

# The South African functional metropolis – A synthesis

Herman Geyer, Philip Geyer & Manie Geyer

Peer reviewed and revised

## Abstract

Confusing usage of terms such as *metropolis* and *metropolitan region* in planning policy in South Africa has led to the need for a fundamental investigation into the morphological and functional properties of the country's three largest cities. Using Gauteng, Cape Town and Durban as examples, the article distinguishes between different elements of functionality of metropolitan areas linking *urban function* to *urban form*. Starting at the global level and zooming in, the article examines metropolitan functional space at the national through the regional to the local level. Semantically, it distinguishes between the terms *metropolis* and *megalopolis*; *daily* and *weekly urban systems*; and between urban *monocentricism*, *multinodality* and *polycentricism*. Based on morphological differences, it classifies Cape Town, Durban, Pretoria and the Witwatersrand as metropolitan areas, but regards the sprawled urban agglomeration in Gauteng as a megalopolis. A case is also made for greater recognition of the daily urban regions of the three primary cities of South Africa as part of the larger urban system of each. Planning has focused for too long on metropolitan space inside the urban edge and too little on those parts of the cities that lie outside the edge.

**Keywords:** Urban system, polycentrism, multimodality, urban function

## DIE SUID-AFRIKAANSE FUNKSIONELE METROPOOL - 'n SINTESE

Die verwarrende gebruik van terme soos *metropool* en die *metropolitaanse streek* in beplanningsbeleid in Suid-Afrika lei tot 'n behoefte aan 'n fundamentele ondersoek na die morfologiese en funksionele eienskappe van die land se drie grootste stede. Deur gebruik te maak van Gauteng, Kaapstad en Durban as voorbeelde tref die artikel 'n onderskeid tussen verskillende funksionele elemente van metropolitaanse gebiede waarin stedelike funksie en stedelike vorm verbind word. Beginende by die globale vlak en deur in te fokus op die nasionale, streek- en plaaslike vlak word daar in die artikel gekyk na metropolitaanse funksionele ruimte. 'n Semantiese onderskeid word getref tussen die terme *metropool* en *megalopool*; *daaglikse* en *weeklikse stedelike sisteme*, en tussen *monosentrisme*, *multinodaliteit* en *polisentrisme*. Gebaseer op morfologiese verskille word Kaapstad, Durban, Pretoria en die Witwatersrand as metropolitaanse gebiede geklassifiseer, maar word die verspreide stedelike kompleks van Gauteng as 'n megalopolis beskou. 'n Saak word ook uitgemaak vir groter erkenning vir die daaglikse stedelike streke van die drie primêre stede van Suid-Afrika as deel van die groter stedelike sisteem van elk. Vir te lank het die klem in beplanning op metropolitaanse ruimte binne die stedelike grens geval en te min op die deel van die stede wat daarbuite val.

**Sleutelwoorde:** Stedelike sisteem, polisentrisme, multimodaliteit, stedelike funksie

## 1. INTRODUCTION

Terms that are used to describe different forms of *urban settlements* have always been somewhat confusing. Terms such as *village*, *town*, *city* and *metropolis* are usually defined in terms of population size, areal extent, or density (Parr, 2012). Other researchers such as Parr (2007) use spatial relationships to define different parts of cities, while terms such as *urban agglomeration*, *conurbation*, *city region* and *megacity* define settlements by means of the structure of aggregation. Then there are terms defining urban settlements as subsets of greater urban settlements such as *central business district*, *inner-city*, *suburbs*, *core nucleus*, *core city*, and *edge city*, while terms such as *multinodal city*, *metropolitan region*, *polycentric city*, *megalopolis*, *ecumenopolis* and *micropolis* are overarching concepts referring to the form and functioning of the urban settlement.

To some degree, each person has a personal interpretation of the meaning of the terms, because the distinctions between these terms are not always clear or clearly understood. However, using the same term interchangeably in policy documents is not only confusing, but could also be counterproductive. This particularly applies to the South African situation where there is an apparent confusion about the usage of the terms *metropolitan area* and *metropolitan region* in current urban policy documents. In some instances, the term *metropolitan area* is used, whereas the particular evolving urban pattern being described no longer resembles the generally accepted definition or description of that particular urban form while the term

Mr Herman Geyer, Centre for Regional and Urban Innovation and Statistical Exploration (CRUISE), Department of Geography and Environmental Studies, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa. 021 808 3104, email: <hsgeyerjr@sun.ac.za>

Mr Philip Geyer, Centre for Regional and Urban Innovation and Statistical Exploration (CRUISE), Department of Geography and Environmental Studies, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa. 021 808 3104, email: <19699026@sun.ac.za>

Prof. Manie Geyer, (i) Centre for Regional and Urban Innovation and Statistical Exploration (CRUISE), Department of Geography and Environmental Studies, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa. 021 808 9223, email: <hsgeyer@sun.ac.za> (ii) Unit for Environmental Sciences and Management, North-West University, Private Bag X6001, Potchefstroom, 2520, South Africa.

*metropolitan region* is used when it clearly means different things in different policy documents and in different policy contexts.

The purpose of this article is to clarify some of this confusion by first discussing different elements of functional metropolitan space. Johannesburg, Cape Town and Durban – three primary cities in South Africa – will be used as illustrations. In pursuing greater clarity in the usage of terms such as *metropolitan area* and *metropolitan region*, they will be linked to concepts such as the *urban edge*, *megalopolis*, *polycentricism* and *daily and weekly urban systems*.

To deal with these terms in an orderly fashion, the role of the three metropolitan cities within the global context will be investigated, whereafter the article zooms in downwards through the national and regional contexts to the local and intra-city contexts. It is hoped that the introduction of these concepts will broaden and enrich the current South African planning policy lexicon.

## 2. METROPOLITAN FUNCTIONAL SPACE – THE SUPRANATIONAL CONTEXT

Although all urban settlements form part of the global urban network, only those at the upper end of the global urban hierarchy play a visibly meaningful role at that level. World city network research gained prominence and popularity with the establishment of the Globalisation and World Cities Research Network at the turn of the previous millennium. Studies in this research network differ on the selection of upper tier world cities, but most include Johannesburg and Cape Town (and some also Durban) as lower order world cities (Beaverstock, Smith & Taylor, 1999; Taylor, 1997, 2000, 2001). Subsequent studies have confirmed this (Geyer Jr., Geyer & Du Plessis, 2015; Onyebueke, 2011; Van der Merwe, 2004).

Work in this field has demonstrated that cities are not only integrated with local, regional or national urban networks, but that functionally they also form part of the wider global

network of cities. Due to faster access to information and easier flows of goods and services in recent decades, it is not only easier for cities to engage a wider selection of cities in the global urban network than in the past, but they are similarly more readily impacted upon by the wider urban system (Castells, 1996; Graham, 1998, 1999; Sassen, 2001; Geyer, 2007). Terms such as urban networks, systems, grids, hierarchies, webs, actors and relations, all point to the functional interconnectedness and interdependence of cities globally.

However, as Ottaviano & Thisse (2004) convincingly argue, despite the freer flow of information, economic space still tends to be linear rather than expansive – spatially focused on arcs and propagated along vertices. Despite the freer flow of information and goods and services, the location of a city relative to other prominent cities in the global hierarchy is a critical factor in the performance of the city. The degree to which cities are integrated with the global economy depends on factors such as their locations relative to high concentrations of economically advanced and innovative populations and the degree to which they integrate with the information and business-networking highways of the world, as indicated in Figure 1. City size, economic vibrancy and its location relative to other economically vibrant cities in the wider global urban network hold distinct advantages for cities. *Ceteris paribus*, those that are located in areas where high concentrations occur (see Figure 1A, B and C) are potentially in a better position to benefit from regional economic spillovers than those that are located in the global periphery.

Prominent world cities, therefore, potentially benefit from close proximity to other large vibrant cities in the global urban network. In the global economic landscape, imagined topographically, a city such as New York would be a global economic Mount Everest surrounded by other globally ranking economic peaks in the economic Himalayan range of the Eastern Seaboard agglomeration, whereas, by comparison, prominent

cities in Africa usually represent lone standing Kilimanjaros in an otherwise African economic and innovation flatland (Van der Merwe, 2004; Onyebueke, 2011; Geyer, Geyer Jr. & Du Plessis, 2012; Geyer Jr. *et al.* 2015). Historically, world city research bears this out (Taylor, 1997, 2009).

To some extent, Johannesburg is a contradiction in the African continent. It forms the centre of a network of metropolitan areas – Pretoria, Cape Town and Durban. Functionally, this intertwined network of metropolitan cities undergirds Johannesburg and provides momentum as a lower order world city in the global city network. Without this extended network of cities, it is arguable that Johannesburg – far removed from the business highways of the world (Figure 1) – would not have qualified as highly as a world city as it presently does.

