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Urban Explosion and Inclusive Human Development in Africa: Does Structural Transformation Policy Have Implications?

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Abstract: This paper is part of this dynamic, seeking to enrich the debate on urbanization and inclusive human development by analyzing the crucial role of structural transformation. Using a panel of 45 countries for the period 2010-2022, estimates were made applying several approaches. Our results highlight three distinct regimes of inclusive human development. The level of structural transformation in each regime determines the extent to which urban influence affects equitable well-being. Consequently, these findings suggest the implementation of urban policies backed by structural transformation, tailored to the specific characteristics of each level of inclusive human development in Africa.

Keywords*:* Urbanization, Structural Transformation, Inclusive Human Development.

JEL Code*:* R23 – O14 – I30 – C33 – O55

INTRODUCTION

Urbanization is a demographic process whereby an increasing proportion of the national population resides in urban areas (Potts, 2012). It thus stimulates the concentration of industrial production and improves the quality of life. Africa is one of the regions that has experienced late and rapid urbanization. The continent's urbanization rate rose from 35% in 2000 to 43.5% in 2020, and is expected to reach around 50% by 2035 (United Nations Economic Commission for Africa, 2019). This urban explosion is causing concern, as it is often the result of rural populations migrating to cities in search of better economic opportunities. In this

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regard, Christiaensen *et al*. (2013) argue that urbanization in Africa is primarily demographic rather than economic in nature, which does not guarantee genuine industrial development, particularly the transformation of the continent's raw materials into finished products. However, the literature has shown that urbanization promotes economic, cultural, and social development (Luo *et al*., 2016; Liu *et al*., 2021). On the other hand, according to Lewis's theory of economic development (1954), urbanization results from the transfer of resources from the predominant agricultural sector to more advanced industrial and tertiary sectors. This process is accompanied by structural change, marked by the transfer of agricultural labor from the rural sector to urban growth (Firman *et al*., 2007).

Furthermore, the level of urbanization is a key indicator of a country's socioeconomic progress (Wang *et al*., 2022), as it promotes better access to healthcare, education, and increased productivity, which are essential elements of inclusive human development[1]. However, if urban growth does not take socio-economic inequalities into account, it can become a real double-edged sword. It could, in fact, improve the quality of life for some city dwellers while deteriorating the living conditions of the majority of the peripheral urban population and migrants. In this case, development theory recommends a change in the economic structure of the states concerned (Cadot *et al*., 2017; Mama & Ongono, 2019). Thus, the issue of structural transformation emerges as a central concern for highly urbanized economies in a context of low inclusive human development.

Referring to the interdependent process of structural change that accompanies economic development, the theoretical basis of the literature argues that structural transformation is a catalyst for sustainable development in developing countries (Clark, 1940; Lewis, 1954), and consequently, for inclusive human development in Africa. This involves a reallocation accompanied by a process of modern economic growth (Kuznets & Murphy, 1966), which takes place in the agriculture, industry, and services sectors, redirecting the least productive economic activities toward the most productive sectors (McMillan & Rodrik, 2011). However, the urban explosion in African countries in recent years has not been accompanied by significant progress in terms of value added in the main sectors, resulting in an IHDI level

1. Inclusive human development measures the average level of human development in a society, while accounting for inequality in the distribution of health, education, and income. It is approached in the literature through the IHDI (Asongu *et al*., 2015). This concept reinforces the human development approach developed by the UNDP (1990), serving as an indicator to define the equitable allocation of resources.

that differs from the HDI. This demonstrates that the structural transformation of African countries remains a challenge in terms of leveraging the impact of urban growth on inclusive human development.

Faced with this challenge, structural adjustment programs have been adopted by African countries, as have most developing countries since the 1990's, to liberalize their economies and achieve urbanization that leads to inclusive human development. Despite these reforms, urbanization in Africa continues to face major constraints such as the structural transformation of economies. This is why Sackey (2009) asserts that countries with a high HDI are those that have succeeded in transforming their economies. On this subject, Cadot *et al*. (2017) consider that structural transformation in Africa has been a failure, as national experiences of development "without factories" are too rare and specific to serve as a model. Castells-Quintana & Wenban-Smith (2020) have argued that urbanization in many developing countries, particularly in sub-Saharan Africa, does not bring the expected benefits, as has been observed elsewhere in the world. Furthermore, Ravallion *et al*. (2007) found that urbanization contributes to the reduction of poverty and inequality in other regions, but not in Africa. Why, then, does urban growth in Africa not guarantee equitable well-being, despite the progress of structural transformation in the region? To understand this controversy, this paper aims to examine the effects of urbanization on inclusive human development, then to inspect the importance of structural transformation.

Since then, theoretical literature has focused on understanding the nature and impact of urbanization on aspects of development (Parnell & Walawege, 2011; Gong *et al*., 2012), but has failed to establish a clear link with inclusive human development. Empirically, this relationship has been partially demonstrated (Tripathi, 2021; Wang *et al*., 2022; Yasmeen & Zameer, 2024) and the issue raised above remains unexplored. Furthermore, from a methodological perspective, previous studies have focused on the microeconomic level, cross-sectional data, and small-sample panel data with heterogeneous countries, unable to identify heterogeneity in dynamic adjustment.

Our contribution is therefore necessary, as it goes beyond previous research in several respects. On a theoretical level, our paper contributes to the theoretical debate in the literature by not only establishing the relationship between urbanization and inclusive human development, but also by incorporating structural transformation as a precursor to this link. Empirically, it addresses the case of African countries using a finite mixture model with instrumental variables, combined with a generalized linear model, accompanied by multiple forms of robustness. The study emphasizes the impact of urbanization on inclusive human development with the moderating effect of structural transformation. In addition, our study opens up new econometric perspectives by using innovative estimation methods that take into account endogeneity and heterogeneity, and split the analysis according to the structure of the countries in the sample. The use of a set of relevant control variables reduces the bias of omitted variables. Estimating the level of inclusive human development by class allows us to effectively control for the heterogeneity of our sample and formulate specific implications for each category of countries.

