Diversity of urban growth patterns in Sub-Saharan Africa

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Since 1960, urbanization in Sub-Saharan Africa (SSA) has been rapid. While consistent demographic statistics now exist on urban population growth rates, these data have not been fully exploited to improve our understanding of the evolution of urbanization at the continental scale. We investigate urban change between 1950 and 2010 across SSA using clustering analyses performed on 3 complementary aspects: the evolution of urban growth rates, the evolution of macrocephaly, and the densification of the urban mesh. Results show that SSA countries followed diverse urbanization trajectories over the last 60 years and are currently unevenly distributed along the urban transition model.

Keywords: urbanization; Sub-Saharan Africa; growth rate; macrocephaly; urban mesh; typology

Introduction

Sub-Saharan Africa (SSA) has long been the least urbanized continent, though it has had the highest rates of urban growth since the 1960s (Bocquier, 2017, Cohen, 2003, Montgomery, 2008). The origin of the recent large urbanization process observed in SSA can be found in colonial history (Hope, 1998; Vennetier, 1991). During the first half of the 20th century, colonial powers used existing cities (e.g. Djenné, Mogadishu, Mombasa, or Ouagadougou,) or new colonial ones (e.g. Abidjan, Dakar, Kinshasa, Lubumbashi or Nairobi) to control politically and administratively and to economically exploit their new territories (Coquery-Vidrovitch, 2014; Hope, 1998; Stren & Halfani, 2001; Vennetier, 1991). Most of colonial investments were made in their political and/or economic capitals, named primary cities (Fox, 2012; Vennetier, 1991). Economic factors also reinforced the development of some of these cities through rural-urban migration (Cohen, 2004; Hope, 1998). For example, manpower was concentrated around mining extraction

sites such as in Lubumbashi or Johannesburg. With the development of transportation for extracting agricultural and mining products, a faster urban development also began to occur around transportation nodes such as harbors (e.g. Abidjan and Mombasa) and railway stations (e.g. Parakou). However, cities were growing slowly during the colonial period as African migration to the city was strictly controlled and limited to existing workforce needs (Kuper, 1965; Simon, 1989).

After the independence of SSA countries (1950s - 1970s), the new authorities gradually relaxed population mobility restrictions (Cohen, 2003). Consequently, people massively migrated toward the primary cities in search of economic opportunities (Cohen, 2003, Hope, 1998). The so-called 'rural exodus' was reinforced by push migration factors such as rural conflicts and economic crises (Cohen, 2003). Combined then with the high urban natural growth rates (Hope, 1998), the population of primary cities grew rapidly reinforced their place at the top of their nations' urban system leading to a very strong primacy or macrocephaly, i.e. the hypertrophy or the hyper-enlargement of the largest city of a country (Lois-Gonzales & Lopez-Gonzales, 2013; Pumain & Moriconi-Ebrard, 1997). In some countries, the historical/economically largest urban centre was not chosen as the political capital after the independence, and their urban hierarchy is therefore dominated by two cities: an economical and a political center.

Africa's primary cities grew considerably both in terms of population and spatial extent during the decades following independence and started to absorb peri-urban settlements that were subsequently reclassified as urban areas even though they did not necessary have the requisite urban amenities (Castells, 2016).

This urban population growth substantially modified the population distribution within SSA countries (Cour, 1984).

While it was neglected for long in the absence of updated statistics, the socio-economic crisis that started in the 1970s with the petroleum crisis had a significant impact on African urban growth rates. By the late 1990s and 2000s, African censuses revealed substantial urban growth rate divergences between countries according to their economic situation (Dubresson & Janglin, 2010; Potts, 2012). In some cases, counter-urbanization occurred due to a combination of weakened natural growth with lower net migration (Dubresson & Jaglin, 2010; Potts, 2012). The lower natural growth was possible due to an increased urban mortality, as a result of the adverse effects of the World Bank – IMF Structural Adjustments Programs on public health. Conversely, decreased net urban migration might be linked to the degradation of life in primary cities also due to the negative impact of the same Structural Adjustments Programs on rural areas (Potts, 2012). The HIV/AIDS in SSA has also a significant limiting effect on urbanization by differentially affecting mortality, migration, and fertility between the urban and rural (Dyson, 2018); the epidemic has shifted not only from those at highest risk to a generalized epidemic, but also from one concentrated in urban areas to one whose effects are felt almost as much in rural areas (Piot, 2001). Moreover, urban growth is no longer restricted to primary cities but is also now evident in small and medium-sized cities, e.g. those near international borders and/or natural resources (Bruneau, 1995; Dubresson & Jaglin, 2010; Potts, 2012).

While consistent demographic statistics on urban population growth rates in SSA countries and cities are now available, they have not been fully exploited to analyze, compare and map the evolution of urbanization in SSA at the continental

scale. Therefore, the objective of this paper is to make use of existing demographic data to improve our understanding of the urban growth diversity that has occurred in SSA over the past 50 years. More specifically, this paper attempts to identify where (i) urbanization is growing faster or slower than 50 years ago, (ii) the domination of primary cities is stronger or weaker than 50 years ago and (iii) where the urban mesh was densified by the emergence of urban centers.

Data and methods

In most SSA countries, censuses are infrequent and of poor quality and we must therefore rely on demographic projections. Here we used the database provided by the World Urbanization Prospects (2014 revision) of the United Nations (https://esa.un.org/unpd/wup/) as it is currently the most consistent and detailed database on urban population for the last 50 years. Demographic projections include a base year population estimate by age and sex, and assumptions of mortality, fertility, and migration rates to fill temporal gaps. The urban and the total population counts were extracted for each SSA country by decade from 1960 to 2010 for all countries with cities above 100,000 inhabitants in 2000 (which is not the case for Equatorial Guinea and Swaziland). We also extracted the urban population size for the 1950 – 2010 period for all agglomerations of more than 300,000 inhabitants (hereafter called cities) in 2014 (n=373), and computed their rank in the national urban system in 2000 according to their population. We limited the period of analysis to 2010 because the most recent data are the most uncertain as they are submitted to revision by the World Urbanization Prospects in the following years.