## 3. METROPOLITAN FUNCTIONAL SPACE – THE NATIONAL CONTEXT

Although the concept of a city region is often applied in South African policy documents, there is no universal method to determine what a city region is or is not. The Gauteng Growth Management Perspective (GGMP, 2014) describes the *Gauteng city-region* as one that incorporates the ‘three large metropolitan municipalities’ and a range of smaller centres ‘spread across the province and beyond the provincial borders’. The National Development Plan simply mentions Gauteng city region, without providing any specific information on what it is or how it is determined (NDP2030, 2011). Gauteng 2055, a discussion document on the long-term development plan for the Gauteng city-region, calls the broader Gauteng city-region a continuous urban region surrounded by the wider urban region stretching over a distance of one hundred and fifty kilometres. The Gauteng Spatial Development Framework of 2011 (GSDF) identifies the city region as several fast-growing areas linked by development corridors within the metropolitan built-up area in Gauteng. Similarly, the Draft Western Cape

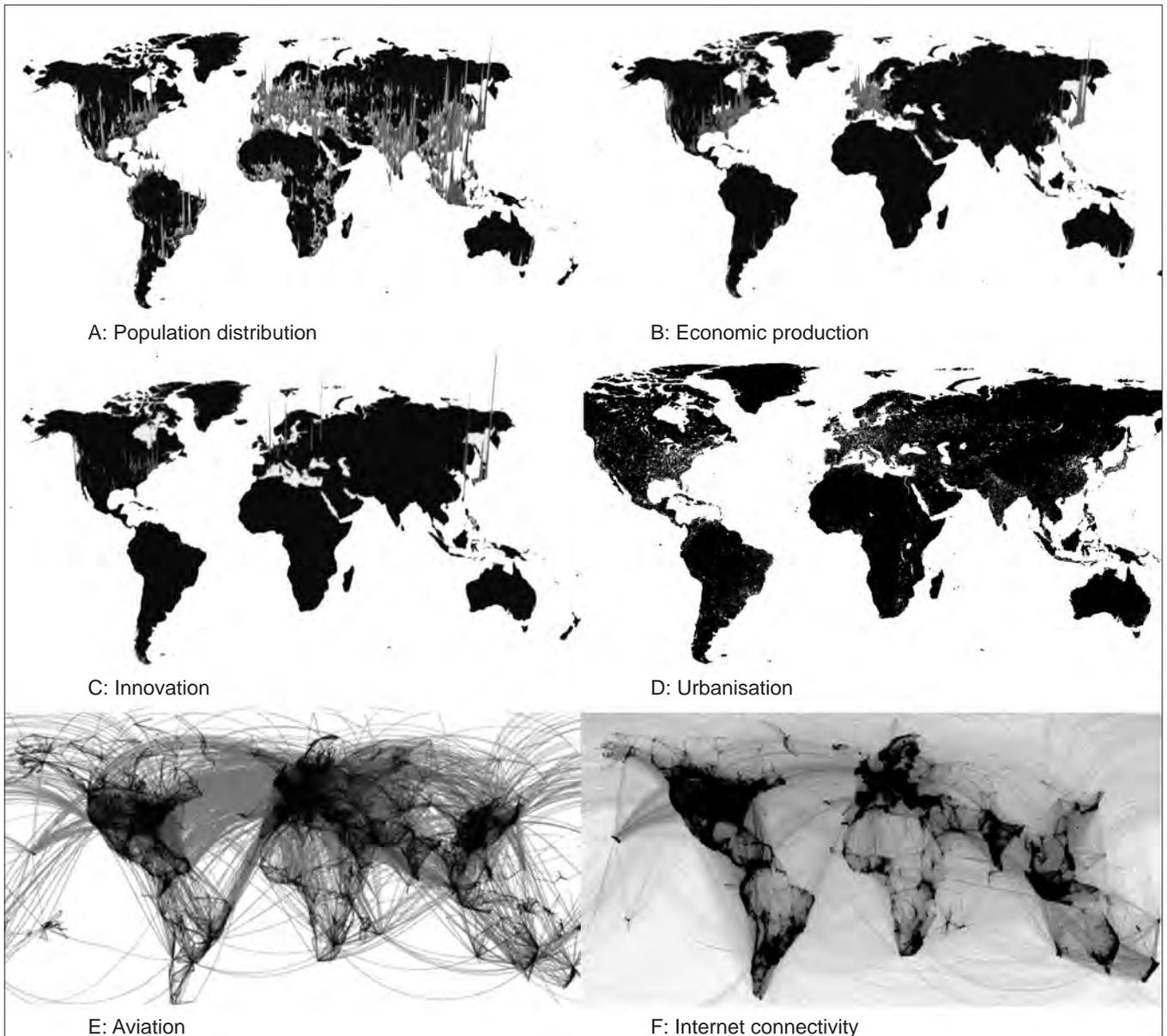


Figure 1: Interrelated factors leading to the information, financial and business

Source A, B, C: Florida, 2005

Provincial Spatial Development Framework (WCPSDF, 2013) identifies the city-region as a group of integrated functional regions.

However, South African city-regions have recently been linked to the *daily urban system* concept (Geyer Jr. & Geyer, 2015a). The term *daily urban system* was coined by Doxiadis (1968) more than four decades ago and has remained widely used ever since (Berry, 1972, 1973; Bourne & Simmons, 1978; Coombes, Dixon, Goddard, Openshaw, & Taylor, 1979; Hall & Hay, 1980; Clay, 1998; Bretagnolle, Paulus & Pumain, 2001; Pumain, 2002, 2004; Van Nuffel & Saey, 2005; Erlebach, Klapka, Halás

& Tonev, 2014; Kraft, 2014). It relates to Friedmann & Miller's (1965) *urban field* (see also Friedmann, 1978), Fox & Kumar's (1965) *functional economic areas*, Berry, Goheen & Goldstein's (1969) *daily movement systems*, and Antikainen's (2005) *functional urban areas*. A limit of one hour has remained a fairly constant daily commuting distance in different settings over the years (Newman, 2004; Marchetti, 1994; Fox & Kumar, 1965).

Closely associated with the daily urban system is the concept of the *weekly urban system* (Hall & Hay, 1980) – an area containing regional centres that are within a weekly commuting distance from large urban

centres. Regional centres serve as daily commuting centres in the extra-metropolitan hinterland, but are dependent upon economic spillovers provided by the large urban centres.

To distinguish between the different metropolitan regions in the provincial spatial development frameworks and the provincial growth and development strategies of Gauteng, Cape Town and Ethekeeni, a distinction has been made between what are termed the daily and weekly metropolitan regions of the metropolitan areas. The daily metropolitan region boundary lies one hour away from Johannesburg, Pretoria (Gauteng), Cape Town and

Durban (Ethekewini), the core cities of the respective metropolitan areas, whereas the weekly urban system lies between one and two hours' drive from core cities. Respectively, these limits are regarded as fair representations of the daily and weekly urban reaches of the cities.

To determine what role population redistribution patterns played in the emergence of these regions, municipalities were identified which, cumulatively, have contributed 80% of the net migration gain of the total Black and White populations over the period from 2001 to 2011 (Geyer Jr. & Geyer, 2015, 2015a). From a national perspective, the three primary cities, their satellite towns and the nearest intermediate-sized cities within the two-hour travelling range have collectively gained more migrants

faster than the majority of towns and cities in the deeper periphery (see zones indicated in red on Figure 2).

Although Whites are leaving the core cities of Gauteng and Durban, significant gains of this subpopulation are recorded in the satellite city zone and intermediate-sized cities around the metropolitan areas.

To compare the spatial demographic trends displayed in Figure 2 to spatial economic trends, contour maps were drawn displaying impact of the economic weights of towns and cities expressed in terms of the Urban Function Index – *i.e.*, the number of financial, commercial, service and industrial enterprises in towns and cities in the country (Figure 3).

At or around the positions of the nearest intermediate-sized cities to

the three primary cities, the contours in all the diagrams tend to rise rapidly. The economic cones thus formed confirm the significance of the primary cities and the centres within their daily and weekly urban systems as collections of centres of attraction within the national space economy.

#### 4. METROPOLITAN FUNCTIONAL SPACE – THE REGIONAL CONTEXT

In a recent study of functional subsets of the three core cities of South Africa, metropolitan regions were broken down into the metropolitan inner cores; the suburban zones; the metropolitan fringes; the daily urban systems, and the weekly urban systems. The

