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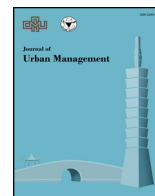
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The evolution of national urban systems in China, Nigeria and India

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ABSTRACT

As a country transitions from a lower order of development to a higher order of development, it undergoes a structural transformation. Accordingly, the spatial economy transforms from a system organized around smaller economic units distributed throughout the countryside, to one comprising larger economic units concentrated in dense urban areas. While historically this process unfolded at a rather gradual pace, it is now being redefined by the unprecedented pace and scale of the contemporary urban narrative. This has presented new patterns of urbanization. Utilizing comparable datasets for China, Nigeria and India this paper examines the evolution of national urban systems under conditions of rapid urbanization. In doing so, it scrutinizes three key dynamics: the spatial distribution of cities, the rate of growth by city size class and the size hierarchy of cities. The results are compared to see if uniform patterns emerge. The findings of this paper suggest a certain degree of heterogeneity among national urban systems; and in some instances contrasting patterns can be observed. We thus caution against a 'one size fits all' approach to interpreting the urban transition in developing countries. The findings of this paper have implications for both theory and policy.

1. Introduction

As a country transitions from a lower order of development to a higher order of development, it undergoes a structural transformation; shifting from an economy previously based on subsistence living to one based on industrial production. As such, the spatial economy transforms from a system organized around smaller economic units distributed throughout the countryside, to one comprising larger economic units concentrated in dense urban areas. This shift from a predominantly rural society to a predominantly urban one is commonly known as the urban transition (Northam, 1975; Zelinsky, 1971). Whereas, in developed countries the urban transition has been unfolding for the better part of two centuries, in developing countries it has largely been confined to the past 65 years (Bairoch, 1988). A defining feature that distinguishes the two experiences is the unprecedented pace and scale unfolding in today's developing countries. This has presented new patterns of urbanization.

In 1950, 18 out of the 30 largest urban agglomerations were located in developed countries; as of 2015, however, the equilibrium

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had shifted and developing countries were now home to all but 6 (Cohen, 2006). It is the rise of megacities, like Mexico City, Jakarta and Cairo that have attracted the most attention from researchers and policymakers in recent years. To a certain extent, this has detracted from the processes unfolding among other settlement sizes and typologies. It is important to recognize, however, that the outcomes of the urban transition are not confined to large metropolises alone, but instead contribute to the dynamics of a national urban system as a whole (Chadwick, 1987; Ding, Lai, & Wang, 2012). While at any time, a settlement may be growing as a result of internal migration, another may be declining due to rural exodus; the same can be said about natural population increase and decrease. Moreover, the growing contribution of reclassification, through the addition and subtraction of settlements, has also influenced the spatial configuration of national urban systems (United Nations, 2001). Cities should thus be viewed as part of a dynamic urban system comprising varying sizes, locations and typologies, and not simply in isolation. Against the backdrop of the unprecedented pace and scale of urban change unfolding in developing countries today, this paper seeks to examine how urban systems have evolved under conditions of rapid urbanization. As the three countries projected to experience the largest increase in urban population – and in effect the most dramatic transformations to their urban systems – China, Nigeria and India have been selected as notable case studies.

Utilizing comparable datasets from the *Géographie-cités Lab*, this paper employs a number of quantitative techniques commonplace in urban economics. To begin, we employ the spatial Lorenz curve to observe the changing nature of the *spatial distribution of cities*. The findings suggest that, while some national urban systems have become more evenly distributed over time (Nigeria), others have become uneven (China); and despite adding a significant amount of cities to its urban system, the balance of India's distribution has remained unchanged. We then go on to examine the *growth rates of city size classes* to determine which cities are growing the fastest. We find that small cities and towns predominate in all three countries, however, when it comes to the fastest growing cities, the results tend to vary. In China, the fastest growing cities are megacities (> 10 million), while in Nigeria it is large cities (1–5 million) and in India it is intermediate cities (500 thousand–1 million). Finally, the rank size distribution is turned to in order to inspect the *urban hierarchy among all three countries*. We find that in the case of China and Nigeria, both urban systems have begun to conform to a distribution similar to that which is predicted by Zipf's law, suggesting a more integrated city-size hierarchy. Meanwhile, in the case of India, the distribution has become more uneven over time. The results are compared to see if national urban systems exhibit tendencies towards spatial uniformity or spatial heterogeneity. Despite general uniformly valid urbanization processes, the findings of this paper suggest a certain degree of heterogeneity among national urban systems in the countries of interest; and in some instances contrasting patterns can be observed. We thus caution against a 'one size fits all' approach to interpreting the urban transition in developing countries.

The remainder of the paper is structured as follows. Section 2 provides an overview of the dominant theoretical literature. Section 3 presents the materials and methods employed in this paper. Section 4 summarizes the results. Section 5 discusses the implications in relation to policy before concluding.

2. Overview of the literature

The urban transition can broadly be divided between historical accounts in what are now considered today's developed countries, and contemporary accounts which are currently unfolding in developing countries. With nearly 90 percent of the impending urban population growth expected to occur in Asia and Africa alone (United Nations, 2014), it appears that the urban transition is being redefined by the contemporary conditions of developing countries. This is presenting new patterns of urbanization that no longer fit neatly into our classical conceptualizations. Consequently, there is a need to revisit many of the theories, models and principles that have become core to our understanding of urban transformation. While some of these assumptions may hold true in the contextual circumstances of both historical and contemporary urban narratives, others may not, and thus warrant a deeper discussion on the heterogeneity of urbanization experiences. Before doing so, however, this section provides a brief history of the urban transition and a review of the dominant ideas surrounding urban systems research.

2.1. A brief overview of the urban transition in developed and developing countries

According to Northam (1975), as a country develops it undergoes a spatial transformation, reorganizing the population. This can be seen in the three stages of the urbanization curve. During the initial stage, the majority of the population resides in rural areas practicing a predominantly subsistence lifestyle; this is followed by an accelerated stage involving the structural transformation of the economy and a shift towards urban areas; and finally a country enters into the terminal stage, in which the majority of the population is concentrated in densely populated cities (Mulligan, 2013). Throughout this process, a network of settlements begins to form and eventually evolves into a diversified and fluctuating urban system (Higano, Kourtit, & Nijkamp, 2013).