At the country scale, two indicators were derived for each decade, both expressed in percentages: i) the urbanization rate defined as the proportion of people living in urban areas, and ii) the proportion of the urban population living in the two largest cities as a measure of national macrocephaly. We chose to measure the macrocephaly of the two largest cities because of the dual existence of political and economic capitals in some African countries or of the small size of some political capitals (e.g. in Nigeria or Tanzania). At the city scale, we computed the compound annual growth rate for each decade by dividing the population count at the end of the period by its count at the beginning of the same period, raise the result to the power of one divided by the period length in years and subtract on from the subsequent result; such formula takes into account the geometric nature of the population's evolution (Leridon et al, 1997).

The urban population thresholds used in the database varies by country, ranging from 1,500 inhabitants in Djibouti, Guinea Bissau and Somalia to 40,000 inhabitants for Mali) and are often defined in combination with with administrative or economic functions (Buettner, 2015; Potts, 2012). Because of this national heterogeneity in urban population thresholds, this analysis will focus on temporal trends and orders of magnitude of change in urban population growth.

In order to simplify the large number of temporal trajectories, convergences and divergences in the urban evolution of SSA countries were identified by performing two clustering analysis. A cluster analysis aims at finding natural groups in a set of observations using a similarity measure (i.e. the euclidean distance between the observations. The analysis was implemented using the general-purpose K-Means algorithm, which is indicated when dealing with few

natural groups of comparable sizes. The K-mean clustering analysis identifies iteratively the clusters according to the nearest mean, serving as a prototype of cluster (Jain, 2010). The first clustering analysis was based on national urbanization rates from 1960 to 2010 and was used to classify countries according to their temporal profile. The second clustering analysis looked more specifically at the evolution of the urban population concentration in the two largest cities in each country in order to measure the impact of urbanization on the national urban systems. In both cases, the k number of clusters was determined by performing a silhouette analysis which is a method of interpretation and validation of the consistency of the clusters (Rousseeuw, 1987).

We then explored the evolution of the number of cities at the continental level and we mapped the size of cities of 300,000 inhabitants or more in 2014 for different dates between 1950 – 2010 study period. Two k-means clustering analyses were then performed at the city-level in order to identify convergences and divergences in the evolution of cities: one based on the size of cities and the other on the average annual growth rate.

Results

Are urban growth rates decreasing in SSA?

While the total population of SSA rose from 226 million in 1960 to 871 million in 2010, with an increase of its compound annual growth rate from 2.5% to 2.7%, the urban population expanded from 33 million in 1960 to 307 million in 2010 (Fig. 1). The annual urban growth rate decreased significantly in the last two decades: from 4.9% during the 1960s, 1970s and 1980s to 4.1% after the 1990s (Fig. 2).

Our cluster analysis of urbanization rates from 1960 to 2010 identified 6 types of countries (Fig. 3). In 1960, three groups of countries' clusters can be distinguished based on their urbanization rate, whereas in 2010, the urbanization rates are more diverse. While countries of types B and F had similar and relatively high urbanization rates in the 1960s, countries of type F urbanized much faster, reaching 80% of their population living in cities in 2010 (Djibouti and Gabon), than the ones of type B that reached 60% (South Africa and Congo-Brazzaville). Among the least urbanized countries in 1960 (i.e. types D, A, C), urbanization progressed very rapidly in countries of type D (Botswana, Cameroon, Gambia and Mauritania), especially between 1980 and 1990, whereas the pace was slower for types A (Angola, Benin, Guinea, Guinea-Bissau, Madagascar, Mali, Mozambique, Togo, Namibia, Nigeria, Somalia, Sudan, Zimbabwe,) and C (Burkina Faso, Burundi, Chad, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Niger, Rwanda, South Sudan, Tanzania, Uganda). The urbanization rate in type C countries remained low throughout the study period. Type E countries were is characterized by a moderate urbanization rate of 20% in 1960, but this rate grew progressively except for the 1990 - 2000 period when it slowed a bit (Democratic Republic of Congo, Ivory Coast, Ghana, Liberia, Senegal, Sierra Leone, Republic of Central Africa, Zambia).

Although urban growth rates have generally decreased in SSA since the 1990s, diverse urban evolutions can be observed across the continent leading to urbanization rates ranging between 20% and 81% in 2010.

Is the domination of primary cities growing or decreasing in SSA?

The second country-level cluster analysis based on urban population

concentration in each country's two primary cities identified 6 groups of countries with different temporal patterns (Fig. 4). In 1960, 3 groups of types are clearly identified (I and V, II and III, IV and VI). Countries having almost 80% of their urban population living in the two first cities in the 1960s (Types IV and VI) diverge into two temporal profiles: a relatively stable (Type IV: Burundi, Democratic Republic of Congo, Eritrea and Djibouti) and a decreasing up to 50% in 2010 (Type VI: Kenya and Zimbabwe). In the latter, the urban population was growing faster in the small and medium cities. Among the countries with around 40% of the urban population living in the two first cities in 1960 (Types II and III), there are two temporal trajectories. The macrocephaly of type II shows rapid growth from the 1960s to the 1990s and then decreases up to 2010 (Type II: Angola, Burkina Faso, Guinea-Bissau, Liberia and Malawi). For type III, the urban concentration is slower between 1960 and 1980 and decreases after that (Type III: Gabon, Ghana, Guinea, Ivory Coast, Madagascar, Niger, Rwanda, Senegal, Soudan, Togo and Uganda). Both types are characterized by a de-concentration of the urban population after the 1980s-1990s period. For countries with about 25% of the urban population living in the two first cities in the 1960s, the proportion rose up until the 1980s and1990s and then stabilised for Type I (Type I: Cameroon, Central African Republic, Chad, Congo-Brazzaville, Mali, Mauritania, Namibia, Sierra Leone, Somalia, South Africa and Zambia) or decreased for Type V (Type V: Benin, Ethiopia, Kenya, Mozambique, Nigeria, South Sudan, Tanzania and Zimbabwe).

