. Nguea, Access to water and sanitation in Africa: does globalization matter? Int. Econ. 170 (2022) 79–91.
[161] A.V. Banerjee, E. Duflo, Inequality and growth: what can the data say? J. Econ. Growth 8 (2003) 267–299.
[162] A. Berg, J.D. Ostry, C.G. Tsangarides, Y. Yakhshilikov, Redistribution, inequality, and growth: new evidence, J. Econ. Growth 23 (2018) 259–305.
[163] M. Norkutė, V. Sarafidis, T. Yamagata, G. Cui, Instrumental variable estimation of dynamic linear panel data models with defactored regressors and a multifactor error structure, J. Econom. 220 (2) (2021) 416–446.
[164] J.C. Driscoll, A.C. Kraay, Consistent covariance matrix estimation with spatially dependent panel data, Rev. Econ. Stat. 80 (4) (1998) 549–560.
[165] A. Heston, R. Summers, B. Aten, Center for international comparisons of production, income, and prices at the university of pennsylvania, Penn World Table Version (2012). *7.1*.
[166] World Bank (2022). Development indicators. Available at: https://datacatalog.worldbank.org/search/dataset/0037712/World-Development-Indicators. Retrieved on September 25, 2023.
[167] World Bank (2022). *World Development Indicators.* World Bank, Geneva. URL: (Accessed 9 October 2022) https://data.worldbank.org/indicator/SP.URB.TOTL?locations=ZG.
[168] A.H. Studenmund, Using Econometrics, A Practical Guide, Pearson Education Limited, 2014.
[169] J. Miles, Tolerance and variance inflation factor, Wiley Stats Ref: Stat. Ref. Online (2014), https://doi.org/10.1002/9781118445112.stat06593. Retrieved on November 8, 2023.
[170] A. Levin, C.F. Lin, C.S.J. Chu, Unit root tests in panel data: asymptotic and finite-sample properties, J. Econom. 108 (1) (2002) 1–24.
[171] K.S. Im, M.H. Pesaran, Y. Shin, Testing for unit roots in heterogeneous panels, J. Econom. 115 (1) (2003) 53–74.
[172] M.H. Pesaran, A simple panel unit root test in the presence of cross-section dependence, J. Appl. Econ. 22 (2) (2007) 265–312.
[173] M.A. Baum, D.A. Lake, The political economy of growth: democracy and human capital, Am. J. Pol. Sci. 47 (2) (2003) 333–347.
[174] C.F. Baum, A. Nichols, M.E. Schaffer, Evaluating one-way and two-way cluster-robust covariance matrix estimates, in: *BOS10 Stata Conference* 11, Stata Users Group, 2010, September.
[175] E. Boateng, F.W. Agbola, A. Mahmood, Foreign aid volatility and economic growth in Sub-Saharan Africa: does institutional quality matter? Econ. Model. 96 (2021) 111–127.
[176] M.M. Ahamed, S.J. Ho, S.K. Mallick, R. Matousek, Inclusive banking, financial regulation, and bank performance: cross-country evidence, J. Bank Financ. 124 (2021) 106055.
[177] J.M. Wooldridge, Introductory econometrics: a modern approach (upper-level economics titles), in: Southwestern College Publishing, Nashville, T ATN, 41, 2012, pp. 673–690.
[178] N. Scholl, S. Klasen, *Re*-estimating the relationship between inequality and growth, Oxf. Econ. Pap. 71 (4) (2019) 824–847.
[179] A.J. Sovey, D.P. Green, Instrumental Variables Estimation in Political Science: A readers' Guide, American, 2011.
[180] F. Kleibergen, R. Paap, Generalized reduced rank tests using the singular value decomposition, J. Econom. 133 (1) (2006) 97–126.
[181] M. Douch, H. Edwards, T. Landman, S. Mallick, Aid effectiveness: human rights as a conditionality measure, World Dev. 158 (2022) 105978.
[182] N. Gaffan, C. Dégbey, A. Kpozèhouen, Y. Glèlè Ahanhanzo, R.C. Johnson, R. Salamon, Is Benin on track to reach universal household coverage of basic water, sanitation, and hygiene services by 2030? PLoS ONE 18 (5) (2023) e0286147.