The factors that contribute to settlement formation include rural to urban migration, natural population increase and reclassification of rural areas as urban (Chen, Valente, & Zlotnik, 1998; United Nations, 2001). Research has shown that in industrial Europe cities could only grow so large, as poor living conditions and high rates of mortality placed a natural ceiling on them (Bairoch, 1988; Kasarda & Greshaw, 1991). According to Fox (2011), if it was not for the constant stream of migrants from rural areas, the growth of cities would not have sustained. However, due to technological advancements and increased access to medical services during recent times, life expectancy has improved dramatically, and cities are now growing primarily as a result of urban natural population increase; albeit migration has also remained high (Jedwab, Christiaensen & Gindelsky, 2014). This transformation has presented new patterns of urbanization; characterized by comparatively larger cities and the establishment of new settlement typologies. It is also worth noting that reclassification of rural areas as urban has also played a more prominent role in recent times

(Farrell, 2017). In some instances, governments have established new urban settlements to address spatial imbalances, while in others rural settlements have grown beyond specified population thresholds and have been upgraded to urban areas. Such dynamics have added to the complexity of national urban systems.

2.2. National urban systems

As early as the 19th century, scholars began studying the organization of the population and economy based on themes of specialization, hierarchy and location (Coffey, 1998). This led to various observations about the self-organization of cities and urban systems. In his thesis on the central place theory, Christaller (1933) posited that the number, size and location of cities within an urban system followed a logical pattern. Zipf (1949), in a similar manner, later observed what he dubbed ‘rank size regularities’, which were characterized by statistical relationships between the size and ordinal rank of cities. More recently, scholars have begun to examine the scaling properties of cities, observing that different parts of a system have different relative rates of growth (Bettencourt, Lobo, Helbing, Kuhnert, & West, 2007). Owing to the regularity of these patterns, such observations have been compared to physical laws of science. This has added a level of complexity to our understanding of cities and an overall shift in our thinking from viewing ‘cities as machines’ to viewing ‘cities as organisms’ (Batty, 2011). Although numerous laws of cities have been observed, the most basic laws of urban geography can be boiled down to: the *law of distance-decay*, the *rank-size law* and the *allometric scaling law* (Batty, 2011; Chen & Feng, 2017; Chen & Jiang, 2018).

2.2.1. Spatial distribution of cities

The core of urban systems research focuses on examining the spatial/territorial organization of the national economy and social and political systems (Bourne, 1998). Location becomes an important factor as it impacts a cities connection with other settlements and its general interaction with its surroundings (Graybill, Hays-Mitchell, Zeigler, & Brunn, 2016). One of the earliest attempts to explain the location of settlements was the work of Von Thunen. In *‘The Isolated State’* (1826), he theorized that an abundance of fertile land was a necessary prerequisite for a population to grow. From this, he formulated a model, in which a city was situated in an area with an abundance of land, comprised of a series of concentric zones serving the functions of dairy production, gardening, animal husbandry, forestry and crop yielding (Clark, 1967). Though this was far from a comprehensive understanding of complex urban systems, it offered important insights into the differentiation of land use and the costs of transport. Later, Alfred Weber, who built on early works of location theory, proposed an alternative theory based on a least cost theory of industrial location (McCann & Sheppard, 2003). In this model of cost minimization, industry would locate where transport costs were lowest (O’Sullivan, 2012); thus in the case of mining and forestry, it would be more beneficial to locate closer to the required resources.

Arguably the most advanced of these theories, however, was Christaller’s work on the central place theory. Christaller’s aim was to develop a theory for the size, number and distribution of settlements. In this model, cities were central places tasked with providing goods and services and thus needed to be located centrally among a network of bigger and smaller cities (Northam, 1975). Central to this idea was the concept of order. Higher order cities provided a greater amount of good and services and would thus be spaced further apart as they had larger catchment zones, while lower order cities would be closer together; depending on the complexity of the settlement system, they would be nested in patterns of three’s, four’s and seven’s (Northam, 1975). Ultimately a settlement pattern would emerge where larger higher order cities would be few, while smaller lower order cities would be many. Central to this theory is the law of distance-decay, which states that as the distance between two phenomena increase the interaction among them begins to decline; a concept that links geography with frequency of activity (Pun-Cheng, 2017). While larger cities will tend to have a higher frequency of activity and more specialized services and amenities, smaller settlements will have less activity and less specialization. This helps to explain the spatial arrangement and nesting structures of urban systems. Though, Christaller’s central place theory has provided one of the most comprehensive explanations for the spatial configuration of a system of cities, its applicability has been rather limited. According to El Shakhs (1972), this is because urban systems comprise a complexity of functions and networks; as we move beyond the market place model to more complex social and political models, such systems tend to become less regular. Additionally, Pacione (2009) has noted that the central place theory is primarily economic and takes no account of other factors such as history or the ability of government to influence investment decisions. Despite this, central place theory has provided a useful framework in which to understand the spatial distribution of cities.

2.2.2. Size distribution of cities

Arguably the most famous work on city size distribution was that of George Zipf, in which he empirically demonstrated that the population size of a city within any given system is an inverse function of its rank (Zipf, 1949). By this, he meant that the second largest city was half the size of the first, and the third largest city was one-third and so on. This has manifested itself empirically more than any other regularity, forming the basis of Zipf’s law. Mark Jefferson, in his empirical research in developing countries observed that the largest city in an urban system is disproportionately larger than the second city (Jefferson, 1939). He referred to this as urban primacy. According to El Shakhs (1972), these contrasting observations manifested themselves in the form of a dichotomy, in which balanced urban systems were associated with development, while unbalanced urban systems were associated with under-development. Empirically, however, this did not hold. Berry (1961), demonstrated that the hierarchy of cities in countries is not related to the economic development of a country, but instead reflects the culture and history of the country; with countries that have a longer history of urbanization reflecting a more integrated distribution of city sizes, while countries with shorter histories of urbanization reflect an uneven urban system.