The suite of the introduction analyzes the literature review in section 1, section 2 presents the estimation methodology, and section 3 presents and discusses the results before concluding with the economic policy implications.

I. LITERATURE REVIEW

Economic analyses of the relationship between urbanization and economic development, linking structural transformation, align with the logic of Lewis's (1954) and Boserup's (1965) demographic transition theory. This theory proposes that the transition from a traditional society (rural workers) to an urban and industrial society leads to greater productivity and improved living standards due to a denser population concentration. Rostow (1959) views this structural transformation as an essential factor in urbanization. Since then, two main arguments have emerged in the literature. Some authors argue that urbanization can improve incomes and strengthen economic development (Njoh, 2003; Bertinelli & Black, 2004; Kessides, 2007; Tripathi, 2021). Others present the argument of urbanization without development, claiming that urbanization has not led to economic development (Jedwab & Vollrath, 2015; Sakketa, 2022). A group of authors adds that the economic benefits of cities are often offset by urban blights (Glaeser, 2011).

Furthermore, theoretical studies have not reached a consensus on the relationship between urbanization and economic development in general, or inclusive human development in particular. Turok & McGranahan (2013) found no necessarily positive or negative relationship. However, they argue that both possibilities exist, depending on factors such as the quality of institutions and infrastructure available in countries. Henderson (2003) observes the existence of an inverted U-shaped relationship between urbanization and economic development, showing that in the first stage of development, urbanization improves economic growth, but in the second stage, a negative correlation appears. Moreover, Di Clemente *et al*. (2021) were unable to establish a linear relationship between urbanization and economic development. However, Oyvat (2016) finds that urbanization increases discrimination and socioeconomic inequalities between urban and rural areas. Elsewhere, it has led to persistent poverty and slowed structural transformation (Jedwab & Vollrath, 2015). Malik (2014) argues that a high level of urbanization does not necessarily generate better human development outcomes, as the link between urbanization and the IDHI is indirect and depends on how urbanization is managed. Poorly managed urbanization can lead to greater deprivation, inequality, and exclusion for populations. Hence the importance of accompanying urban growth with structural transformation.

Empirically, the results of various studies on the relationship between urban growth and inclusive development are also mixed and ambiguous, depending on the areas and measurement indicators used. Yasmeen & Zameer (2024) analyze the effects of urbanization on inclusive development, measured by inclusive growth, in a sample of 48 African countries. By specifying a panel data model with fixed effects and generalized least squares over the period 1995-2020, his results show that urbanization significantly improves inclusive growth in Africa. He obtains similar results for each region (North Africa, West Africa, East Africa, and Central Africa), except Southern Africa, where urbanization tends to worsen inclusive growth.

Using a set of administrative data on Ireland's main social inclusion program, Whelan *et al*. (2023) examine the effect of location on the incidence of barriers to social inclusion. They find that certain forms of social exclusion, particularly those related to economic exclusion, are more prevalent among residents of independent towns than among those in large cities, commuter towns, or rural areas, even after taking into account the level of deprivation in the region. Their findings suggest that current policy, which has traditionally focused on combating social disadvantage in the most urban or rural areas, is not well-targeted and would benefit from a broader spatial scope.

Pozhidaev (2020) studies the case of Uganda, which has experienced impressive growth over the past three decades, with an annual GDP growth rate of around 6%, and has one of the fastest urbanization rates in the East African region. However, this growth has not been accompanied by a corresponding improvement in quality of life. Average incomes have lagged behind GDP growth, while poverty and inequality have increased. Urbanization has positive effects on well-being, but these effects are unevenly distributed across urban areas, with cities being the main driver of inequality at the national level. However, secondary cities are characterized by lower levels of inequality than primary cities, with a relatively higher share of high-productivity sectors, particularly manufacturing. The contribution of cities to structural transformation is undeniable, with more than 70% of national non-agricultural GDP being produced in urban areas.

Other authors have focused their research on the relationship between urbanization and human development. Tripathi (2021) assesses the effects of urbanization on the value of the HDI at the national level using a random effects, Tobit model and dynamic panel data estimates for 187 countries between 1990 and 2017. He finds that the percentage of the urban population residing in a country's largest city hurts the HDI value, while other indicators of urbanization have a positive effect on human development. Similarly, Nipo *et al*. (2021) examine the impact of globalization and urbanization on human development in 33 lower-middle-income economies over the period 2000-2019. Using robust fixed-effects models on panel data, their results reveal that a higher level of urbanization, resulting from higher income, does not necessarily guarantee an improvement in quality of life.

Taking household consumption, exchange rates, per capita income, and unemployment rates as control variables, Wang *et al*. (2022) demonstrate that governance moderates the influence of urban planning on inclusive green growth. They use a dataset covering the years 2004 to 2019 for 64 countries in the Belt and Road region. Their results, obtained using the two-stage system of the robust generalized method of moments (GMM) with the D-K regression methodology, confirm the dynamic and significantly positive nature of inclusive green growth.

Theoretical and empirical reviews have revealed that no clear link has been established between urbanization and inclusive human development. This shows that the relationship between these phenomena depends on other economic factors, such as structural transformation, which the literature has not taken into account. Furthermore, the estimation methods used in empirical studies examine samples as a whole, without taking into account differences in economic development and degree of urbanization. It is therefore necessary, in the case of Africa, to analyze the effects of urban explosion on human development, taking into account socioeconomic inequalities and highlighting structural transformation. To our knowledge, such an investigation into this issue is the first of its kind on the continent.