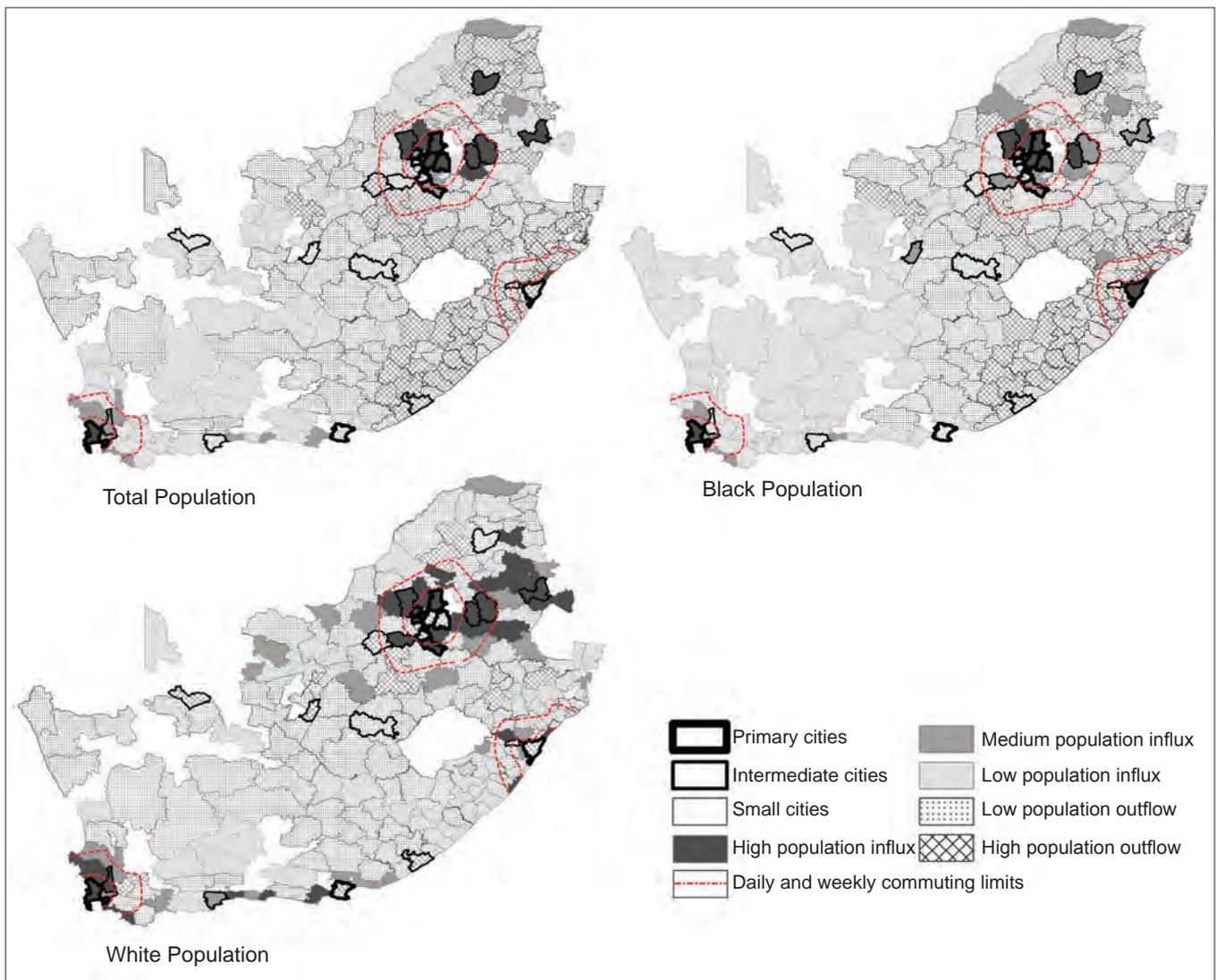


Figure 2: Net migration gains of satellite towns and intermediate-sized cities around South African primate cities  
 Source: Geyer Jr. & Geyer, 2015

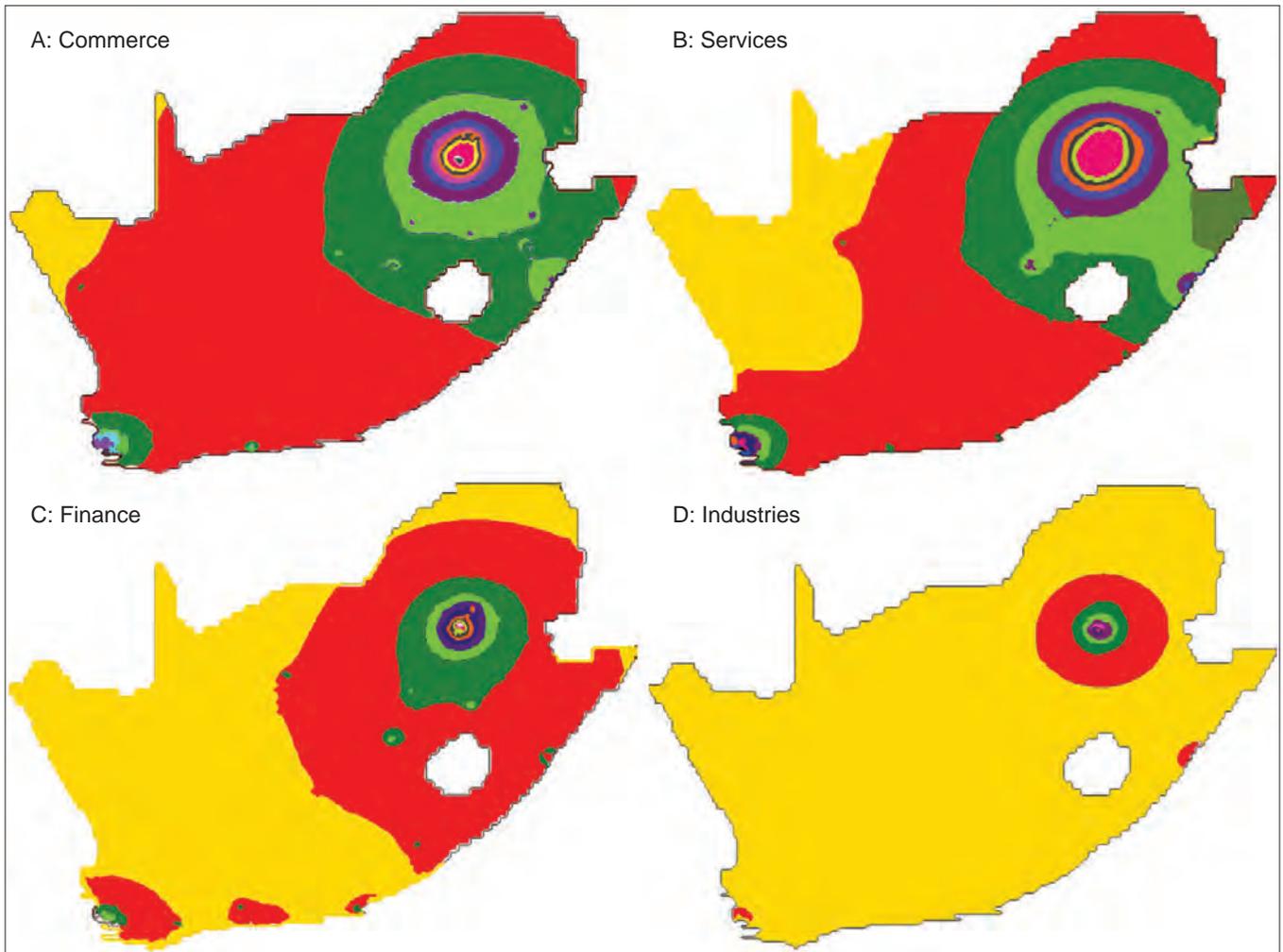


Figure 3: Spatial distribution of business enterprises in South Africa, 2006

Source: Geyer, 2008

outer limits of the latter two zones were based on one- and two-hour commuting distances from the inner cores centres, respectively (Figure 4). Interesting patterns of population change emerged.

The inner cores of all three cities tended to lose population from 1996 to 2001 on an annual basis, but started gaining population as of June 2001, mostly through the in-migration of population groups that previously were not allowed to live in the cities. National migration trends bear this out (Geyer Jr. & Geyer, 2015a).

## 5. DISCUSSION

### 5.1 Metropolis or megalopolis

In view of the functional properties of the three South African core cities discussed earlier, three pertinent questions arise. First, are Cape Town, Durban and the metros in Gauteng all, morphologically, metropolitan? Secondly, what are the limits of the cities? What do they consist of? To answer the first, a distinction needs to be made between the concepts *metropolitan* and *megalopolitan*. Views on the meanings of these two urban forms differ. Wells (1902) was one of the first to foresee megalopolitan development. Mumford (1961) calls the metropolis 'a formless city'. Haggett (1979) uses the two terms interchangeably. Squires (2002) regards it as a region consisting of a densely populated

urban core and its less populated surrounding territories, sharing industry, infrastructure, and housing. Others (Morris, 1974; Abler, Adams & Gould, 1972; Pacione, 2010) focus on its organisational peculiarities rather than its morphology – its economic domination of adjacent smaller nodes and its measure of self-sustainability, as one of them put it: its ability to survive from 'washing its own linen'. Lloyd & Dicken (1972), Abler *et al.* (1972) and Guerois & Pumain (2008) refer to the general tendency of declining density at increasing distance from the inner-city even in instances where the original core lost its dominance (Bertaud, 2004; Bertaud & Malpezzi, 2003; Gordon & Richardson, 1996). However, in all the discussions of the metropolis, a high level of interaction between the core and its surrounding satellite cities seems paramount – an

