APPLICATION OF DIFFERENTIAL PERSON AND HOUSEHOLD GROWTH IN THE GAUTENG CITY-REGION, 2001-2011

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March, 2018

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DECLARATION

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ABSTRACT

This study deals with differential person and household growth at electoral ward level for the period 2001 – 2011 for the Gauteng City-Region. From a theoretical perspective such growth at such small area level is very valuable when dealing with issues around urban growth and urbanisation and the characteristics that this brings. At a spatial level, the manifestation of growth is critical in terms of picking up changes in its structure and distribution. Differential urbanisation has been seen to take place in other parts of the world whereby growth shifts from places in the urban core to intermediate cities and even onto smaller places before the cycle repeats itself. These urban development cycles are important to take note of and to track over time in order to be able to react to changing patterns of urban growth. In this regard it is important to appreciate what drives growth and how this plays into the realm of how a region moves a process of decentralisation to one of reurbanization and the impact this has for spatial and urban planning. This study made use of the 2001 and 2011 Census harmonised to the 2011 boundaries and using the standard deviation measure within a Gaussian distribution to create six categories of growth, three either side of the mean that are divided by one and two standard deviations. The study then showed characteristics for various characteristics for different levels of person and household growth before establishing spatial trends and patterns that identified hotspots in the city-region and in the metros of Gauteng on their own as well as identifying clustering and outliers of growth for the city-region and metros alone as well. The study identified some key findings in the shape of there being a strong urban core that drives most growth in the city-region; the mining industry along the mining belt stretching from the West Rand in Westonaria all the way north up to Rustenburg in the North West province showed its own unique trends and characteristics; and finally there is a definite trend across the city-region to move away from areas with poor service delivery towards areas that provide good quality of living with quality and reliable delivery of services.

Key words: Population growth, Household growth, differential urbanisation, migration, urbanisation, growth clustering

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OPSOMMING

Die studie handel oor die differensiële groei van persone en huishoudings op ‘n kieswykvlak tussen 2001 en 2011 in die Gauteng stad-streek. Bevolkings- en huishoudingsverandering op kleinareavlak is, uit ‘n teoretiese oogpunt, besonder waardevol vir die studie van vraagstukke wat verband hou met stedelike groei en verstedeliking, asook die eienskappe daarvan. Die manifestasie van groei is van kritiese belang om veranderings in die struktuur en verspreiding van bevolkings en huishoudings op ‘n ruimtelike vlak te identifiseer. Differensiële verstedeliking in ander wêrelddele word gekenmerk deur ‘n sikliese verskuiwing van groei uit die stedelike kern na intermediêre stede, en self na kleiner plekkies voordat die siklus herhaal word. Dit is belangrik om stedelike ontwikkelingsiklusse waar te neem en oor tyd te volg ten einde te kan reageer op veranderende verstedelikingspatrone. Dit is in hierdie verband veral belangrik om die faktore wat aanleiding gee tot groei, hulle rol in die verandering van desentralisering tot herverstedeliking, sowel as die impak daarvan op ruimtelike en stedelike beplanning, te verstaan. Hierdie studie het gebruik gemaak van die 2001 en 2011 sensusdata wat geharmoniseer is tot 2011 grense. Ses kategorië van groei, drie aan weerskante van die gemiddeld, is geskep deur gebruik te maak van standaardafwykings gemeet binne ‘n Gaussiese verdeling. Die studie het die eienskappe van verskillende vlakke van bevolkings- en huishoudingsgroei geidentifiseer voor ruimtelike patrone en tendense vasgestel is wat ‘hotspots’, sowel as ‘clustering and outliers’ (groepering en uitskieters) in die stad-streek as geheel en die metros in Gauteng afsonderlike geidentifiseer het. Kernbevindinge sluit in dat ‘n sterk stedelike kern die meeste groei in die stad-kern dryf; dat die mynbouindustrie in die mynboubelt wat strek van Westonaria aan die Wes-Rand tot Rustenburg in die Noordwes Provinsie sy eie unieke eienskappe en tendense vertoon; en dat daar ‘n definitiewe beweging oor die stad-streek heen is om weg te beweeg van areas met swak dienslewering na areas wat ‘n beter kwaliteit van lewe bied met meer bestendige en hoër kwaliteitsdienste.

Sleutel woorde: Bevolkingsgroei, huishoudingsgroei, differensië verstedeliking, migrasie, vesrstedeliking, groeibondeling.

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ABBREVIATIONS AND ACRONYMS

Central Business District (CBD)

Council for Scientific and Industrial Research (CSIR)

Differential Urbanisation (DU)

Further Education and Training (FET)

Global Bilateral Migration Database (GBMD)

Gauteng City-Region (GCR)

Gross Domestic Product (GDP)

Health and Demographic Surveillance Site (HDSS)

South African Cities Network (SACN)

Southern African Development Community (SADC)

Spatial Temporal Evidence for Planning in South Africa (STEP-SA)

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CHAPTER 1: INTRODUCTION

1 INTRODUCTION

1.1 RATIONALE

People and the households that they belong to are the cornerstone of society and are targets of policy makers and planning activities in the communities in which they live. A wide array of planning activities are dependent on population and household numbers as inputs and often plans are formulated regardless of variations within municipalities. In addition to this is the uncertainty of how population will be distributed in future years. Where will people move to or move from? Harrison and Hoyler (2015) define the global city-region as a dense polarized mass of capital, labour and social life that are bound together in complex and dynamic ways which can stretch across national or international boundaries. They are formed by the outgrowth of contiguous metropolitan areas together with their surrounding hinterland. The Gauteng City-Region is one such global city-region which serves as a functional unit in the Gauteng province but which includes areas beyond the border of Gauteng which has a functional relationship with the metropolitan municipalities of Gauteng which make up the core of the Gauteng City-Region and as such makes this an ideal region to base this study upon. Literature does exist indicating that primary cities will enjoy slower growth at the expense of secondary cities and towns (Geyer, Geyer Jr., du Plessis & van Eeden, 2012 and Geyer & Geyer Jr, 2015). It remains however to be seen to what degree this is occurring.

Examples of planning are long terms fiscal planning by National Treasury, health care provisioning and in particular child immunization rates by the Department of Health and inputting of a demographic profile for the National Development Plan by the National Planning Commission. At a regional and urban level however planning also needs to take place and at this level the growth of these smaller areas is critical to such planning and to the allocation and usage of resources. Outside the planning environment, academia is also in need of such data for any population based modelling and simulation exercises. Special attention which needs to be given through policy interventions is often being misdirected because of inability to consider data at sub-municipal levels and to take into account spatial trends and variations accounting for such data.

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1.2 PROBLEM STATEMENT

As people get attracted to urban centres for better lifestyles and increased access to employment opportunities the process of suburbanisation is resulting in higher growth in suburbs as opposed to the urban centre. This can result due to the motorisation of urban centres with business districts sprouting up far from the urban centre or due to the saturation of growth in the urban centre. It is critical that resources are allocated to such areas and that such resource allocation is not done in a one size fits all approach. By knowing which areas of a municipality for certain sub-groups are growing more than others, service delivery, retail location, transport networks and the like can be planned more effectively. It is important for various planning activities to have an understanding of migration dynamics in terms of origin and destination particularly for the Gauteng City Region because this is the area within South Africa which attracts most migrants.

The competition for scarce resources such as employment and labour is not uniformly distributed throughout the country or the city-region and hence identification of growth areas at a small scale are critical to identify developmental and planning paths.

1.3 RESEARCH AIMS AND OBJECTIVES

This study hence aims to explore the differential patterns found at both person and household level disaggregated to ward level in the Gauteng City Region. This is done because the city-region represents a functional region which includes all areas which due to their proximity has a functional relationship with Gauteng and with its core metropolitan municipalities. These functional relationships can include trade but also represents the market for various products as well as the sphere of influence that the central core areas have on those areas outside such a core. By determining population growth for each ward in the Gauteng City Region different growth categories can be created. These groups are based on the standard deviation measure. This measure also allows for 6 groups to be identified provided that the distribution is normally distributed and these are hence groups which are statistically and not arbitrarily defined. For those wards beyond 2 standard deviations of the average growth, these can be considered the super growers (positive) or super decliners (negative). This represents all scores (of growth) which cover 95% of the distribution of all scores in a normal distribution. Between one and two standard deviations either side of the mean would be the growers and decliners and those

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wards within one standard deviation would be the regular growers or decliners. Of course not all wards have incidents of all groups. The study will aim to look at those wards beyond one standard deviation, in other words the growers and super growers on the positive side and the decliners and super decliners on the negative side. Once these groups are determined profiles will be drawn for fast growing areas and slow growing areas respectively by comparing socio-demographic characteristics such as age structure, employment profile, population group make up, migration and other relevant indicators. A similar approach will be taken towards households but in this case household indicators will be focussed on for a household profile. Household growth is considered because households represent the number of service points that municipalities need to service from a service delivery point of view and is therefore critical when dealing with distribution of infrastructural resources. Subsequent to establishing profiles and an understanding of the type of communities that make up the various groups spatial analysis will be undertaken to establish where the clustering of these six groups occur. This spatial analysis will attempt to identify a typology of areas that are exposed to high and low growth patterns.

In short, the objectives of this study are hence,

- to determine areas of fast and slow (or negative) growth in the Gauteng City Region
- Establish a profile for categories for fast growth and slow growth in order to understand its urban makeup and urban form
- to establish patterns of spatial clustering areas of fast growth and slow growth respectively in the Gauteng City Region with the view to understand the dynamics of each of these groups.

1.4 HYPOTHESIS

It is expected that the metros within the Gauteng City Region will in most parts experience high person and household growth and that beyond these areas growth will be concentrated around the intermediate cities and regional service centres that make up the remaining municipalities. The profiling and spatial analysis will be enable the study to identify possible reasons for why growth is occurring where it does.

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CHAPTER 2: LITERATURE REVIEW

2 LITERATURE REVIEW

2.1 PATTERNS AND CHARACTERISTICS OF URBANISATION AND URBAN GROWTH

2.1.1 Urbanisation and Metropolitanisation

The issue of urban growth and changing dynamic of movement of people within the Gauteng City Region touches many issues that is reflected in available literature and which forms the basis for this paper. An initial review of literature finds a scarcity of literature on the topic at hand of person and household growth in a city-region such as the Gauteng City-Region, but a wealth thereof with regards to the various issue that this paper will touch on. Movement of people has been a natural process that has existed for as long as can be recalled as people are driven to better opportunities or to places that offer a better chance to pursue such opportunities. Areas where people chose to reside compared to those where the demand to reside is less, is based on a complex relation of factors that go beyond the scope of this paper, but it remains critical to understand what characteristics people have who move into areas of high growth and how they differ from those who live in areas of low growth or even decline. Furthermore movement as well as economic development is not a static phenomena. They are both dynamic in that they react to the environment in which they occur and over time areas of growth can vary quite substantially. Some of the literature to be reviewed herein will make reference to the impact of economic development on population growth as well as to its spatial distribution thereof. Part of this dynamism refers to the impact that growth in one place has on places around it and it points to questions as to how sustainable continued growth in such areas can be maintained. The review will also point to how does growth manifest itself in other parts of the world and what sets growth in a particular region of the world different from others, for the purpose of any lessons to be learned to be heeded for implementation in our own communities as they develop. Of course, a literature review would not be complete without reference to issues of growth, urbanisation and consequences related to such in South Africa.

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The African continent is experiencing concurrent demographic, economic and urban transitions, all of which connect to and influence the process of socio-economic development (UN-Habitat, 2014). Over the coming decades, rapid growth in urban populations has been projected for the continent, and levels of urbanisation, currently estimated at 40%, are expected to reach 50% by the year 2035 (UN-Habitat, 2014; United Nations, 2014). Within the Southern African region, approximately 62% of the population presently resides in urban areas, and the urban population is projected to increase to 68% by the year 2030 (United Nations, 2014).

Within the Southern African region, South Africa presents a unique set of circumstances which has shaped its urban transition. The country's socio-political economy of apartheid and the colonial periods preceding it significantly influenced the process of urbanisation and patterns of migration within the region. Controlled migration was introduced during the colonial period as a mechanism to curb permanent urban settlement of the black African population who were recruited from surrounding areas to the cities as a part of an urban workforce (Zlotnik 2006). What followed was the formalised system of apartheid that legislated patterns of settlement and restricted the black African population from residing permanently in urban areas (Wentzel & Tlabela 2006). A system of oscillatory labour migration ensued, whereby predominantly male workers would move between urban places of employment and rural homelands where families were accommodated (Gelderblom & Kok 1994). By the end of the apartheid era, South Africa's settlement profile was reflective of government's attempts to curb permanent urbanisation of the black African population (Kok *et al* 2003). The 1990s saw an increase in the proportion of black South Africans classified as urban-dwellers, from an estimated 42% at the end of apartheid in 1994 (Anderson 2006) to a level of approximately 48% in 2001 (Kok & Collinson 2006). Following the release of the 2001 population census results, the level of urbanisation for South Africa as a whole was estimated at 56,26% (Kok & Collinson 2006).

Into the 2000s, it was expected that the rate of urbanisation would continue to increase, and this is supported in South African national data. The most recent United Nations estimate indicates that 64% of the South African population resides in urban areas (United Nations, 2014). Interestingly, and in contrast to the trends observed elsewhere on the continent, there has been a decline in the growth rate in South Africa's urban areas, which is not attributed to decreases in internal migration but rather to decreases in natural population growth in the context of a high infectious disease burden (Turok 2012). Nevertheless, the United Nations

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projects that the proportion of South Africa's urban population will reach 77% by 2050. Thus understanding patterns of migration is all the more significant in this region.

Measurement of urban population and related characteristics is a complex challenge from the official statistics point of view. Various role players have failed to agree on a definition for urban and rural and hence the geo type variable is used which is primarily used to classify enumerator areas into urban areas, tribal or traditional and farm areas. This may result is some urban centres having non-urban parts to it and some 'rural' towns having urban characteristics. Using this typology we get an urban geo type for 62.9% of the country at the time of Census 2011 which compares very closely to the UN figure quoted above.

South Africa holds a dominant position in the region's economy with a GDP of $12390 per capita PPP 2011 (UNDP, 2016), and attracts increasing numbers of international migrants whereby 47.3% of all foreign born migrants reside in Gauteng (Stats SA, 2017; Landau & Segatti 2009). Within the country's borders, levels of migration are high. South Africa's process of urbanisation is driven largely by economic opportunity and the search for employment (Cross 2006; Turok 2012). The Gauteng province (which includes the Johannesburg, Tshwane and Ekurhuleni metropolitan areas) is the most economically productive and accounts for approximately 32% one-third of national economic output (South African Cities Network, 2011; Turok 2012). The Cape Town and eThekwini municipalities follow with collective contributions of approximately 20% of national output (Turok 2012). In correspondence with levels of economic productivity, employment opportunities and earnings are also concentrated in the country's more populous metropolitan areas (South African Cities Network, 2011). It is then not surprising that these regions are also the most attractive destinations for internal migrants.

National data confirm Gauteng as the most attractive province for migrants, with positive net migration observed in both the 2001 and 2011 population censuses (Statistics South Africa, 2012). Although at a considerably lower level, the Western Cape consistently demonstrates positive net inflows of migrants from other provinces (Statistics South Africa, 2012). While the dominant flows in the country are in the direction of the large metros, the National Development Plan highlighted that approximately 78% of migration from rural areas and smaller towns was directed towards similar settlement types (National Planning Commission, 2011). Furthermore, there is evidence that patterns of temporary migration, a legacy of

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apartheid's labour migration system, have persisted and migrants often keep a foot in their rural origin areas following a move to the city (Collinson *et al* 2007; Hosegood *et al* 2005). Migration in these instances operates as an important livelihood strategy to maintain rural homes through remittance income (Casale & Posel 2006). Within South Africa, migration streams are becoming increasingly feminised as more females seek employment opportunities in urban and surrounding areas (Collinson *et al* 2006; Posel and Casale 2003). Thus contemporary patterns of movement within South Africa are diverse. The questions of who moves, at what distance, to where and for how long are all pertinent in this context.

South Africa's National Development Plan (NDP), which presents a vision for South Africa for 2030, emphasises the reduction of poverty and inequality as critical for South Africa over the coming decades (National Planning Commission, 2011). In order to achieve this vision, a set of priorities are articulated. These focus on, amongst others, the promotion of economic development and the transformation of human settlements (National Planning Commission, 2011). Economic development requires job creation and more integrated rural participation. The urban expansion may be viewed as a positive force, but improving infrastructure and service delivery, and in particular conditions in informal settlements, are policy imperatives (Turok 2012). These changes cannot be effected without a sufficient handle on South Africa's current population trends and settlement patterns.

Urbanisation and urban growth are concepts often use interchangeably but which have slightly different meanings and which are central to this paper. Urbanisation is the process resulting in a larger proportion of the total population living in urban areas where as urban growth is the increase in the population in this urban areas from one point in time to another. It is evident that urbanisation has occurred over mankind's history with the global north experiencing this since the late 19th century when the UK, USA and Western Europe showing significant signs of urbanisation. It is only in the middle of the 20th century that urbanisation began to become more widespread in other parts of the world, including the global south. Between 1950 and 2015 the urban population has increased sevenfold between 738 million to 5.1 billion. Since 1970 most of these urban dwellers have come from the so called less developed regions of the world with most of this growth coming in Africa and Asia. The causes of urban growth are multiple and literature points a lot to migration as well as natural growth in urban areas. It is estimated that between 1975 and 1990 54% of urban growth can be attributed to migration in 24 of the developing countries of the world. Plenty of these moves though are temporary for

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work purposes and it masks migration that occurs in developed countries like the USA where one in five migrates annually, albeit between urban centres (Pacione, 2009)

One of the concepts that deals with urban growth and population growth in general most profoundly is the issue of the demographic transition theory. This is one of the key theories that exists in the study of demography. It assumes human civilization began with high mortality and high fertility rates due to high levels of attrition in terms of health. With the discovery of penicillin and other improvements, especially around public health, mortality rates declined sharply and this led to a rapid acceleration in population growth. In a local context, it could be equated to the health benefits of Gauteng and the Western Cape but it is usually used to describe what occurred in Europe and the USA as opposed to other parts of the world who would follow in later years. As a result of this rapid growth fertility rates began to decline as they currently are declining around the developing world, at least in most parts. This decline is also correlated with general levels of development characterised by high levels of service delivery, employment, income, education and a sophisticated economy that shows consistent growth. The fourth and final phases is one characterised by fertility rates that have declined to the level of mortality rates and below the replacement total fertility rate level of 2.1 and which oscillate continuously at about that level. This in itself brings with it a different set of problems since it is the onset of slower growth resulting over time in negative growth. This negative growth in young populations means that the working age twenty years from then will be smaller than what it is now and this means that the workforce will either have to be supplemented by migrants or the economy will need to become less labour dependent and more innovative in order to grow more with less input. No countries in the global south have reached this stage yet but it is inevitable that countries and even regions need to start planning for this. In Western Europe, Japan, Australasia, USA and Canada this is already a fact of life on how these countries are having to deal with and how best to manage the migrants that supplement their workforce. (Weeks, 2011) In the study area of this paper the demographic transition theory also plays a role in that it explains in relation to births and deaths why population growth is what it is and how migration impacts on the relationship between births and deaths. In the study area, the Gauteng City-Region it could be said that the transition occurred earlier than other parts of the country along with health improvements and access to opportunity to control one's fertility. It became a point of attraction for migrants with the various economic opportunities and this in turn resulted in the importing of more people, mostly young, with their own health and epidemiological profiles which resulted in moderating the growth of the area.

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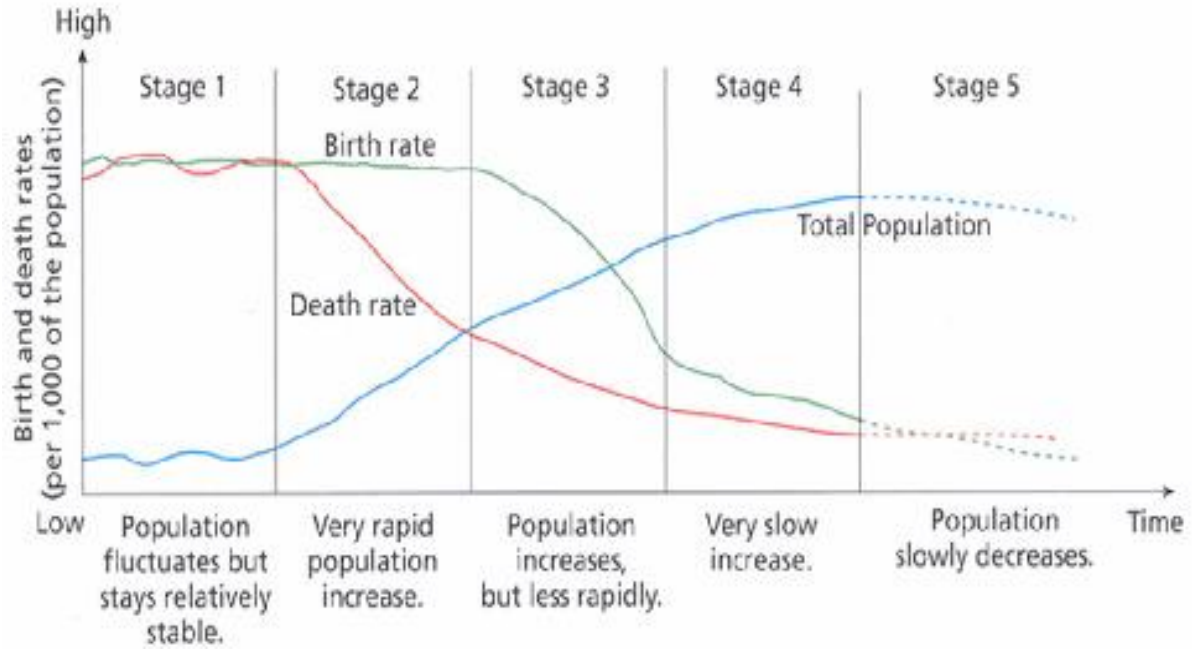
Figure 1 Demographic Transition Model and Population Growth



Source: General Certificate for Secondary Education – Geography Unit 2 [n.d.]