2. DATA AND METHODOLOGY

2.1. Data sources and variable descriptions

The Inequality-adjusted Human Development Index (IHDI) variable is sourced from the UNDP database (2024). Data for the other variables are sourced from the World Bank Database (2024). The time horizon covers the period from 2000 to 2022, with the choice of this period being dictated by data availability. The dependent variable used to measure inclusive human development is the IHDI, in line with the literature on inclusive development (Asongu *et al*., 2015). The concept of IHDI, developed by Foster *et al*. (2005), reflects the idea that human development cannot be fully measured without accounting for social and economic disparities. The independent variable of interest, used to measure urbanization, is the urban population growth (urbang). Following Tripathi (2021), it can be expected that well-managed urbanization will improve equitable well-being. Industrial variables are used in this paper as factors conditioning the impact of urbanization on inclusive human development. The control variables defined in the literature include: Total natural resources rents (tnrr), inflation rate (infl) measured by consumer prices, sex ratio at birth (sexratiob), general government final consumption expenditure (govcons), regulatory quality (rquality), access to electricity in urban areas (accelurb), and youth unemployment (unempyt). The descriptive statistics for the variables are presented in Table 1. The statistics show a relatively high average urban growth rate

Table 1: Descriptive statistics

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Variables	Obs	mean	sd	min	max
Inequality-adjusted Human Development Index	597	0.353	0.0963	0.184	0.633
Urban population ratio	598	43.15	18.72	-2.675	90.74
Urban population growth	598	3.473	1.259	-0.216	7.211
Regulatory Quality	598	-0.621	0.531	-2.002	1.197
Total natural resources rents	552	10.11	8.720	0.00236	51.84
Gross fixed capital formation	505	10.17	19.92	-43.46	257.7
Inflation rate	580	6.402	7.372	-4.295	64.71
Sex ratio at birth	598	1.033	0.0111	1.007	1.077
access to electricity in urban	598	73.68	20.86	7.200	100
Unemployment youth	598	16.89	16.19	0.414	82.41
Government consumption	584	6.418	2.254	0	10
Signe log of net migration	598	-0.395	0.920	-1	1

Source: Author

of around 43.15% during the study period. The IHDI has a minimum value of 0.184 and a maximum value of 0.633, reflecting the low level of human development, which is unevenly distributed among inhabitants and across countries.

2.2. Estimation methods

To estimate the effect of urbanization on inclusive human development in Africa, with an emphasis on structural transformation, the econometric model (1) below can be used:

$$\mathrm{IHDI}_{i,t} = \beta_0 + \beta_1 urbang_{i,t_{i,t}} + \beta_2 \mathrm{tnrr}_{i,t} + \beta_3 \mathrm{infl}_{i,t} + \beta_4 \mathrm{sexratiob}_{i,t} + \beta_5 govcons_{i,t} + \beta_6 rquality_{i,t} + \beta_7 accelurb_{i,t} + \beta_8 unempyt_{i,t} + \sigma_{i,t} \quad (1)$$

; where $\sigma_{i,t} = \theta_i + \alpha_t + \varepsilon_{i,t;}$ $\varepsilon_{i,t;} \sim \mu^2$; *i* denotes the country index, t denotes the year, and θ_i captures the time-invariant fixed factors of country *i*. $\varepsilon_{i,t}$ is the error term. The other terms retain their meanings as defined in section 3.1.

We also assume specific intercepts for year t, represented by α_t, reflecting common exogenous urban demographic shocks. The parameter of interest, β_1, estimates the marginal effects of urban growth on the level of inclusive human development. Similar to this variable, the econometric approach assumes that the other explanatory variables, which are assumed to be control variables, are similar across all countries, which follow the same single regime of inclusive human development. As a result, the literature explores traditional methods such as the generalized method of moments (GMM), ordinary least squares (OLS), fixed effects models, and autoregressive models (ARD) for estimating equation (1). These traditional methods are limited due to their restriction on homogeneous slope parameters and the omission of heterogeneities in the IHDI within African countries. Furthermore, the contribution of urban growth in Africa to inclusive human development may vary depending on each country's level of industrial development. Consequently, the relationship between urbanization and inclusive human development is conditioned by structural transformation.

To incorporate this constraint into our model, we use the finite mixture model (FMM) estimation method combined with instrumental variables. This semi-parametric regression technique addresses the issues raised by modeling unobserved heterogeneity in the sample. The FMM model allows us to relax the single model assumption (Ouedraogo *et al.*, 2020; Sawadogo *et al.*, 2024), which posits that all observations can be characterized by a single model, potentially masking essential characteristics of the data (Morduch & Stern, 1997). The suitability of this model for resolving macroeconomic phenomena has attracted the attention of many authors in recent economic literature (Ouedraogo *et al.*, 2020; Sawadogo & Semedo, 2021; Sawadogo *et al.*, 2024; Mohamadou, 2025). The advantages of the FMM model highlighted by these authors include, among others, the ability to assign countries to subgroups in an endogenous and probabilistic manner. This feature is considered more advantageous than the exogenous or ad hoc selection of members, which may be subject to arbitrariness, data mining, and sample selection bias (Di Vaio & Enflo, 2011). It thus generates endogenous membership in a group and makes it possible to explain membership of a particular group using several covariates (Ouedraogo *et al.*, 2020). Consequently, countries are endogenously assigned to a group, each with its own probability of belonging to one group or another (Sawadogo & Semedo, 2021).