Overall the domination of primary cities generally grew at first and then stabilized or decreased. Diverse evolutions can be observed over the last 60 years making the macrocephaly highly variable from one country to the other in 2010.

Is there an ongoing densification of the urban mesh?

The evolution of cities of more than 300,000 inhabitants between 1950 and 2010 (Fig. 5) shows i) the progressive appearance of one or two primary cities per country, ii) the emergence of medium-sized cities from the 1980s in Democratic Republic of Congo and Nigeria, and iii) the emergence of new city between 1990 and 2010 in Ghana, Tanzania and South Sudan. The Republic of South Africa already had an urban network of 3 cities with more than 300,000 people in 1950.

As a consequence of the fast urbanization and densification of the urban mesh, the number of millionaire population cities in SSA increased from 1 to 37 between 1960 and 2010 (Table 1) while the number of cities between 300,000 and 1 million inhabitants increased from 5 to 82. As a result, urban growth in SSA densified the urban networks.

A cluster analysis of the evolution of the size of the cities from 1950 to 2010 led to 4 groups of temporal profiles (Fig. 6). Type C were large cities even in 1950 that continued to grow and multi-millionaire in 2010 e.g. Johannesburg, Kinshasa and Lagos. Types A, B and D were of similar size in 1950, but have since been characterized by different growth rates.

An analysis of the evolution of annual growth rates per city led to the identification of two temporal profiles (Fig. 7): 64 cities are characterized by a relatively stable annual growth rate of around 4%, whereas for the remaining 75 cities, the annual growth rate decreased from an average of 9% in 1960 to 4% in 2010. Currently, the urban growth rates of most African cities are fairly similar.

Figure 8 summarizes the results obtained by the two city-scales typologies presented above: the evolution of city sizes and population growth rates.

The urban mesh has been densified since the 1990s in most SSA countries and the continent's cities have been increasing at a relatively similar rate of ~3.7% since then. Still this is higher than SSA's annual natural growth of 2.7%.

Discussion and conclusion

Although mainly designed to explain the long-term evolution of cities in developed countries, the urban transition model (Fig. 9) might be of use in interpreting some general trends of urbanization in SSA (Moriconi, 1995; Steck, 1995). Indeed, during the colonial era, SSA's urbanization progressed slowly because the number of cities was small and the population was mainly rural (Phase 1). After the independence, these cities urbanized rapidly thanks to massive rural – urban migrations in search of job opportunities (Phase 2). Since the 1970s-1980s, depending on the country and the city, urban population growth has generally slowed down mainly due to lower natural increase rather than by diminishing rural – urban migration (Phase 3). Yet, these global trends, shown on this urban transition model (Fig. 9) do not fully capture the diversity of urban temporal patterns in SSA because of national or local socio-economic factors.

Although urban population growth has generally decreased at the continental scale since the 1980s, national urbanization rates are still increasing but at different rates. We distinguished several temporal urbanization profiles in the 1960 - 2010 period. Unlike before the 1960s, urbanization differences between countries have increased. In the 1960s, urbanization levels in SSA ranged between 5% and 40%, in 2010 they ranged between 20% and 80%. The less urbanized countries are either very poor and landlocked countries where people emigrate to foreign cities, and/or old and very organized civilizations with high

historical rural densities and rural structures capable of holding their population in place. The lower urbanization rate observed for type E from 1990 to 2000 could be linked to the influence of structural adjustment policies as explained by Potts (2012); indeed, the latter induced not only at the national level currency devaluation and wages' reduction, but also in the cities, loss of formal jobs and lowering or the removal of public subsidies (e.g. for staple foods, school, housing, …) which worsened the urban conditions of living.

Except for a few countries starting with a very strong macrocephaly in their urban system in the 1960s, estimated by the concentration of the urban population in the two largest cities, all other countries in SSA are characterized first by a reinforcement of the macrocephaly of their urban systems in the 1960 -1990 period, followed by a slow-down or a decline of the same since then. The concentration of job opportunities is largely explained the macrocephaly reinforcement of the first period (Hope, 1998). The subsequent relative decline of the urban population concentration could be explained by the persistent urban socio-economic crisis occasioned by factors like macroeconomic mismanagement, corruption, poor governance, and in global commodity prices and the attendant urban economic difficulties (Potts, 2012).

Ongoing urban population growth and its declining concentration in the two largest cities had aided the spread of the population into smaller cities, creating a growing net of small and medium cities in most SSA countries. The growth of SSA cities above 300,000 inhabitants was very strong (around 9%) in the 1960s for more or less half of the cities and diminished regularly from the 1960s to 2010 up to around 4%. The other half of the cities grew with a slowly decreasing growth rate from around 4.5% to +/- 3.5%. This confirms what was

already suggested in previous studies (Bruneau, 1995, Dubresson & Jaglin, 2010, Potts, 2012). Bruneau (1995) observed in D.R.Congo a slower growth since the 1980s of larger cities and a reinforcement of the small and medium ones, explained by the profound socio-economic crisis lasting since the 1970s. Dubresson and Jaglin (2010) reviewed 50 years after the independence's wave the causes of the slow-down of urbanization in their former African colonies among other topics which are a slow-down of the natural population growth, a weaker migration balance toward large cities and the refuge's role of small cities in unsecure areas/periods. Potts (2012) analyses the urban growth according to city's size with national statistics for a set of African countries from the 1980 – 2010 period; she shows that urban growth can be relative rapid for medium and small cities and that in a context of stagnant or negligible urbanization small and medium cities can growth faster than the largest one(s) (e.g. in MOzambic, Sudan, Togo, Benin).