Alongside this theory of demographic transition is Zelinsky's (1971) theory of Mobility Transition which operates in a similar way depicting a transition from a traditional society with no movement of people other than that required to fulfil social functions and obligations. This phase is followed by an early transitional phase whereby massive movements from the countryside to cities is found alongside movement to colonial frontiers in lands that may be available but not necessarily attractive ones. This phase also is the beginning of various types of circulation of human mobility showing prevalence. In the third phase of a late transitional society, the movement from countryside to city continues although at a lesser pace as does the outflow of people to the colonies as well as to foreign lands. There are increases in more types of circulation which become structurally more complex. The fourth phase is one of an advanced society whereby residential mobility has reduced and oscillates from time to time as well as the movement from countryside to city which has reduced even more. There is now the onset of immigration of semi-skilled and unskilled people from underdeveloped areas as well as movement of people from city to city. International migration does begin to show more movement of skilled and professional persons but the quantity and direction of the flow depends on the country concerned. The circulation that has been building up to now is accelerating especially that related to economic and pleasure oriented movement as well as others. The fifth and final phase of super advanced society is characterised by reduced

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residential mobility as well as circular movement due to increased and improved communication and delivery systems are introduced. The little residential migration will be inter-urban and intra-urban in nature. Further unskilled labour is possible from underdeveloped parts of the world. Further acceleration of circular movements is expected along with the introduction of new forms. This phase however introduces political control or management of international migration. (Pacione, 2009)

This onset of migration control at international level is far more explicit than that dealing with internal migration which will concern this paper more. Policy may take any of four forms in dealing with migration. It may firstly be negative whereby migration and migrants are declared undesirable and barriers are instituted to discourage such movement. The second is that of being accommodative whereby migration is deemed inevitable and so various programs are introduced to minimise its impact at origin and destination. The third type of policy response is manipulative whereby it sees migration as inevitable and even desirable but tries to deflect it to other regions and the final policy intervention to manage migration is that of being preventative by addressing the reasons for migration by tackling joblessness, poverty and instability at the source and making the destination appear to be less desirable than what it is. (Parnwell, 1993)

At a city region level the above policy measures can manifest themselves in various ways. Policy tries to be accommodative by planning for continuous inflow of migrants and ensuring that services such as education, health and household services exist for the increased demand that will exist. In some cases a manipulative approach will occur whereby migrants to a particular saturated region will be encouraged to go to another part of the city-region where opportunities in another industry or facilities to accommodate such migrants may exist. Ultimately migrants will move to where such opportunities for better living exist for their given skills, even when discouraged from doing so.

A study by Elliott (1997) that deals with population and inter-county migration that reveals localised deconcentration which is a common sub-process of metropolitanisation. It is important to note that metro based migration is dependent on local patterns of metropolitanisation. Since the 1970s there has been a pattern of people moving away from the large metropoles in the US to non-metropolitan counties and vice versa. It has been suggested that metropolitan areas may have reached saturation point even though three quarters live in

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them they have not ceased to develop. Upon saturation it may result in people settling in the larger megalopolis or in intermediate towns and cities. As metropolitan areas mature it is posited that they deconcentrate to surrounding suburbs and thereafter to distant metropolitan areas or peripheral areas. The urban life cycle model which attempts to show a transition from urbanisation to deconcentration fails to explain the phenomenon which occurs in the US since the 1970s. With regards to differing migratory experiences for metros that experience different phases of this phenomenon the relationship with nearby non-metropolitan areas is key. Non-metro to metro migration is hence not as chaotic as suggested but deconcentration from metro is likely to persist and this deconcentration is likely to manifest itself by deflecting populations to distant metros and non-metros.

Closer to home work done by Ginsburg et al (2016), based on Census 2011 and the Agincourt Health and Demographic Surveillance Site (HDSS) used migration flows between five settlement types (metro, secondary city, large town, small town and rural) using the former and an analysis of permanent and temporary migrants using the latter. These HDSS form part of what is known as the INDEPTH network. This is a group of similar surveillance sites in the developing world which monitor health and demographic outcomes in geographically defined areas that contain a specific characteristic. In the case of the Agincourt HDSS in Mpumalanga this is characterised as one in a fairly dense rural settlement close to a border community. The value of considering a HDSS for a study of this nature is that it takes into consideration amongst other things mobility of people from catchment areas of those moving towards the city-region in question for this study and is able to add value around movements at a small area level. Ideally the HDSS should be in the City-Region but as Ginsburg et al indicate in this study of changing settlement patterns there is value in understanding the nature of movement of people.

An analysis of internal migrants between the abovementioned five settlement types shows high prevalence of migration from metro to metro, a shift from metro to all other types of settlements as well as flows and counter flows between all settlement types. The Agincourt HDSS is made up of 32 villages making up over 100 000 people. The area is a rural, dense settlement made up in the area of the former Bantustan of Gazankulu where 31% are Mozambican immigrants who are mostly self-settled former refugees. A HDSS is a population registration system which monitors health and demographic dynamics in a geographically defined area. It does however discern its migrants as being either temporary or permanent. In this case a temporary migrant is one who is away most of the time but has a significant link or relationship to their base household. A permanent migrant is one who leaves a household with a permanent intention.

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An analysis of these two types of migrants shows that temporary migrants go mostly to the main metropolis whereas permanent migrants go much closer from their former base to nearby villages. The findings show that from Census the metros are still the most populated and significant origin and destination for internal migrants. The HDSS site shows that a sizeable proportion of migrants in contemporary South Africa are temporary, with strong links to their base household. Triangulation between these two sources show that metropolitanisation is a key finding at national level but that a lot of this urban-ward movement is temporary. There is no doubt though that these are the genesis of signs of counter-urbanisation and of structural interdependencies between rural and urban areas and this should be taken cognisance of when it comes to spatial planning. It is a key concern, by means of example, that funding from National Treasury is given to a province like Gauteng because that might be where a migrant goes to work but when that person is ill and in need of medical attention, the person goes back to their province of origin which would be elsewhere and which has not received funding to cater for such a person. Even at a regional or local level, when aggregated this can be a consequential shortfall of funds needed to deliver a particular service.

2.1.2 International experiences of Urban Population Growth

Levels of urbanization in other parts of the world are important to consider for purposes of comparison. In Latin America a study of levels or urbanization in Ecuador, Peru, Colombia and Bolivia was conducted by using Census data and level of night lights. The level of urbanization is of course dependent on history as well as level of economic development. In 2009 the world's urban population passed the rural population for the first time in history (UN, 2010). By 2030 it is estimated that 60 % of the world's population will live in 0.6% of the terrestrial area of the earth's surface. This should amount to approximately 8 billion persons by this time. Urban population growth can be a cause of climate change but it also presents an opportunity to centralise infrastructure, technological innovation and economic activities. Rates of urban growth vary amongst countries, and this variance is due to its history and level of economic development (Bocquier, 2005). Zelinsky's (1983) mobility transition theory is key in explaining the change of from low level of urbanisation to higher levels thereof such as is the case of the 4 countries concerned in this study. These four countries has increased their urban population rapidly from 37% to 74 % urban from 1950 to 2010 and the different forms of urban growth are important to understand. Along with Census data, night time light (NTL) was used as an indirect form of measuring urban growth. The rapid urban growth in Latin

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America requires that housing and basic services be provided for such a population. These countries are typical of those experiencing rapid urbanization as well as those attempting to meet the social and service delivery related demands of such countries. Countries whose urban growth has been in existence for a long time find lower urban population growth and reduced levels of urban expansion whereas countries in the early stage of urban growth are expanding faster as a result of this growth. (Alvarez-Berrios et al, 2012)

Population growth in Australia is analysed by McGuirk and Argent (2011) with the view to provide affordable housing, employment, infrastructure and services and managing anxieties around urban diversity and densification. In rural areas issues around depopulation, demographic decline and ageing all contribute to growth management issues. These issues related to depopulation mentioned above can be pointed towards employment and housing particularly with an ageing population as well as their associated environmental constraints. Dealing with these challenges equates to the main growth management priorities for what is a 'big-urban' Australia and how these will help its economy to grow. When dealing with the phenomenon of population growth, it is often very tempting to look at the national picture and contemplate the consequences of it over the long term without even pausing to think of regional variation and differential consequences of such growth. In a country like Australia that inhabits a thin coastal strip planning for growth by rolling out further infrastructure and service is critical. This paper shows relevance to this research being conducted by highlighting the importance of spatial research in formulating inclusive and integrated spatial planning even if the contexts are different.

As a final experience of urban growth, Perry (2002) looks at population growth in the USA from the 2000 Census since the growth noted in the preceding decade was the greatest in recent times across more states, regions and counties than ever before. This paper aims to unravel new patterns of growth in the US in order to establish a new population distribution across the USA. The 1990s, as highlighted in the 2000 Census, showed growth in every single state of the US, something that had never previously occurred. A main finding is that the US is shifting to the South and to the West as well as to and within metropolitan areas. From 1950 to 2000 the percentage living in Metropolitan areas increased from 56% to 80%, however in the metropolitan areas the growth is in the outer region of the metropoles, either outside the central city or in outlying counties, similar to that described in differential urbanisation. This is a focal point of this research paper and the spatial analysis component will attempt to explain which

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factors dominate or explain growth and which don't. Most relevant to this thought is the question as to whether the inflow of migrants or the youthful age structure that growing populations are associated with is a universal phenomenon or whether it is localised towards certain areas of the city-region. As mentioned, movement has occurred to the South and to the West. Between 1950 and 2000 the percentage of the population residing in Southern and Western cities of more than 100 000 increased from 20% to 29% whereas those in the North-East and the Midwest declined from 36% to 23%. The consequence of this has been the establishment of various new cities in the south and west and it would be of interest to spatial planning if these patterns were to persist.

2.1.3 Urban growth and its effects in Africa and South Africa

The final part of this review deals with issues of urban growth in South Africa as well as the African continent at large where most of the urban growth globally is due to take place over the medium term. A study by Becker and Morrison (1988) shows that Sub-Saharan Africa urban population growth in the 60s as well as from 1970-1982 has been outstripping that for low income countries quite comfortably. Proportion of Africans living in Urban areas in this period doubled from 11% to 22% whereas for low income countries it increased from 17%-21%. Unfortunately, this growth did not come along with the structural transformation associated with urban growth required to benefit from such a change. By means of comparison in manufacturing, middle income African countries compared favourably with other middle income countries from around the world but with regards to low income countries their growth in manufacturing was dismally low below the global average for low income countries. On the African continent no discernible pattern is visible between food production and exports on the one hand and urban population growth on the other, with some countries showing low output and high growth, high output and low growth and in the classic case of Botswana, high output with high growth. With no discernible pattern evident an analysis of various factors that explain urban growth needs to be undertaken in order to see if economic factors can indeed explain the notion of urban growth. This study by Becker and Morrison (1988) finds a wealth of literature in microeconomic determinants of migration but few such in macroeconomic studies and these needs to be understood especially when they can be influenced by public policy. The study finds only 8% of urban growth can be explained by the urban employment growth rates and secondly that public policy matters by means of rural growth policy which limit rural push factors and results in reduced urban growth. Agriculture is a key industry in the sense that it

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redirects population movement to secondary cities in addition to the welfare benefits which it provides. Government policy to promote urban production also matters but less so than the priority of improving rural lives. (Becker & Morrison, 1988) This research is of relevance to the research study being under taken because it considers the impact the public and economic policy has towards urban growth but also towards improvement of rural livelihoods which may moderate the movement of people to more urbanised areas which are exposed to a modern economy. One of the migration management policy options discussed earlier indicated acceptance of migration but trying to minimise it by addressing some of the factors causing people to leave one area for another. This is a key example of such a strategy which also attempts to deflect such movement to secondary cities.

Finally as indicated above, there are social consequences to urban growth and densification. In South Africa, there is also the added dynamic that movement to urban areas is taking place more so by woman on their own and this of course creates an added dynamic of meeting the unique health needs of women migrants as a result of such movement. Pick and Cooper (1997) show that historically migration to urban centres has been male dominated. In subsequent years especially after the abolition of influx control and the transition to democracy migration has involved women considerably more. Census 2011 indicates that approximately just under half of all migrants to Gauteng were female. The women who do migrate to the cities are not by any means socially isolated. The main difference between new arrivals to the city and those who have been there for a while are the latter's establishment to be active in civic organisation. Many of the new arrivals are mostly young women who leave rural areas and in most cases their strongest social support, their parents. In this regard this means that child care is a critical concern since the traditional child carer is now far away. With regards to dominance of a male partner in decision making in the household is circumvented by many such women choosing to remain single and it is expected that patterns of male dominance will change over time. Urbanisation does have a profound effect on the fertility pattern of women. Generally speaking, urban populations can grow principally from migration but also because new in-migrants bring with them their fertility patterns and regimes which take time to change to that of their host urban counterparts as a result of lower infant and child mortality rates in cities. Urbanisation also brings with it better awareness of health concerns such as AIDS and cervical cancer as well as health services available for the treatment of these and other conditions. It is hence to be expected that better child and reproductive health outcomes can be expected as migrants enjoy the benefits of urban health services. This study shows us that migration in the form of

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urbanisation is upon us and there is no wishing it away. The feminization of migration is also a reality that needs to be taken into account when planning for the inflow of people and or urban growth. The traditional roles of women are also being left behind since they and their children are no longer being left behind as was the case when men were the ones moving away from their place of origin. This means policy must be directed in a balanced manner towards the neglected rural areas as well as the transfer of poverty from these rural areas to urban areas. Government must be prepared to deal with the double spectre of dealing with urban poverty as well as providing services to urban residents (Pick & Cooper, 1997).

2.1.4 African Migration trends

It is commonly perceived that African migration is directed towards the European side of the Mediterranean Sea and that it is driven by poverty and violence. Thanks to the Global Bilateral Migration Database (GBMD) at the University of Sussex we are able to ascertain the flows of African migrants more empirically. It is found that African migration mostly intra-African with this making up 75% of all African migrants, with only 16% going to Europe. The decline of intra and extra continental migration between 1960 and 2000 can be attributed to the end of colonialism and the rise of African nationalism as key factors. Further analysis of the data shows that migration from the poorest African states, which are mostly landlocked ones are movements of mostly short distances and that countries with higher levels of development experience more migration to destinations outside of Africa. Africa is hence a very modest contributor to extra-continental international migration. It is found that higher education, income and access to information all increase the ability to migrate. (Flahaux, 2016; de Haas, 2011) With regards to the Gauteng City-Region this is important since these trends explain that movement of foreigners into South Africa and into Gauteng in particular are based from Africa and are based on movements of short distances. Similarly within the ambit of internal migrants it is considered that migrants into the city-region are based on proximity and may be based on movement within the city-region but also based on movement from neighbouring municipalities to the city region, hence the identification of such movements in the analysis phase of this research and do differentials such as education, income and access to sources of communication matter. With regards to South Africa, data from the 2011 population Census shows that 2.1 million international migrants resided in South Africa at the time of Census, equating roughly 4.2% of the total population. Of these 68% came from the SADC region of which 45.5% came from Zimbabwe, 26.2% from Mozambique and 10.9% from Lesotho. Just

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over half (52%) resided in Gauteng. (Statistics SA, 2015b). These findings tell a similar story to that of the GBMD in the sense that an overwhelming amount of the migrants in South Africa come from nearby and that the movement of people from far away countries is more the exception than the rule.

Further afield, post-industrial order in USA led to change in spatial structure of communities. Scholars showed relationship between societal development, urbanization/metropolitanization and migration. Hence the rate, direction and character of migration flows reflects the stage of societal development and its system of urban agglomeration. Long (1985) suggested that higher socio-economic development stimulated migration which changed the pattern which changed spatial settlements in the nation. Differences in development between the core and the periphery will lead to a new labour and capital mobility, that is, migration streams of people driven by the pursuit of labour and capital interests. (Wilson, 1988)

In addition to this Beukes et al (2014) suggests that between 1996 and 2011 there was the youth aged 15-34 migrated out of a distressed rural and traditional areas towards urban areas. This can be as a result of a reaction to the collapsing of apartheid laws which restricted people's movement. In spatial terms city regions including the Gauteng City-Region have received an influx of young people as well as regional centres in the City-Region such as Rustenburg and it is evident that most of these youngsters are coming from Limpopo, Eastern Cape and KwaZulu-Natal. The National Income Dynamic Survey (NIDS) which is a nationally representative longitudinal study found most migrants are between 20 and 30 and that the highest proportion of labour migrants (29%) come from KwaZulu-Natal whilst Gauteng is the preferred destination for all types of migrants (Clarke et al, 2014). From a household perspective, households are growing, in places at a faster rate than the population and household sizes are getting smaller. The aforementioned youth migration results in single person households as they move from place to place. This increases the number of households but it also contributes to the decreased size. It is most likely that these households are unstable and that the person constituting it is unemployed and more vulnerable than the parent household forcing these households to live off grants. Todes, et al (2010) indicates that they may find themselves in temporary accommodation as well as informal accommodation from which they struggle to get out of. Moreover the increase in households provides challenges for service delivery particularly in places with a weak or declining economic base (Van Niekerk, et al, 2014). From a gender perspective, Posel (2006) and Ardington (2014) found that women

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receiving an old age grant are more likely to share some if it with the household and to take care of children which allows other women to migrate in search for jobs. These trends have implication for family composition and for the ability of children to migrate to urban areas if their mother and father are already there (Grieger, 2014).

2.2 DIFFERENTIAL URBANISATION AND URBAN DEVELOPMENT CYCLES

2.2.1 Differential Urbanisation

Geyer et al (2012) have developed the theoretical framework around the concept of differential urbanisation. In this regard location of different land uses of the four largest metros in SA shows strong signs of decentralisation from the core to the metropolitan fringes. Strong centrifugal patterns are at play linked to decentralisation and deflected urbanisation at a regional level. This has resulted in the perpetuation of the post-apartheid city and the strengthening of the multi-centric urban framework of the four metropolitan cities. In addition to this population deconcentration began to become a feature in the early 1970s (Beale, 1975; Berry, 1976). As this phenomenon occurred in other parts of the world it was clear that it was due to consecutive phases of urbanisation and counter-urbanisation. These two process indicate that polarisation reversal must have taken place at some point. This occurs when forces of agglomeration in primary cities give way to deconcentration resulting in population and industry moving to within an arm's length of large urban centres. In South Africa, apartheid still has an impact on income and ethnic migration differentials due to the cost of migrating as well as the desire for people to live amongst other people similar to themselves. Homogenous economic geographic models hence are not applicable to a heterogeneous makeup such as South Africa. The differential urbanisation model is a combination of spatial economics and migration theory which link the abovementioned concepts of urbanisation, counter-urbanisation and polarisation reversal. This comes to light more clearly when the population is broken down by age or population group or any other sub-group. Nationally the narrative is that urbanisation has led to increases in population in urban centres but this in turn has led to decentralised urban development in the four major metropoles and the related population growth in satellite cities functionally linked to the major urban centre.

The differential urbanisation model when disaggregated down to regional and local level assists in explaining contradictory migration trends. The high densities on the periphery of

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primary urban centres represent a new phenomenon in urban and spatial development and this is manifested by environmental-driven migration from inner cities and productionist-driven deflected urbanisation to these metropolitan fringes. Although urban management policies are directed towards densification of the inner city, it is clear that despite efforts to promote it, it is not happening at the rate and scale envisaged by such plans. Reasons for this vary from high cost of land in the urban centre, low friction of distance of transport costs to congestion spillovers and environmental quality of location. (Geyer et al, 2012)

A subsequent paper to the above by Geyer et al (2014) applies the above theory to long term (1996-2011) migration patterns and issues of industrial agglomeration as a result of regional economic development and dynamics. Furthermore by breaking down population into subgroups it is able to understand contradictory mainstream and sub-stream migration flows based on differential urbanisation theory. Mainstream, productionist migration comes from mainly the lower skilled and black sub-population whereas counter stream environmental migration is coming from mostly, skilled, employed and white population. It would appear that different sub-populations are moving towards a more evenly and less spatially fragmented urban landscape. Redistributive policies related to social welfare, housing, education and basic services have amongst other factors resulted in different urbanisation patterns. Major cities are still experiencing strong net urban growth as well as rural-urban flows although at a declining rate. This DU model provides a spatial framework from which the regional side effects of specific policies and socio-economic trends on different population groups can be empirically measured. At an aggregate level population migration and industry agglomeration seem to take on a normal urbanisation pattern but when disaggregated migration patterns of people and agglomeration of industry seem to take on a more nuanced and differentiated pattern showing both concentration and deconcentration patterns. Migration to the cities still exceeds that to intermediate amongst the black population for economic reasons. However the growth of intermediate cities points to social motivations for migration within this sub-population. A similar thing is seen amongst the lesser skilled sub-population group. Even if we look at white and/or highly skilled people where a counter-urbanisation pattern exists, it is clear that different migration motivations are resulting in differential migration patterns for different sub-populations. It also appears that environmental-oriented motivations and production-orientated motivation may result in different spatial effects on different sub-populations, resulting in spatial differentiation of South African cities. As an equilibrium of migration patterns is

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reached it would however appear that the spatial landscape is moving in the direction of a less fragmented society.