To specify a finite mixture model, we must assume that each country belongs to one of the latent classes j=1,…k, and that countries are heterogeneous across classes. Subject to the observed covariates, there is homogeneity within a given class j. In its general specification, the FMM model is defined as follows:

$$f(y\backslash X;\ \Theta) = \sum_{j=1}^{k} \pi_k \varphi(y\backslash X; \beta_k, \sigma_k) \tag{2}$$

Where $f(y\backslash x;\ \Theta)$ is the distribution of inclusive human development conditioned on membership in class k and covariates X. The optimal value of k is chosen using certain goodness-of-fit criteria such as the Bayesian information criterion (BIC) developed by Schwarz (1978); π_k is the probability of belonging to group k; the parameters π_k and σ_k are to be estimated, considering the likelihood of each observation belonging to each of the subgroups.

If we assume that $\varphi(y\backslash X;\ \beta_k,\ \sigma_k)$ is a Gaussian distribution with conditional expectations equal to $(y\backslash x = x\beta_k$, with j = 1, the model reduces to a single class or a single parametric function when j= 1: $y = x\beta_1 + \varepsilon_1$ (3) with $\varepsilon_{1} \sim N(0, \sigma_2^2)$. This refers us back to specification (1). In general, for j = k, the model generalizes to n classes: $y = x\beta_n + \varepsilon_n$ (4) , with $\varepsilon_{n} \sim N(0, \sigma_n^n)$, where $\varepsilon_1;\ \varepsilon_2;\ \ldots et\ \varepsilon_n$ are independent and identically normally distributed within the group, with variances $\sigma_1^1;\ \sigma_2^2; \ldots and\ \sigma_n^n$, respectively. In this case, the mixture model boils down to an estimation of a density function using the kernel method. Since the coefficients $\beta_1;\ \beta_2; \ldots et\ \beta_n$ are apparently different, the covariates X do not explain the differences between the observations belonging to each given group identically. The probability of belonging to a given break k is: $\Pi_k = \frac{\exp(\delta_k)}{\sum_{k=1}^{k} \exp(\delta_k)}$ (5), where $0 < \Pi_k < 1$ and $\sum_{k=1}^{k} = 1$.

The econometric model to be estimated will therefore depend on equation (1) and on k. This assumes that the population is composed of k subgroups for which the relationship between the dependent variable and the explanatory variables is different. For a given number of components k, the FMM model can be estimated by maximum likelihood using the Expectation-Maximization (EM) algorithm of Dempster *et al.* (1977), which is the most commonly used approach for maximum likelihood estimation of FMM models (Konte, 2013). By adopting this procedure, we obtain the following specification: $MaxlogL = \sum_{i=1}^{N}\left(log\left(\sum_{k=1}^{k} \Pi_k f_k(y \backslash \Theta_k)\right)\right)$ (6)

After choosing the number of regimes k and estimating the model parameters, it is appropriate to calculate the posterior probability that each country is assigned to a given latent inclusive human development regime k using the following Bayes' rule:

$$\hat{\pi}_{ik} = \frac{\hat{\Pi}_k f_k(\text{Ineqsal}_{i,t} \backslash \text{Ineqsal}_{i,t}, X_{i,t}; \hat{\beta}_k; \hat{\sigma}_k)}{\sum_{k=1}^{k} \hat{\Pi}_k f_k(\text{Ineqsal}_{i,t} \backslash \text{Ineqsal}_{i,t}, X_{i,t}; \hat{\beta}_k; \hat{\sigma}_k)} \qquad (7)$$

Following this rule, the estimated probabilities for each country will be used to assign countries to the different inclusive human development regimes identified. Thus, a given country i is assigned to an inclusive human development regime k instead of j if its estimated probability $\hat{\pi}_{ik}$ is higher than its probability $\hat{\pi}_{ij}$ for k ≠ j. The number of components must be chosen judiciously to avoid underfitting if it is too small and to prevent a loss of interpretability if it is too large. This number, which is not known a priori, is inferred from the data by estimating the model with several alternative regimes (1, 2, 3, or more), and we use the lowest BIC values to minimize the loss of information in the estimation. The Bayesian information criterion, developed by Schwarz (1978) and used to select the number of components, is defined as follows: $BIC = -2log(L) + (3K-1)\ LOG(N)$. Where L is the estimated value of the log-likelihood, K is the number of free parameters, and N is the number of observations.

In addition, we incorporate the lagged value of urban growth from the previous period as an internal instrument to account for endogeneity in the data structure. Finally, the structural transformation variables defined in Section 3.1 are incorporated iteratively to assess the role of structural transformation in the relationship between urbanization and inclusive human development. These models allow us to relax the single model generally used in classical regressions while addressing issues of endogeneity and heterogeneity. The inclusion of the latent variable, structural transformation, facilitates the classification of individuals into different classes of inclusive human development and allows for the consideration of any unobserved heterogeneity.

3. RESULTS

3.1. Basic results

Before presenting the basic estimation results, we determine the optimal number of latent classes using the Bayesian Information Criterion (BIC). The results obtained are summarized in Table 2. These show that the optimal model corresponds to the lowest value of the criterion, i.e., for C = 3. In fact, the criterion value is relatively high for classes below or above 3. Thus, the division into three regimes is the best fit and has been retained for further estimation in this paper.

Table 2: Test for selecting the number of groups

	C1	C2	C3	C4
BIC	-1502.452	-2033.366	-2185.518	-2161.277

Source: Author

After determining the number of inclusive human development regimes, the results of the fixed-effects and finite mixture models with instrumental variables for the three regimes are presented in Table 3. This analysis examines the effects of urbanization on inclusive human development, while controlling for the macroeconomic environment. While urbanization has a positive and significant effect on inclusive human development in the fixed-effects model, its effects are differentiated according to the three classes identified in the finite mixture model with instrumental variables. The FMM-IV model thus reveals this heterogeneity, which is masked in the fixed-effects model. We therefore applied the delta method to obtain the means of the variables of interest, IHDI and urbanization growth, for the latent classes. The results of these averages, recorded in the last lines of Table 3, are significant at the 1% threshold with a 95% confidence interval. Class 3 has the highest average IHDI value (0.3547654) and one of the lowest average urbanization rates (3.508787). On the other hand, class 2 has the lowest IHDI value (0.3115593) and the highest average level of urbanization (3.554555). Class 1 falls between the two dimensions analyzed, with 0.3407082 for IHDI and 3.501091 for Urbanizaton growth.