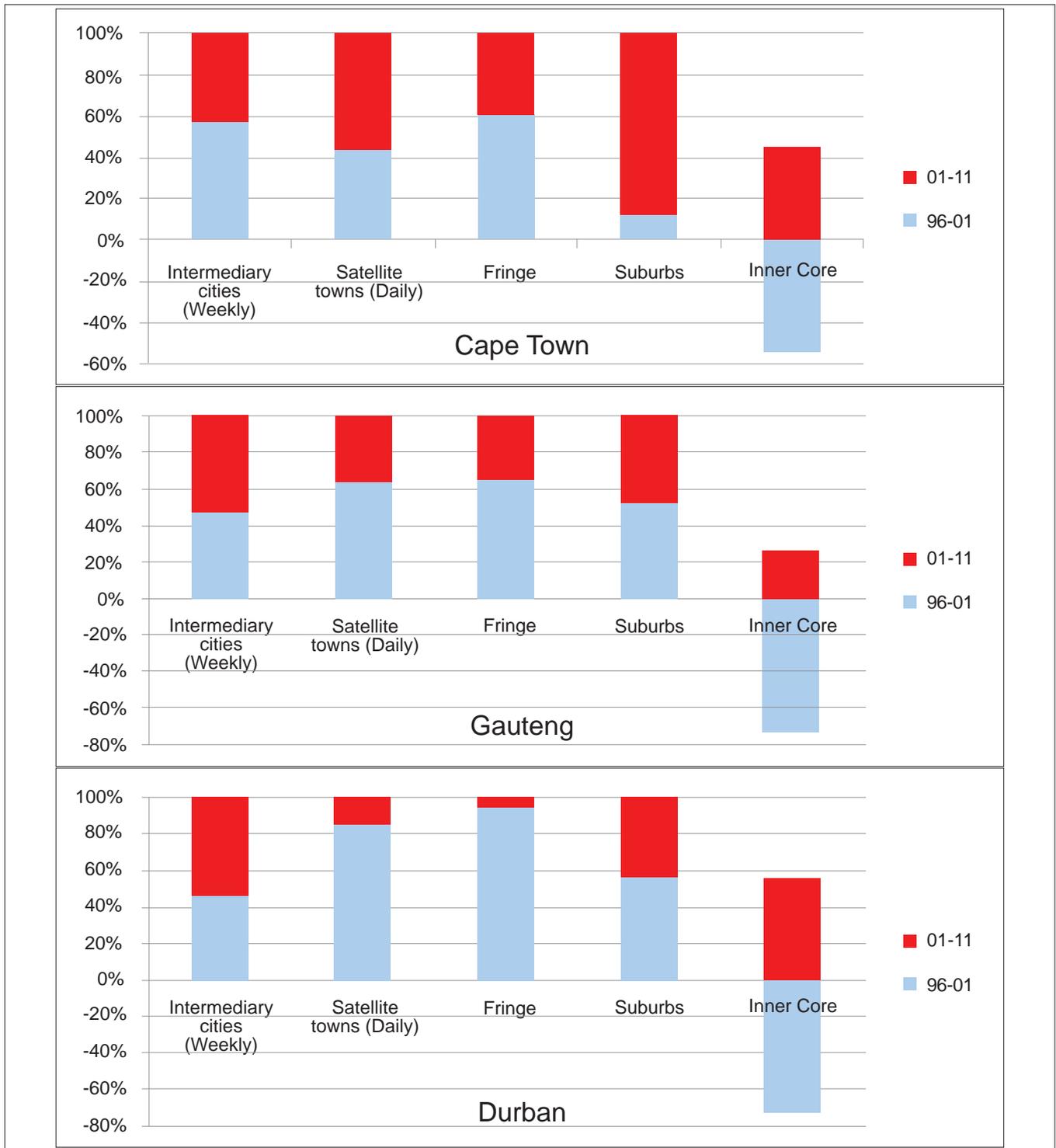


Figure 4: Population change in the functional zones of the three core cities of South Africa, 1996 to 2011

Source: Author's own analysis

underlying issue which this article also attempts to bring to light.

The meaning of the term 'megalopolis', which was first used a century ago (Geddes, 1915), has changed over time from merely a historical urban phenomenon (Mumford, 1961) to smaller (Doxiadis, 1974) and larger versions thereof (Gottmann, 1961; Mumford,

1938, 1961; Doxiadis, 1974; RPA, 2014; Harrison & Hoyler, 2015). In this article, a distinction similar to that of Doxiadis is followed. A *metropolis* is regarded as an expansive *multinodal city*, either formed by (once individual) adjacent cities that have coalesced, or an expanding city in which secondary nodes developed, some of them

becoming sufficiently prominent to take on a morphological form that resembles the former morphological form. At the lower end of the scale, there are *micropolitan* areas (US Census Bureau, 2013) that are smaller (emerging) versions of the larger metropolitan morphological form, while the megalopolis is simply a larger version of the phenomenon.

The latter is formed when two or more metropolitan areas coalesce over time (Doxiadis, 1974).

Viewed from these angles, it could be said that, individually, Cape Town, Durban, Pretoria and the fused cities along the Witwatersrand are all metropolitan areas of one of the two kinds explained earlier. However, together, the sprawling city of Gauteng – *i.e.*, Johannesburg, Ekurhuleni, and the West Rand, as well as Tshwane as metropolitan areas – qualifies as a megalopolis (see Gottmann's view in this regard as long ago as 1976, Figure 1). The Vereeniging-Vanderbijlpark area in Gauteng, however, could be regarded as a micropolis.

## 5.2 Where does the metropolis begin?

To answer the questions regarding the structure of the core cities and where they spatially begin, the meaning and relevancy of the following related terms need to be discussed: *metropolitan core*; *suburban areas*; *metropolitan fringe*; *multinodal city*; *polycentric city*, as well as *daily and weekly urban systems*. Normally, a metropolitan area is composed of a dominant *metropolitan core*, *suburban areas*, and a *metropolitan fringe*. Combined they form a *multinodal city*. To qualify as a megalopolis, at least two metropolitan areas should have coalesced, each one containing

a metropolitan core. *Polycentrism* applies to the latter urban scale.

To determine where the metropolis begins, the *urban edge* concept needs to be brought into the discussion. Differences in the efficiency-equity debate continue to be drawn along ideological lines (Żylicz, 2013). In these exchanges, neoliberals traditionally argue that efficiency is necessary to sustainably achieve equity, whereas Marxists argue that equity comes before efficiency (Bontje, 2001). Linking social and economic issues of inequality in cities with environmental concerns related to climate change, urban policymakers subscribing to the latter school of thought have, in recent decades, sought spatial solutions through strategies of urban densification, land-use integration and the geographical restriction of urban expansion. It has since become a popular policy approach in many parts of the world (Geyer Jr. & Geyer, 2015a). The declaration of *urban edges* is often considered an effective policy instrument to achieve these goals (Geyer, 2009).

This also applies to South Africa. Since the end of apartheid, *integrated urban development* and *urban densification* have become central themes in the policy lexicon of urban planning in the country. Urban edges were widely regarded as an effective policy measure to curtail urban sprawl and to force policymakers to remain

spatially focused. However, continuing market forces caused some local governments to reconsider this policy (see, for instance, GSDF, 2011). As Perroux (1950) very convincingly demonstrated, based on historical evidence, economic forces always tend to be stronger than administrative forces because, in Berry's (1964: 235) words: "cities are systems, operating within systems of cities".

It can be concluded from this that, economically speaking, people who live in towns and cities within the daily urban system, but work in the metropolis are just as much part of the metropolis as those living inside the city (see Figure 5 for an indication of daily and weekly urban space in the cases of Cape Town and Gauteng). Systemically, a metropolitan core, its suburban subcentres and its surrounding satellite towns form an economic whole. The daily commuting distance, therefore, forms the outer limit of the metropolis. That is where the metropolis begins. Planners need to recognise this fact. Metropolitan planning based on areas of jurisdiction that exclude the daily urban system is bound to be systemically deficient. To illustrate the point: Paarl and Stellenbosch are just as much part of Cape Town as Somerset-West and Strand – all of them satellite cities – and yet only the latter two officially form part of the metropolis. A regional approach to

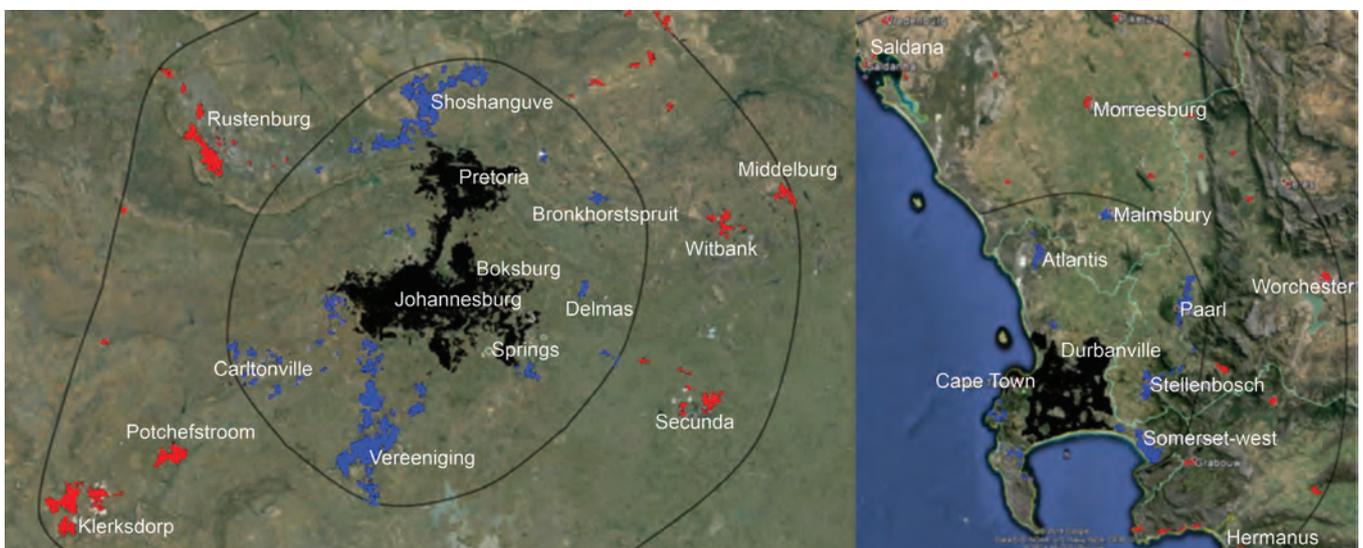


Figure 5: The daily and weekly metro regions of Gauteng and Cape Town

metropolitan planning would obviate these kinds of inconsistencies in metropolitan planning practice. It is this aspect of the economic space of cities that has made the *functional urban region* (FUR) concept just as relevant in planning policy as the edge-defined city has become in recent years.