2.2.2 Differentials and Characteristics of Urban Population Growth

High population growth is traditionally associated with high levels of dependency which is detrimental to economic growth. This is because such population growth is associated with growth at younger ages and such increases are contrary to any benefits related to the demographic dividend. Others (Lenski et al, 1995) believe growth equates to increased labour force which is a positive but this is clearly directed to growth in the working ages. The paper by Crenshaw (1997) posits that increase in child population relates to the former whereas adult growth relates to the latter.

Early demographic and economic literature usually takes the Malthusian approach that population growth hinders economic development yet after industrial revolution it was thought that population growth actually spurs economic growth. Crenshaw goes forth to investigate this looking at age specific growth rates so that it can be ascertained if this group is amongst working age people or not. By shifting economic growth back in time it is possible to test this by seeing which age of the population is the one growing. Impact is such that growth of children has a detrimental effect on economic development to the extent that if economic growth was equal for those below age 15 and those over age 15 that the latter would not compensate for the former as is the case in almost all economies. It was also established that a stationary population has no economic development benefits. Demographic transition theory explains economic outputs of growing populations and changes from country to country. Also relevant is what happens to economic growth when a baby boom comes along in terms of stagnation of such growth. (Crenshaw et al, 1997)

Goldstein and Mayer (1965) indicate in their study from the mid-1960s that the metropolitanization that occurred in the USA in the 20th Century is characterised by the proportion of its population in metropolitan areas increasing from about 33% in 1900 to about 63% by 1960. Another characteristic is the movement of people from the centre to the suburbs whereby growth in the centre between 1950 and 1960 was only 11% whereas in the suburbs it was 49%. The dynamic includes a combination of centripetal forces from outside the metropolitan area along with a centrifugal force to the suburbs away from the central cities and

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a differential natural increase. Studies showed that in early metropolitanization those moving out of the central cities to the suburbs represent a very selective segment of the population which over time became more diversified. The study by Goldstein and Mayer in the state of Rhode Island shows there are demographic differences in the makeup of suburban residents as opposed to central city residents but these differences are differences of degree and not of uniquely different populations and this is regardless of class differentials. Although a study of this nature is considerably old, the findings do find resonance with regards to the proposed findings that this paper intends to achieve.

One of the issues that society needs to deal with in as far as urban growth and densification go are the social consequences thereof. Studies on child health show better health outcomes in urban over rural areas due to better income levels and education. Further to that densely populated areas have better access to health services for children. However density also brings its problems when insufficient and inefficient sanitation results in spread of disease resulting in child mortality and child stunting. The study by Goldstein and Mayer finds that the interrelationships go beyond dichotomous view of urban vs rural but looks at cases where density results in good or bad health outcomes. The study also looks at spillover effects of poor sanitation on the community. From a spatial perspective the study also highlights the need to understand where poor sanitation is occurring so that policy interventions can be suitably directed. (Coffey & Hathi, 2017) This is of particular relevance to this study since it is one of the stated objectives of this study to understand the spatial characteristics of something such as sanitation and how it manifests across urban vs rural space or high growth vs low growth areas and that often differences in this regard are not as clear cut by lying on one side of a divisive line but that the spatial characteristics determining the differences in its outcome can be far more complex and nuanced than something like that.

Health is as mentioned above, one of the major concerns when an area has a population that becomes dense despite the benefits of densification. In developing countries these include wealth, level of schooling and of course better access to health services. However inefficient sanitation in such areas leads to open defecation which is a reason for health concerns which lead to infant and child mortality as well as child stunting. These arguments go beyond a simple dichotomous urban/rural distinction but describes the way in which densification is either positively or negatively associated with health outcomes. It is also considered the extent of spillover effects of poor sanitation in one household and the impact it has on that of the

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immediate community. The study finds that the health benefits of densification are negated if there is poor sanitation. The combination of dense populations with poor sanitation is very detrimental to early child health. In this regard from a policy perspective in areas where sanitation is poor priority should be given to areas where population density is highest. (Hathi et al, 2017)

One of the objectives of this paper is to determine patterns and characteristics of growth at small areas in order to make targeted interventions. Characteristics of places with growth patterns are important to understand what growing places look like and what they relate to. In the study by Fuguitt and Field (1972) characteristics of villages are looked at in terms of their socio-demographic characteristics as well as the relationship between location to larger towns and industry. Many similarities occur between these villages and larger places. The relationship between industry and growth suggests that location is closely related to function. Towns can either serve as a place from which commuting to a large centre can occur or for those that are more distant they serve as service centres in the rural hinterland. The classification of communities allows us to see interrelationships with cities so that we can understand community structure. For the purpose of the study by Fuguitt and Field (1972) availability of data was a concern for small communities however in South Africa in the current age this data is available provided that issues of confidentiality are adhered to. Various studies referred to by Fuguitt and Field indicate the importance of population size as a criterion in determining a place to be urban or rural and change thereof is important in determining level of urbanization. Locality is key in determining relationships with places around it in a system of cities. Rural community studies have focussed on interdependence with small towns surrounding them and their dependence on the bigger towns. Fuguitt found that in larger towns there were more people residing that belonged to the labour market. Villages growing 5% or more as opposed to those growing less than that or even declining had an age structure with more people under 15 and less over 65. Growth is a key indicator since it is in these places that economic opportunity and employed people are most likely to find themselves. The small villages play an important role in terms of their structure, characteristic and functional relationship with those areas around them. Although their size is small and they are getting smaller and facing profound economic difficulty the study of them remains an important part of spatial analysis. This study shows relevance towards the Gauteng City-Region in terms of the relationships between the smaller towns in the city-region and the prime urban centres such as Sandton, Centurion and the East Rand amongst others but it also finds resonance in the dynamic

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relationship that the key characteristics that small towns have and how they are related to their spatial location.

2.3 STAGES OF URBAN DEVELOPMENT

An important contributor to this discussion of urban change is provided by Champion (2001) who describes how the transition regarding urbanization and urban change has occurred over the years from urbanization which was seen as the concentration of population into towns and cities and the concentration of the population into such cities' core at the expense of its periphery. Put in alternative way, it is also seen as the way in which large size cities attract proportionally more migrants that intermediate and small sized cities. The most extreme form of this is in cases whereby major cities in a rank size settlement pattern were up to six times larger than the second largest city, such as the case of London compared to Birmingham. This phase is follow by one of suburbanisation which originated with the building of large homes by wealthy entrepreneurs on the outskirts of highly populated centres. This accelerated as a result of changes to transport networks and accumulation of wealth. This resulted in being the dominant form of urban change in the 1960s across most of Western Europe. A separate but related phenomenon is that of polarisation reversal which was coined by Richardson (1980) based on urbanization and counter-urbanizatiom theory which have some commonalities between each other. It is defined as that point in time when spatial polarisation of the industrial location in the economic core gives way to spatial dispersion to locations in the inner periphery. It also signifies the beginning of a regional wave of deconcentration which over time results in a national migration pattern of counter-urbanisation. This concept of polarisation reversal is very relevant to the discourse around differential urbanisation discussed above. It is further postulated by Geyer and Kontuly (1993) that cities go through a cyclical phase or urbanization to polarisation reversal and counterurbanization starting with primate cities then intermediate cities and finally small cities going through the cycle before cycle repeats itself again.

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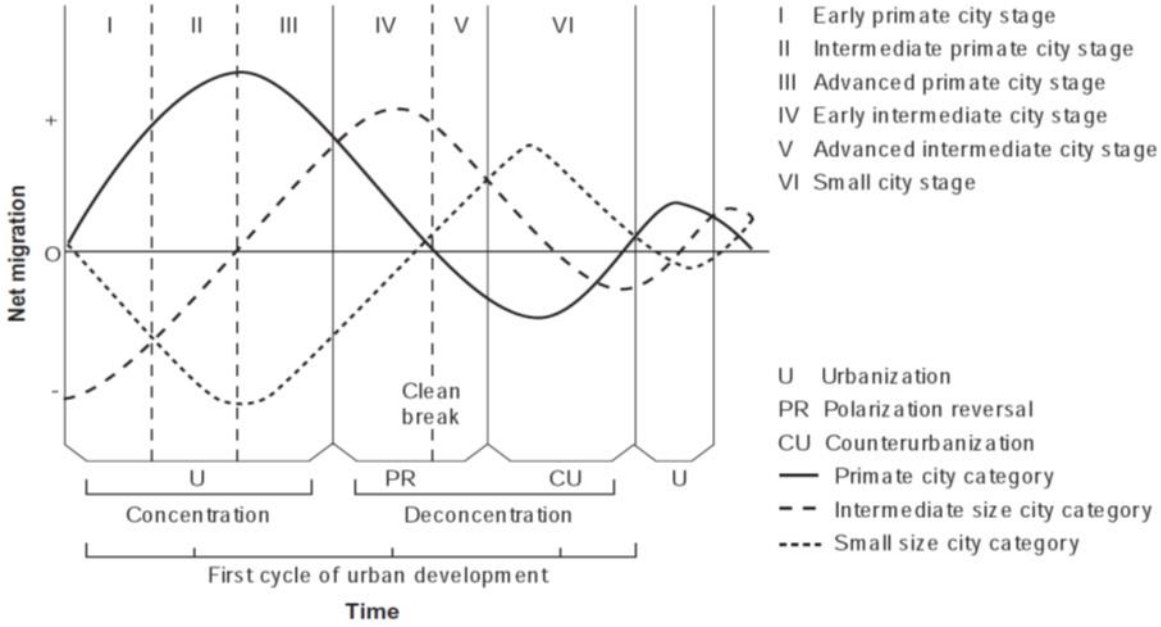
Figure 2 Concept of differential urbanisation



Source: Geyer and Kontuly: 1993 in Champion (2001)

Figure 3 Relationship between migration and settlement size

Source: Fielding (1982) in Champion (2001)

The figure above show the relationship between net migration and urbanization (a) and counter-urbanization (b) which forms part of the above cycle as well as part of Champion's typology of urban change. Suburbanization forms part of the movement away from the core in preference of the periphery, whereas counterurbanization can be argued is either a different phenomenon or an extension of suburbanization. This all depends on the growth of smaller cities and on the reasons for people moving towards smaller cities and the appeal of their characteristics. In as far as the differential urbanisation model is concerned, the system goes through a transitional phase of polarisation reversal described above, where the intermediate size city overtakes the

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primate city in terms of migration growth before reaching the counter-urbanization phase whrein the small city category becomes the strongest growing, as seen in figure 3. The final phase of reurbanization is one associated with the slowing of the urban-region decline which is initiated by the core and followed by the periphery and involves a process of renewed centralization. Reasons for this process of reurbanization are quite varied and is still the subject of research by urban geographers. Advanced economies have moved to a situation of beyond urbanization whereby urban trends are repeating themselves but with a new and evolved context. Urban systems of today are very different to those of 50 years ago and that changes that were foreseen are a mosaic of growth and decline due to success and failures of people to adjust to opportunities in various circumstances.

With regards to the Gauteng City-Region this discourse finds much relevance in terms of how urban trends have evolved over time and whether developments on the ground have resulted in growth spurts or nodal centres which have altered the urban growth patterns and how such spatial patterns have manifested themselves. It is also relevant in terms of the cyclical form of city development that Kontuly and Geyer illustrated for the core of the city-region and the surrounding areas around it which have developed due to development of various industries.

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CHAPTER 3: METHODOLOGY

3 METHODOLOGY

3.1 GENERAL APPROACH

In order to fulfil the objectives of this study an approach that combines a descriptive and spatial analytical path was taken. To this end, growth rates for harmonised wards using Census 2001 and Census 2011 were used to identify electoral wards that are growers and those that are decliners. It is important to note that all data was harmonised to the 2011 electoral boundaries so that when one speaks of a particular ward in a given municipality that we are referring to the same geographic space for both points in time. It is prudent to mention at this point that 1996 Census was not considered because the ward delimitation was not contiguous resulting in various wards in 1996 with blank values. Furthermore, the 2016 electoral boundaries for the 2001 Census were not readily available and hence the 2011 boundaries were used.

3.2 RESEARCH DESIGN

The analysis for this study comprises of two parts. The first is the descriptive part which will describe the data at hand by means of cross tabulation and correlation analysis after having categorised data according to standard deviation measures. The second part of the analysis is a spatial analysis which uses spatial statistics techniques to identify trends and relationships at a spatial level based on growth and factors which determine it.

The identification of the fast growers and slow growers will be done by applying cut off points that lie within two standard deviations of the mean growth for the study area in either direction. This was done for purposes of the descriptive analysis by using the technique of visual binning in SPSS. This process calculates the cut off points for one and two standard deviations from the mean for each variable. For the *person_growth* and *household_growth* variable percentage of growth was used. For all other variables numerical values were used. One of the main shortcomings of spatial research is that distributions are produced based on raw numbers do not take the denominator into account and maps are created regardless of the size of the denominator in the area concerned. For this purpose growth percentages are used for each ward

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instead of the number of persons or households by which a ward grew in order to create a more relevant measure. Other variables used numerical values so that the categorisation by standard deviation could be used consistently. For the purpose of the spatial analysis however, the ArcMap software from ESRI which includes spatial analysis techniques the cut off points were calculated by selecting the standard deviation method of classification under graduated colours and graduated symbols and it was on this basis of classification that clustering and hotspots analysis was done for households and persons separately. In the case of this spatial data analysis, percentages were used for all variables in order to avoid a situation whereby all variables would have the highest count in areas (wards/municipalities) with the highest population, instead of showing proportions per geographic unit.

It is necessary at this point in time to discuss the limitations of such processes related to the use of standard deviations. Once data was sourced the task of grouping each variable into categories began because it would make very little sense to tabulate data by individual values which were all unique. The premise of this categorisation was that they should not be made by the researcher but be determined by a statistical technique which this paper already determined to be the standard deviation.

When dealing with issues related to the normal distribution and standard deviations, the concept of a Gaussian distribution must be considered. This is best explained by the so called 68-95-99 rule which indicates that 68% of all cases will lie within one standard deviation, 95% of all cases will lie within two standard deviations and that 99.7% will lie within three standard deviations. All this however depends on the proviso that the distribution of cases must be normally distributed. Given the nature of this data, none of the variables are normally distributed and so in essence we are using a normalised measure to categorise data which is itself not normally distributed. The possibility of normalising the data was considered but then there would be complications with its analysis and with making it relevant to what is being researched to start with.

3.3 ANALYSIS TECHNIQUES

If we consider that there are potentially 6 groups; first would be for more than two standard deviations less than the mean (left red zone), second would be for between one and two standard deviations less than the mean (left yellow zone), third would be for within one

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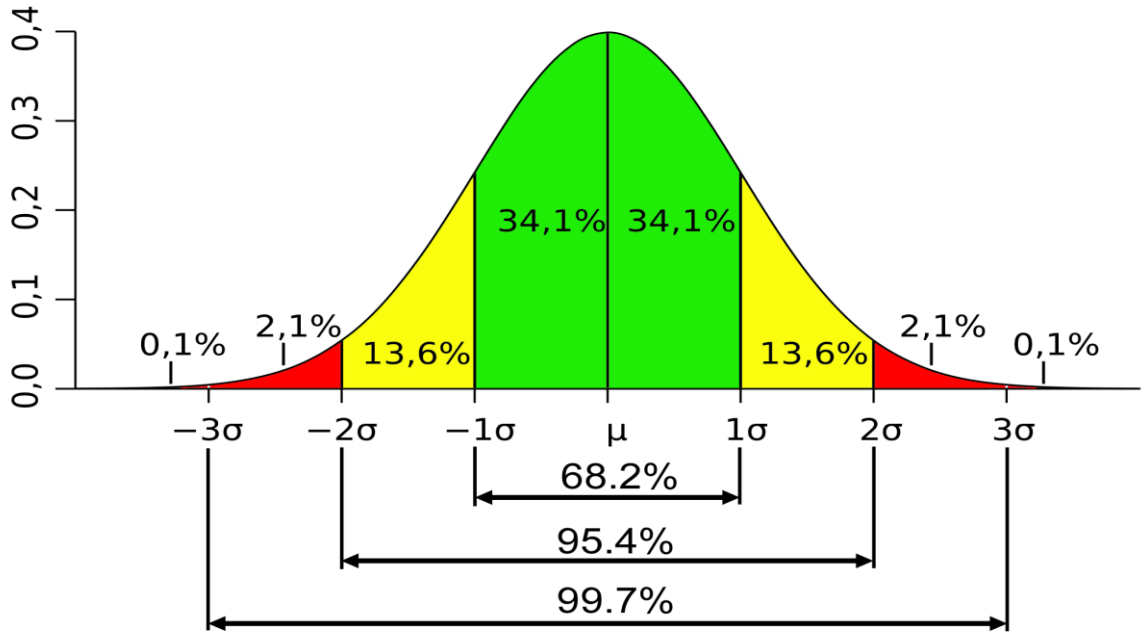
standard deviation less than the mean (left green zone), fourth would be within one standard deviation greater than the mean (right green zone), fifth would be for between one and two standard deviations greater than the mean (right yellow zone) and the sixth would be for cases that are more than two standard deviations greater than the mean (right red zone). In most of the cases variables do not have values for all 6 categories, usually it is only 4 or 5 cases as the analysis will show.

Figure 4 Gaussian Distribution with spread of three standard deviations



Source: Kanbanize [n.d.]

Growth was calculated by using an exponential growth formula which is the standard in the analysis of such in the population sciences.

The formula for such growth is:

$$r = ln(P_1/P_0)/t \qquad (1)$$

Where r = growth rate of persons or households

ln = inverse function of the exponential function (e) which is a constant of value of approximately 2.71

P_1 and P_0 are the household or person population totals at later date and earlier date respectively. In the case of this study P_0 can be 2001 and P_1 can be 2011

t = period of time between the abovementioned points measured in years which is = 10

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The process of creating profiles was done for person growth and these profiles will be done by functional age group, income level, level of education, labour market participation and migrant status variables. From a household growth perspective profiles was based on household services as well as variables related to household goods which will be considered as part of this profile. Ultimately a differential profile will be possible for the fast growers as well as the slow growers (or decliners) and it will be possible to see what constitutes the differences between various levels of growth.

Attention will be given to migratory behaviour and it will be ascertained where such migrants come from and what implications it has for growth in the places where they have settled. It can also be possible to see if migrants in a particular part of the Gauteng City Region are coming from particular areas of the country, or the world or whether their distribution is randomly distributed. It is also of interest to see if those people entering the Gauteng City Region are doing so from neighbouring municipalities or provinces or whether they are from the non-neighbouring ones. An advantage of using growth instead of migration numbers is that migration analysis from Census only allows you to do so up to municipal level but by using growth at ward level, growth can be used as an indirect proxy for net migration, since growth is made up of natural growth (births-deaths) as well as net migration provided that natural growth is stable over the period in question. Although administrative birth and death data is not available at such small areas and Census data of these phenomena suffer from varying levels of completeness we can assume that if over time natural growth is stable then net migration is subject to fluctuation, and it is this which this research can focus upon.

In order to determine association between variables a Spearman rank-order correlation test was performed which enabled to determine which variables had a strong positive relationship, if any, with person or household growth.

Finally, once all these descriptive statistics have been established the two groups (person and household growth) in the above profile was subjected to spatial statistical analysis such as Anselin's Local Moran's I to test for significance of clustering and Getis-Ord Gi*hotspot analysis. The Getis-Ord Gi* and the Anselin Local Moran's I are both examples of mapping clusters which show the researcher what is clustering and where this is happening. The Getis-Ord Gi* identifies clusters of features with high values known as hotspots and low values known as cold spots. To be statistically significant the hot spot must have a high value and be

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surrounded by other features with high values. The opposite holds true for coldspots. For the analysis to be relevant the feature class must contain at least thirty features, each feature should have at least one but optimally eight neighbours but not have all other features as neighbours. The Anselin Local Moran's I on the other hand identifies clusters of high or low values as well as spatial outliers. It compares the value of each feature in a pair to the mean value for all features in the study area. Statistically significant clusters can consist of high values (HH) or low values (LL). However, a feature can be surrounded by other features with dissimilar values. Such a feature is an outlier and these can a high value surrounded by low values (HL) or a feature with a low value surrounded by ones with high values (LH). As is the case with the Getis-Ord Gi* this test requires for there to be at least 30 feature classes and each feature should have at least one but optimally eight neighbours without a feature being a neighbour to all other features.

These tests will enable the analysis to determine whether distribution in the descriptive portion of the analysis are such by mere chance or whether there is a significant existence of clustering of the respective domains of the profile. In addition to subjecting the city-region as a whole to these techniques, the three metros will be jointly subjected to the same techniques in order to see if different patterns exist in the metros as opposed to the city-region as a whole.

Something worth taking note of with regards to defining functional geographic areas is the work done by the CSIR through its Spatial Temporal Evidence for Planning in South Africa (STEP-SA) project which has developed and identified a settlement typology which sets out, not to differentiate or define urban and rural but to determine a diversity of settlement types with different characteristics.