The two variables analyzed have distinct profiles: class 3 could represent countries with the highest levels of inclusive human development but with moderate levels of urbanization. Countries in this class are making efforts to distribute the benefits of urbanization equitably among their populations. Class 2 includes the most urbanized countries but with a low level of inclusive human development. These countries are unable to accompany their urban growth with equitable improvements in living conditions, such as health, education, and income. The countries belonging to class 1, which are in the minority, form a heterogeneous group in transition. The classification of countries according to Bayes' rule, based on the three regimes detected, is presented in Table A1 in the appendix. This classification depends on factors other than geographical areas or income levels, which are conventionally classified.

In classes 1 and 2, urbanization has a positive and significant effect at the 1% threshold on inclusive human development. A one percentage point increase in urbanization is associated with an improvement in inclusive human development in countries belonging to these classes of 0.0186 and 0.0130 percentage points, respectively. This means that cities in countries in these classes have better human development in terms of education, health, and living standards, and that this development is relatively well distributed across the population. These results corroborate those found by Yasmeen and Zameer (2024) in his measurement of inclusive development through inclusive growth. It should be noted that although the two classes show similar effects, the coefficient is lower in class 2, which includes the majority of countries, than in class 1, which includes a minority of countries. Urbanization, when accompanied by structural investment, therefore acts as a catalyst for inclusive human development. It facilitates social inclusion through access to basic social infrastructure and services, access to employment, and improved living conditions in general.

In class 3, urbanization has a significant negative effect on inclusive human development at the 1% threshold. A one percentage point increase in the urban growth rate reduces the Inequality-Adjusted Human Development Index by 0.0416 percentage points. These results indicate that urbanization leads to significant disparities in access to education, health, and income among the inhabitants of countries belonging to this class. These results are similar to those found by Whelan *et al*. (2023) for Ireland and by Pozhidaev (2020) for Uganda, which share similar socio-economic characteristics with the countries belonging to this class. This decline in inclusive human development following urban growth in African countries belonging to this class could be explained by the lack of control over a form of urbanization characterized by the growth of slums, exceeding the capacity of municipalities to provide equitable basic social services, due to a lack of education, morbidity, poverty, and the risk of exclusion from public services. Furthermore, this unplanned urbanization is believed to be the result of urban unemployment and low-productivity informal jobs, which hinder social inclusion and amplify exclusion traps. This reinforces the claims made by Harris and Todaro (1970) that urbanization can exacerbate inequalities and undermine well-being if migration to cities is not accompanied by labor market adjustments. Similarly, Nipo *et al*. (2021) argue that poorly managed urbanization can lead to greater deprivation, inequality, and social exclusion for populations.

Table 3: Basic results of the finished mixture model with instrumental variables

Independent variable:	*Inequality-adjusted Human Development Index*			
Models	*FE*	*Instrumental-variable finite mixture models (IV-FMM)*		
Variables		*Class 1*	*Class2*	*Classe 3*
Urban population growth	0.00377**	0.0186***	0.0130***	-0.0416***
	(0.00176)	(0.00342)	(0.00303)	(0.00301)
Total natural resources rents	-0.000844***	0.00262***	-0.00355***	0.000964*
	(0.000134)	(0.000293)	(0.000632)	(0.000522)
Inflation rate	-0.000119	0.0000745	-0.0000184	-0.0000184
	(0.000107)	(0.00115)	(0.000582)	(0.000582)
Sex ratio at birth	-0.127	3.410***	-2.613***	1.577***
	(0.343)	(0.850)	(0.640)	(0.283)
Government consumption	0.00136**	0.000867	0.00552***	-0.00595***
	(0.000641)	(0.00180)	(0.00131)	(0.00168)
Regulatory Quality	-0.0165***	0.0887***	-0.00632	0.00527
	(0.00463)	(0.00850)	(0.00905)	(0.00616)
access to electricity in urban	0.00141***	0.000918***	0.00161**	0.00202***
	(8.42e-05)	(0.000172)	(0.000729)	(0.000187)
Unemployment youth	0.000109	0.00244***	0.000614*	0.00265***

Independent variable:	*Inequality-adjusted Human Development Index*			
Models	*FE*	*Instrumental-variable finite mixture models (IV-FMM)*		
Variables		*Class 1*	*Class2*	*Classe 3*
	(0.000246)	(0.000400)	(0.000328)	(0.000446)
Constant	0.357	-3.334***	2.834***	-1.295***
	(0.354)	(0.875)	(0.617)	(0.297)
Observations	526	526	526	526
Number of countries	45	45	45	45
R-squared	0.481			
Test de Wald P-value		-0.0073172		
		(0.0070332)		
Mean Urban population growth		0.3407082***	0.3115593***	0.3547654***
		(0.0045626)	(0.007537)	(0.0029562)
Mean Urbang		3.501091***	3.554555***	3.508787***
		(0.0613811)	(0.0066728)	(0.0066279)
Posterior probability		14.50%	31.12%	54.36%

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author

3.2. Robustness analysis

In order to verify the robustness of the results in this paper, several alternative estimation approaches and specifications were used. We modified the regression technique by combining the finite mixture model with generalized linear regression (FMM-GLM). In addition, we used an alternative measure of urbanization, added control variables, and finally, divided the sample according to the three regimes before re-estimating each class with standard models such as OLS, FE, and DMC. The estimation results from the FMM-GLM model are shown in Table 4. Similar to our baseline results, urbanization has a positive effect on inclusive human development in classes 1 and 2, and a negative effect on the inequality-adjusted human development index for countries in class 3.