Based on the idea of a progressive core and a lagging periphery, Lipton (1977), determined that large cities consumed a

disproportionate amount of resources and were thus parasitic to national economies. Governments around the developing world responded by implementing measures to restrict rural to urban migration to large cities; further exacerbating the problem of rural poverty (Bairoch, 1988). This led to a surge in research attempting to explain the causes and consequences of urban primacy. For example, Ades and Glaeser (1995) found that urban primacy was correlated with political instability and the centralization of power. Frick & Rodriguez-Pose (2017) noted that the relationship between large cities and productivity varied by size of country, and that it was the quality of infrastructure and the level of governance that allowed a country to benefit from agglomeration. While, Henderson (2003), proposed that there is a best degree of urbanization when it comes to productivity, but this varies by level of development and country size. A key conclusion stemming from this research stream was that the size of a city is a reflection of the quality of its institutions, and their ability to maximize economies of scale while minimizing urban diseconomies.

2.2.3. Growth and scaling of cities

As noted earlier, cities grow as a result of rural to urban migration, urban natural population increase and the reclassification of rural areas as urban. While Zipf (1949) made the claim that cities tend to grow proportionally, Gibrat (1931) observed that cities grow at varying rates and that there is no methodical behavior between growth rates and sizes. This raises questions as to whether or not there are underlying properties to city growth. According to Chadwick (1987), the size distribution of cities is evolutionary, correcting itself to allow for a structural hierarchy of functions, varying degrees of specialization and organization through the division of labour. More recent explanations, however, have attributed city growth to governance and institutions and their ability to maximize economies of scale, while mitigating against urban diseconomies (Frick & Rodriguez-Pose, 2017; Glaeser, 2011).

As of recently, scholars have directed attention towards the scaling properties of cities. Most popular is the research of Geoffrey West, Luis Bettencourt and their team who found that for every doubling of city size, they have observed a 15 percent increase in other characteristics such as productivity, innovation and even crime (Bettencourt, Lobo, Strumsky, & West, 2010). This rule also applies to other infrastructural and amenity needs in cities such as number of gas stations per population size (Arbesman, Kleinberg, & Strogatz, 2009). Such observations are based on the laws of allometry, a concept originally borrowed from the field of biology. Allometric growth suggests that different parts of a system will have different rates of growth; rather than increasing proportionally in a linear way (one to one), they scale at a super-linear rate (greater than one to one) (Bettencourt et al., 2007). This pattern can take the form of both positive allometry and negative allometry. For example, wages tend to grow at an increasing rate as population grows (positive), while physical infrastructure, such as roads, tends to grow at a decreasing rate (negative) (Batty, 2011). Allometric-scaling laws are thus linked with both urban economies and diseconomies. As cities continue to change in size, they will also continue to change in shape (Batty, 2011). Understanding the laws of allometry are necessary for ensuring cities are equipped with the infrastructure and amenities needed to enable them to function as drivers of productivity while also improving the quality of life for their inhabitants.

Although the aforementioned theories and laws have been criticized for their lack of applicability, they have been influential in terms of serving as a benchmark in which to examine the changing nature of urban systems and its deviations from the early theoretical models. They have also reinforced the idea that cities should not be viewed in isolation, but instead as part of complex urban systems connected by broad economic and social structures that continuously evolve (Friedmann, 1969; Pacione, 2009).

3. Materials and methods

The definition of urban areas varies considerably among countries. According to a survey by the United Nations (2014), common criteria include: population thresholds, densities, share of non-agricultural employment, presence of physical infrastructure and availability of education and health services as the most common criteria. In China an urban area is politically determined, with only those with local hukou status (excluding the migrant population) included in the definition (Qin & Zhang, 2014). In Nigeria, an urban area is based on demographic criteria, referring to any settlement with a population greater than 20,000 persons (World Bank, 2016). While in India, the definition is much more complex, comprising multiple criteria, which include a minimum population threshold of 5,000 persons, a density greater than 400 persons per square kilometer and more than 75 percent of the population engaged in non-agricultural employment (Census of India, 2011). Such diversity among definitions makes it difficult to compare the extent of urbanization across countries.

Fortunately, recent progress in remote sensing has made it easier to produce harmonized databases. The majority of these databases use Landsat Satellite Imagery to provide a measure of urban extent based on contiguous built-up area, overlaying population data. Examples of such databases include the *Atlas of Urban Expansion*, which uses data associated with enumeration zones for 200 cities globally; and, the *EuroStat database*, consisting of local administrative units in both rural and urban areas for all European countries. For the purpose of this study, however, this paper incorporates data provided by the *Géographie-cités Lab*, which have produced harmonized datasets for a number of countries, including Brazil, Russia, India, China and South Africa (BRICS countries); with an extension of this initiative conducted by the OECD, which includes all countries in West Africa (Africapolis Project) (OECD, 2018). Urban settlements in this context refer to settlements greater than 10,000 persons comprising functional urban areas (Pumain et al., 2015). Details regarding the *Géographie-cités* methodology have been documented extensively and can be found in Pumain et al. (2015) and Moriconi-Ebrard, Harre, and Heinrigs (2016). The specific datasets used for this study include: China (1982–2010), Nigeria, (1960–2010) and India (1961–2001).

As far as methods go, this paper has employed a number of quantitative techniques that are commonplace in the field of urban economics. The spatial Lorenz curve has been employed to examine the spatial distribution of cities in order to determine whether an urban system is becoming more concentrated or more dispersed over time (Lorenz, 1905; Song et al., 2010). Growth rates have been

computed to identify the rate of growth of city size classes. The rank size distribution is used to examine the size-hierarchy of cities (O'Sullivan, 2012; Rose, 2006). The results are then compared to see if uniform patterns can be observed among the national urban systems in the countries of interest.

4. Results: the evolution of national urban systems

Building on these earlier accounts, this section examines the spatial Lorenz curve, the rate of growth of city size classes and the rank size distribution to see how the urban transition in China, Nigeria and India has transformed over time. The results are then compared in the discussion section to see if national urban systems exhibit tendencies towards spatial uniformity or spatial heterogeneity.