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Table 1 Population and economic activity per type of urban area/settlement

Functional Settlement Type (CSIR/SACN 2013v2)	Area_Km	% of National Area	Population 2011	% of National Population	Service Economy (Service Sector GVA (xR1000))	Economic Activity (*Total GVA (xR1000))	Contribu-tion to Formal Nat Econ Activity
CityRegions	20 575	1.65%	21 856 192	42.22%	758 652	1 185 948	56.77%
Cities	8 225	0.66%	3 876 064	7.49%	102 574	178 276	8.53%
TOTAL CITIES	28 800	2.30%	25 732 256	49.70%	861 226	1 364 224	65.30%
Regional Centres	18 079	1.45%	7 313 730	14.13%	141 580	229 697	10.99%
ServiceTowns	7 232	0.58%	2 720 372	5.25%	47 847	87 232	4.18%
TOTAL MAJOR TOWNS	25 311	2.02%	10 034 102	19.38%	189 427	316 929	15.17%
Local or Niche Towns	29 756	2.38%	4 327 891	8.36%	69 102	121 169	5.80%
Rural Nodes in High density areas	928	0.07%	191 123	0.37%	2 537	4 850	0.23%
TOTAL SMALL TOWNS	30 684	2.45%	4 519 014	8.73%	71 639	126 019	6.03%
High Density Settlements	59 276	4.74%	6 081 912	11.75%	40 074	73 587	3.52%
Sparse Rural Areas	1 070 931	85.66%	3 036 010	5.86%	51 830	184 994	8.86%
Dense Rural Areas	35 258	2.82%	2 366 803	4.57%	13 921	23 351	1.12%
TOTAL REST OF SA	1 165 465	93.22%	11 484 725	22.18%	105 826	281 932	13.50%
NATIONAL TOTALS	1250260	100.00%	51770097	100%	1228117	2089104	100%

2011 Population in cities,towns & Settlements 89.56%

2011 Population in cities & towns 77.82%

** GVA Total excludes Construction sector*

SOURCE: CSIR GAP 2013 based on StatsSA Census 1996,2001,2011; SACN/CSIR Settlement Typology 2013v2, CSIR TAT (Temporal Analyses Tool) 2013

Source: CSIR (2013)

Whilst the above table covers data from across the country, the Gauteng-City region does comprise of cities, major towns and small towns. It is a critical characteristic that the regional centres and service towns provide essential government services in areas outside the metros and this too prevails in the city region. Whilst CSIR (2013) stresses the difference in linear growth between different settlement types, this paper wishes to stress the characteristics, trends and relations at play for overall exponential growth in the Gauteng City-Region. The contribution from the aforementioned study by the CSIR is relevant however in terms of identifying the distinct and varying growth patterns in places of different typology which necessitate different policy and planning interventions.

This typology is set out to represent functional roles that cities and towns play in regional contexts. Table 1 above is then designed to show not only the various parts of this typology but also the area that they take up, their population as well as economic activity for the various categories of place. This paper has also mentioned that although this typology is designed to categorise placenames at the national level it is not suitable for issues of comparability and hence a different typology was used for that purpose. However this typology is presented here as a means of understanding different places, their different economic roles and function and the implication that has for urban development and planning.

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3.4 DATA SOURCES

Data to be used for this study are the person and residential household totals by ward level for the Gauteng City Region from Census 2001 and Census 2011 which has been harmonised to the 2011 electoral ward boundaries. Residential household refers to the exclusion of households that are not used for housing purposes such as joint living arrangement structures, or institutions as they are known such as prisons, boarding schools, military barracks and the like. In this regard it should be noted that Ward 8 in the Westonaria Local Municipality and Ward 19 in the Merafong City Local Municipality were excluded specifically because in either the 2001 or 2011 data points all residents belonged to the aforementioned joint living arrangements and hence resulted in having blank values for the conditions set out herein.

3.5 STUDY AREA

The choice of the Gauteng City Region is quite deliberate. Whilst any of the metros in Gauteng could have been chosen for this study from an administrative point of view it was considered that more value could be deduced from such an exercise by using functional boundaries in the province of Gauteng which directly pointed to the Gauteng City Region.

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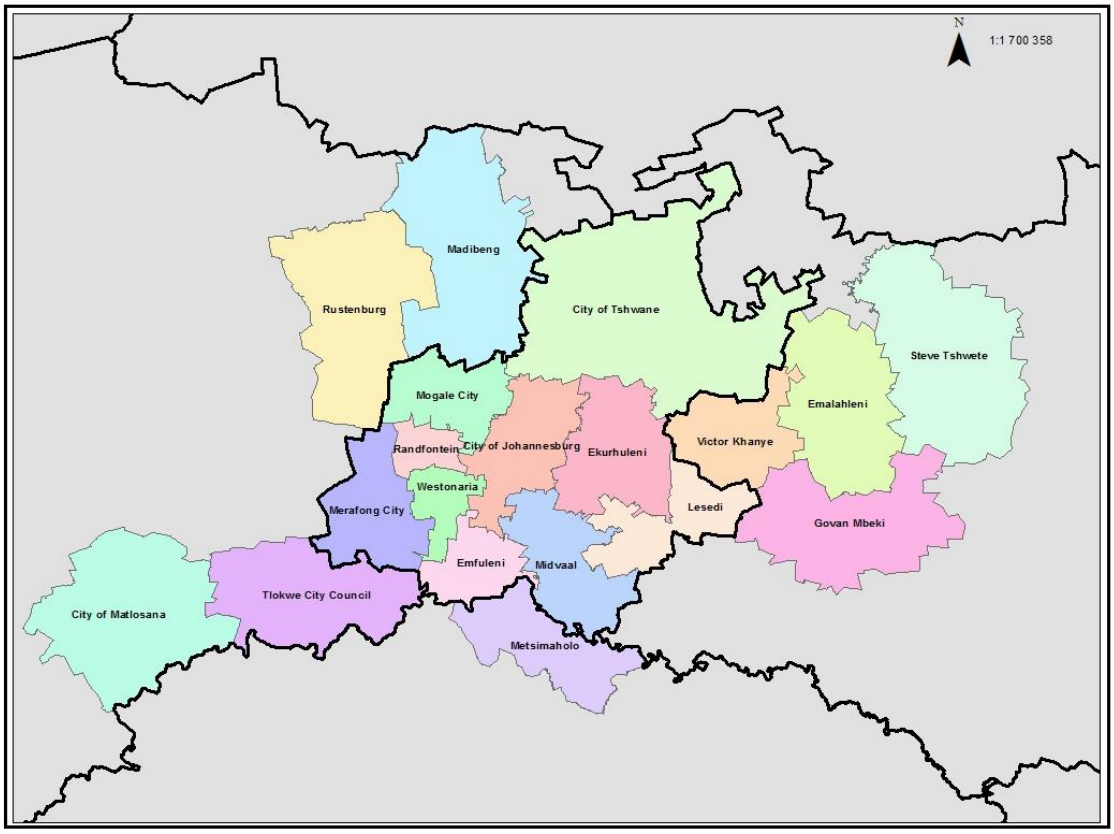
Figure 5 Gauteng City-Region



The Gauteng City-Region is an integrated cluster of cities, towns and urban nodes making up the heartland of South Africa and its economic hub. Most of the city-region is in the province of Gauteng and includes not only the financial and administrative centres of power in South Africa, namely Johannesburg and Pretoria but also smaller mining and industrial towns. Beyond Gauteng there are smaller centres and concentration of population. In the North-West province there is the town of Rustenburg central to the platinum mining industry. In the Free State there is the town of Sasolburg known for its production of oil from coal. To the South-West are gold mining towns such as Potchefstroom and Klerksdorp which have seen a stagnation of population growth in recent years. To the east are towns such as Emalahleni (Witbank), Middelburg and Secunda anchored on their involvement in coal mining, iron and steel production and energy generation. Finally to the north east is a unique semi urban settlement of displaced urbanisation housing people once prohibited by the apartheid regime from settling in the major urban centres but who are nonetheless functionally connected to the Gauteng economy via subsidised transport routes who have enabled workers to commute into and out of Pretoria every day. Using different methods of estimating the population of the city-region this functional area can be up to 16.8 million persons or roughly 30% of the national population. From an economic point of view 33.8% of the national GDP (in current prices) was

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produced in Gauteng. It is an area considered to provide greater opportunities in the workplace, in terms of housing, services, education and general standards of living. Notwithstanding it is an area of great attraction for migrants from within the country and from beyond the national borders. There is a widespread perception that work and education opportunities are better in the Gauteng City-Region compared to other parts of the country. The superior levels of housing and household infrastructure, closeness to urban amenities and standard of living make it a popular choice amongst internal and international migrants alike.

Despite all these characteristics it is a mirror of global society in that it has its pockets of poverty, unemployment and social ills that need to be addressed by the various administrations governing the area. The Gauteng City-Region is not immune to conditions of inequality that the rest of the country is exposed to. Pockets of wealth exist alongside informal settlements and a lot of the spatial patterns related to socio-economic conditions still closely resemble apartheid spatial patterns despite integration taking place over the past twenty years. Labour market opportunities also mimic those around the country and in other parts of the world whereby not enough jobs exist for everyone. New market entrants, especially the youth find much difficulty in entering the job market. This results in a very positive quality of life for some but a very frustrating experience for others who more often than not tend to be migrants. Although the different administrations ruling over the city region have different mandates and priorities it is imperative that they work together for the city region to overcome its challenges and for it to reach its potential as it looks forward. In addition to inter-governmental co-operation there also needs to be a strong relationship with business and civil society in order to realise this potential.

For the purpose of this study the Gauteng City-Region will refer to all of Gauteng as well as those municipalities with linkages to Gauteng that lie beyond the province. These are: Matsimaholo (FS204), Tlokwe (NW402), City of Matlosana (NW403), Madibeng (NW372), Rustenburg (NW373), Victor Khanye (MP311), Emalahleni (MP312), Steve Tshwete (MP313) and Govan Mbeki (MP307).

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CHAPTER 4: ANALYSIS AND RESULTS

4 ANALYSIS AND RESULTS

This chapter will look at the key findings of the research described herein by first looking at some key indicators of the Gauteng City Region and how they compare to the national picture. Hereafter a series of descriptive statistics will be displayed which take into consideration person and household growth across the City-Region, categorisation of such growth rates, cross tabulation by key variables and a correlation analysis for person and household growth. The next section of this chapter will look at descriptive statistics from a spatial perspective by showing a series of maps at person and household growth level that show the distribution of various key variables with the view to create a profile of the characteristics of high and low person and household growth. Finally the chapter will conclude with some spatial statistical analysis in the form of Getis-Ord* hotspot analysis as well as the Anselin Local Moran's I test for clustering and outliers. This will be done for the City-Region and then for the metros jointly.

4.1 GENERAL OVERVIEW OF GAUTENG CITY REGION

A look at some key indicators from Census 2011 paints the picture of life in the Gauteng City-Region:

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Table 2 Indicators for Gauteng City-Region and South Africa (2011)

Indicators for GCR and South Africa 2011 (% unless stated)					
	South Africa	**GCR**		**South Africa**	**GCR**
Population (Total)	**48 968 986**	**14 054 778**	**Households (Total)**	**14 449 664**	**4 773 808**
Functional Age Groups			**Age of Head of Household**		
0-14	29.2	24.4	10-19	1.6	1.1
15-64	65.4	71.4	20-64	84.9	90.3
65+	5.3	4.2	65+	13.5	8.6
Dependency (per 100)	52.8	40.16	**Sex Ratio of Head of Household (per 100)**	142.7	197.4
Sex Ratio (per 100)	106.6	101.8	**Unemployment of Head of Household**	18.9	16.3
Level of Education			**Household Income**		
No schooling	10.2	5.6	No income	15.1	16.4
Some primary	37.8	25.3	Low	29.0	20.1
Primary	7.9	5.8	Medium	48.5	52
Some Secondary	47.0	42.6	High	7.5	11.5
Secondary	30.7	36	**Household Size**	3.4	2.9
Higher	12.1	25.2	**Housing Type**		
Moved since 2011	19.1	31.3	Formal	78.3	79.3
Personal Income			Informal	13.8	20.2
No Income	44.9	45.7	Traditional	8.0	0.5
Low	35.0	23	**Tenure Status**		
Medium	18.3	27.6	Rented	25.9	37.7
High	1.8	3.7	Owned but not paid	12.2	15.7
Population Group			Occupied Rent free	19.2	16.3
Black	79.5	78.5	Owned and paid off	42.8	30.3
Coloured	9.1	3.2	**Energy for Lighting**		
Indian	2.6	2.6	Electricity	84.7	86.8
White	8.9	15.7	Other	15.0	12.9

Continued overleaf

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Table 2 continued

Table 2 Indicators for Gauteng City-Region and South Africa (2011)

Indicators for GCR and South Africa 2011 (% unless stated)					
	South Africa	**GCR**		**South Africa**	**GCR**
Previous Municipality			None	0.3	0.3
GCR Municipality*	12.3	72.1	**Access to Piped Water**		
Neighbouring Municipality		3.2	Piped in dwelling	46.3	59
Non-Neighbour*	6.3	24.7	Piped outside dwelling	45.0	38.5
Unemployment			No Piped	8.8	2.5
Youth Unemployment	38.6	34.4	**Refuse Removal**		
Total Unemployment	29.8	26.4	Weekly	62.1	84.9
			Other Refuse Removal	32.5	12.5
			None	5.4	2.6
			Access to Sanitation		
			None	5.2	1.2
			Flush to Sewerage	57.0	94.6
			Other	35.7	3
			Bucket	2.1	1.2
			Access to Internet		
			Home	8.6	11.5
			Elsewhere	26.6	32.6
			No Access	64.8	56.1
			Access to Satellite Television	25.8	31.6
			Access to Computer	21.4	29.1
			Access to Motor Car	29.5	36.6

Source: Census 2011

**At national level intra-provincial and interprovincial migration respectively used as a comparative measure*

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As can be seen in Table 2 just over a quarter of the country's population resides in the city region. A quarter of those are generally considered young aged 0-14 with a dependency ratio of 40.2 persons outside the economically active ages dependent on every 100 persons in the economically active age group. There are 101.8 males per 100 females across the entire population of the city region which is indicative of a population that attracts migrants, especially males. Just over a third (36%) of persons aged over 20 have completed their matric and just over a quarter (25.2%) have a higher education qualification of some sort and this is indicative of a region that has five universities as well various technical universities and colleges. The city region is very mobile with almost a third (31.3%) having moved into or within the city region in the period between 2001 and 2011 and this is based on the analysis of one's last move only. Repeat moves and cyclical migration may reveal a more dynamic and complex picture of mobility. What is of interest is that of all those who moved in the period between 2001 and 2011, 72.1% moved from within the City Region to another part of the City Region. Only 3.2% came from municipalities neighbouring the City Region, whereas the remaining quarter came from beyond such parameters. As mentioned previously, pockets of poverty exist amongst areas or prosperity with almost half (45.6%) reporting having received no income per annum whilst 27.6% being medium income earners which was defined in Statistics SA (2015) as those earning between R19 201 and R307 200 per annum. From a demographics point of view, over three quarters (78.5%) are Black African with 15.7% being white. The labour market, which is a key point of attraction of Gauteng and of the various interactions within the city region indicate an unemployment rate of 26.4% and for the youth (aged 15-34) of 34.4%

From the perspective of households almost a third of all residential households are found within the Gauteng City Region. Not surprisingly about 90% of all household heads are in the ages between 20 and 64 with 8.6% over the age of 65 and most concerning is that just over 1% of all household heads are aged 10-19 – an age group when such a child should be in school or starting off with tertiary education. The sex of head of household produces a very interesting finding given that it is usually males who head household, but the extent of it is such that there is a sex ratio of 197 males per 100 female household heads, a ratio that is almost double that of the overall population of the City Region. Although the existence of mostly male household heads is not a surprise the fact that there is almost a 2:1 ratio of household heads may be indicative of fewer female headed households due to divided families' migration patterns due to economic reasons. Because of the certainty of opportunity families are likely to migrate as

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one whether it be in one movement or successive movements. At a national level the sex ratio of household heads is also male dominant although the ratio is somewhat more moderated at 142 male heads per 100 female heads. Furthermore the heads of household show an unemployment rate of 16.3% which considerably less than the full population. The existence of poverty which was mentioned above is also prevalent at household level whereby a third of all household either earn nothing or up to R19 200 per annum and just over half (52%) earn between R19 201 and R307 200. Household size sits at just under 3 which is a drop from pre 2001 times and reflects young people moving out of their homes to pursue further education or employment whereas a higher household size would reflect bigger families staying together such as tri-generational households. Housing type is mostly formal at just 79.3 and most of the remaining fifth (20.2%) being informal. A very small amount of traditional housing suggests a dearth of tribal land and tribal living arrangements. In terms of tenure of the properties that people live in just over a third (37.7%) are rented and just under a third (30.3%) are owned and paid off. When we consider delivery of services, electricity for lighting, weekly refuse removal and flush toilets connected to sewerage all show high levels of service (over 84%) with piped water in the dwelling only being prevalent in 59% of households. Closer inspection of the data however shows that 0.3% of households in the City Region have no electricity, 2.5% have no piped water of any sort, 2.6% have no refuse removal, 1.2% have no sanitation and a further 1.2% use a bucket system as their form of sanitation. Finally in terms of household goods, those goods associated with a modern economy such as access to internet and computer were selected along with satellite TV as a means of receiving news and information about opportunities in the City Region. Use of a motor car in the household was also selected given the main roads in the City Region and that the motorization of households can explain linkages albeit at far distances from the urban core of the City Region. In this regard just over half (56.1%) had no access to internet of any sort which is a concern given the information age that a modern economy demands. Access to satellite TV (31.6%), computer (29.1%) and a motor car (36.6%) all centred around a third of all households. The latter is indicative of the reliance on public transport especially the taxi industry as well as intercity buses especially those to the north east of the City of Tshwane.

The above is intended to paint a general picture of the Gauteng City Region. The key questions are however how do these play out in areas that showed high growth versus low growth? Where do these intersection of these indicators with growth occur and finally what relationships at a spatial level exist in terms of growth and the factors that possibly drive it?

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4.2 DESCRIPTIVE ANALYSIS

The distribution of growth across the Gauteng City Region and the categorisation of this will make for the basis of further research. In this section the intention is to paint a descriptive picture of the City Region but broken down into smaller parts to appreciate the variation in growth. For that purpose a breakdown of the city region will be provided by the various municipalities in order to see how growth manifests itself throughout the city region.

Table 3 Person and Household Growth within the Gauteng City-Region

Municipality	Person Growth p.a.	Household Growth p.a.	Person Standard Deviation	Household Standard Deviation
79700 JHB	2.15	3.09	2.16	2.40
79800 TSH	2.73	3.54	4.50	4.44
79900 EKU	2.97	4.08	3.46	3.65
74201 Emfuleni	0.76	1.64	1.87	2.06
74202 Midvaal	3.84	4.26	3.93	3.72
74203 Lesedi	3.23	4.74	15.52	15.43
74801 Mogale City	2.22	3.20	4.44	4.59
74802 Randfontein	1.35	1.80	3.25	3.08
74803 Westonaria	0.44	2.16	5.17	4.70
74804 Merafong City	0.44	1.70	3.72	5.66
42004 Matsimaholo	2.44	3.49	4.43	5.32
83007 Govan Mbeki	2.79	3.07	3.84	3.91
83101 Victor Khanye	2.81	4.25	5.13	4.07
83102 Emalahleni	3.60	4.70	3.83	3.75
83103 Steve Tshwete	4.38	5.84	4.91	4.22
63702 Madibeng	3.30	5.20	4.18	4.27
63703 Rustenburg	3.37	5.63	5.44	5.62
64002 Tlokwe	2.55	4.95	5.60	5.94
64003 City of Matlosana	1.19	2.55	3.29	3.01
Gauteng City Region	2.51	3.56	4.47	4.60

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It is clear to see that there is a wide dispersion of growth not only within the city-region but within each individual municipality itself. Those values in the peach colour are those above the average for the city region for each category and those in blue are below the average. A closer look reveals that person growth is higher in the Steve Tshwete Municipality in Mpumalanga as well as Midvaal in Gauteng whereas household growth is highest in Steve Tshwete too but also Madibeng and Rustenburg in the North-West Province as well. On the counter side, person growth is lowest Westonaria, Merafong City and Emfuleni, all in Gauteng whereas household growth is lowest in Emfuleni and Merafong City as well but also Randfontein. In addition to this variation exists within each municipality since growth is not equally distributed. The standard deviation is one such measure that is able to quantify variation or dispersion in a distribution. The standard deviation is also, as mentioned earlier in this paper, the measure used to categorise the distribution into different groups. Essentially, the standard deviation measures the average distance between points in a distribution and its' mean. The higher the value the wider the spread of the values concerned and the more leptokurtic the distribution is. In Table 3, with regards to dispersion on person and household growth we can see those municipalities with valued higher than the city region are in a peach colour and those less than the value of the city region are in blue. Upon closer inspection one can see that there is a big spread of values in the Lesedi Municipality that has standard deviation values of 15.52 and 15.43 for person growth and household growth respectively. On the opposite end of the scale Emfuleni Municipality has values for person and household growth most closely distributed to each other with standard deviation values of 1.87 and 2.06 respectively. This means that the spread of values of growth rates for both persons and households is more widely spread or platykurtic in the case of the former with a greater variation between the highest and lowest values. On the opposite end of the scale the latter municipality (Emfuleni) shows a more closely distributed series of values of growth rates for persons and households resulting in a leptokurtic distribution. In such a distribution the difference between the highest lowest values are much closer together. In essence this means that that the distribution with platykurtic distribution has more variation and more areas (wards) with extreme values suggesting areas of attraction and areas that are centripetal in nature. These can be referred to areas where there is a net higher pull versus push factors respectively.