The future evolution of urbanization in SSA will probably be as diverse as during the last 60 years given current to demographic and global or local socio-economic. Indeed, the urban way of living, the education of women, … are known to influence the population fertility; global economic trends such the price of some mineral extractive products will influence the attractiveness of nearby cities; local socio-economic trends succeeding in the creation of urban job opportunities will also reinforce the urban growth; conflicts, droughts, or others risks may also influence positively or negatively the urban growth according on their location. At the continental level, one cannot say if and when the last stage of the urban transition model (the cities are growing slowly as a result of internal natural population growth and they are concentrating the largest part of the population) will occur, except maybe for Djibouti and Gabon which already reached an

urbanization rate of nearly 80%. But for sure, cities in transition (Stage 2) are and will be difficult manage and plan (Steck, 2006).

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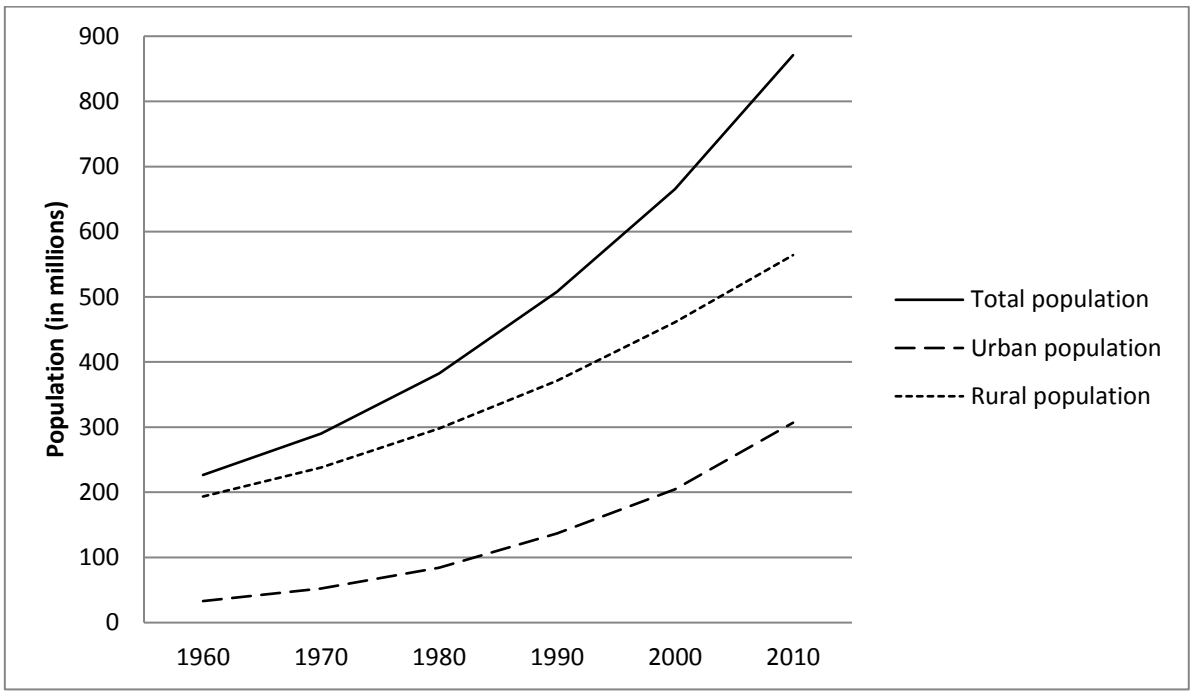
Table 1: Number of millionaire population cities in SSA

	0,3-1	1-8	>8
1950	5	1	
1960	11	1	
1970	20	4	
1980	37	10	
1990	50	18	
2000	57	31	
2010	82	37	2

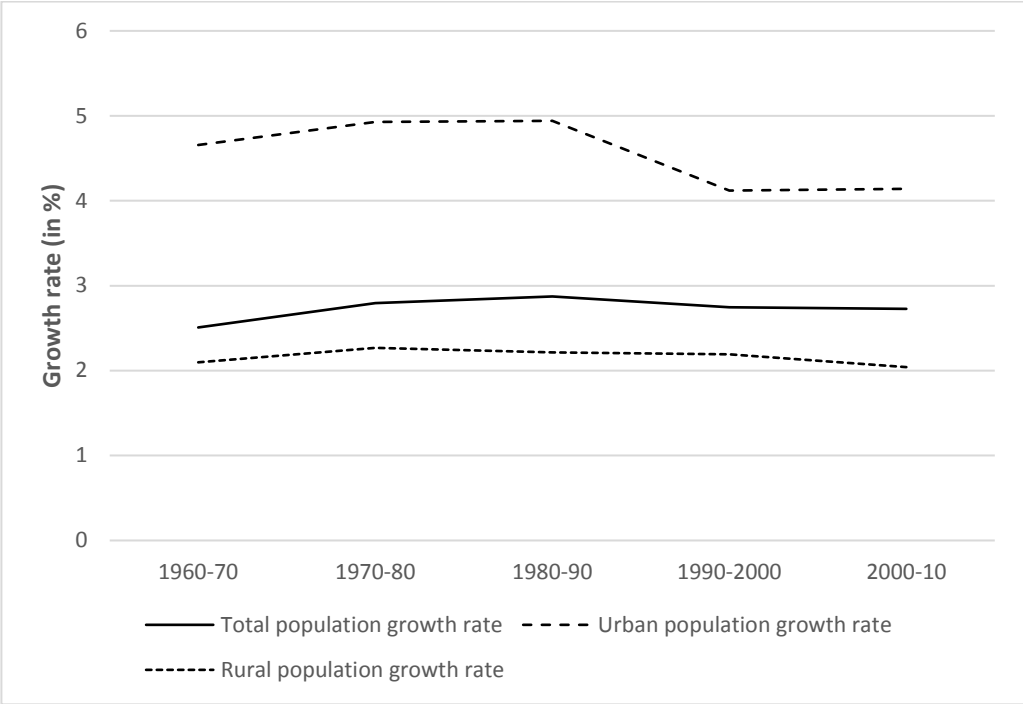
(Data source: United Nations Population Division, 2014)