4.1. Spatial hierarchy of cities – China, Nigeria and India

The spatial Lorenz curve (Lorenz, 1905), which reflects the cumulative proportion of cities ranked in order from highest to lowest against the cumulative proportion of states/provinces in a country, can be used to analyze the spatial distribution of cities within an urban system. The closer the Lorenz curve is to the 'line of uniformity', which depicts an equal amount of cities spread across all states/provinces, the more spatially balanced the urban system. When plotted sequentially across different time periods, the spatial Lorenz curve depicts whether an urban system is showing a greater tendency towards concentration or dispersion. The spatial Lorenz curve can also be reflected as a Gini coefficient, with an estimate of 0 representing perfect spatial equality and an estimate of 1 reflecting the highest degree of spatial inequality. It should be noted, given that Nigeria and India underwent periods of state restructuring, the calculation for the spatial Lorenz curve is based on the boundaries that exist in the most recent time period.

By analyzing the spatial distribution of cities over time, we gain a deeper understanding as to how the urban transition has unfolded; and whether or not it has led to a more geographically balanced urban system or one that has become more concentrated. Fig. 1 illustrates the spatial Lorenz curve for China, Nigeria and India, while Table 1 provides a spatial Gini coefficient for each country. In the case of China, the spatial Lorenz curve has shifted further away from the line of uniformity, registering a spatial Gini coefficient of 0.39 in 1982 and 0.42 in 2010. This indicates that the distribution of cities among provinces has become more uneven over time. The degree of change, however, is rather inconsequential. This contrasts to the experience of Nigeria, in which the spatial Lorenz curve appears to have approached the line of uniformity, demonstrating a shift in the spatial Gini coefficient from 0.39 in 1960 to 0.26 in 2010. This indicates that the spatial configuration of cities has become more evenly distributed over time. As for India, the spatial distribution of cities has gone relatively unchanged, as indicated by a spatial Gini coefficient of 0.67 in both 1960 and 2000. Unfortunately, in the case of India no data exists for 2010. While China and Nigeria have somewhat of an evenly distributed system of cities, India's urban system appears considerably more uneven.

4.2. Rate of growth by city size class – China, Nigeria and India

In this subsection, we assess the overall structure of the national urban system by examining the distribution of cities among size classes and computing their average annual growth rates. Organizing the cities by size class provides an opportunity to identify which size classes dominate the urban system and how this distribution has changed over time. As previously noted, cities serve a variety of functions and specializations, and therefore a natural size hierarchy evolves over time. As the theory suggests, one would expect to see a large number of smaller towns, a moderate number of intermediate cities and few large and mega cities (Christaller, 1933; Zipf, 1949). When it comes to the fastest growing cities, however, the theory is mixed. While early studies of developing countries have suggested that it is the large cities that tend to grow the fastest (Friedmann, 1969), more recent accounts have observed that the fastest growing cities are those with a small population base, and as the scale increases growth rates begin to decline (Cohen, 2006).

Fig. 2 depicts the proportion of total cities comprising each size class for China, Nigeria and India over the course of several periods. In the case of China, it appears that towns between 20 and 50 thousand inhabitants have dominated the size hierarchy during all four periods. However, in the most recent period between 2000 and 2010, the size category that saw the greatest increase was small towns of 10–20 thousand inhabitants, which grew by 12 percent; while all other categories either decreased or stayed the same. According to Table 2, which depicts the average annual growth rate for settlements in each size category during the most recent decade, it was megacities greater than 10 million that grew fastest in China; averaging a growth rate of 6.3 percent annually. As for Nigeria, small towns between 10 and 20 thousand inhabitants have comprised the largest size class across all six periods. Although, between 2000 and 2010, the proportion of small towns between 10 and 20 thousand shrunk by 4 percent, while the proportion of towns and small cities of 20–50 thousand and 50–100 thousand experienced a slight increase. All other city size classes, more or less, remained unchanged. Large cities between 1 and 5 million inhabitants in Nigeria grew at an impressive 13.7 percent during the most recent decade. Since there are very few large cities, however, such findings need to be interpreted with caution. Like Nigeria, in India the city size category that dominated across all four periods was small towns with 10–20 thousand inhabitants. Uniquely, the proportion of settlements featured in each size class, appears to have gone unchanged across all four time periods, indicating that city size classes grew relative to each other. Registering an average annual growth rate of 3 percent between 1990 and 2000, intermediate cities with 500 thousand to 1 million inhabitants grew the fastest.