In the following section of this chapter a spatial analysis will look at this more closely at ward level and map the distribution along with other key indicators related to growth in the city region.

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As mentioned earlier the process of creating categories for all variables was necessary because an analysis based on unique values would be redundant. For this reason it was necessary to create categories upon which to perform further analysis. The means by which these categories would be created would be by applying the standard measure of one and two standard deviations greater than and less than the mean. Although this could be done manually, the process of visual binning in SPSS was used to do this to each variable and to create cut-off points where applicable based on these measures. The resulting output would be values of 1 to 6 where applicable because in the case of many variables there wouldn't be any cases in some of the categories and so there would be only 4 or 5 categories. In Appendix A, it can be seen what the minimum and maximum statistic is and this indicates the categories from left to right of a normal distribution curve, with 1 being greater than two standard deviations less than the mean, 2 being between one and two standard deviations less than the mean, 3 being within one standard deviation less than the mean, 4 being within one standard deviation more than the mean, 5 being between one and two standard deviations greater than the mean and finally 6 being more than two standard deviation greater than the mean which can be related to Figure 4.

The measures of skewness and kurtosis are also provided. Skewness refers to whether the distribution is biased positively or negatively. In most cases distributions are positively skewed with only *Dependency* and *Household Size* being negatively skewed. This explains to a significant extent why many variables don't have values for categories 1 and 2. Kurtosis refers to the shape of the curve. If values are packed closely around the mean then the curve is said to be leptokurtic but if the values are dispersed around the mean then they are said to be platykurtic, otherwise a regular distribution is considered to be mesokurtic. As with the skewness most variables have a positive value suggesting a leptokurtic curve and this too can explain why categories 1 and 2 don't have values for many of the variables and how the distribution curve suggests that the distribution is not normal as had been stressed earlier on and this should be taken into account when interpreting the results. It must be stressed that the use of standard deviations is used to create categories but the use thereof implies a normal distribution which is not present in the data that this research is based upon. Figure 6 illustrates the shape of the aforementioned forms of kurtosis which has been explained earlier refers to the distribution of values for a particular category such as those of person and household growth. Areas with a leptokurtic distribution would suggest that there is an equal spread of growth of people and that all areas in a given region are equally appealing where as in a

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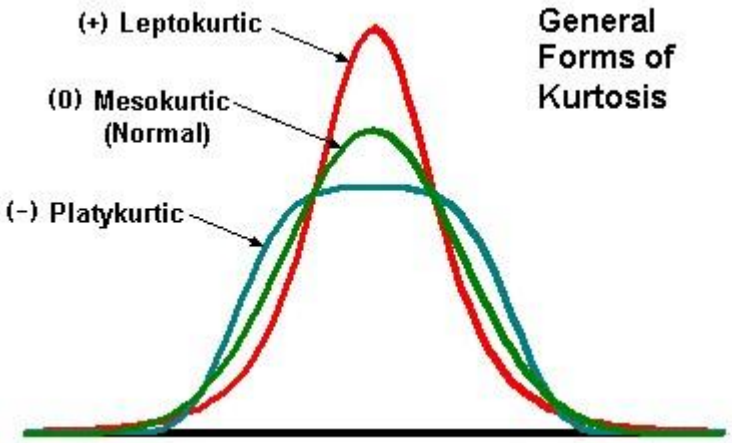
mesokurtic distribution the region has some areas that are very appealing and other areas that are extremely unappealing as place of residence.

Figure 6 General forms of Kurtosis



Source: MVP Programs

When looking at a selection of the cross tabs in Appendix B, it is clear to see that those cells where more than 40% of the explanatory variable lying in a particular growth category, lay in category 3 of the aforementioned explanatory variable. If we consider that category 3 and 4 make up those cases that lie within one standard deviation of the mean then this makes sense, since we know from theory that in a normally distributed distribution, 68% of all cases will lie within one standard deviation either side of the mean. In almost all of these cases the distribution is not normal but the pattern remains similar in the most cases will lie within such parameters. It is hence critical to look for discernible patterns that lie beyond these parameters to indicate something out of the ordinary that occurs within any given growth category. In this regard it is evident that those wards whose growth was beyond one standard deviation (categories 1, 2, 5 and 6) were far and few between.

For the purpose of this analysis growth categories 1 and 2 were called low and moderate-low respectively and those in category 5 and 6 were called moderate-high and high respectively. For the explanatory variables those cases where there was a category 1 and/or 2 were collectively labelled as ‘low’ and those in category 5 and 6 were labelled as ‘high’. Only cases where ‘low’ or ‘high’ made up at least one third of a growth category were flagged as being noteworthy. These observation are summated in table 4 below. For the purpose of person

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variables, person growth is referred to and for household variables, household growth is referred to.

It is clear to see that most growth and occurrence of the explanatory variables occur within one standard deviation as theory would suggest and that the cases highlighted herein are ones that stand out. The only variable that stands out more than others is the household size for moderate-high and high growth wards, hence we can conclude by this observation that extreme cases of growth are not accompanied by extreme values of explanatory variables and that such growth occurs due to dynamic and often complex reason and not simple univariate reasons.

Table 4 Analysis of Explanatory Variables by Growth Categories

Growth Type	**Growth Category**	**Explanatory variable category**	**Explanatory Variable**	**% of Growth Category**
Person Growth	High	High	Moved since 2011	33
	High	High	Migrants from City Region	33
	High	High	Matric highest level	33
Household Growth	Moderate-High	High	Adult (20-64) head of household	37.2
	High	Low	Elderly (65+) heads of household	37.5
	Moderate-High	High	Households with no income	33.4
	High	High	Households with medium income	34.4
	Moderate-High	Low	Household Size	41.2
	High	Low	Household Size	37.5
	Moderate-High	High	Rented Household	37.3
	Moderate-High	High	Access to internet other than in the household	33.3
	Moderate-High	High	No Access to internet	33.3

From table 4 above we can see the proportion of the distribution within a growth category that key explanatory variables are exposed to when cross tabulated with such aforementioned growth categories. In other words, 33% of the variation in those who moved since 2011 lie in a high person growth category.

The final analysis in this section deals with a correlation analysis conducted between person growth with person variables and household growth with is associated variables. The Spearman *rho* correlation for ordinal data was used and is found in Appendix C and is summarised in

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table 5 below for the variables with the strongest correlations. It is important to note that correlation does not indicate causality but merely an association between two variables. The strength of this association cannot be determined through a correlation analysis and for that purpose a least square or multivariate regression analysis would be required. Although the entire matrix for this correlation can be used for various other purposes our main and exclusive interest is the first row of each of the correlation outputs, those being the correlation between person growth and the other person variables as well as household growth and the corresponding household variables. The analysis hereof shows us that correlations between person growth and its corresponding person variables are very weak. Significant however is the fact that the strongest correlations are with the migration variables *Moved since 2011* (.317), *GCR (*.294), *GCR Neighbour* (.346), *Non-neighbour* (.313). Although these correlation co-efficients are the highest of all the variables, they remain nonetheless weak. Correlations of between 0.6 and 0.9 are generally considered to be strong and these fall short of that mark. However the impact of migration whether it be from within the city region, from a neighbouring municipality or from beyond such is significantly stronger than any other variable concerned with person growth and this will need to be unpacked in subsequent sections.

From a household growth perspective, the analysis is more complex. There are two major patterns to consider but once again none of these is considered strong. Indeed the household growth correlations are even weaker than the person growth ones. The first of these patterns are negative correlations. These refer to *elderly head of household* and *household size*. This means that as number of households grow the wards where elderly headed households exist is declining. Also, and possibly more obvious, as households grow the wards where this happens experience a decline in household size. It stands to reason that if household numbers in a particular ward are growing it is due to households splitting up into smaller ones due to adolescents moving out of a parental home or due to separation of nuclear family units.

The second pattern refers to poor service delivery. For households with *no piped water (.263), bucket (.222), other energy for lighting (.278), other refuse removal (.220)* and *no refuse removal (.233)* it will appear people are either moving out of such households to form households with better service delivery or new developments are occurring in wards with previously poor service to be replaced with dwellings with better service resulting in household growth. The only exception to this is *flush to sewerage (.227)* which represents a full service delivery with regards to sanitation. The only explanation for this might be that in wards where

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people are aware of good sanitation service delivery, a proliferation of new households is found in order to benefit from such service. It would hence appear that there is a push and pull factor to new household formation or growth of households in wards where this is found emanating from moving away from poor services or being attracted to such places with good services. This too will require further unpacking in the remainder of this research.

Table 5 Summary of Spearman correlation analysis for person and household growth

Type of growth	Variable	Spearman rho*
P	Moved since 2011	0.317
P	GCR	0.294
P	GCR Neighbour	0.346
P	Non-Neighbour	0.313
H	Elderly head of household	-0.236
H	Household Size	-0.298
H	No piped water	0.263
H	Flush to sewerage	0.227
H	Bucket	0.222
H	Other energy for lighting	0.278
H	No energy for lighting	0.251
H	Other refuse removal	0.22
H	No refuse removal	0.233

**** Significant at the 99% level of confidence***

4.3 DESCRIPTIVE SPATIAL ANALYSIS

The above analysis leaves many questions unanswered and leaves a lot up to speculation. For this reason the use of spatial methods presents a unique opportunity to elucidate the research topic further and to provide a clearer explanation as to why person and household growth occur as they do and where they do. This spatial analysis will manifest itself in three forms. Firstly a series of descriptive maps will be presented showing person growth with one other person characteristic as well as household growth with one other household characteristic. Once the descriptive data is dealt with the Getis Ord Gi* will be conducted which will identify clusters of hotspots and coldspots of person and household growth across the Gauteng City-Region. A

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decision was taken to isolate the metros from the rest of the City-Region since the metros drive the growth factors in the City-Region and so this technique is repeated for the metros in the City-Region. Once this is done, the Anselin Local Moran's I is conducted which identifies clustering and outliers of high and low growth within the City-Region as well as across the metros as was the case with the hotspots and coldspots. The strength of the Anselin Moran's I is not just identification of clusters and outliers across the City-Region or metro but of outliers within clusters of one or other extremity of growth. This allows any intervention to be targeted to specific areas with specific characteristics. This is also as the name applies a localised statistic and not a global one. This means each geographic unit is treated separately when processing the output for this technique and is hence able to give a localised result of clusters and outliers of high and low growth.

The first maps to be displayed are those of person and household growth for the city region. These show the wards as individual units that displayed growth which is categorised by standard deviation. The Arc Map software categorises distribution of data by various methods but the standard deviation uses cut off points of -0.5 to 0.5 standard deviations away from the mean and then increments them by one standard deviation at a time. In other words, it would then proceed to -0.5 to -1.5 standard deviations away from the mean, -1.5 to -2.5 standard deviations away from the mean and finally more than -2.5 standard deviations from the mean. This method of determining standard deviation is based on the same principles as outlined earlier but is different in terms of the cut offs within the Arc Map software.

On the positive side of the normal distribution the same categorisation would occur. Subsequently, figure 7 shows person growth for the city region broken down by the above standard deviation based categorisation. It must be noted once more, that the standard deviation is a measure associated with a normal distribution and that the data underlying person growth is not necessarily normally distributed but this measure is used merely for the purpose of categorisation based on a recognised measure. It is evident from the map that slow growth, relative to other wards is occurring in the eastern mostly rural parts of the municipalities in Mpumalanga province, parts of Midvaal, City of Matlosana, Merafong, Rustenburg as well as Madibeng amongst others. However, the higher growth areas also seem to occur in some of these areas as well. Rustenburg stands out as an area with growth less than 2.5 standard deviation than the mean for the City Region and a substantial part of Mogale City as having growth 1.5 to 2.5 standard deviations less than the mean. However when we look at those areas

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with growth greater than the mean they would appear to be in similar areas to those experiencing lesser growth highlighted above. These include other parts of Mogale City, City of Tshwane, Steve Tshwete municipality, parts of Metsimaholo which lies in the Free State close to Sasolburg, Tlokwe where Potchefstroom is found and City of Matlosana where we find Klerksdorp as well as area close to Rustengurg in the North West. The nexus where City of Johannesburg, City of Tshwane and Ekurhuleni Metros meet also seems to be an area of growth of 0.5 to 1.5 and greater than 1.5 standard deviations away from the mean growth of the Gauteng City Region.

If we consider growth in the metros alone, in order to isolate the impact of the non-metro areas of the city region then person growth takes on a very interesting shape. This is illustrated in Figure 9 below.

From the map in figure 9 we can see growth is concentrated in Sandton, Roodepoort, Central Soweto, Soshanguve, parts of Mamelodi and Centurion all places around economic opportunity and favourable living circumstances. On the counter side slow growth manifests itself in small pockets of some areas which have been mentioned as places of concentrated growth such as Soweto, Sandton, Springs, Alberton, Atteridgeville, Mamemlodi and Mabopane to name a few. This tells us that the dynamic nature of growth has a high granularity and that pockets of opposite type of growth at the two extremes can exist in the same main place. An analysis at very small place level such as suburbs might reveal a clearer distinction.

With regards to household growth at both GCR level and within the three metro (Figure 8 and 10 respectively), the pattern is largely similar to the population growth pattern. Amongst those wards that show low growth are Rustenburg, Mogale City and Sasolburg. Those experiencing high growth would include non-urban areas around Potchefstroom in Tlokwe, Merafong City, North West areas of Tshwane such as Soshanguve, Rustenburg and the Steve Tshwete local municipality.

Considering household growth in the metros alone, this too paints a picture that is similar to person growth for the metros alone. The areas showing concentration of person growth are the same but for those areas showing slow growth areas such as Randburg and Tembisa are additions to the trends shown under slow person growth. It is clear from Figure 9 that the spatial pattern shows nodes of growth where people prefer to stay due to proximity to work

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opportunities, housing developments, schools and access to main thoroughfares. The fact that there are not that many active mines in the metros with the exception of southern Ekurhuleni means that it is the aforementioned points of attraction that create nodes of attraction.

Figure 7 Person growth in the Gauteng City-Region

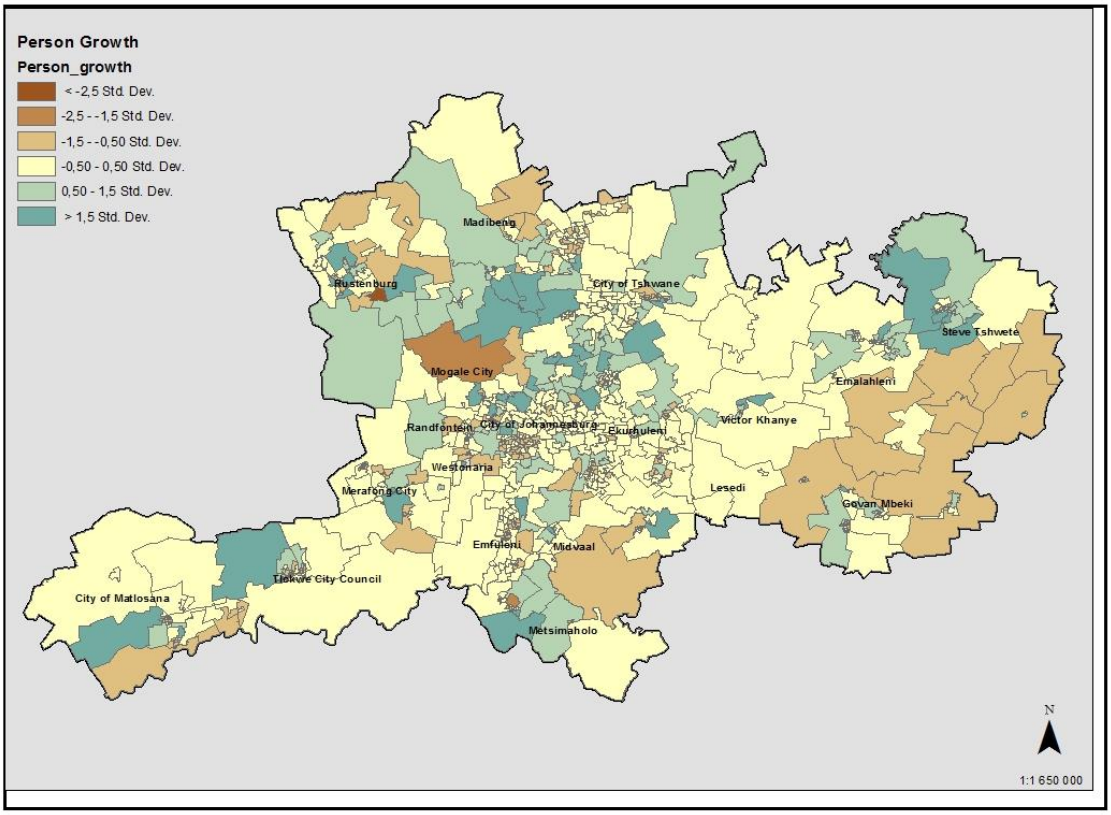

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Figure 8 Household Growth in Gauteng City-Region

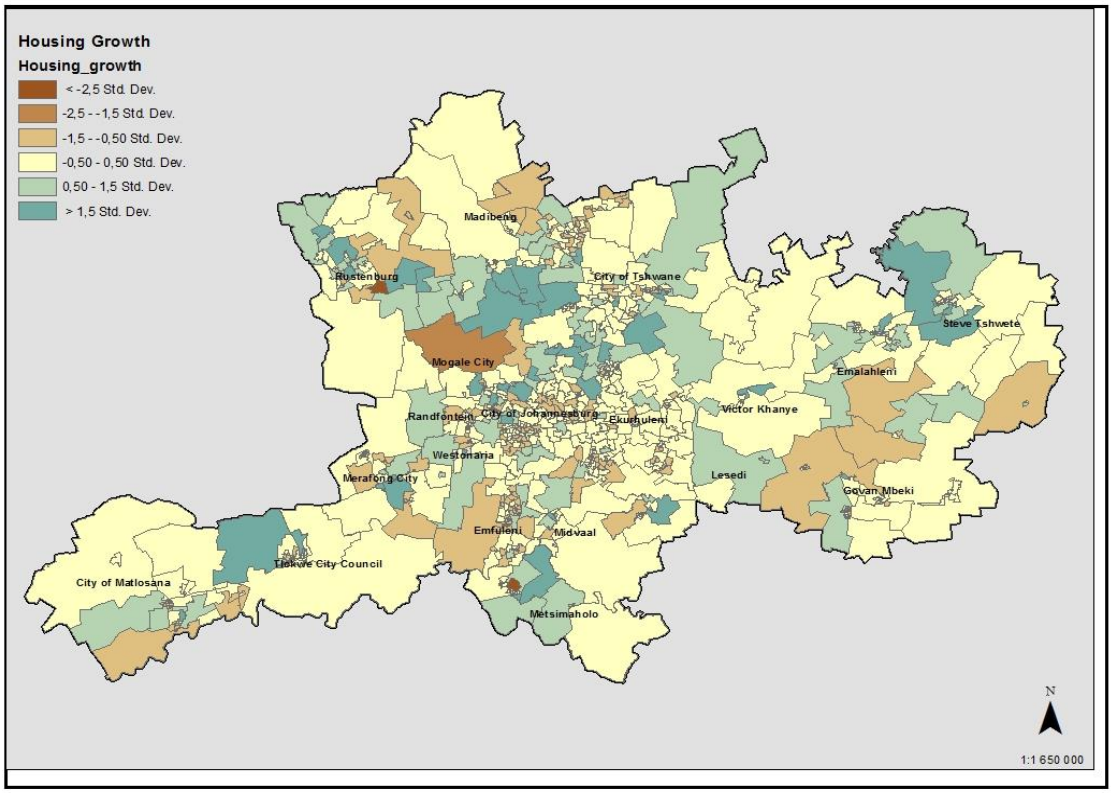

Figure 9 Person Growth in the metropolitan municipalities of Gauteng, 2001 – 2011