[183] D. Satterthwaite, V.A. Beard, D. Mitlin, J. Du, Untreated and Unsafe: Solving the Urban Sanitation Crisis in the Global South, 2019. *Working Paper*Retrieved from.
[184] UN-Habitat (2017b). Issue Paper on Informal Settlements. Habitat III Issue Papers, May 31, 2015. https://unhabitat.org/wp-content/uploads/2015/04/Habitat-III-Issue-Paper-22_Informal-Settlements. Retrieved on 9 October 2022.
[185] UN-Habitat, World Cities Report 2016. Urbanization and Development Emerging Futures, a, United Nations-Habitat, Nairobi, 2017.
[186] P.K. Guma, J. Monstadt, S. Schramm, Hybrid constellations of water access in the digital age: the case of Jisomee Mita in Soweto-Kayole, Nairobi, in: Water Alternat., 12, 2019, pp. 725–743.
[187] T. Kjellstrom, S. Friel, J. Dixon, C. Corvalan, E. Rehfuess, D. Campbell-Lendrum, J. Bartram, Urban environmental health hazards and health equity, J. Urban Health 84 (2007) 86–97.
[188] F. Fagbemi, G.E. Nzeribe, T.T. Osinubi, S. Asongu, Interconnections between governance and socioeconomic conditions: understanding the challenges in sub-Saharan Africa, Region. Sustainab. 2 (4) (2021) 337–348.
[189] Lahouij, H. (2017). Governance and economic growth in developing economies: a comparative study. MSC Thesis.
[190] D. Castells-Quintana, V. Royuela, Are increasing urbanisation and inequalities symptoms of growth? Appl. Spatial Anal. Pol. 8 (2015) 291–308.
[191] M. Al Mamun, K. Sohag, M.K. Hassan, Governance, resources, and growth, Econ. Model. 63 (2017) 238–261.
[192] B. Fayissa, C. Nsiah, The impact of governance on economic growth in Africa, J. Dev. Areas (2013) 91–108.
[193] K. Griffin, Stratégies de développement, Economica (1989).
[194] H. Hughes, Industrialization and development: a stocktaking. Industrialization and Development, Greenwood Press, Westport, 1984, pp. 5–29.
[195] S. Bazzi, M.A. Clemens, Blunt instruments: avoid common pitfalls in identifying the causes of economic growth, Am. Econ. J.: Macroecon. 5 (2) (2013) 152–186.
[196] I. Maket, I.S. Kanó, Z. Vas, Urban agglomeration and regional economic performance connectedness: Thin ice in developing regions, Res. Glob. 8 (2024) 100211.
[197] T.M. Daw, C.C. Hicks, K. Brown, T. Chaigneau, F.A. Januchowski-Hartley, W. W. Cheung, T.R. McClanahan, Elasticity in ecosystem services: exploring the variable relationship between ecosystems and human well-being, Ecol. Soc. 21 (2) (2016).
[198] Mumssen, Y., & Saltiel, G. (2018). Aligning institutions and incentives for sustainable water supply and sanitation services.
[199] J. Agergaard, C. Tacoli, G. Steel, S.B. Ørtenblad, Revisiting rural–urban transformations and small town development in sub-Saharan Africa, Eur. J. Dev. Res. 31 (2019) 2–11.
[200] A.W. Parsons, C.T. Rota, T. Forrester, M.C. Baker-Whatton, W.J. McShea, S. G. Schuttler, R. Kays, Urbanization focuses carnivore activity in remaining natural habitats, increasing species interactions, J. Appl. Ecol. 56 (8) (2019) 1894–1904.
[201] Beard, V. A., Mahendra, A., & Westphal, M. I. (2016). Towards a more equal city: framing the challenges and opportunities. *Growth, 2015*, 2030.
[202] M.O. Asibey, M. Poku-Boansi, I.O. Adutwum, Residential segregation of ethnic minorities and sustainable city development. Case of Kumasi, Ghana, Cities 116 (2021) 103297.
[203] G. Adom-Asamoah, C. Amoako, K.K. Adarkwa, Gender disparities in rural accessibility and mobility in Ghana, Case Stud. Transp. Pol. 8 (1) (2020) 49–58.