## 6. POLYCENTRICITY

To understand polycentrism requires an understanding of its origin. Inadequacies of the initial monocentric model led to increasing dissatisfaction with the unreality of the basic tenet of a lasting single dominant city centre (Richardson, 1988). The advent of modern transport allowed the decentralization not only of labour, but also of business, while still retaining many of the benefits of agglomeration (Bruegman, 2005; Musterd & Van Zelm, 2001), resulting in multinodal cities. Differences of opinion remain as to what the concept really implies (Musterd & Van Zelm, 2001; Bailey & Turok, 2001).

Parr (2004) presents an overview of reasonable conditions that define a polycentric city. These conform to two basic tenets, namely morphological and functional. Morphologically, it is defined as a plurality of centres. Due to factors influenced by friction of distance, there are obvious justifications for some kind of viable maximum distance limit. The insistence of size and spatial distribution often appears in literature (*cf.* Kloosterman & Musterd, 2001; Parr, 2004); yet it is usually justified only on normative, not necessary absolute grounds.

In terms of functionality, defining polycentricism is problematic. Similarly, there needs to be a minimal distance required to ensure that centres are sufficiently distinguishable for polycentricism in order to become meaningful. In addition, in terms of size, it makes sense to limit centres to a minimum size to ensure significant results. Linking distance to functionality complicates the issue, because functional polycentrism is commonly defined in terms of the level of interaction between

centres (Parr, 2004). However, functionality does not imply a fixed state or condition. High levels of interaction do not necessarily imply polycentricism. As research on world cities shows, cities can be physically remote and still display high levels of economic interaction. This includes centre specialisation, which is often regarded as a popular signpost of polycentricism, but which easily occurs irrespective of polycentricism, responding instead to local economic conditions. Proximity, therefore, could enhance polycentricity (Parr, 2004).

To tie these loose ends together, this article makes a technical distinction between the terms *multinodality* and *polycentricity*. In the case of the former, the suffix refers to a metropolis (or smaller city) consisting of a dominant primary and one or more secondary suburban nodes. The suffix of the latter refers to a (morphologically and economically) more advanced state of urban development, *i.e.*, where, in addition to secondary nodes, two or more rivalling primary nodes or cores exist, each one serving as a competitive primary nodal force of attraction within the larger urban structure. As in the distinction between the terms *metropolitan* and *megapolitan* earlier, multinodality is associated with a monocentric city structure, in which a single dominating primary node exists, surrounded by secondary nodes, whereas polycentricity implies more than one functionally linked monocentric city. The latter can either emerge from a single city, in which one or more former secondary nodes developed to such an extent that they start rivalling the original city centre, or it can consist of two or more functionally related contiguous or adjacent monocentric cities.

Functionally, the polycentric city is likened to Boudeville's (1967) *polarised or multinodal region*, *i.e.*, a region consisting of an urban network that displays a certain functional coherence, an interdependence of parts resulting in more interaction with one another within the region than with urban centres outside. Without this cohesion, polycentricity, conceptually, falls apart.

Viewed from this angle, the term 'polycentricity' is usually only relevant at the megalopolitan level. In the South African context, this applies to Gauteng. The Gauteng megalopolis is centred around two core cities – Pretoria as a government and administrative centre and Johannesburg as a diversified manufacturing, retail and service centre. There has been a powerful historical or urban economic interdependency between the two.

In terms of morphological distribution, Gauteng displays complex spatial distribution patterns. Population concentration adds further levels of complexity: population concentrations demonstrate the same spatially heterogeneous distribution, and they do not necessarily correspond to economic concentrations. Certain regions demonstrate high concentrations of wealth with low population densities, while others demonstrate the opposite pole of dense impoverished populations (Figure 6).

Commuting patterns have long been an important measure of functional polycentricism (Burger & Meijers, 2012). GCRO has performed surveys of commuting patterns in the Gauteng region, but, due to weighting problems, it is difficult to draw any meaningful conclusions from this data beyond the statistical spread. However, one may tentatively conclude that they do indicate more significant commuting patterns between centres than from the rest of the region (Figures 7 and 8).

Commuting patterns, however, can be indirectly measured. Three examples of these are transportation infrastructure development, axial development, and labour versus economic concentration disparities. In terms of transportation infrastructure, it can be inferred that if transportation infrastructure between centres is more extensive than beyond the centres, this indicates a certain proportion of inter-urban interaction volume. For instance, on examining the north-south transportation lines between the Vaal Triangle and Johannesburg, there are two class U1 urban arterials, one class U2

urban arterial, and one class R1 rural arterial. Southward, beyond the Vaal Triangle, there is one class R1 rural arterial and three class R2 rural arterials. Based on the average annual daily traffic specifications AADT, one can estimate differences

in carrying capacity: 40-120K for U1, 20-60K for U2, 5-100K for R1, and 2-25K for R2 (Committee of Transport Officials, 2012). Based on these values, one can infer a traffic capacity of 105-400K between the Vaal Triangle and Johannesburg (average

252.5K), and 11-175K beyond the Vaal Triangle (average 93K). The traffic volumes between Pretoria and Johannesburg are even higher, with three U1 and three U2 urban arterials versus one R1 and four R2 rural arterials, adding up to 180-540K