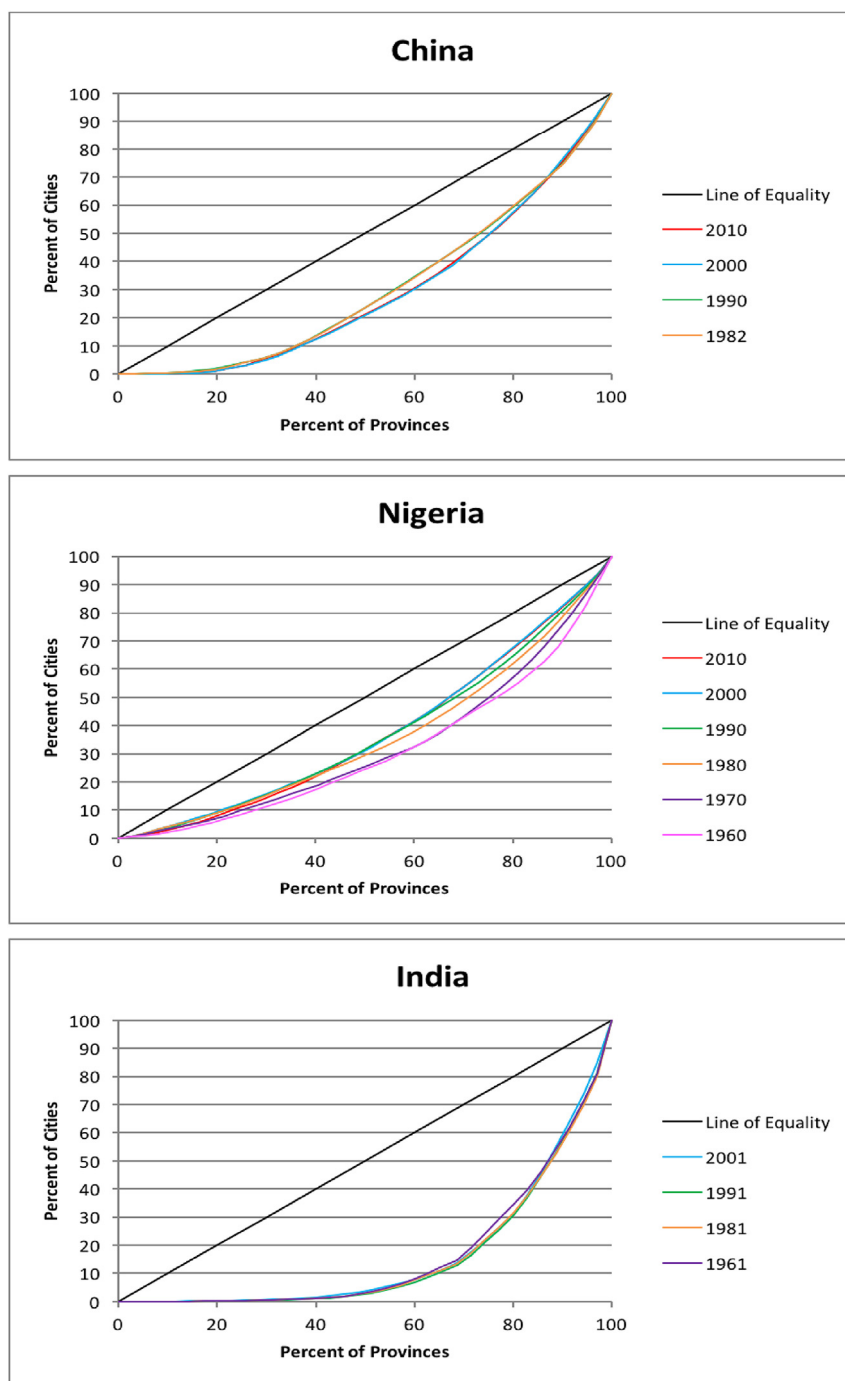


Fig. 1. Spatial Lorenz Curve for China, Nigeria and India for various years. *Source.* Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#).

4.3. Size hierarchy of cities – China, Nigeria and India

A convenient diagnostic for analyzing the composition of cities by size is the rank size distribution, which posits that an order of cities exists within an urban system, in which the second largest city is half the size of the first city, the third largest is one-third the size and so on (O'Sullivan, 2012). The order is found by plotting the log value of the city rank and the log value of city population within a given urban system, ultimately revealing a size hierarchy of cities (Decker, Kerkhoff, & Moses, 2007). According to Zipf's Law, a negatively sloping distribution with a coefficient of -1 , reflects a perfectly even hierarchy. Although none of the previous

Table 1
Spatial Gini coefficient.

Decade	China	Nigeria	India
1960	–	0.39	0.67
1970	–	0.35	–
1980	0.39	0.29	0.69
1990	0.39	0.26	0.69
2000	0.42	0.25	0.67
2010	0.42	0.26	–

Source. Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#). Authors calculations.

studies have proven that a distribution must follow the rank-size rule, when plotted over time it avails an opportunity to inspect the changing structure of the city-size hierarchy ([Song & Zhang, 2002](#)).

[Fig. 3](#) plots the rank size distribution for China, Nigeria and India over consecutive periods. This avails an opportunity to examine how their city-size hierarchies have evolved. The most obvious observation is that the distribution in all three diagrams has increased in length and shifted in an upward direction over time. This illustrates that the national urban systems in all three countries have grown in both the number of cities that comprise them and the overall population size of the cities. For China and Nigeria, the most recent time periods resemble a straighter distribution than earlier accounts, suggesting that a more integrated hierarchy of cities has formed. This is confirmed by their coefficients in [Table 3](#), which in the case of China has increased from -0.76 in 1980 to -1.04 in 2010 and in the case of Nigeria has decreased from -1.20 in 1960 to -1.03 in 2010. Both urban systems have begun to conform to a distribution similar to that which is predicted by Zipf's law. This suggests a more integrated city-size hierarchy. In the case of India, however, the distribution appears to have become more uneven over time; this can be seen in the step-like pattern among the larger cities during the most recent time period. It is also confirmed by the coefficient in [Table 3](#), which has experienced an increase from -1.19 in 1961 to -1.24 in 2001, suggesting a more uneven urban hierarchy.

A similar trend can be observed in the urban primacy index. An urban primacy score is calculated by dividing the population of the largest city by the second largest city. [Table 4](#) provides a summary of the urban primacy scores for China, Nigeria and India. In the case of China, the urban primacy score has decreased from 1.23 in 1980 to 1.06 in 2010. In the case of Nigeria, it increased from 1.56 in 1960, reaching a peak of 3.53 in 2000, followed by a drastic decline to 1.69 in 2010. However, in the case of India, the urban primacy score experienced an immediate decrease from 1.15 in 1960 to 1.08 in 1980, followed by a sharp increase to a high of 1.21 in 2010. It should be noted, however, when likened to other developing countries, these urban primacy scores are comparatively low. According to a study of African countries conducted by [Moriconi-Ebrard et al. \(2016\)](#), Liberia, which is Western Africa's most primate urban system, registered an urban primacy score of 25.7 in 2010. Though, Liberia is substantially smaller than the countries being examined in this study.

5. Discussion

This paper set out to examine how national urban systems have evolved under conditions of rapid urbanization. In doing so, it examined *the spatial distribution of cities*, *the rate of growth by city size class* and *the size hierarchy of cities*. Despite general uniformly valid urbanization processes, the results of this paper suggest a certain degree of heterogeneity among national urban systems in China, Nigeria and India. These dynamics will now be compared and discussed against the backdrop of the contextual circumstances of the urban transition unfolding in the countries of inquiry.