Figure 1: Total, urban and rural population in Sub-Saharan Africa, 1960 - 2010



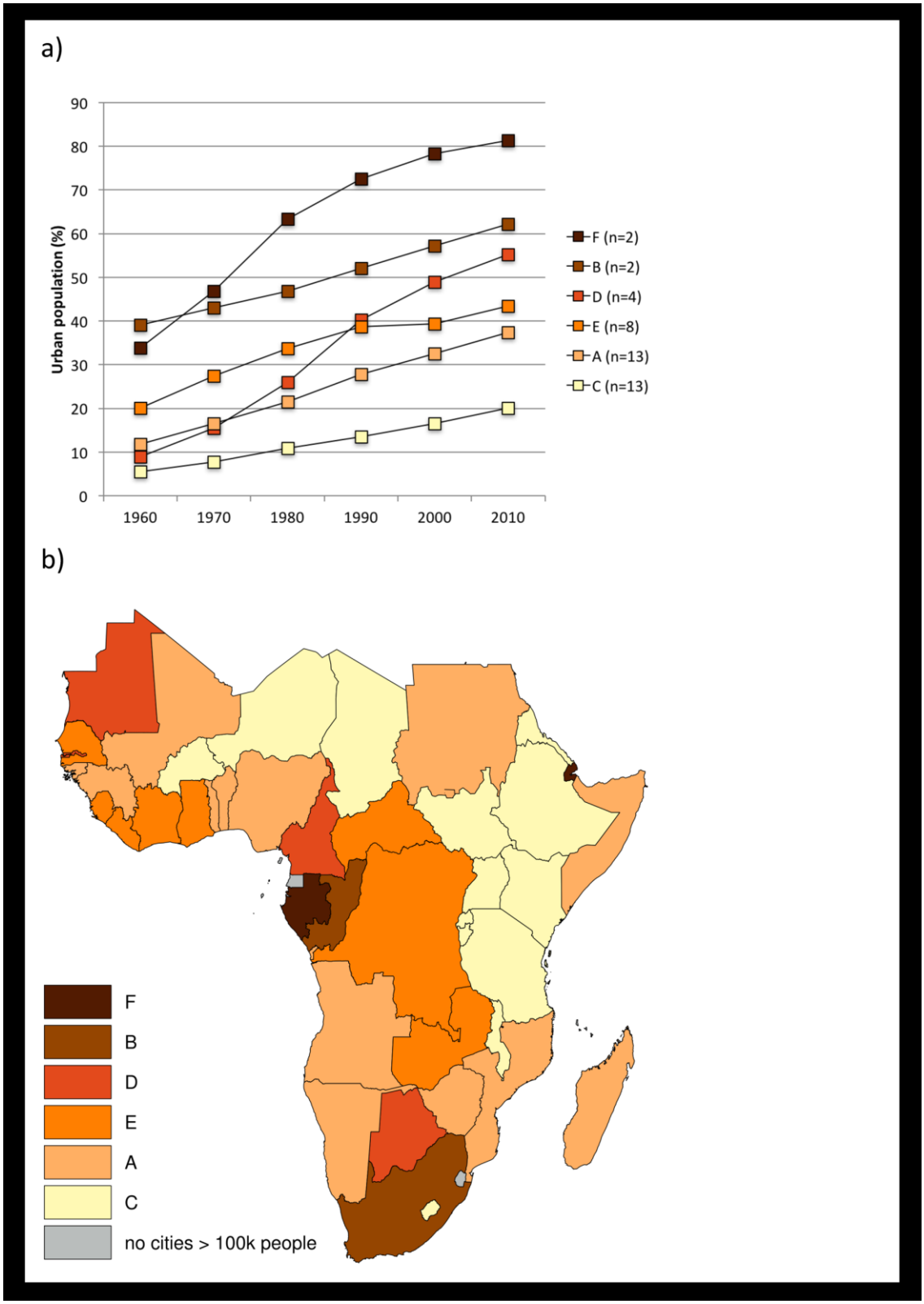
(Data source: United Nations Population Division, 2014)

Figure 2: Total urban and rural population growth rates in Sub-Saharan Africa, 1960 - 2010