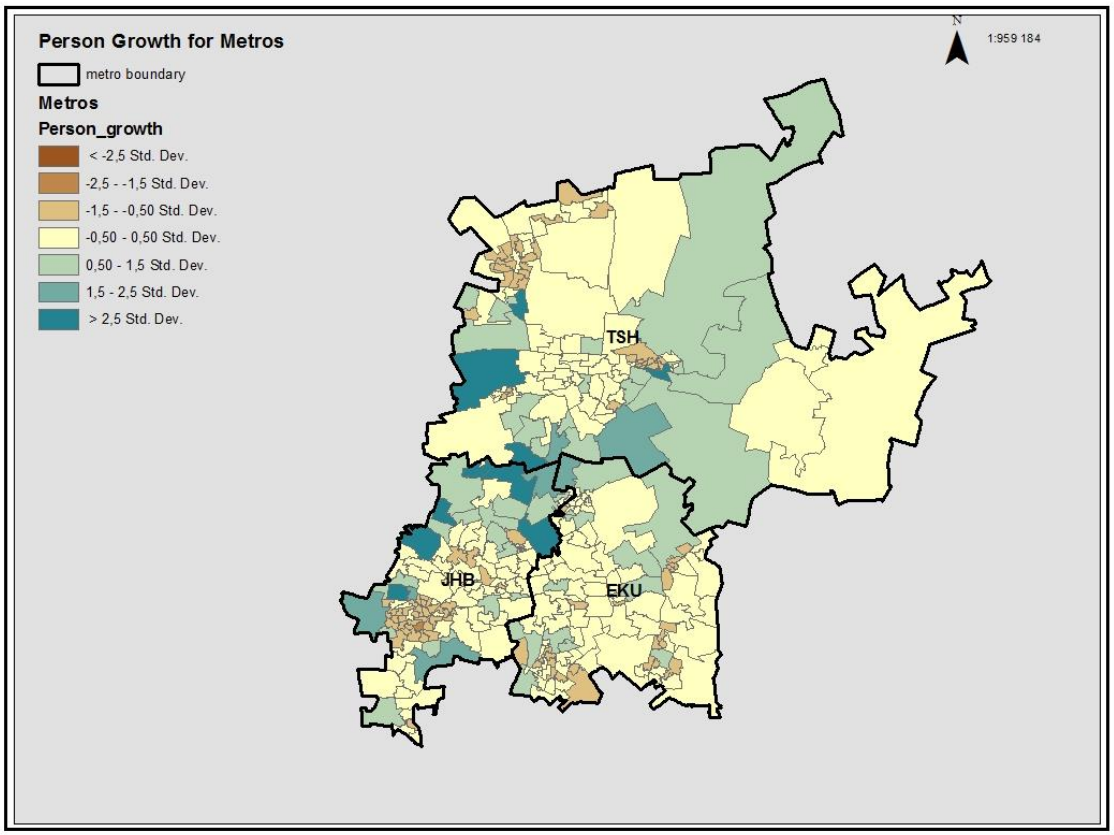

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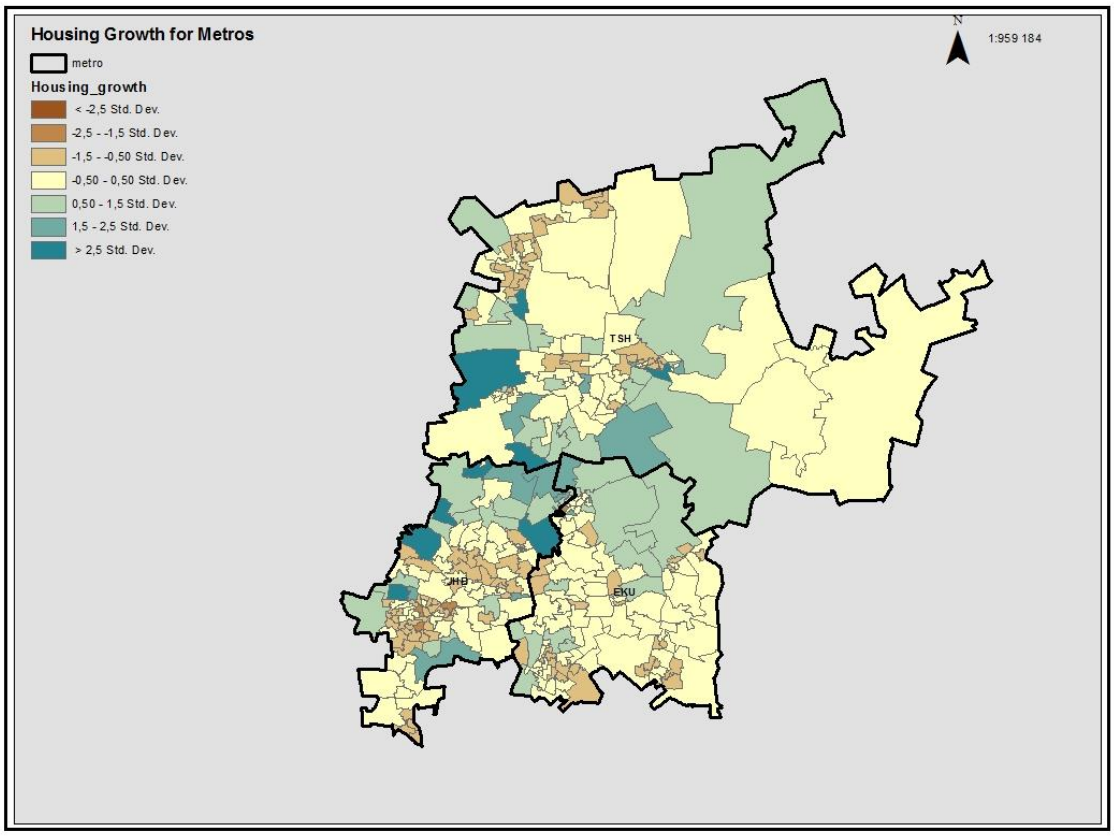
Figure 10 Household growth in metros of Gauteng, 2001-2011



For the purpose of much of the analysis that follows, reference will not be made to individual placenames, unless necessary but to generalised names representing functional categories within the context of the GCR. This typology is not based on any published typology but rather upon the different types of places that exist within the city-region. Consultations with the authors of the CSIR/SACN typology by Van Huyssteen et al (2013) revealed that this typology was used to define national settlement patterns and would not be adequate for comparative type reporting at a lower scale of spatial analysis such as this study. There are also no placename classifications that classify the city-region at a more detailed scale than the existing national level classification of this nature at a national level. Geyer and Geyer (2016) does however make reference to a classification which has been adopted for use in the analysis of this research. Areas referred to as non-urban are defined by Statistics SA as such as part of the Census classification of the geography type of a group of enumerator areas that do not contain a settlement or town as displayed below but do include populations of various magnitudes.

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Table 6 Classification of Placenames for the Gauteng City-Region

Type	**Description**	**Example**
Inner core areas	CBD and immediate surrounding areas of high population concentrations around core business districts	Pretoria CBD, Sunnyside
Suburbs	Residential areas including traditional townships that were established when the policy of separate development was in force	Moreleta Park, Rivonia, Bedfordview, Tembisa, Soweto, Mamelodi,
Metropolitan Fringe	Areas between the suburbs and satellite cities that have a close relationship with the former	Mabopane, Krugersdorp
Satellite towns within metropolitan daily catchment areas	Secondary cities or towns of the Gauteng City-Region within the daily catchment areas	Springs, Heidelberg, Vereeniging, Westonaria, Brits, Bronkhorstspruit
Intermediary cities within weekly urban system of the agglomerations	Secondary cities or towns within the weekly urban system of the Gauteng City-Region	Rustenburg, Potchefstroom, Witbank, Middelburg

Source: Based on Geyer & Geyer, 2016

An analysis of some of the descriptive maps can be very useful in determining patterns and characteristics of growth at household and person level in the electoral wards of the Gauteng City-Region. These descriptive maps can also form the basis for understanding the spatial analysis which will follow. The intention of these descriptive maps is as the name suggests to describe patterns of some key variables across space and where possible to suggest reason for these, although such cannot be possible in all such cases. These maps indicate person or household growth at a ward level that are shaded according to the category of standard deviation from the mean that they represent and are superimposed by dots of explanatory variables which are colour coded according to the distribution of the category that they fall in which is based on standard deviations away from the mean. The first of these maps relate to age whereby distribution of functional ages by growth can be assessed. The main observation that can be made is that people of adult (15-64) and elderly ages (65+) seem to live in areas showing higher than average growth whereas the youth (0-14) live in those areas showing average or less than average growth in the north and central areas in areas of the inner core and metropolitan fringe but in above average growth in the eastern, southern and south-western areas of the City-Region in the metropolitan fringe and satellite cities as well as small towns. A good summary measure of age are dependency ratios. This is a measure which looks at the

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number of dependants who depend on the economically active population. This refers to the dependency of the youth (0-14) and the elderly (65+) on the economically active (15-64). It is prudent to acknowledge that not all 15-64 are working with many chosing not to work due to study or to domestic responsibility, many not being able to work due to be being genuinely unemployed and it should be noted that not all people stop working at 64 with many working through to their 70s in the current times. With a few exceptions, most areas characterised by high dependency ratios are located in low growth areas which can be said to be mostly agricultural with low dependency occurring in areas with lower fertility such as the metros which leads to an older age structure. Out migration is also a major factor in areas of high dependency due to mainly the youth seeking greener pastures.

Figure 11 Person Growth by Under 15

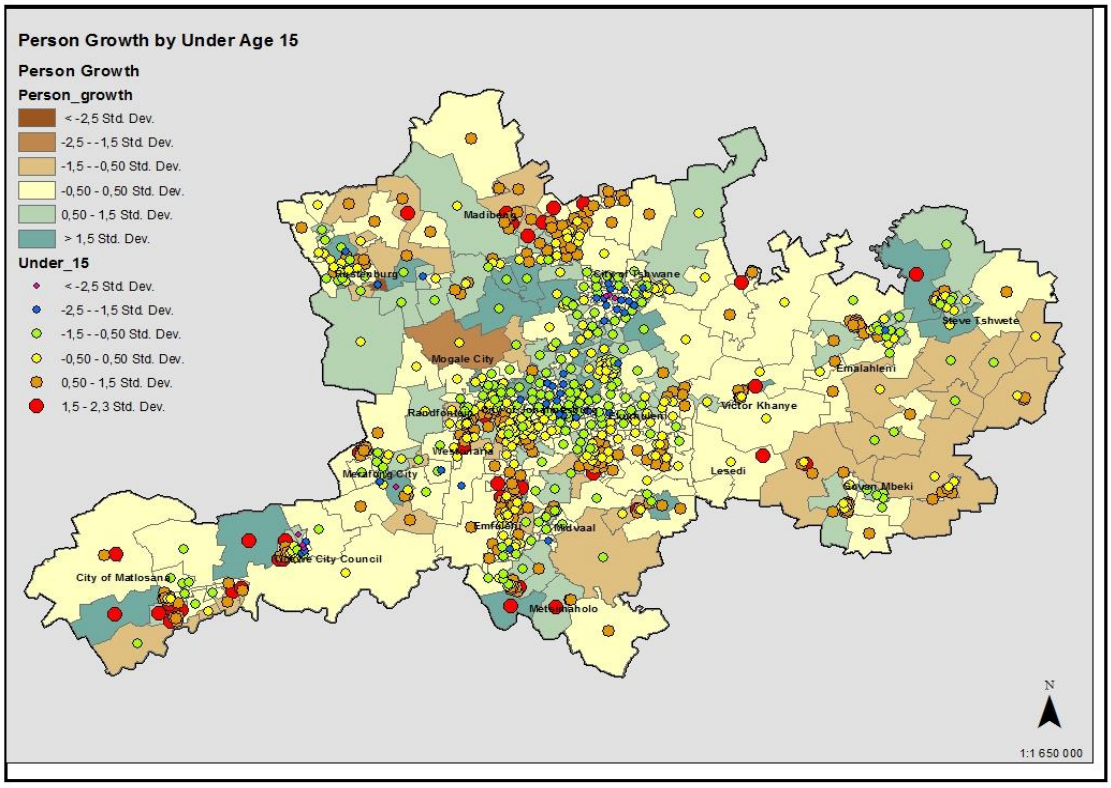

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Figure 12 Person Growth by Age 15-64

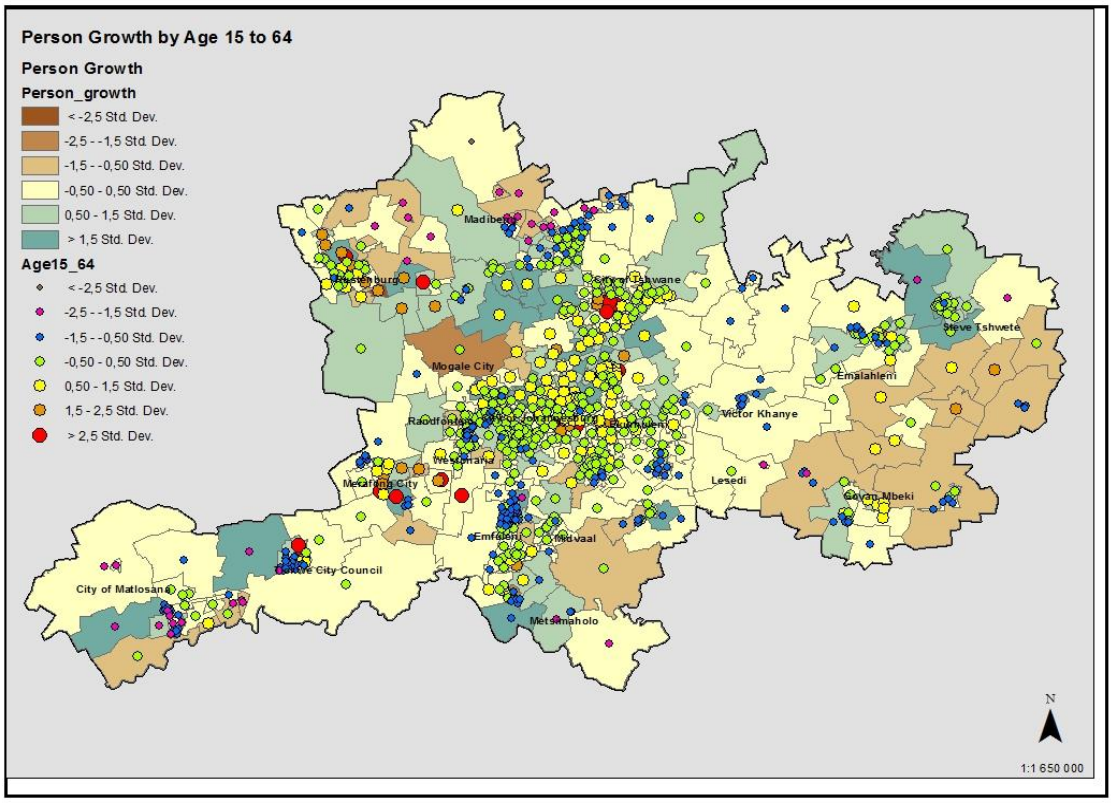

Figure 13 Person Growth by Aged 65+

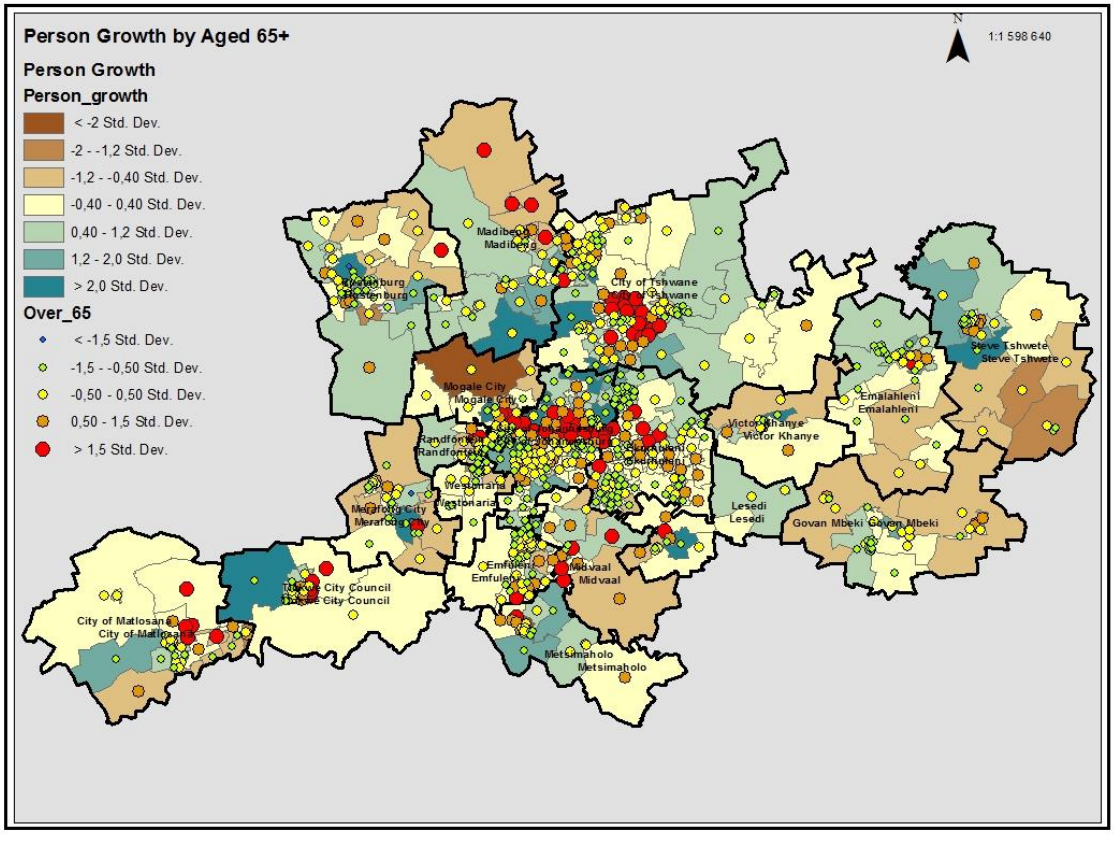

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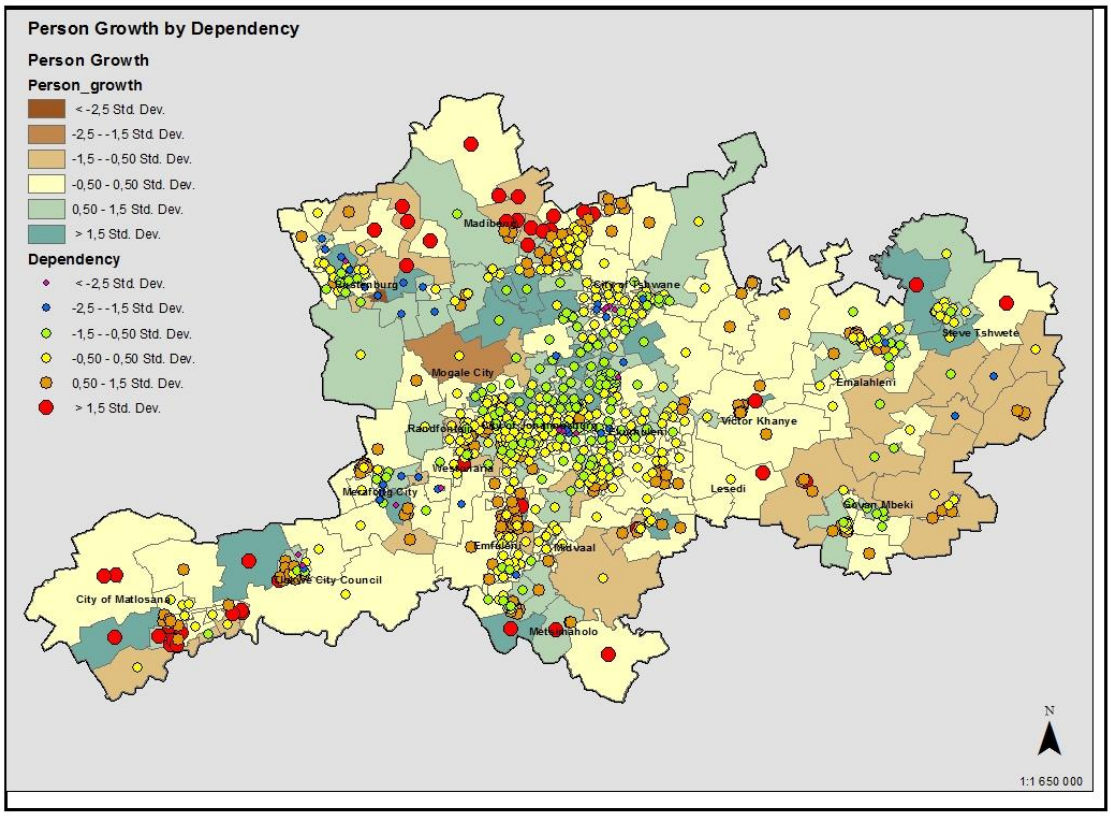
Figure 14 Person Growth by Dependency Ratio



A major demographic consideration is of course sex. In this regard the sex ratio has been used as a measure to describe the relation of males to females. In this case sex ratio refers to the number of males per 100 females. Most wards across the City-Region have as expected a sex ratio of close to 100 but some notable exception do occur. Near Potchefstroom, we see a special case of a satellite city where possibly due to the existence of the university there is a sex ratio of less than 100 suggesting more women than men. The opposite, whereby a sex ratio of more than 100 occurs can be found by mining towns in the metropolitan fringe or in satellite cities within this industry. An interesting scenario manifests itself in wards that are indicated with the blue dots which indicate -.5 to -1.5 standard deviations less than the mean. This suggests that there are more women than men which is feasible in university towns or areas such as the aforementioned one of Potchefstroom but also in Hatfield, Pretoria. Another explanation for this is when either the male spouse lives and works away from his family home leaving the female with her children at home or when children are sent elsewhere or sent from elsewhere to live with members of their extended family in these areas of the City-Region.