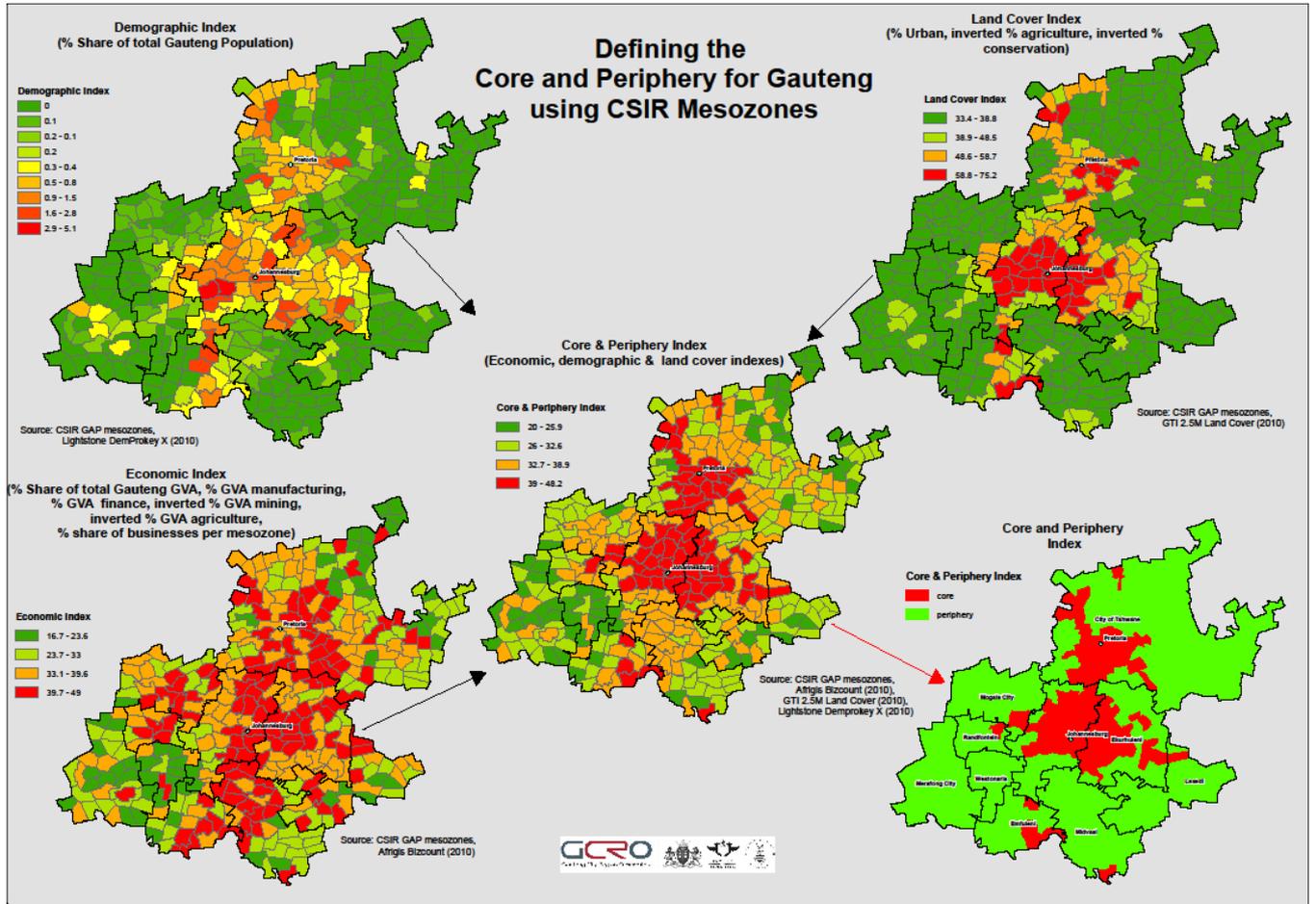


Figure 6: Core-peripheral areas in Gauteng

Source: GCRO, 2010

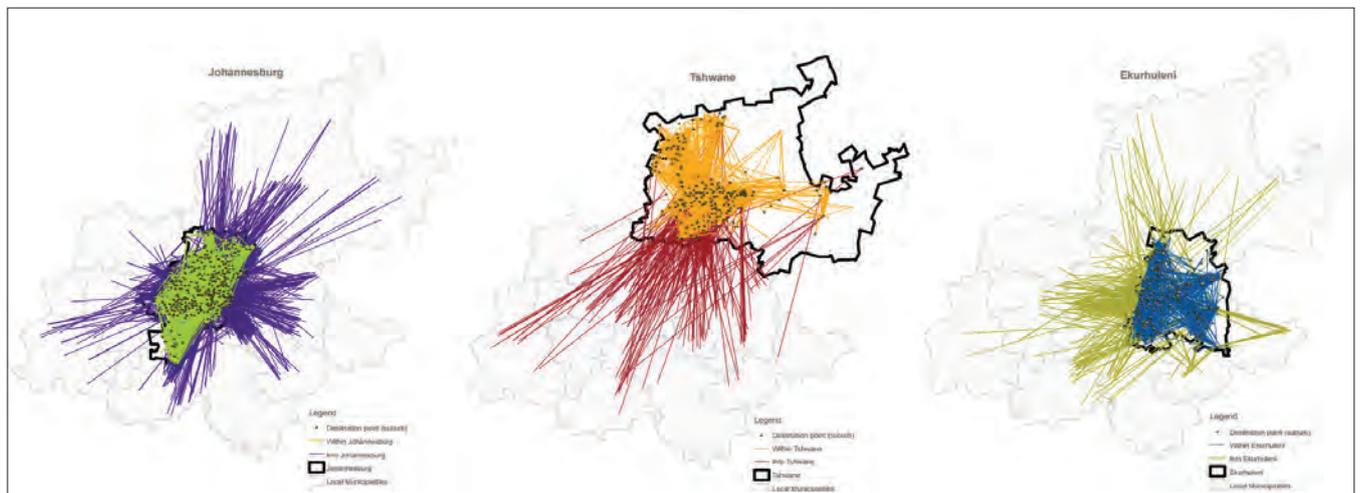


Figure 7: Internal-external commuting patterns in different parts of the megalopolis

Source: GCRO, 201

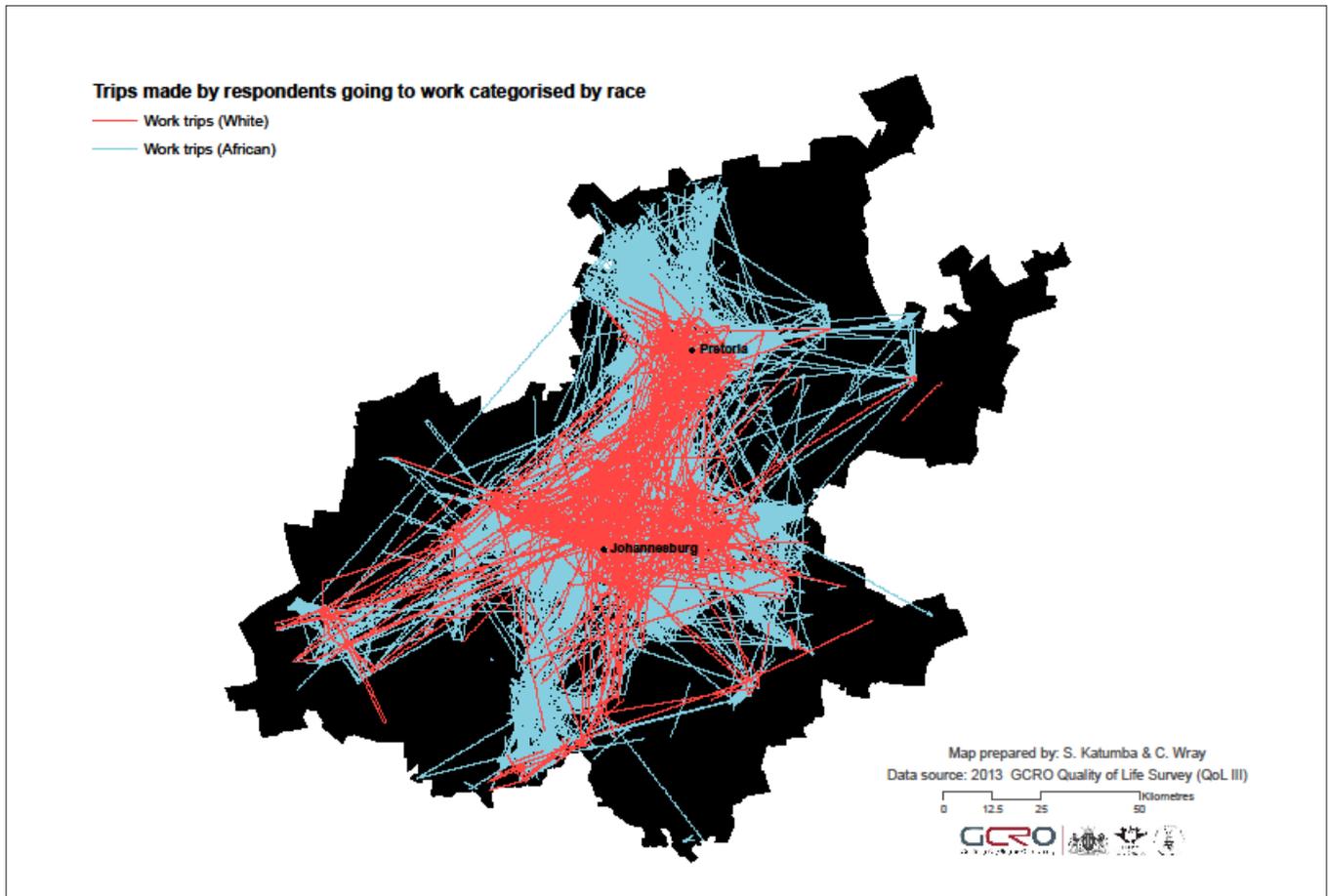


Figure 8: Black-White commuting patterns in Gauteng  
 Source: GCRO, 2014

(average 360K) between the cities and 13-200K (average 106.5K) beyond. Even with a large margin of error, these values still imply a major increase in traffic above the external incoming traffic volumes between the main urban centres. This implies significant interaction and, therefore, functional polycentricism between these major urban areas.

The development axes themselves constitute important indicators of functional polycentricism, as development axes typically only form along corridors where high amounts of interaction occur. In these terms then, the degree of development along a corridor is a strong indicator of the amount of interaction between two growth poles. Development axes form over time in relation to the population and economic concentrations at either of their poles, the amount of interaction between the poles, and the distance between the poles. Development axes

proceed through different stages: an infant stage, where there is little development between growth poles; a mature stage, where subcentres form along the corridor, and an advanced stage, where polarisation reversal occurs and subcentres grow faster than the centres themselves (Geyer, 1989).

A clear north-south development axis is visible between the three main centres. As the urban land cover maps show, there is a near continuous line of built-up land extending between the main centres and beyond, extending beyond provincial boundaries extending almost two hundred kilometres from north to south. The Pretoria-Johannesburg section is the most developed of the two axes, with clear signs of the mature stage of development and perhaps even of the advanced stage, with growth within subcentres exceeding that of

the poles (Brand & Geyer, 2014; Pilay & Geyer, 2014).

Lastly, another important indicator of polycentricism is the heterogeneous distribution of economic versus population densities. Implicitly, this means that there will be significant polycentric interactions between labour and employment centres (Champion, 2001). In Gauteng, as with many developing countries, there are significant spatial inconsistencies between economic and population concentrations. Poverty leads to density, in order to maximise occupation of land at locations where land is cheap, remote from economic centres. This drives up land-value differences, leading to high spatial segregation of population.

## 7. CONCLUSION

Various functional elements of the three core cities of South Africa are discussed in metropolitan and

provincial planning policy documents of Gauteng, Cape Town and Durban. From the use of terminology related to urban functionality, it is clear that different meanings are sometimes attached to the same terms in these documents. The term *metropolitan region*, in particular, is sometimes used inconsistently. This article attempted to bring more clarity and consistency to the use of concepts that are related to metropolitan functionality in these documents.