Table 4: Robustness test using an alternative estimator

Independent variable	*Inequality-adjusted Human Development Index*		
(1)	*(2)*	*(3)*	*(4)*
	Finite Mixture of Generalized Linear Models (FMM-GLM)		
Variables	*Class 1*	*Class2*	*Classe 3*
Urban population growth	0.0183***	0.0128***	-0.0417***
	(0.00358)	(0.00178)	(0.00300)
Total natural resources rents	-0.00215***	0.000440	0.00109*

	(0.000720)	(0.000278)	(0.000591)
Inflation rate	0.00107*	0.000233**	0.00149***
	(0.000593)	(0.000108)	(0.000568)
Sex ratio at birth	-1.888**	-1.580***	1.061
	(0.763)	(0.180)	(0.751)
Government consumption	0.00810***	0.00380***	-0.00657***
	(0.00239)	(0.000498)	(0.00174)
Regulatory Quality	0.0321***	-0.00780*	0.00515
	(0.00822)	(0.00414)	(0.00697)
access to electricity in urban	0.00116*	0.000812***	0.00196***
	(0.000610)	(0.0000922)	(0.000279)
Unemployment youth	0.00126***	0.00139***	0.00222***
	(0.000337)	(0.000138)	(0.000467)
Constant	2.065***	1.817***	-0.746
	(0.760)	(0.187)	(0.772)
Observations	526	526	526
Number of countries	45	45	45
R-squared			
Test de Wald P-value	-0.0073528		
	(0.0054434)		
Posterior probability			

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author

Table 5 presents the results of the regression of our baseline model, replacing the variable of interest, the urban population growth, with the ratio of the urban population to the total population (urban), which was one of the most significant variables in Tripathi' (2021) study. The results reinforce our basic conclusions, namely that the effect of urbanization on inclusive human development is not the same for all African countries. In classes 1 and 2, urbanization also has a positive effect on the IHDI, while its impact is negative in class 3.

Table 5: Robustness test through chang of the variable of interest

Independent variable	*Inequality-adjusted Human Development Index*		
	(2)	*(3)*	*(4)*
	Finite Mixture Model with Instrumental Variable Regressions (FMM-IV)		
Variables	*Class 1*	*Class2*	*Classe 3*
Urban population ratio	0.0316***	0.00108***	-0.00111***
	(0.00329)	(0.000141)	(0.000302)
Total natural resources rents	-0.00501	0.000371	-0.00222***
	(0.00738)	(0.000296)	(0.000403)

Independent variable	*Inequality-adjusted Human Development Index*		
	(2)	*(3)*	*(4)*
	Finite Mixture Model with Instrumental Variable Regressions (FMM-IV)		
Inflation rate	-0.00895**	0.000602**	-0.00136***
	(0.00386)	(0.000284)	(0.000264)
Sex ratio at birth	-42.59***	-1.223***	-0.700**
	(0.196)	(0.242)	(0.273)
Government consumption	-0.0121	-0.00298***	-0.0122***
	(0.0315)	(0.00109)	(0.00125)
Regulatory Quality	-0.622**	0.0412***	0.00856**
	(0.243)	(0.00646)	(0.00410)
access to electricity in urban	0.00249	0.00116***	0.00945***
	(0.00388)	(0.000132)	(0.000256)
Unemployment youth	-0.0666***	0.000723***	-0.0000795
	(0.00798)	(0.000232)	(0.000366)
Constant	43.59	1.494***	0.525**
	(0.222)	(0.248)	(0.267)
Observations	347	347	347
Number of countries	45	45	45
R-squared			
Test de Wald P-value	0.0294675***		
	(0.0033056)		
Posterior probability	2,48437	81,7353	15,78032

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author

We analyze the results of the robustness check presented in Table 6, adding several control variables. These variables include net migration and gross fixed capital formation, which are considered in the literature to be determinants of inclusive human development (Chowdhury & Chowdhury, 2024). The hypothesis that the introduction of these variables could influence our results has not been verified, as our results remain consistent with those of the baseline model. Urbanization affects inclusive human development according to all three regimes.

Table 6: Robustness test by adding several explanatory variables

Independent variable	*Inequality-adjusted Human Development Index*		
	(2)	*(3)*	*(4)*
	Finite Mixture Model with Instrumental Variable Regressions (FMM-IV)		
Variables	Class 1	Class2	Classe 3
Urban population	0.0193***	0.0218***	-0.0453***
	(0.00294)	(0.00605)	(0.00258)

Independent variable	*Inequality-adjusted Human Development Index*		
	(2)	*(3)*	*(4)*
	Finite Mixture Model with Instrumental Variable Regressions (FMM-IV)		
Total natural resources rents	-0.000289	-0.00382***	0.00157***
	(0.000467)	(0.00108)	(0.000566)
Inflation rate	0.00182***	0.000711*	0.0000412
	(0.000443)	(0.000389)	(0.000508)
Sex ratio at birth	-1.550***	-3.047***	1.704***
	(0.422)	(0.270)	(0.286)
Government consumption	0.00580***	0.00268	-0.00633***
	(0.00137)	(0.00191)	(0.00232)
Regulatory Quality	0.0359***	-0.0164	0.00878**
	(0.00728)	(0.0208)	(0.00442)
access to electricity in urban	0.000912***	0.00150***	0.00217***
	(0.000148)	(0.000313)	(0.000198)
Unemployment youth	0.00468***	0.000565**	0.00237***
	(0.000313)	(0.000245)	(0.000793)
Migration rate	0.0104***	0.00911***	0.00779
	(0.00405)	(0.00332)	(0.00555)
Gross fixed capital formation	0.0000503	-0.000533**	-0.0000306
	(0.0000862)	(0.000251)	(0.000183)
Constant	1.697***	3.271***	-1.413***
	(0.430)	(0.276)	(0.293)
Observations	457	457	457
Number of countries	45	45	45
Test de Wald P-value	-0.0243088*		
	(0.0122474)		
Posterior probability	18,15203	30,75039	51,09758

Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$
Source: Author

We split our sample by class and re-estimated each class using OLS, FE, and DMC models, with the lagged endogenous variable as an instrument. The results are present in Table 7. This new specification shows that all three models produce the same results in each class and are consistent with the basic results regressed on the entire sample. Urbanization has a positive influence on inclusive human development in countries belonging to classes 1 and 2, and is negatively associated with the IHDI in class 3.