Based on the analysis performed above, China's national urban system appears particularly robust; both the spatial distribution (spatial Lorenz curve) and the size hierarchy of cities (rank size distribution) reflect a seemingly balanced urban system. In terms of the trajectory, however, China is displaying tendencies towards an increasingly imbalanced spatial distribution as can be seen in the directional nature of the spatial Lorenz curve (drifting away from the line of uniformity); though the extent of this appears to be rather limited. While the origin of China's national urban system is likely a reflection of the geography of the country, the contemporary configuration ultimately needs to be understood against the backdrop of both centralized state-led processes and the rise of a market economy. According to the data, China has gone from a system of 856 settlements over 10,000 inhabitants in 1980 to 9,487 in 2010. Since opening-up reforms in 1978, the drastic restructuring of China's urban system can be attributed to three key spatial policies: *city administering county*, *converting county to city* and *large cities annexing surrounding counties as districts* ([Ma, 2005](#)). Another influential driver underpinning China's spatial restructuring is the role of *special economic zones*, which have further concentrated urban development along the eastern and southern coastal areas ([Friedmann, 2005](#)). Though such efforts have led to a reduction in regional disparities, regional inequalities between the interior and the coast continue to persist ([Li & Haynes, 2011](#)). When it comes to the size hierarchy of cities, China appears to have become more integrated over time, conforming to a pattern similar to that which is predicted by Zipf's law. Despite China's urban system being dominated by smaller settlements (towns of 20–50 thousand), the distribution across size categories appears to be somewhat balanced; this can be seen in a comparatively higher proportion of medium and intermediate sized cities. While China has attempted to regulate the size of its cities through policies “to strictly control the growth of the large cities, to rationally develop the medium-size cities, and to vigorously promote the growth of the small cities and towns” (Renmin Ribao, 16 October 1986 in [Ma & Lin, 1993](#), 583), the intended outcomes have not always been achieved.

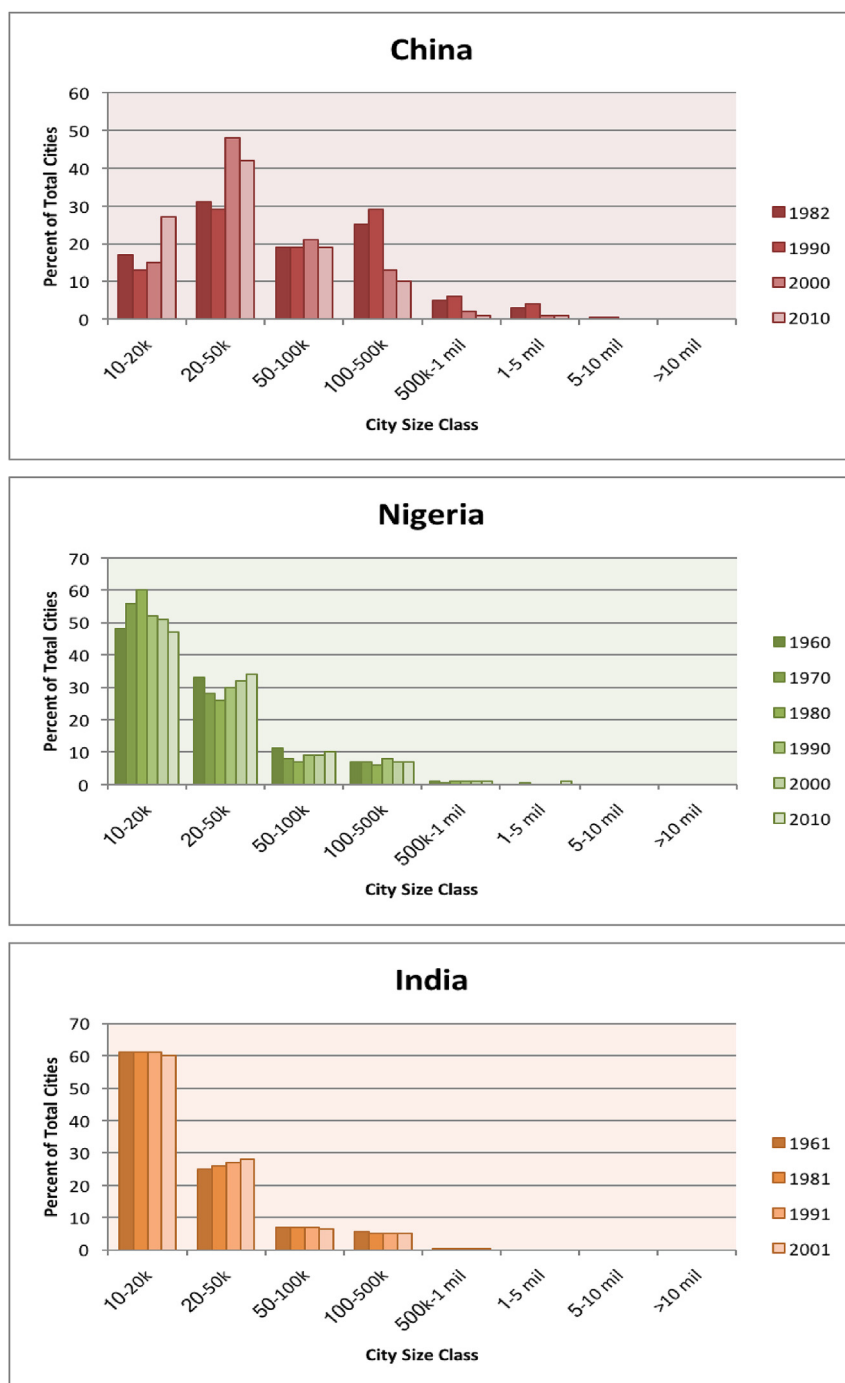


Fig. 2. City Size Classes for China, Nigeria and India for various years. *Source.* Data for China and India is from the *Géographie-cités Lab* (2018) and data for Nigeria is from *OECD* (2018).

This can be seen in the fact that megacities are China's fastest growing size category, growing at a rate of 6.3 percent. Much of this can likely be explained by the increasing presence of market forces, attracting rural migrants to the cities with the most employment opportunities (Pannell, 2002). Despite this, however, China is far from displaying tendencies towards urban primacy. Though the Chinese government has taken a concerted effort towards managing the evolution of its urban systems through national spatial policies, it is evident that market mechanisms have also left their mark on the overall distribution of the population.