[204] S.P. Maurya, P.K. Singh, A. Ohri, R. Singh, Identification of indicators for sustainable urban water development planning, Ecol. Indic. 108 (2020) 105691.
[205] W. Lee, M. Choi, M.L. Bell, C. Kang, J. Jang, I. Song, H. Kim, Effects of urbanization on vulnerability to heat-related mortality in urban and rural areas in South Korea: a nationwide district-level time-series study, Int. J. Epidemiol. 51 (1) (2022) 111–121.
[206] L. Osei, J. Amoyaw, G.O. Boateng, S. Boamah, I. Luginaah, The paradox of water accessibility: understanding the temporal and spatial dimensions of access to improved water sources in Rwanda, J. Water Sanit. Hyg. Dev. 5 (4) (2015) 553–564.
[207] R. Bloch, S. Fox, J. Monroy, A. Ojo. Urbanisation and urban expansion in Nigeria. *Urbanisation Research Nigeria (URN) Research Report*, ICF International, London, 2015.
[208] J. Nyika, M.O. Dinka, Water Challenges in Urban Sub-Saharan Africa, in: *Water Challenges in Rural and Urban Sub-Saharan Africa and their Management*, Springer Nature Switzerland, Cham, 2023, pp. 17–37.
[209] S. Ndam, A.F. Touikoue, J. Chenal, Baraka Munyaka, A. Kemajou, A. Kouomoun, Urban Governance of Household Waste and Sustainable Development in Sub-Saharan Africa: A Study from Yaoundé (Cameroon), in: *Waste* (Vol. 1, No. 3,, MDPI, 2023, July, pp. 612–630.
[210] P. Branchet, N.A. Castro, H. Fenet, E. Gomez, F. Courant, D. Sebag, C. Gonzalez, Anthropic impacts on Sub-Saharan urban water resources through their pharmaceutical contamination (Yaoundé, Center Region, Cameroon), Sci. Tot. Environ. 660 (2019) 886–898.
[211] Woetzel, J., Madgavkar, A., Ellingrud, K., Labaye, E., Devillard, S., Kutcher, E., Manyika, J., Dobbs, R., & Krishnan, M. (2015). McKinsey Global Institute [online]. https://www.mckinsey.com/featured-insights/employment-andgrowth/how-advancing-womens-equality-can-add-12-trillion-to-global-growth. retrieved on November 8, 2023.
[212] A.J. Venables, Urbanization in developing economies: building cities that work, J. ERSA 5 (1) (2018) 91–100.

Further reading

[1] P. Burr, I. Ross, R. Zaman, A. Mujica, L. Tincani. Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH): Regional Assessments of the Operational Sustainability of Water and Sanitation Services in South Asia Oxford Policy Management, 2015. Oxford, UK.
[2] R.A. Easterlin, Does economic growth improve the human lot? Some empirical evidence, Nations and, in: Households in Economic Growth, Academic press, 1974, pp. 89–125.
[3] OWID (2023). Human development index in 2020. Our world in data, Oxford. (Accessed on April 16, 2023) https://ourworldindata.org/human-development-index.
[4] X. Sala-i-Martin, G. Doppelhofer, R.I. Miller, Determinants of long-term growth: a Bayesian averaging of classical estimates (BACE) approach, Am. Econ. Rev. 94 (4) (2004) 813–835.
[5] J.M. Wooldridge. Econometric Analysis of Cross Section and Panel Data MIT, 2nd edition. edition, Press, Cambridge, 2010. ISBN 978-0-262-23258-6.
[6] E.M. Field, M. Kremer, *Impact evaluation for slum upgrading interventions*, in: World Bank, Poverty Reduction and Economic Management, Thematic Group on Poverty Analysis, Monitoring and Impact Evaluation, 2006.
[7] E. Riva Sanseverino, R. Riva Sanseverino, E. Anello, A cross-reading approach to smart city: A european perspective of chinese smart cities, Smart Cities 1 (1) (2018) 26–52.
[8] R. Antunes, R. Frontini, N. Amaro, R. Salvador, R. Matos, P. Morouço, R. Rebelo-Gonçalves, Exploring lifestyle habits, physical activity, anxiety, and basic psychological needs in Portuguese adults during COVID-19 Int, J. Environ. Res. Public Health (2020) 4360.