Table 7: Estimation by class

Independent variable					*Inequality-adjusted Human Development Index*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
	Class 1			*Class 2*			*Class 3*		
Variables	*OLS*	*FE*	*DMC*	*OLS*	*FE*	*DMC*	*OLS*	*FE*	*DMC*
Urban population	0.00258*	0.000407	0.00131	0.0131***	0.00302	0.0141***	-0.0112	-0.00362	-0.0410***
	(0.00153)	(0.00175)	(0.00384)	(0.00476)	(0.00510)	(0.00127)	(0.00694)	(0.00286)	(0.00317)
Total natural resources rents	-0.000445	-0.000961*	-0.000879*	-0.00241***	-0.00215***	-0.00339***	-0.000319	-0.000595***	0.000876***
	(0.000522)	(0.000553)	(0.000499)	(0.000571)	(0.000382)	(0.000222)	(0.000229)	(0.000147)	(0.000334)
Inflation rate	-0.000128	-0.000151	-8.45e-05	-8.29e-06	2.39e-05	-0.000245**	-0.000463**	-0.000439**	0.000968***
	(0.000251)	(0.000288)	(0.000277)	(0.000110)	(0.000141)	(0.000108)	(0.000196)	(0.000214)	(0.000325)
Sex ratio at birth	-2.767***	-4.702**	-3.190**	-2.507***	1.695*	-2.857***	0.0287	-0.839**	1.716***
	(0.705)	(1.729)	(1.400)	(0.378)	(0.875)	(0.108)	(0.690)	(0.397)	(0.284)
Government consumption	0.00280*	0.00333*	0.00405*	0.00169	-0.00240	0.00465***	0.00100	0.00129*	-0.00398***
	(0.00163)	(0.00188)	(0.00231)	(0.00176)	(0.00157)	(0.000666)	(0.00132)	(0.000737)	(0.00135)
Regulatory Quality	0.0126	-0.00406	0.0150	-0.0149**	-0.0151	-0.00994***	0.00170	-0.0148**	0.00925
	(0.00859)	(0.0129)	(0.00907)	(0.00736)	(0.01000)	(0.00291)	(0.0155)	(0.00596)	(0.00669)
access to electricity in urban	0.00254***	0.00165***	0.00265***	0.00173***	0.00140***	0.00174***	0.00118***	0.00103***	0.00170***
	(0.000589)	(0.000422)	(0.000483)	(0.000280)	(0.000141)	(0.000103)	(0.000190)	(0.000125)	(0.000151)
Unemployment youth	0.00366***	0.000905	0.00347***	0.000474**	0.000927	0.000474***	0.000941*	-0.000351	0.00315***
	(0.000711)	(0.000837)	(0.000608)	(0.000224)	(0.000609)	(7.18e-05)	(0.000560)	(0.000273)	(0.000281)
Constant	2.941***	5.041***	3.377**	2.733***	-1.518*	3.082***	0.276	1.173***	-1.434***
	(0.757)	(1.806)	(1.461)	(0.370)	(0.884)	(0.106)	(0.724)	(0.415)	(0.298)
F			6.85 **			11.30***			105.40***
Sanderson-Windmeijer multivariate			11.76**			11852.60***			3757.84***
Kleibergen-Paap rk LM statistic			7.26**			60.80***			91.07***
Cragg-Donald Wald F statistic			12.18			14565.60			5729.78
Observations	36	36	33	190	190	174	300	300	275
R-squared	1	0.777	0.997		0.649	0.878		0.404	0.908
Number of countries	3	3	3	17	17	17	25	25	25

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author

Thus, all the robustness tests confirm the heterogeneous effect of urbanization on inclusive human development in African countries. These differentiated effects suggest that the relationship between urbanization and inclusive human development in African countries depends on structural factors specific to each country. Hence, the interest in continuing our analysis by examining the role of structural transformation.

3.3. Hypothesis results

In this section, we will analyze the role of structural transformation in countries' membership of the three inclusive human development regimes, each of which has different impacts on the effects of urbanization on inclusive human development. We use the following variables to measure structural transformation: industrial value added, agricultural value added, manufacturing value added, and service value added. The choice of these variables is based on Lewis's theory (1954) and the argument of Kwilinski *et al.* (2023), according to which the intensification of production stimulates urbanization in many countries, promoting economic development and improving the well-being of citizens. The results of the analysis are presented in Table 8. The role of structural transformation differs according to the inclusive human development regimes. It is similar in classes 1 and 2, but differs in class 3.