Zooming in from global to local, the case was made that, as a premier city of Africa, Johannesburg is a global city. Its prominence is not only reinforced by its location relative to other centres within the megalopolis in which it is embedded, but also by its location and functional relationships with Cape Town and Durban as the other two primary centres.

Nationally, the three centres under investigation are without question the most dominant economic nodes in the country, each serving a significant part of the country economically. From the regional to the local levels of spatial aggregation, several layers of functional space were identified.

At the metropolitan regional level, a functional link was established between the core cities and centres within their associated daily and weekly commuting areas. Centres that fall within their daily urban economic space are regarded as *satellite centres* and functionally form part of the core cities. People living in the satellite centres and working and shopping in the core cities are also economically just as much part of the core cities as those living inside them and vice versa.

At the local level, a distinction was made between concepts such as core centre, suburban areas, and core fringe, as well as between multimodality, monocentricity and polycentricity. As monocentric cities, individual metropolitan centres are multinodal. Morphologically, Pretoria and Johannesburg form the cores of a polycentric urban structure. It is not entirely certain to what extent they also functionally represent a polycentric city. Determining how functional interactions manifest across space first requires determining inter-centre spatially relevant urban functionality. The

question of functional polycentrism is complicated by the multidimensional complexity of functionalism. But perhaps the most significant problems are those of measuring and understanding polycentrism.

Polycentrism is a complex concept and, therefore, displays many of the problems inherent to the application of simplified abstract theoretical models onto heterogeneous realities. The obvious answer of increasing the complexity of measurement methodologies and/or theoretical models carries its own pitfalls: higher levels of complexity in data gathering and analysis increase the unreality and inaccuracy of results, and increasing theoretical complexity enhances the degrees of inconsistency and decreases their usefulness. Rather a consensus will have to be reached on the degree of abstraction inaccuracies acceptable, in order to construct a variety of concepts that balance relevance with utility.

A diagrammatic representation of the functional classification of South African metropolitan cities and subsets of the cities would be the following:

Zone	Planning Terms	SCALE	SPATIAL SIGNIFICANCE			
		Zones represented	G	N	R	L
1	Inner core centre	1				
2	Suburban areas	2				
3	Metropolitan fringe	3				
4	Satellite urban system	4				
5	Surrounding Intermediate-sized cities	5				
6	Daily Urban System	1-4				
7	Weekly Urban System	1-5				
8	Contiguous metropolitan city (Built-up area)	1-3				
9	Functional metropolitan boundary	1-4				
10	Multinodal city	1-3				
11	Polycentric city	Functionally multi metro				
12	Megalopolis	Spatially mult metro				
13	World city	Globally significant metro				

G=GLOBAL  
 N=NATIONAL  
 R=REGIONAL  
 L=LOCAL

## REFERENCES LIST

- ABLER, R., ADAMS, J.S. & GOULD, P. 1972. *Special organisation: The geographer's view of the world*. London: Prentice Hall.
- ANTIKAINEN, J. 2005. The concept of functional urban area. Findings of the ESPON project 1.1.1. *Informationen zur Raumentwicklung*, 7, pp. 447-452.
- BAILEY, N. & TUROK, I. 2001. Central Scotland as a polycentric region: Useful planning concept or chimaera? *Urban Studies*, 38(4), pp. 697-715.
- BEAVERSTOCK, J.V., SMITH, R.G. & TAYLOR, P.J. 1999. A roster of world cities. *Cities*, 16(6), pp. 445-458.
- BERRY, B.J.L. 1964. Cities as systems within systems of cities. *Papers of Regional Science*, 13(1), pp. 147-163.
- BERRY, B.J.L. 1972. Population growth in the daily urban systems of the United States, 1980-2000. Population growth and the American future. In: Mazie, S.M. (Ed.). *Population distribution and policy*, Vol. V. Washington: The U.S. Commission on Population Growth and the American Future, pp. 233-270.
- BERRY, B.J.L. 1973. Contemporary urbanisation processes. In: Horton, F.E. (Ed.). *Geographical perspective and urban problems*. Washington: National Academy of Sciences, pp. 94-107.
- BERRY, B.J.L., GOHEEN, P.G. & GOLDSTEIN, H. 1969. *Metropolitan area definition: A re-evaluation of concept and statistical practice*. Working Paper No. 28. Washington: US Bureau of the Census.
- BERTAUD, A. 2004. The spatial organisation of cities: Deliberate outcome or unforeseen consequence? World Development Report 2003, Dynamic Development in a Sustainable World, Background Paper 27864.
- BERTAUD, A. & MALPEZZI, S. 2003. *The spatial distribution of population in 48 world cities: Implications for economies in transition*. The University of Wisconsin: The Center for Urban Land Economics Research.
- BONTJE, M. 2001. *The challenge of planned urbanisation: Urbanisation and national urbanisation policy in The Netherlands in a Northwest-European perspective*. Utrecht: Rozenberg Publishers.
- BOUDEVILLE, J-R. 1967. *Problems of regional economic planning*. Edinburgh: Edinburgh University Press.
- BOURNE, L.S. & SIMMONS, J.W. 1978. Urban systems: Definitions, concepts, and approaches: Introduction. In: Bourne, L.S. & Simmons, J.W. (Eds). *Systems of cities: Readings on structure, growth, and policy*. New York: Oxford University Press, pp. 18-27.
- BRAND, A. & GEYER, H.S. 2014. Corridor development in Gauteng. Centre for Regional and Urban Innovation and Statistical Exploration, Stellenbosch University. Working Paper.
- BRETAGNOLLE, A., PAULUS, F. & PUMAIN, D. 2001. *Time and space scales for measuring urban growth*. 12<sup>ème</sup> Colloque Européen de Géographie Théorique et Quantitative, St-Valéry-en-Caux, France, 7-11 September.
- BRUEGMANN, R. 2005. *Sprawl: A compact history*. Chicago, ILL.: University of Chicago Press.
- BURGER, M. & MEIJERS, E. 2012. Form follows function? Linking morphological and functional polycentricity. *Urban Studies*, 49(5), pp.1127-1149.
- CASTELLS, M. 1996. *The rise of the network society*. Oxford: Blackwell.
- CHAMPION, A. 2001. A changing demographic regime and evolving polycentric urban regions: Consequences for size, composition and distribution of city populations. *Urban Studies*, 38(4), pp.657-677.
- CLAY, G. 1998. *Real places: An unconventional guide to America's generic landscape*. Chicago, ILL.: University of Chicago press.
- COMMITTEE OF TRANSPORT OFFICIALS. 2012. *South African road classification and access management manual*. Pretoria: The South African National Roads Agency Limited.
- COOMBES, M.G., DIXON, J.S., GODDARD, J.B., OPENSHAW, S. & TAYLOR, P.J. 1979. Daily urban systems in Britain: From theory to practice. *Environment and Planning A*, 11(5), pp. 565-574.
- DOXIADIS, C.A. 1968. *Ekistics, an introduction to the science of human settlements*. New York: Oxford University Press.
- DOXIADIS, C.A. 1974. *Ecumenopolis: The inevitable city of the future*. New York: Norton.
- ERLEBACH, M., KLAPKA, P., HALÁS, M. & TONEV, P. 2014. Inner structure of the functional region: Theoretical aspects. In: Klímová, V. & Žitek, V. (Eds). *Proceedings of the 17<sup>th</sup> International Colloquium on Regional Sciences*, 18-20 June 2014. Brno: Masarykova univerzita, pp.722-726.
- FLORIDA, R. 2005. The world is spiky: Globalization has changed the economic playing field, but hasn't leveled it. *The Atlantic Monthly*, October, pp. 48-51.
- FOX, K. & KUMAR, T. 1965. The functional economic area: Delineation and implications for economic analysis and policy. *Papers in Regional Science*, 15(1), pp. 57-85.
- FRIEDMANN, J. 1978. The urban field is human habitat. In: Bourne, L.S. & Simmons, J.W. (Eds). *Systems of cities: Readings on structure, growth, and policy*. New York: Oxford University Press, pp. 42-52.
- FRIEDMANN, J. & MILLER, J. 1965. The urban field. *Journal of the American Institute of Planners*, 31(4), pp. 312-320.
- GCRO. 2010. Core peripheral areas in Gauteng. [online]. Available from: <[http://www.gcro.ac.za/sites/default/files/maps/pdfs/gcro\\_core\\_and\\_peripheries\\_index\\_1\\_with\\_mezozones\\_version\\_2\\_final\\_0.pdf](http://www.gcro.ac.za/sites/default/files/maps/pdfs/gcro_core_and_peripheries_index_1_with_mezozones_version_2_final_0.pdf)> [Accessed 3 September 2014].
- GCRO. 2011. Movement within and into the cities of Joburg, Tshwane and Ekurhuleni. [online]. Available from: <[http://www.gcro.ac.za/sites/default/files/maps/pdfs/gcro\\_qol\\_q4\\_1\\_and\\_4\\_2\\_all\\_movement\\_within\\_and\\_into\\_city\\_of\\_joburg\\_tshwane\\_and\\_ek.pdf](http://www.gcro.ac.za/sites/default/files/maps/pdfs/gcro_qol_q4_1_and_4_2_all_movement_within_and_into_city_of_joburg_tshwane_and_ek.pdf)> [Accessed 3 September 2014].
- GCRO. 2014. Trip to work by race. [online]. Available from: <<http://www.gcro.ac.za/map/october-2014-getting-work-gcr-trips-work-race>> [Accessed 3 September 2014].
- GAUTENG 2055. 2012. Gauteng 2055: A discussion document on the long-term development plan for the Gauteng City-Region. Gauteng City-Region Observatory. Gauteng Planning Commission, Gauteng Province: Johannesburg.
- GGMP. 2014. Gauteng Growth Management Perspective. Gauteng Province: Johannesburg.
- GEDDES, P. 1915. *Cities in evolution*. London: Williams & Norgate.
- GEYER, H.S. 1988. The terminology, definition and classification of