Similar to that of China, both the spatial distribution and the size hierarchy of cities in Nigeria reflect a rather balanced urban system. Between 1960 and 2010, Nigeria's urban system expanded from 209 settlements with a population greater than 10,000

Table 2

Average annual growth rates by city size class, 2000–2010

	City Size Class							
	10-20k	20-50k	50-100k	100-500k	500k-1 mil	1-5 mil	5-10 mil	> 10 mil
China	3.3%	1.7%	1.2%	1.9%	3.8%	4.0%	4.0%	6.3%
Nigeria	3.9%	3.8%	3.2%	5.1%	2.8%	13.7%	4.8%	0%
India	1.8%	1.9%	2.2%	2.5%	3.0%	1.9%	1.9%	0%

Source. Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#). Notes. Data for India refers to 1990–2000. Authors calculations.

inhabitants to 1,020. Part of this can potentially be explained by a dramatic period of political restructuring (1967–1996), in which Nigeria transformed from a country of 4 geographic regions to one of 36 states and 1 federal capital territory ([Adetoye, 2016](#); [Moriconi-Ebrard et al., 2016](#)). Furthermore, high population growth rates have also contributed to this expansion, by pushing many of Nigeria's rural settlements beyond specified population thresholds, which are then reclassified as urban areas ([Farrell, 2018](#)). This potentially explains why towns between 10 and 50 thousand have come to dominate Nigeria's settlement hierarchy. However, due to Nigeria's rather tumultuous economy and heavy reliance on oil exports ([World Bank, 2016](#)), such political restructuring and its demographic dividend have done little to stimulate economic growth throughout the country; subsequently regional disparities have persisted. The fastest growing city size category on the other hand appears to be that of large cities, growing at an impressive 13.7 percent. While rural to urban migration in the form of a growing service industry helps to explain some of the growth of large cities (urban pull dynamics), rising unemployment and conflict in certain regions of the country should not be discounted (rural push dynamics) ([Ogun, 2010](#); [The Economist, 2015](#); [World Bank, 2016](#)). Despite African cities being characterized by a high concentration of population and investment in the nation's largest cities, ([Moriconi-Ebrard et al., 2016](#)), like China, urban primacy does not appear to be a major concern in Nigeria. Though the evolution of Nigeria's settlement hierarchy appears to have shifted towards a more spatially balanced urban system, regional disparities continue to persist and thus one must be careful when drawing conclusions.

When it comes to India's national urban system, the number of settlements over 10,000 inhabitants expanded from 2,675 in 1960 to 7,779 by 2000. Both the spatial hierarchy of cities and the size hierarchy of cities, however, reflect a comparatively imbalanced urban system. This can be seen in the distance between the spatial Lorenz curve and the line of uniformity and the step-like nature among the larger cities in the rank size distribution. While spatial imbalances have long been a concern in India, they are thought to be an artefact of ideological divides concerning a preference for urban and rural lifestyles and clashes between economic and urban decentralization ([Gnaneshwar, 1995](#)). Furthermore, while India has been late to the game when it comes to industrialization, its economic development has not benefitted from the labour intensive gains often sought after by industrializing countries; instead its growth has been concentrated in more capital intensive sectors such as chemicals and pharmaceuticals ([Nijman, 2012](#)). This has done little to attract migrants from the agricultural sector, which as of 2010 still accounted for more than 50 percent of employment opportunities ([World Bank, 2017](#)). Furthermore, while would-be migrants remain in the agricultural sector, rural settlements continue to cross specified population thresholds and are eventually reclassified as urban areas. This likely explains why India's urban system is dominated by smaller settlement sizes. India's fastest growing settlement type, on the other hand, seems to be intermediate sized cities. While this appears to be unusual when compared to China and Nigeria, the use of intermediate cities to promote spatial development and encourage regional integration has been a popular strategy among governments in India ([United Nations, 2008](#)). The results, however, have not been so convincing, as can be seen by the comparatively slower growth rates; averaging 3 percent per annum. Similar to the other two countries, India shows no distinct signs of urban primacy.

What is most noticeable from this analysis is that both China and Nigeria have experienced a high degree of change among all of the indicators over the specified time periods; however, in terms of the trajectory of the spatial distribution, these accounts show contrasting patterns, as can be seen in the directional nature of the spatial Lorenz curve. While Nigeria appears to reflect a continued tendency towards a more balanced distribution of cities over time, China appears to be shifting further away. In the case of India, on the other hand, despite having added a significant number of new settlements to its urban system, both the spatial distribution and the size hierarchy of cities have gone relatively unchanged. With macro-level trends seemingly affecting countries in a similar manner, such differences are likely a reflection of the unique economic and political circumstances of each country. China and Nigeria have actively undergone multiple stages of spatial and political restructuring at the national scale. India's experiences, on the other hand, are often described as being unconscious, partial and uncoordinated ([Gnaneshwar, 1995](#)).

This paper follows a number of studies before it, seeking to understand the general applicability of well-known theories and laws pertaining to urban systems (see [Chauvin, Glaeser, Ma, & Tobio, 2017](#); [Pumain et al., 2015](#)). It reveals that despite providing useful modes of analysis, the relevance of general theoretical frameworks (such as central place theory and the rank size rule) is not sufficient to explain the country specific urbanization phenomena in today's developing countries. This can be seen in the variance among urbanization experiences in the case studies highlighted above; some of which have adhered to the theories and laws outlined in this paper, while others have deviated. The findings of this paper are consistent with [Chauvin et al. \(2017\)](#), which also found varying results when testing for a number of well-known facts about urbanization in Brazil, China, India and the United States. Consequently, more attention needs to be directed toward the spatial drivers of demography, the impact of different forms of industrialization, the implications of different mobility motives (economic, social and cultural), and the institutional ramifications of spatial planning and policy. It seems that a more micro-based orientation is essential for achieving a mature understanding of the