Table 8: Analysis of the role of industrial development in each class

		(1)	*(2)*	*(3)*	*(4)*
	Variables	*industrial value added*	*agricultural value added*	*manufacturing value added*	*service value added*
Class 1	(1)	-0.0144518*** (0.0024076)			
	(2)		-0.0214334 (0.0773115)		
	(3)			0.003172 (0.003536)	
	(4)				-0.0174082*** (0.0052163)
Class 2	(1)	-0.0007848 (0.0026022)			
	(2)		0.0076481 (0.0773653)		
	(3)			0.0089342 (0.0070284)	
	(4)				-0.0087891** (0.0041854)

		(1)	*(2)*	*(3)*	*(4)*
	Variables	*industrial value added*	*agricultural value added*	*manufacturing value added*	*service value added*
Class 3	(1)	0.0152366*** (0.0022251)			
	(2)		0.0137853*** (0.0030301)		
	(3)			-0.0121061 (0.0080807)	
	(4)				0.0261973*** (0.002302)

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Source: Author

The results show that a one percentage point increase in industrial value-added and service sector value-added relative to GDP is associated with a significant reduction in the probability of belonging to class 1, by 0.0144518 and -0.0174082 percentage points, respectively. However, a one percentage point increase in agricultural value-added and manufactured value-added has no significant effect on the probability of countries belonging to this class. These results suggest that countries whose structural transformation is based on industry and services are less likely to belong to class 1, where urbanization has a positive effect on inclusive human development.

Furthermore, the probability of countries belonging to class 2 is negatively influenced by the services sector, with a decrease of 0.0087891 percentage points of GDP. Countries that are less likely to belong to the class where urbanization is already significant are those that manage to transform their services sector only slightly.

Additionally, a one percentage point increase in industrial, agricultural, and service value-added increases the probability of belonging to class 3 by 0.0152366, 0.0137853, and 0.0261973 percentage points, respectively. This class is characterized by a deterioration in human development and unequal access to education, health, and income as a result of urban growth. This implies that the more countries in this class industrialize, the more it generates low living standards and social inequalities.

These results confirm Rostow (1959)'s argument that industrialization is an essential factor for urbanization but partially qualify the demographic transition theory, which argues that urbanization leads to improved living conditions while also being a source of social inequality (Lewis, 1954; Boserup, 1965). Thus, structural transformation facilitates urban growth by improving the supply of manufactured and processed goods and creating new jobs in the service sectors. However, it does not guarantee social equity in the benefits of this urbanization in class 3 countries. This could be explained by the failure of structural transformation, which is unable to stimulate cities in class 3 countries to promote equitable well-being (access to education, health, and better incomes).

CONCLUSION

This paper analyzed the impact of rapid urbanization in Africa on inclusive human development, highlighting the importance of structural transformation. To do this, we used a panel of 45 countries over the period 2010-2022. Estimates were made using an alternative approach and several econometric models. Our results are robust, utilizing the finite mixture model combined with the generalized linear model, ordinary least squares regressions, and double least squares applied specifically to each class. They are also confirmed by the estimation of the baseline model, by changing our variable of interest on the one hand, and on the other hand, by adding several control variables.

The results reveal heterogeneity in the effects of urbanization on inclusive human development, following three latent regimes of inclusive human development. A positive effect is observed in classes 1 and 2, while a negative effect is observed in class 3. It also appears that structural transformation exacerbates the negative impacts of urbanization on inclusive human development in countries belonging to class 3, while modulating the positive effects in classes 1 and 2.

These results raise a red flag regarding African urban growth in a context of low human development inclusion. The study provides evidence that urbanization alone is not enough to improve the living standards of African populations; it must be combined with an industrial revolution. Joint urban and industrial planning policies, carefully coordinated, are needed to initiate inclusive human development in Africa. Thus, authorities in each group of countries must establish the necessary conditions for structural transformation, formalizing the informal sectors occupied by services and agricultural and manufacturing activities through a formal industrial sector. Specifically, countries belonging to classes 1 and 2 must reallocate their activities in the industrial and service sectors to increase the level and equity of their inhabitants' well-being. As for countries belonging to class 3, the essential conditions for structural transformation must be put in place before embarking on rapid urbanization, to facilitate the care of the urban population in terms of income equity, education, and health.

This study was unable to explore all the factors that cause the heterogeneous effect of urbanization on inclusive human development in African countries. The next study will focus on examining structural transformation processus and other factors influencing the uniformity of the urbanization process in Africa.

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APPENDICES

Table A1: Classification of countries according to inclusive human development regimes

countries	*class1*	*class2*	*class3*	*Class-modal*
Algeria	0	0	1	3
Angola	0	0	1	3
Benin	0	1	0	2
Botswana	0	0	1	3
Burindi	1	0	0	1
Burkina Faso	0	1	0	2
Cabo Verde	0	0	1	3
Cameroon	0	0	1	3
Central African Republic	1	0	0	1
Chad	0	0	1	3
Comoros	0	0	3	3
Congo Dem. Rep.	0	1	0	2
Congo Rep.	0	0	1	3
Côte d'Ivoire	0	0	1	3
Djibouti	0	1	0	2
Egypt	0	0	1	3
Eswatini	0	1	0	2
Ethiopia	0	1	0	2
Gabon	0	0	1	3
Gambia	0	0	1	3
Ghana	0	0	1	3
Guinea	0	1	0	2
Guinea-Bissau	0	0	1	3
Kenya	0	1	0	2
Lesotho	0	1	0	2
Liberia	0	0	1	3
Madagascar	0	1	0	2
Malawi	0	1	0	2
Mali	0	0	1	3
Mauritania	0	0	1	3
Mauritius	0	0	1	3
Morocco	0	0	1	3
Mozambique	0	0	1	3
Namibia	0	1	0	2
Niger	0	0	1	3
Nigeria	0	1	0	2
Rwanda	0	1	0	2
Senegal	0	0	1	3

countries	*class1*	*class2*	*class3*	*Class-modal*
Sierra Leone	0	0	1	3
South Africa	1	0	0	1
Tanzania	0	1	0	2
Togo	0	0	1	3
Tunisia	0	0	1	3
Uganda	0	1	0	2
Zambia	0	0	1	3
Zimbabwe	0	1	0	2