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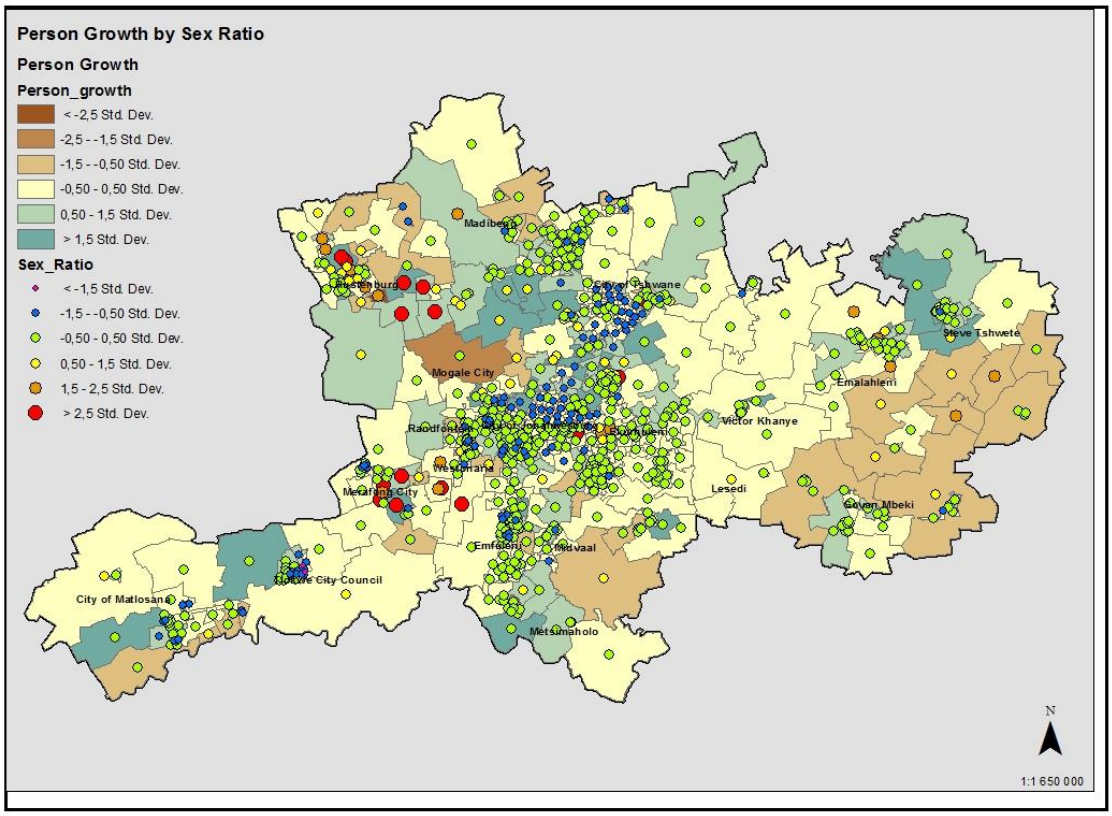
Figure 15 Person Growth by Sex Ratio



The scourge of unemployment also paints an interesting picture whereby the areas with the highest proportion relative to the mean amongst the youth that are unemployed (15-34) and the areas of unemployment across all ages are found mostly in areas with a less than average population growth in small towns and satellite cities. From a GCR perspective above average relative concentrations of the unemployed are mainly located in the fringe areas, and the satellite cities and smaller towns in the metropolitan daily catchment area and the weekly urban system and below average figures in the central metropolitan core areas.

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Figure 16 Person Growth by Youth Unemployment

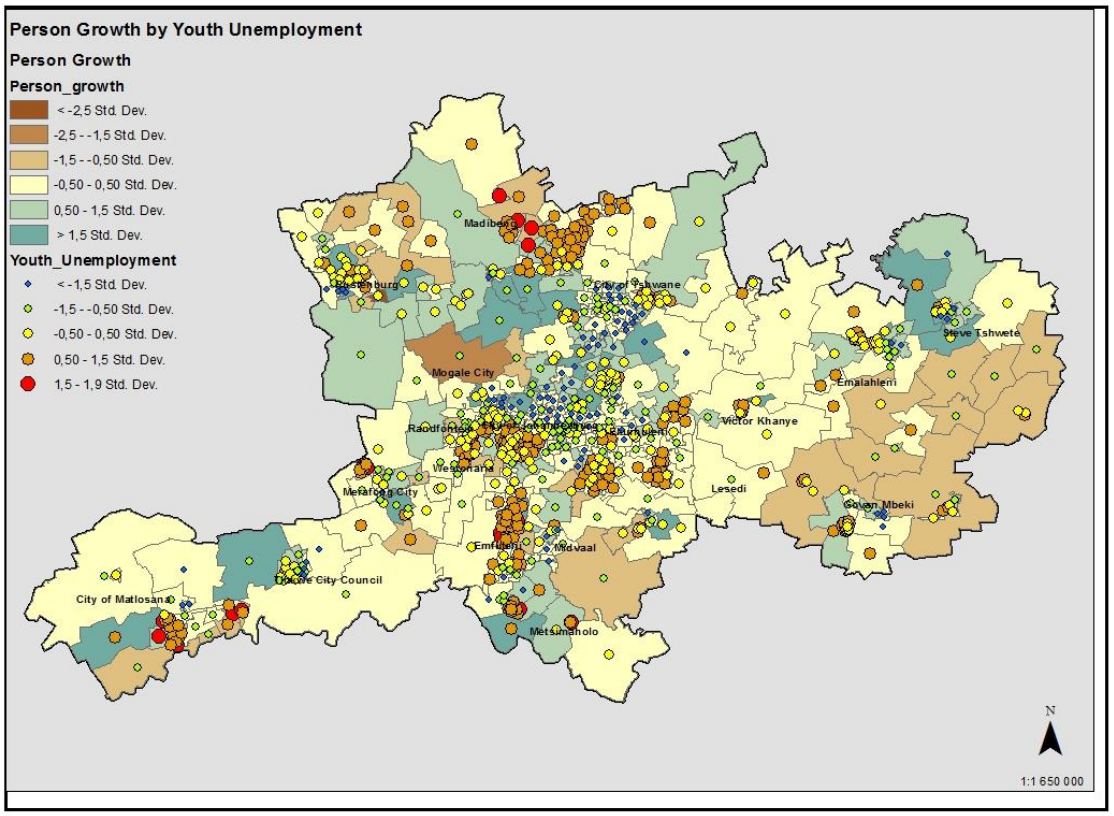
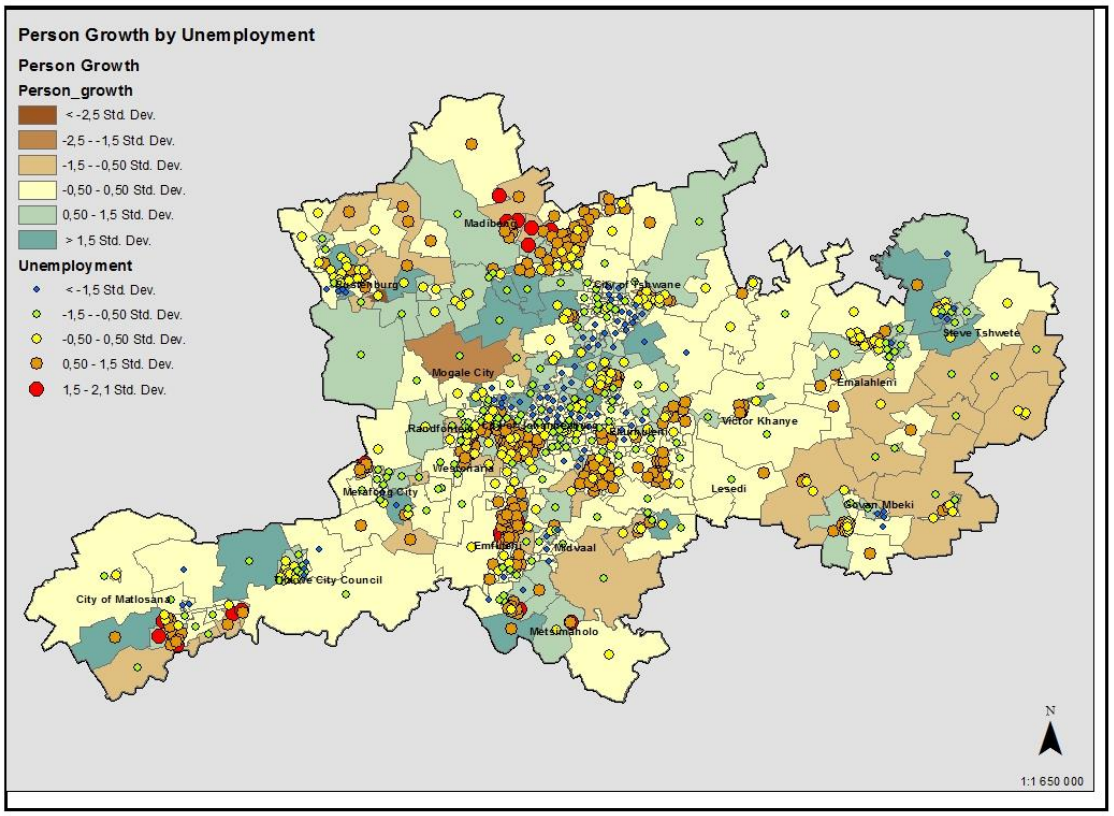


Figure 17 Person Growth by Total Unemployment



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Education is a key indicator of the development of the City-Region which gives it an advantage over other regions. It is also home to five universities and this excludes technical universities and other FET institutions. Since 1994 when a democratic dispensation came into being the proportions of those with no schooling has decreased considerably. The analysis indicates that it is only in non-urban wards of the city-region where there is a substantial proportion (1.5 and more standard deviations above the mean) of the population aged 20 and over with no schooling or only some primary education as a highest level of education. These areas are also characterised by overall population growth rates that converge around the mean. The areas with proportion of adult population with higher education higher than the mean (more than 2.5 standard deviations) reside in the university town of Potchefstroom, and the south and east of Tshwane and Johannesburg in the GCR core area where the five universities of the City-Region exist. These also correspond in high population growth areas.

Figure 18 Person Growth by No Schooling

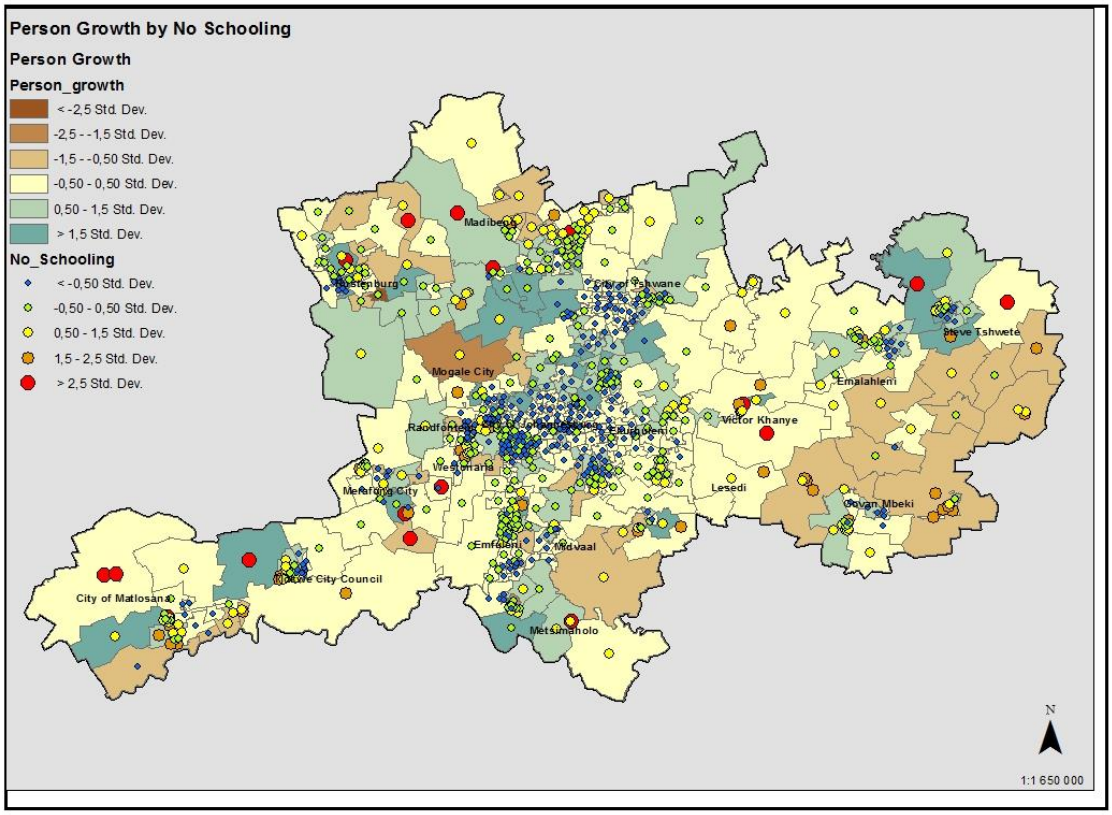

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Figure 19 Person Growth by Some Primary

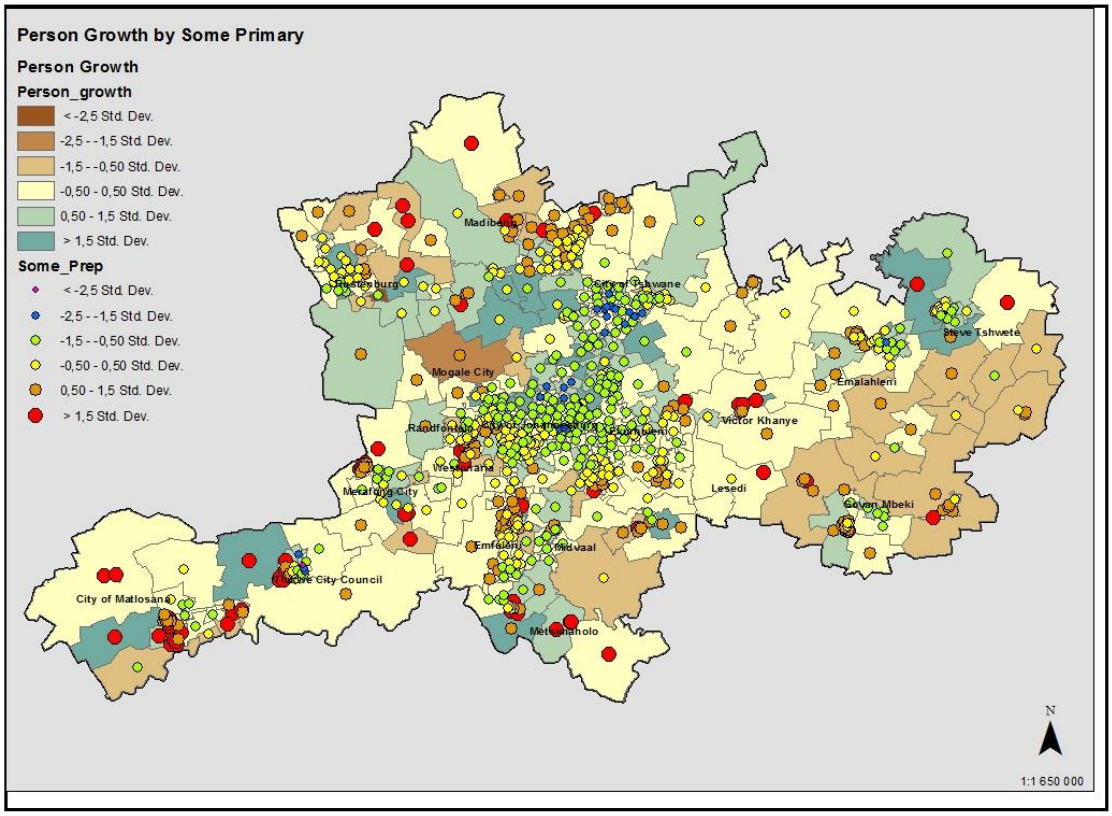
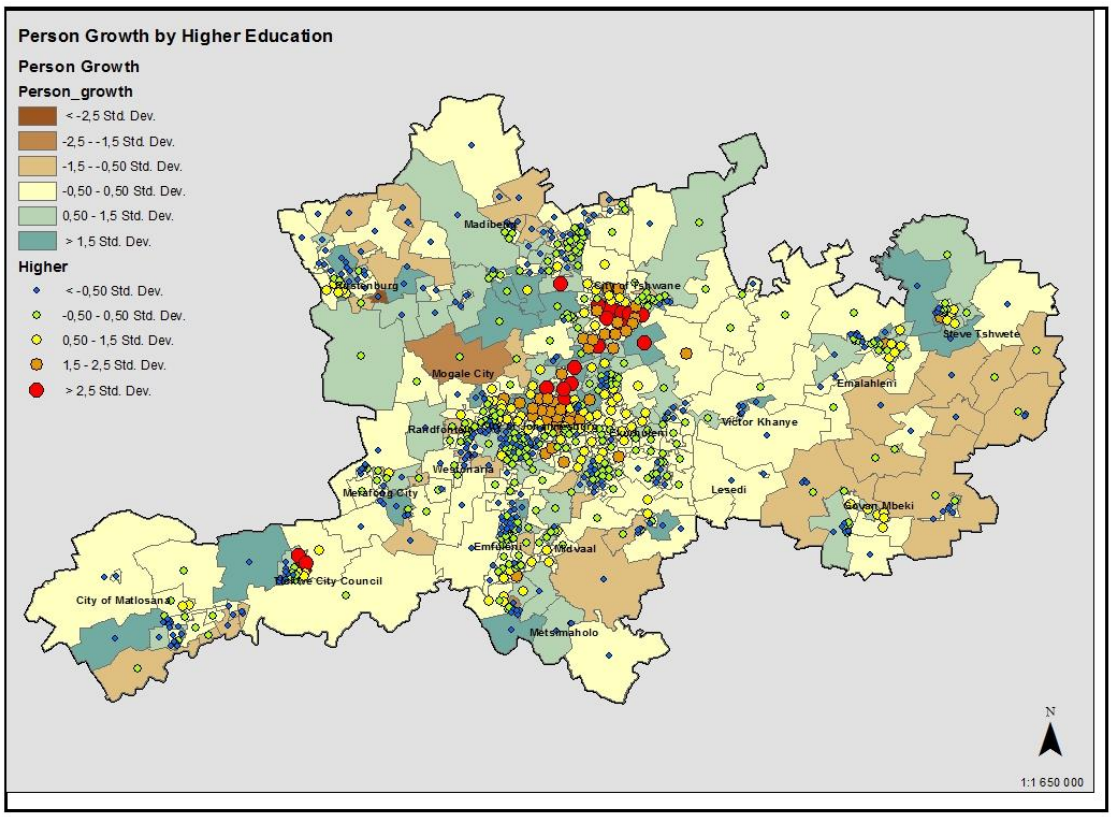


Figure 20 Person Growth by Higher Education



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With regards to poverty and economic vulnerability, the areas with the highest concentration of no income (compared to the mean) are located mostly in the metropolitan fringe areas and the smaller intermediate towns within the weekly urban systems of the GCR, as well as in the traditional township areas in the southern parts of Johannesburg and Ekurhuleni and the northern parts of Tshwane. A similar pattern is largely also applicable to the low income category but with even more pronounced concentration in the settlement areas located in the metropolitan daily catchment area and the weekly urban system. There are also some exceptions in this pattern such as the comparatively low levels (generally below the mean) of low income population in the intermediate city of Secunda area, most likely associated to the petrochemical industry that has refineries in that area and in Rustenburg associated with the mining industry. When shifting the focus to the high income population it is clearly highly concentrated (more than 2.5 deviations above the mean) in the GCR inner core areas – especially the northern parts of Johannesburg and the east and south of Tshwane and as noted above also in Secunda.