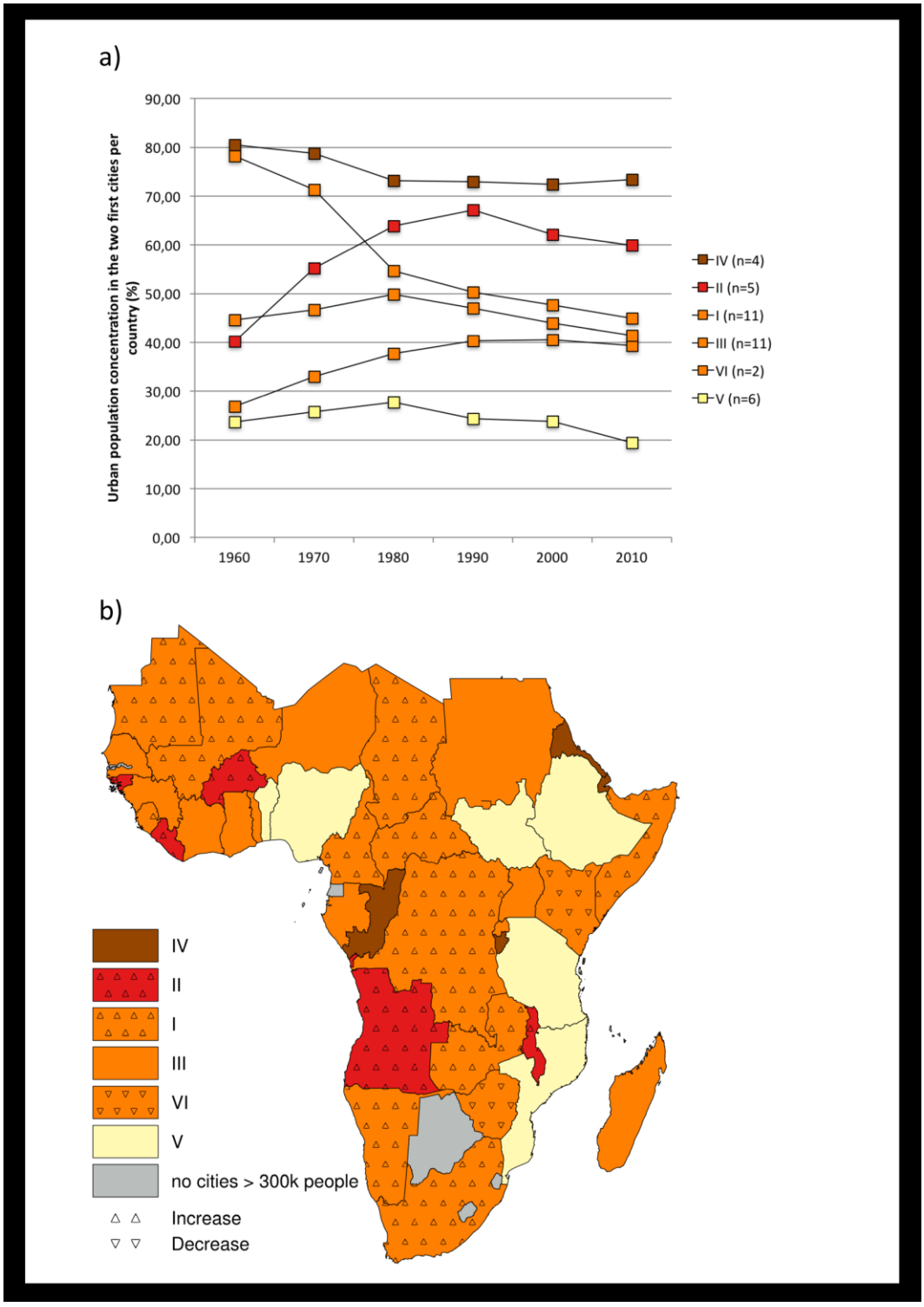
(Data source: United Nations Population Division, 2014)

Figure 3: Typology of urbanization rates by country in SSA (1960-2010): a) Graph of the evolution, b) Map



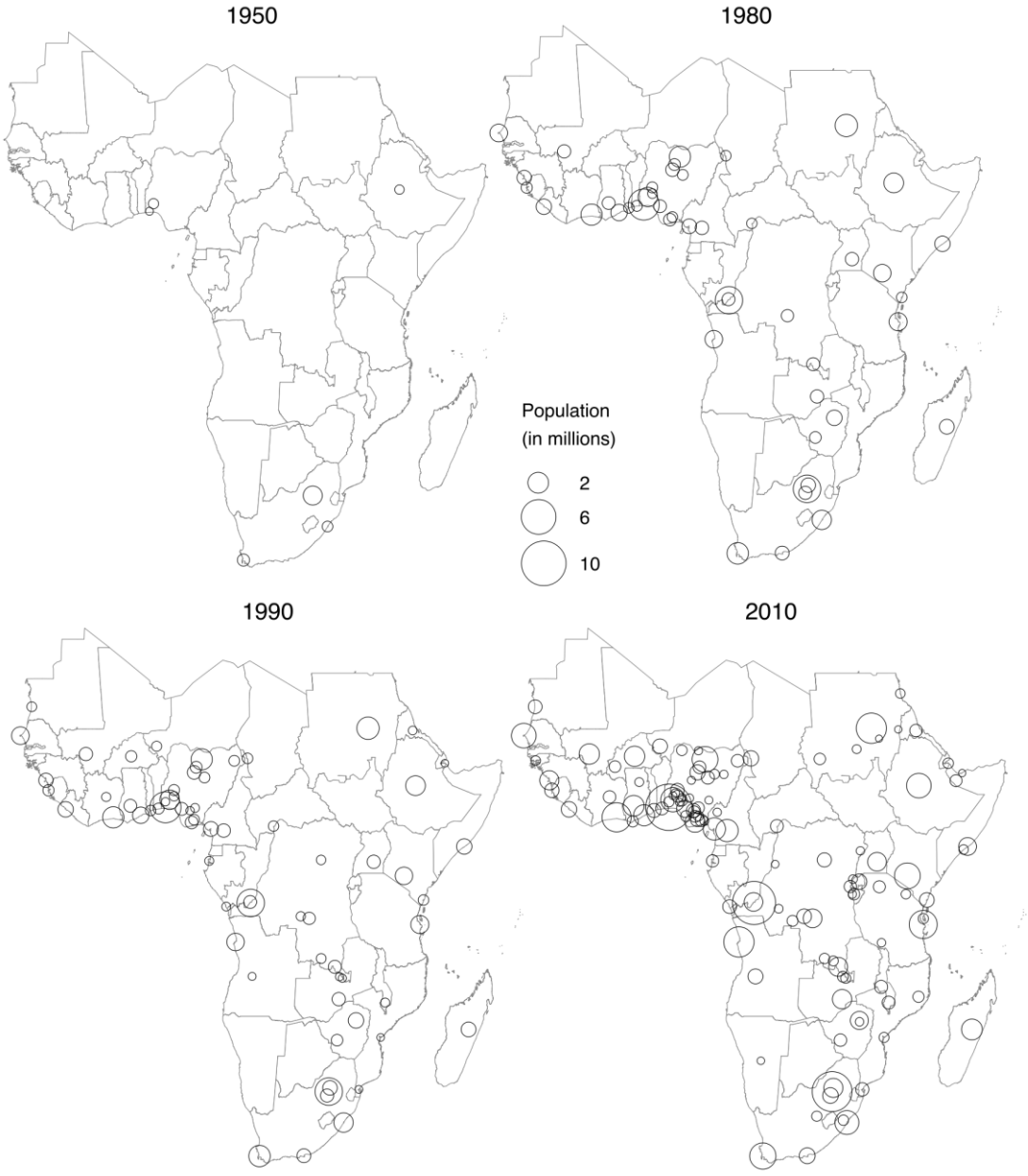
(Data source: United Nations Population Division, 2014)

Figure 4: Typology of the evolution of macrocephaly by country in SSA (1960-2010): a) Graph, b) Map: Groups or countries are ordered according to the macrocephaly in 2010; triangles are indicating whether the global trend increases or decreases since 1950.