- development axes. *The South African Geographer* 16(1/2), pp. 113-129.
- GEYER, H.S. 1989. Industrial development policy in South Africa - the past, present and future. *World Development*, 17(3), pp. 379-396.
- GEYER, H.S. 2007. The evolving urban economic landscape: Trends in the past and present, from local to global. In: Geyer, H.S. (Ed.). *International handbook of urban policy, Volume I: Contentious global issues*. Aldershot, UK: Edward Elgar, pp. 38-58.
- GEYER, H.S. 2008. *The urban function index of South Africa*. Statistics South Africa.
- GEYER, H.S. 2009. The continuing urban form controversy: Toward bridging the divide. In: Geyer, H.S. (Ed.). *International handbook of urban policy, Volume 2: Issues in the developed world*. Aldershot, UK: Edward Elgar, pp. 195-259.
- GEYER, H.S., GEYER, H.S. Jr. & DU PLESSIS, D.J. 2012. Migration, geographies of marginality and informality – Impact on upper and lower ends of urban systems in the North and the South. *European Planning Studies*, 20(4), pp. 1-21.
- GEYER, H.S. Jr., GEYER, H.S., DU PLESSIS, D.J. & VAN EEDEN, A. 2012. Differential urbanisation trends in South Africa – Regional and local equivalents. *Environment and Planning A*, 44(12), pp. 2940-2956.
- GEYER, H.S. Jr. & GEYER, H.S. 2015. Disaggregated population migration trends in South Africa between 1996 and 2011: A differential urbanisation approach. *Urban Forum*, 26(1), pp. 1-13.
- GEYER, H.S. Jr., GEYER, H.S. & DU PLESSIS, D.J. 2015. Primary cities in sub-Saharan Africa: Quasars, loose connections, and black holes. *International Planning Studies* 20(1-2), DOI: 10.1080/13563475.2014.942494.
- GORDON, P. & RICHARDSON, H.W. 1996. Beyond polycentricity: The dispersed metropolis, Los Angeles, 1970-1990. *Journal of the American Planning Association*, 62(3), pp. 289-295.
- GOTTMANN, J. 1961. *Megalopolis: The urbanized north-eastern seaboard of the United States*. New York: The Twentieth Century Fund.
- GOTTMANN, J. 1976. Megalopolitan systems around the world. *Ekistics* (243), pp.109-113.
- GRAHAM, S. 1998. The end of geography or the explosion of place? Conceptualizing space, place and information technology. *Progress in Human Geography*, 22(2), pp. 165-185.
- GRAHAM, S. 1999. Global grids of glass: On cities, telecommunications and planetary urban networks. *Urban Studies*, 36(5-6), pp. 929-949.
- GSDF. 2011. Gauteng Province Spatial Development Framework. Gauteng Province: Johannesburg.
- GUEROIS, M. & PUMAIN, D. 2008. Built-up encroachment and the urban field: A comparison of forty European cities. *Environment and Planning A*, 40(9), pp. 2186-2203.
- HAGGETT, P. 1979. *Geography: A modern synthesis*. New York: Harper and Row.
- HALL, P.G. & HAY, D. 1980. *Growth centres in the European urban system*. Los Angeles: University of California Press.
- HARRISON, J. & HOYLER, M. 2015. Mega-regions: Foundations, frailties, futures. In: Harrison, J. & Hoyler, M. (Eds). *Megaregions: Globalisation's new urban form*. Cheltenham, UK: Edward Elgar, pp. 1-29.
- KLOOSTERMAN, R.C. & MUSTERD, S. 2001. The polycentric urban region: Towards a research agenda. *Urban Studies*, 38(4), pp. 623-633.
- KRAFT, S. 2014. Daily spatial mobility and transport behaviour in the Czech Republic: Pilot study in the Písek and Bystrice nad Pernštejnem regions. *Human Geographies – Journal of Studies and Research in Human Geography*, 8(2), pp. 51-67.
- LLOYD, P.E. & DICKEN, P. 1972. *Location in space: A theoretical approach to economic geography*. New York: Harper and Row.
- MARCHETTI, C. 1994. Anthropological invariants in travel behaviour. *Technological Forecasting and Social Change*, 47(1), pp. 75-88.
- MORRILL, R.L. 1974. *The special organisation of society*. Duxbury: North Scituate Mass.
- MUMFORD, L. 1938. *The culture of cities*. San Diego, CA.: Harcourt Brace Jovanovich.
- MUMFORD, L. 1961. *The city in history: Regions, its elections and its prospects*. San Diego, CA.: Harcourt Brace Jovanovich.
- MUSTERD, S. & VAN ZELM, I. 2001. Polycentricity, households and the identity of places. *Urban Studies*, 38(4), pp. 679-696.
- NEWMAN, P. 2004. Why we're reaching our limits as a one-hour city. *Sydney Morning Herald*, April 26, p. 24.
- ONYEBUEKE, V.U. 2011. Place and function of African cities in the global urban network: Exploring the matters arising. *Urban Forum*, 22(1), pp. 1-21.
- OTTAVIANO, G. & THISSE, J.-F. 2004. New economic geography: What about the N? CORE Discussion Paper No. 2004/65. Leuven: Catholic University of Leuven.
- PACIONE, M. 2010. *Urban geography: A global perspective*. London: Routledge.
- PARR, J.B. 2004. The polycentric urban region: A closer inspection. *Regional Studies*, 38(3), pp. 231-240.
- PARR, J.B. 2007. Spatial definitions of the city: Four perspectives. *Urban Studies*, 44(2), pp. 381-392.
- PARR, J.B. 2012. Spatial-structure differences between urban and regional systems. *Annals of Regional Science*, 49(2), pp. 293-303.
- PERROUX, F. 1950. The domination effect and modern economic theory. *Social Research* 17(20), pp. 188-206.
- PILAY, X. & Geyer, H.S. 2014. Business clustering along the Johannesburg-Pretoria corridor, South Africa. Working paper. Centre for Regional and Urban Innovation and Statistical Exploration, Stellenbosch University.
- PUMAIN, D. 2002. The French urban system. In: Geyer, H.S. (Ed.). *International handbook of urban systems: Studies of urbanization and migration in advanced and developing countries*. Aldershot, UK: Edward Elgar, pp. 119-144.
- PUMAIN, D. 2004. Scaling laws and urban systems. SFI Working paper 2004-02-002.
- RICHARDSON, H.W. 1988. Monocentric vs. polycentric models: The future of urban economics in regional science. *Annals of Regional Science*, 22(2), pp. 1-12.
- SASSEN, S. 2001. *The global city*. 2nd edition. Woodstock: Princeton University Press.
- NATIONAL DEVELOPMENT PLAN (NDP). 2011. *National Development Plan 2030*. Boksburg: Sherino Printers.

SQUIRES, G. (Ed.). 2002. *Urban sprawl: Causes, consequences, and policy responses*. Washington, DC: The Urban Institute Press.

TAYLOR, P.J. 1997. Hierarchical tendencies amongst world cities: A global research proposal. *Cities*, 14(6), pp. 223-232.

TAYLOR, P.J. 2000. World cities and territorial states under condition of contemporary globalization. *Political Geography*, 19(1), pp. 5-32.

TAYLOR, P.J. 2001. Specification of the world city network. *Geographical Analysis*, 33(2), pp. 181-194.

TAYLOR, P.J. 2009. World cities: Organizational networking and the global urban hierarchy. In: Geyer, H. (Ed.). *International handbook of urban policy, Vol. 2: Issues in the developed world*. Cheltenham: Edward Elgar, pp. 74-104.

US CENSUS BUREAU. 2013. *Metropolitan and micropolitan statistical areas of the United States and Puerto Rico*. Washington, DC: US Census Bureau.

VAN DER MERWE, I.J. 2004. The global cities of sub-Saharan Africa: Fact or fiction? *Urban Forum*, 15(1), pp. 36-47.

VAN NUFFEL, N. & SAEY, P. 2005. Commuting, hierarchy and networking: The case of Flanders. *Tijdschrift voor Economische en Sociale Geografie*, 96(3), pp.313-327.

WELLS, H.G. 1902. *Anticipations of the reaction of mechanical and scientific progress upon human life and thought*. New York: Harper.

WCPSDF. 2013. Western Cape Provincial Spatial Development Framework. Western Cape Department of Environmental Affairs and Development Planning: Environmental and Spatial Planning.

ŻYLICZ, T. 2013. New dimension of the efficiency-versus-equity debate. *Studia Ekonomiczne*, 1(76), pp.173-179.