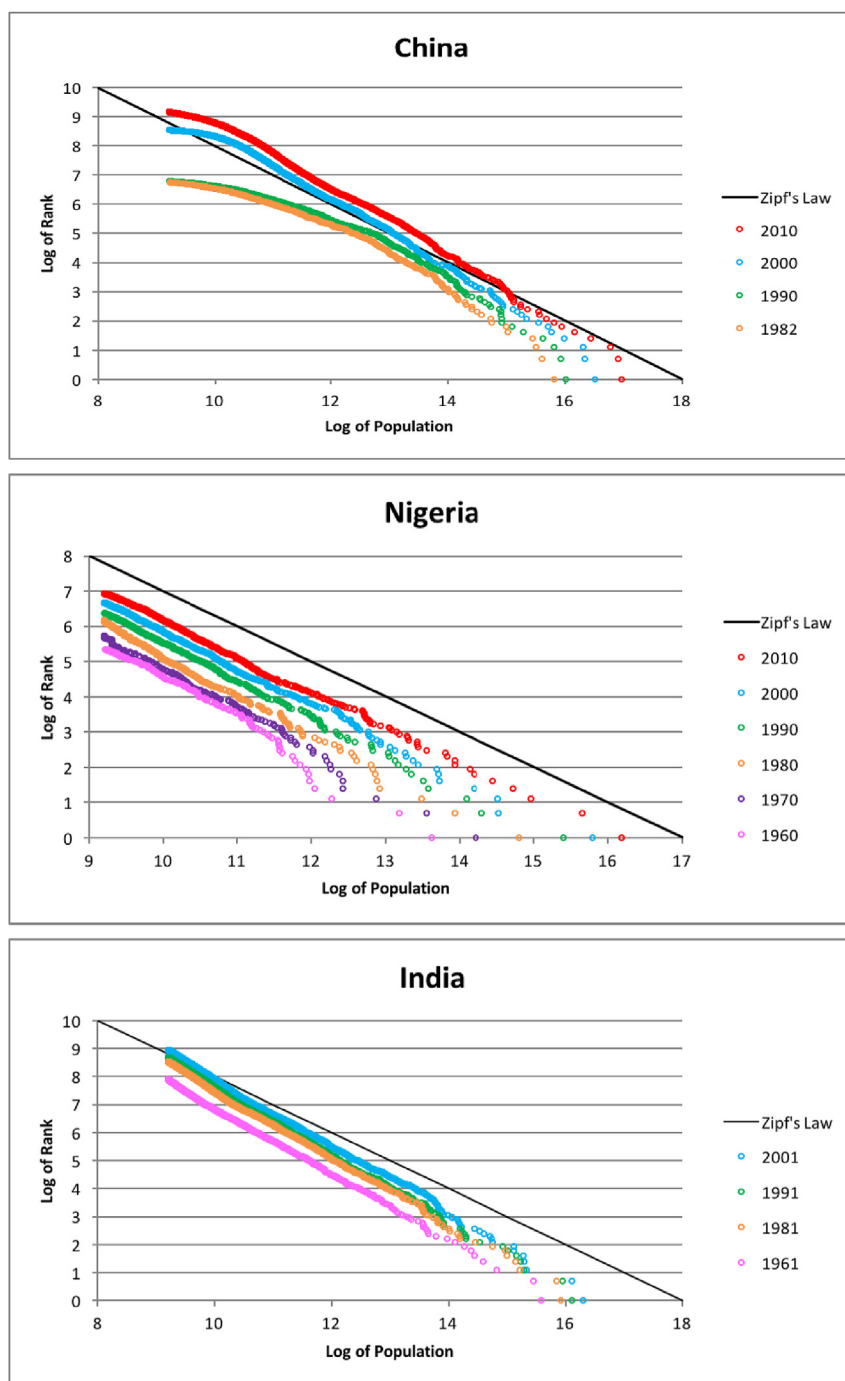


Fig. 3. Rank Size Distribution, China, Nigeria and India for various years. *Source.* Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#).

diversity among emerging urbanization phenomena.

This analysis has concentrated on examining the spatial arrangement of settlements at the scale of the national urban system. Unfortunately, due to data constraints the timespan varies by country, limiting comparability among the case studies in question. Furthermore, limited space has prevented us from discussing important matters such as what this means for the changing urban-rural dichotomy or economic imbalances that exist within a country. It is hoped that future research agendas will unite these pertinent issues, identifying new modes of analysis and sources of data to go beyond our current comprehension of the spacio-economic dimensions of the urban transition in developing countries.

Table 3
Rank size distribution coefficients.

Decade	China	Nigeria	India
1960	–	– 1.20	– 1.19
1970	–	– 1.14	–
1980	– 0.76	– 1.16	– 1.24
1990	– 0.73	– 1.08	– 1.26
2000	– 1.06	– 1.06	– 1.24
2010	– 1.04	– 1.03	–

Source. Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#). Authors calculations.

Table 4
Urban primacy score.

Decade	China	Nigeria	India
1960	–	1.56	1.15
1970	–	1.94	–
1980	1.23	2.41	1.08
1990	1.09	3.00	1.18
2000	1.19	3.53	1.21
2010	1.06	1.69	–

Source. Data for China and India is from the [Géographie-cités Lab \(2018\)](#) and data for Nigeria is from [OECD \(2018\)](#). Authors calculations.

6. Conclusion

It is fairly evident that settlement patterns in today's developing countries represent a radical break from historical accounts. Not only are cities growing larger all the time, but also the number of cities that comprise an urban system is also rapidly increasing. The intriguing question, however, was whether or not emerging urbanization patterns in today's developing countries, many of which are subject to analogous forces, exhibit tendencies towards spatial uniformity or spatial heterogeneity. To answer this question, we have made a comparative study of national urban systems over several decades in three different countries: China, Nigeria and India. Using various statistical indicators we have come to the conclusion that, despite general uniformly valid urbanization processes, the actual heterogeneity among national urban systems in the countries of inquiry is rather high, and in some instances contrasting patterns can be observed. A closer look at the historical evolution of city formation and distribution in China, Nigeria and India shows a high degree of dissimilarity. Given that macro-level trends have seemingly affected countries in a similar way, such differences are likely a reflection of historical context, country specific urbanization policies and decision making structures.

Due to the lack of emphasis regarding important aspects of urban transformation, such as history, culture and politics, the explanatory power of prominent urban systems theories has remained limited. This is especially the case in the context of developing countries where the complexity of such aspects is more widespread. Despite this, however, such modes of analysis have served as useful benchmarks for examining the changing nature of urban systems as a whole. Furthermore, they have proved to be influential in terms of highlighting the importance of viewing settlements as integrated systems and not in isolation.

Declaration of interest

No potential conflict of interest was reported by the authors.

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