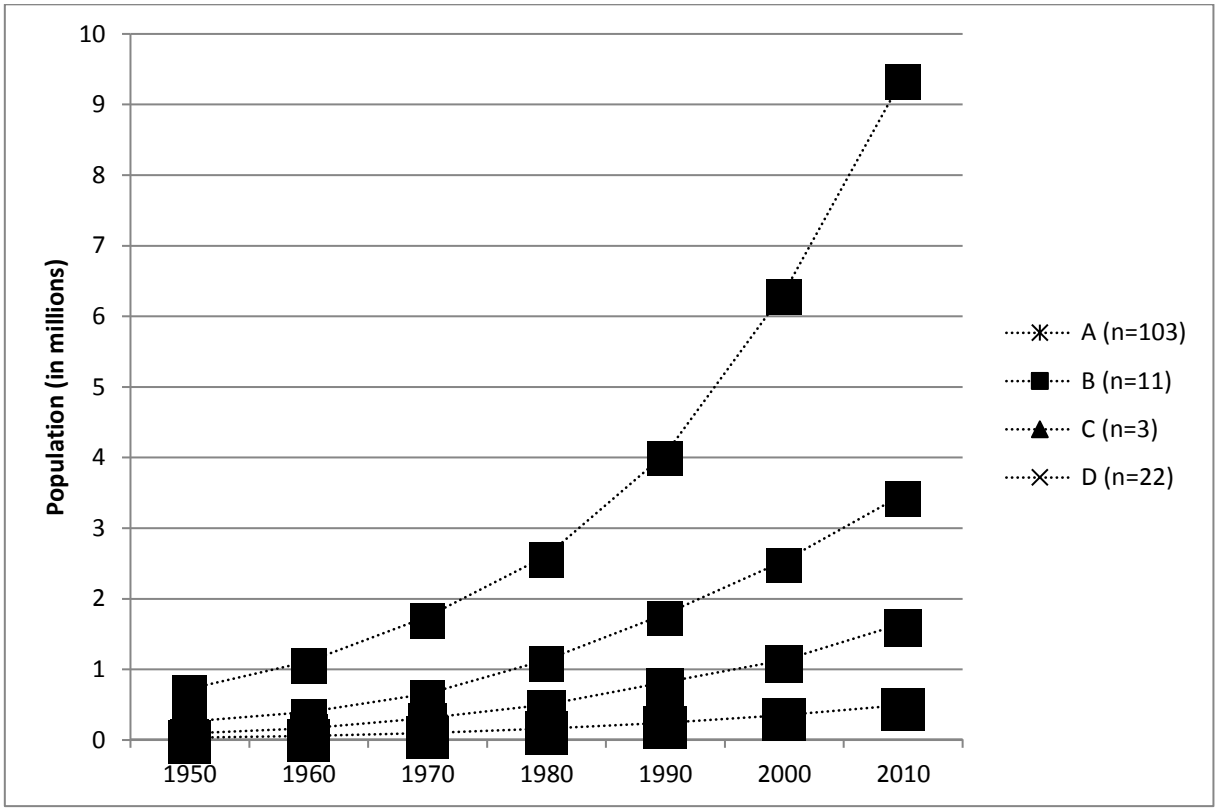
(Data source: United Nations Population Division, 2014)

Figure 5: Cities with more than 300,000 inhabitants in 1950, 1980, 1990 and 2010. The area of the circle is proportional to the number of inhabitants.



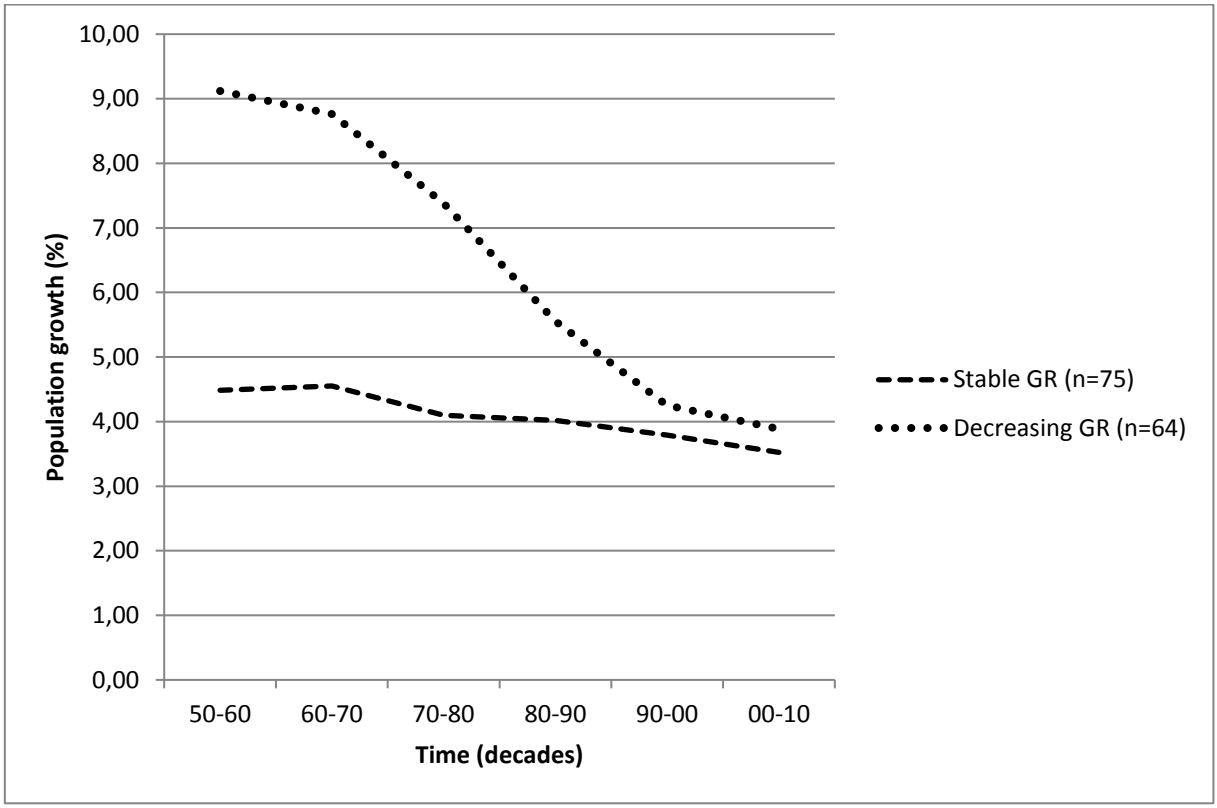
(Data source: United Nations Population Division, 2014)

Figure 6: Evolution of the size of SSA cities by cluster between 1950 and 2010



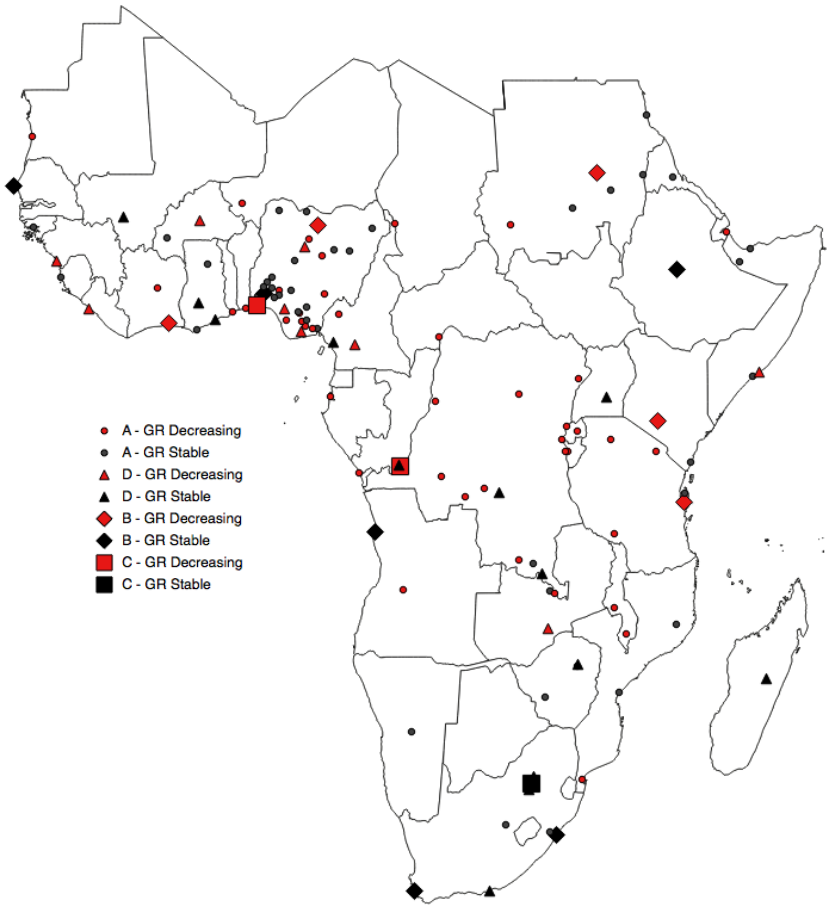
(Data source: United Nations Population Division, 2014)

Figure 7: Evolution of the compound annual growth rates of SSA cities by cluster between 1950 and 2010



(Data source: United Nations Population Division, 2014)

Figure 8: Typology of SSA cities according to the evolution of their size and their growth rate



(Source: United Nations Population Division, 2014)

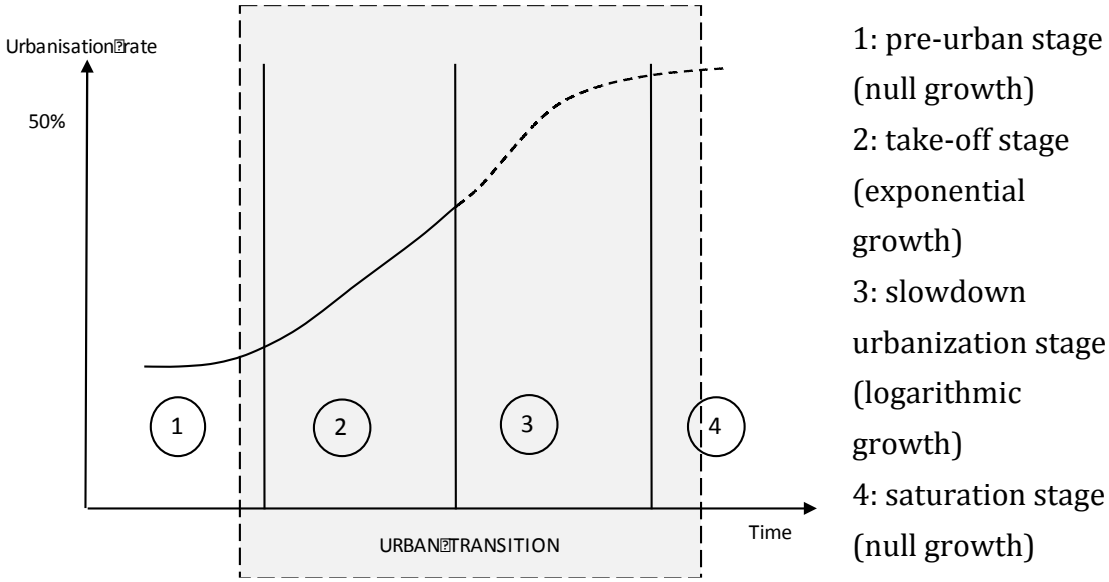


Figure 9: Urban transition model (Adapted from Moriconi, 1995)