Figure 21 Person Growth by No Income

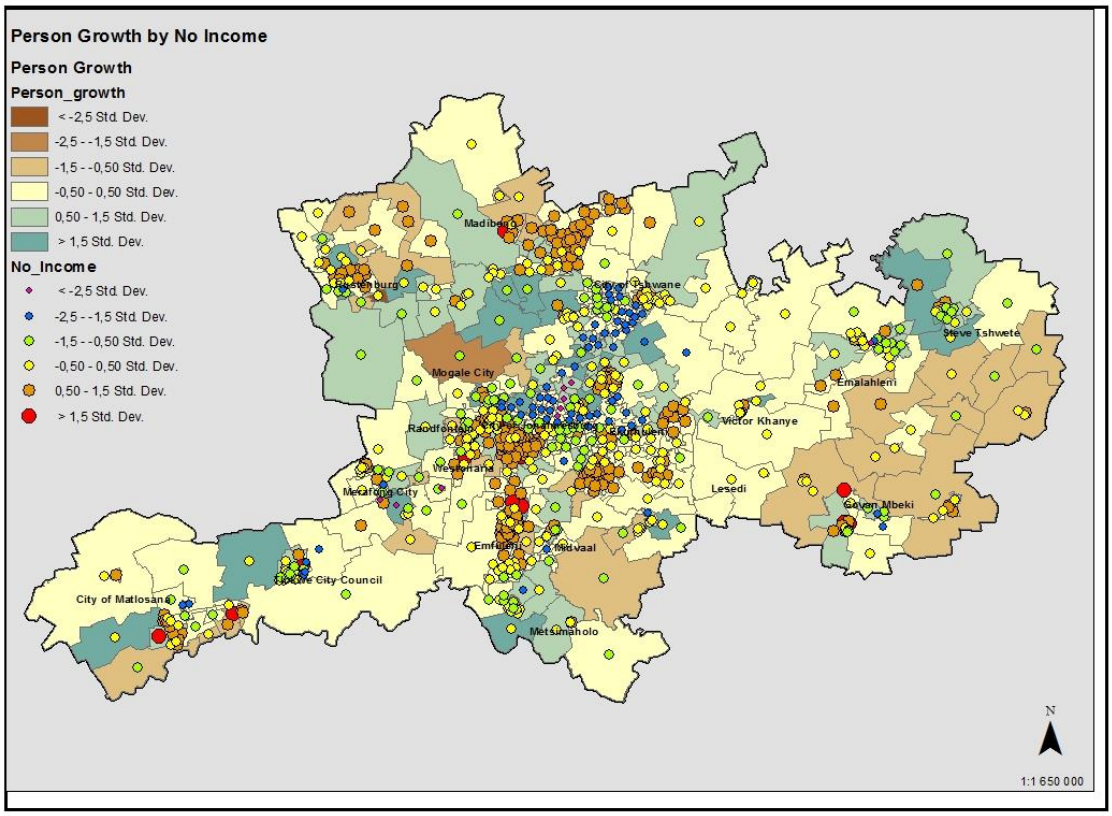

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Figure 22 Person Growth by Low Income

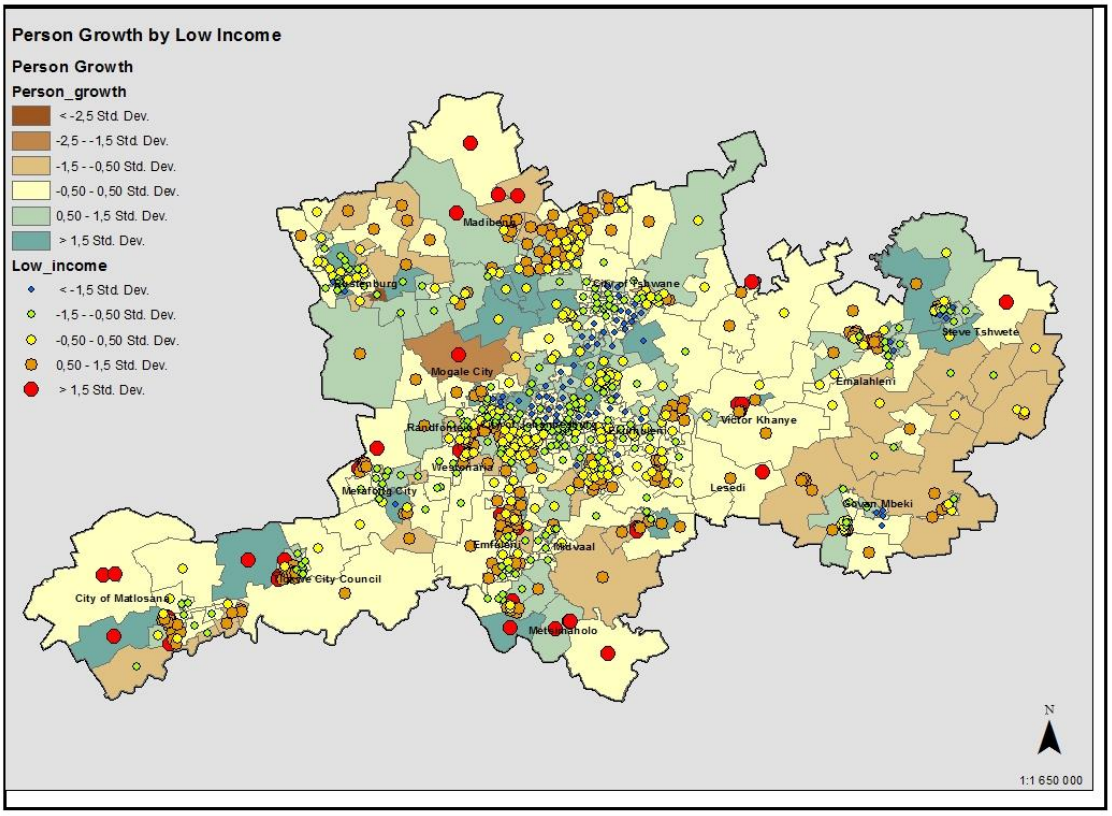

Figure 23 Person Growth by Medium Income

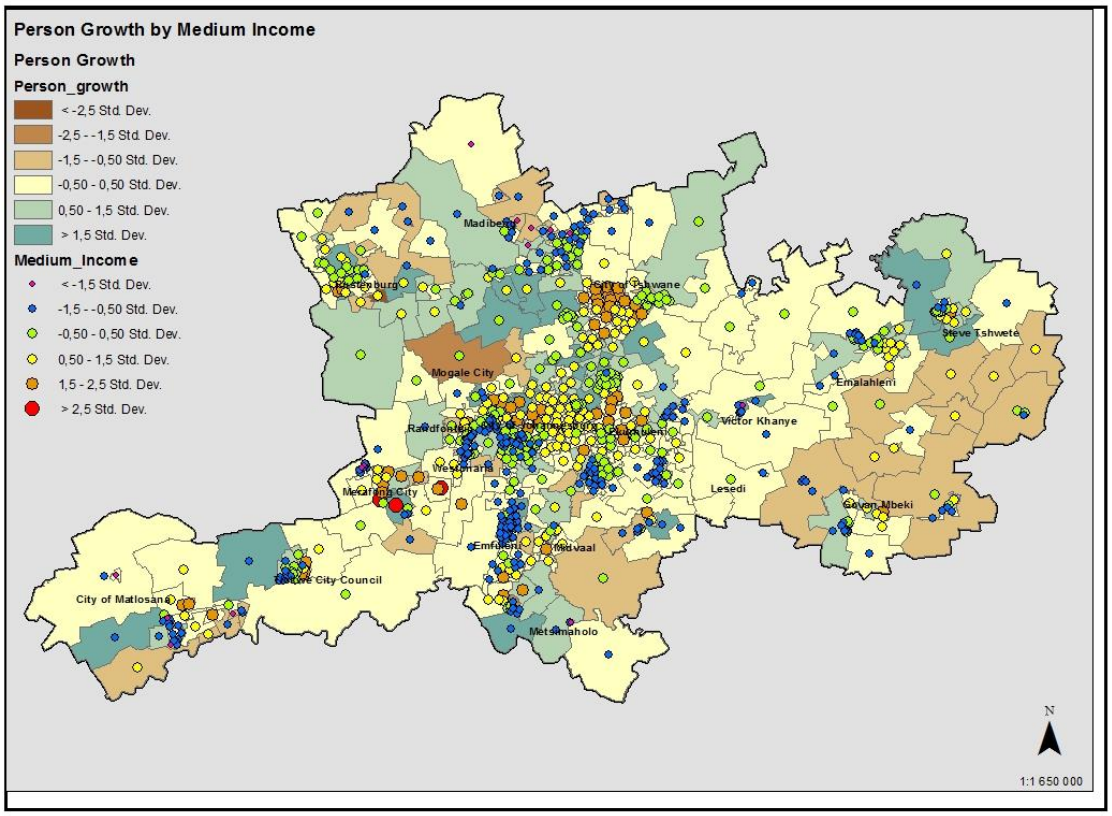

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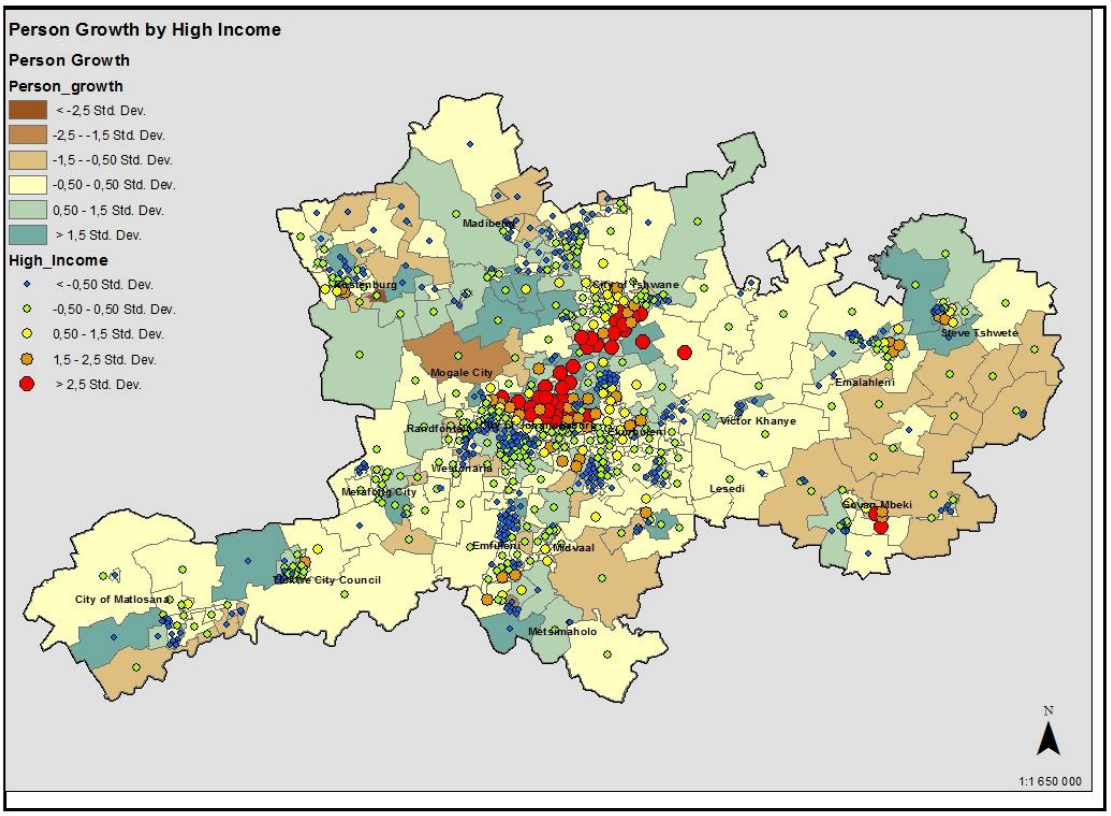
Figure 24 Person Growth by High Income



An area which is worth focussing on is that of migration. The theoretical background to this paper has focussed a lot of attention on the differential urbanisation theory and also expressed views on distance of migration. Whilst growth can be a strong indicator of migration, this is dependent on mortality and fertility rates and patterns being constant over a given period. In the case of South Africa this is not the case. Migration is hence only one of many factors which could influence growth. The first map in this regard indicates wards where the change of municipality of one who moved in the 2001-2011 period, focusing on the last move, came from within the Gauteng City-Region. In this regard a concentration is seen in the metropolitan fringe but there is also a considerable amount of such cases throughout the metros as well as a scattering of this category in diverse areas of the city-region. These cases referred to as considerable are those between 0.5 and 1.5 standard deviations greater than the mean. When considering people who moved in the 2001-2011 period and moved into the City-Region but from a neighbouring municipality outside of the City-Region there is a clear concentration in the satellite cities and towns in the metropolitan daily catchment area and the weekly urban system of the GCR. This certainly shows the type of movement that suggests some kind of differential urbanisation whereby people are attracted to secondary cities in the city-region but

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this must be viewed from perspective that this comes from a low base, in other words these wards have few in-migrants so any movement into such wards generate a high percentage as opposed to the metros where many people move but where the percentage of people from a neighbouring municipality generates a low percentage. The final descriptive map looks at those movers who came from beyond a neighbouring municipality of the GCR. These can be found in satellite cities and the metropolitan fringe but in areas which in many instances are closely related to mining towns and all experiencing considerable growth in the areas concerned. Migrants from further distances hence seem to make calculated decisions as to where to migrate to because their support networks are much further away and they are more vulnerable. Those coming from neighbouring areas could be considered more opportunistic with a lower risk of failure because if things don't work out it is not far to go back to their support and family networks.

Figure 25 Person Growth by Migrants who moved from within the Gauteng City-Region

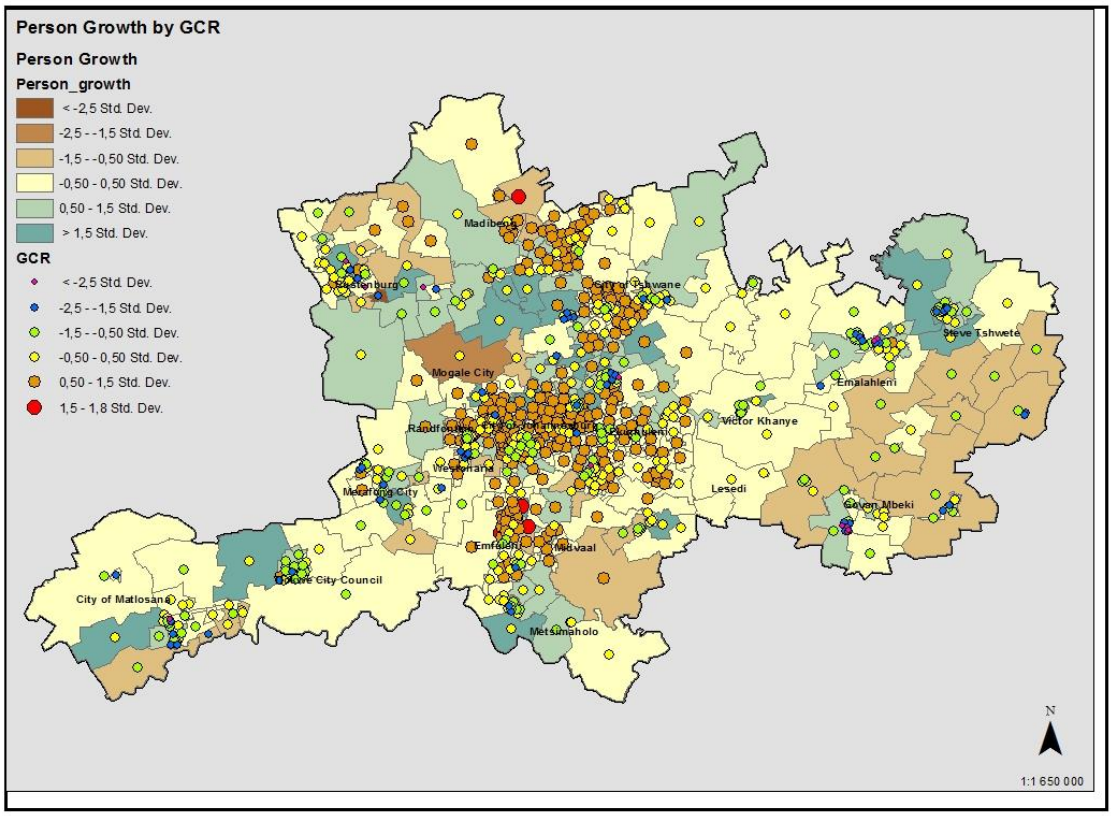

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Figure 26 Person Growth by recent migrants from neighbouring municipality to the GCR

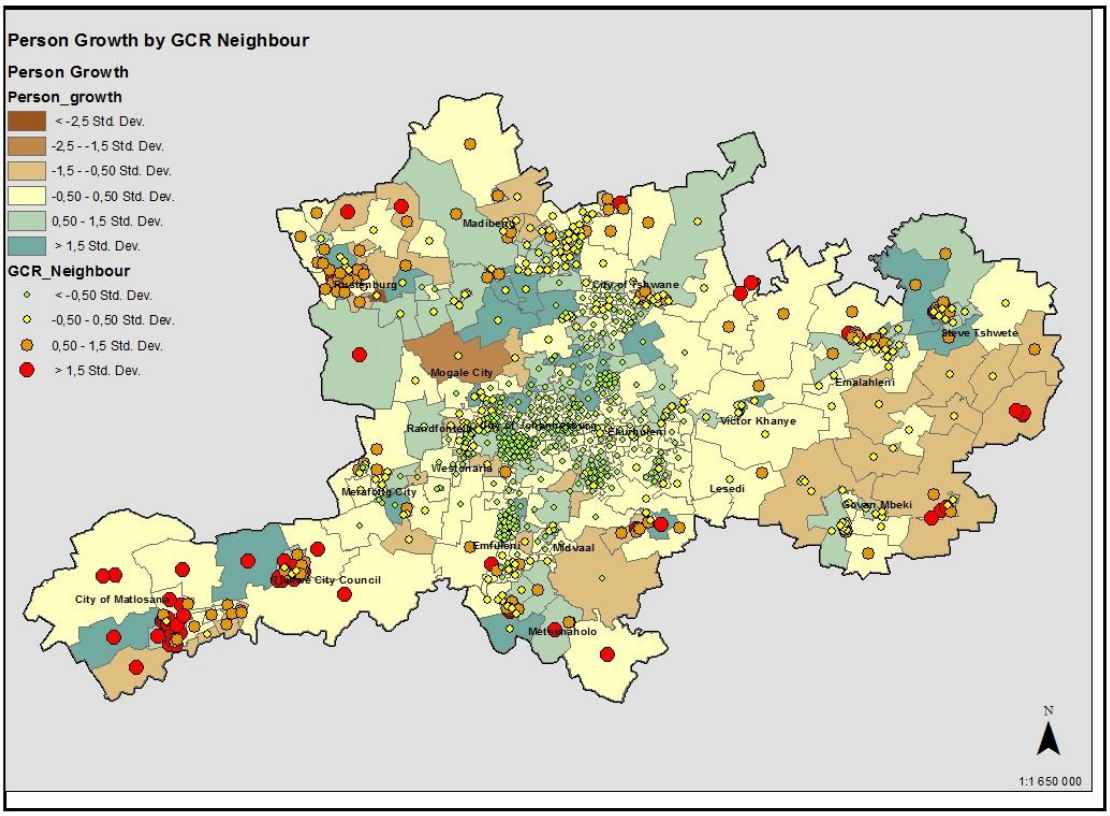
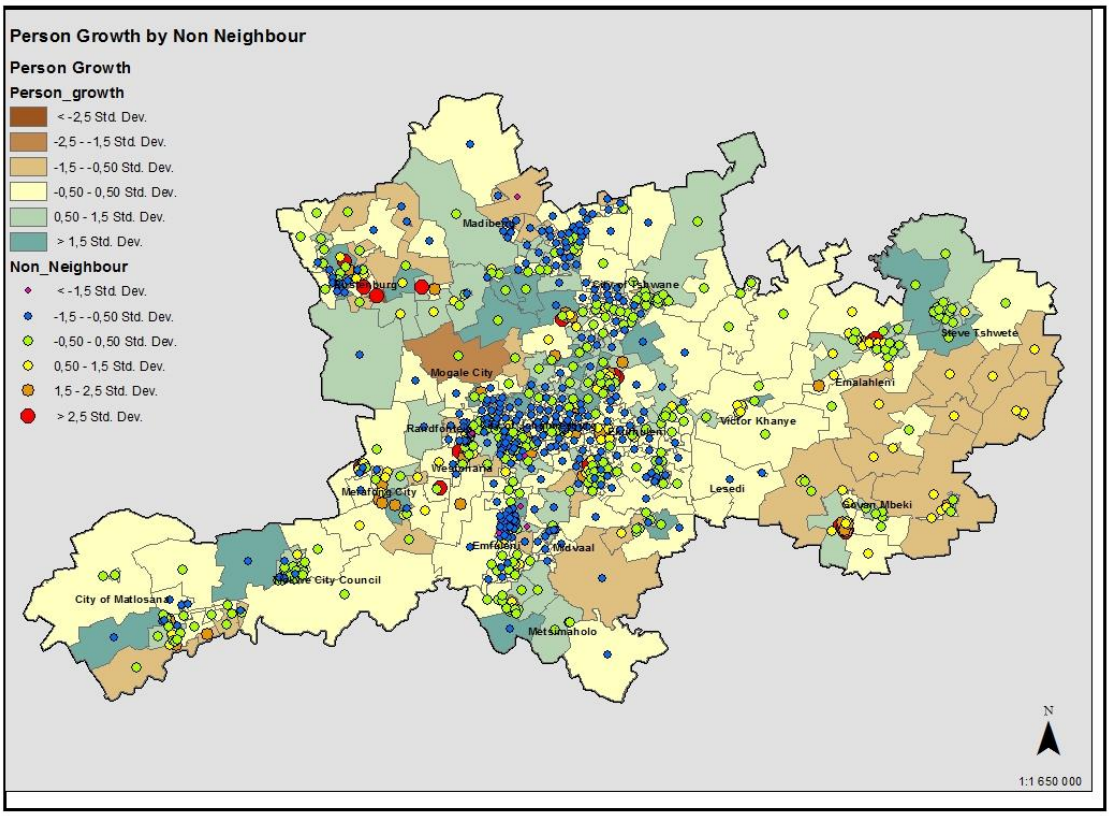


Figure 27 Person Growth by recent migrants from beyond neighbour of the GCR



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The next part of the analysis deals with household based indicators. The household head is an influential figure. It is his/her decisions that set the tone for the quality of living that the household will experience and many of these characteristics are pre-determined by the extent to which household growth has occurred at ward level. Teen headed households are usually an indicator of vulnerability and child poverty or deprivation. The areas on the map indicating high levels of teen headed households could probably be explained by students in student areas where universities exist. These would be in Hatfield (Tshwane), Potchesfstroom (Tlokwe), Braamfontien and Auckland Park (Johannesburg). There were exception however in areas of the metropolitan fringe and satellite cities. Wards with above average concentration of adult household heads are concentrated mostly in small towns and satellite cities in what are mostly mining areas where it could be argued proportionally few children and elderly headed households would exist and corresponds with a mix of high and low growth areas. Amongst elderly headed households an interesting pattern emanates in Madibeng whereby in a low growth area we find a concentration of elderly heads but at the same time a scarcity of teen heads. This may be due to elderly people moving to their traditional places of origin which are barren of any young people.

Figure 28 Household Growth by Teen head of household

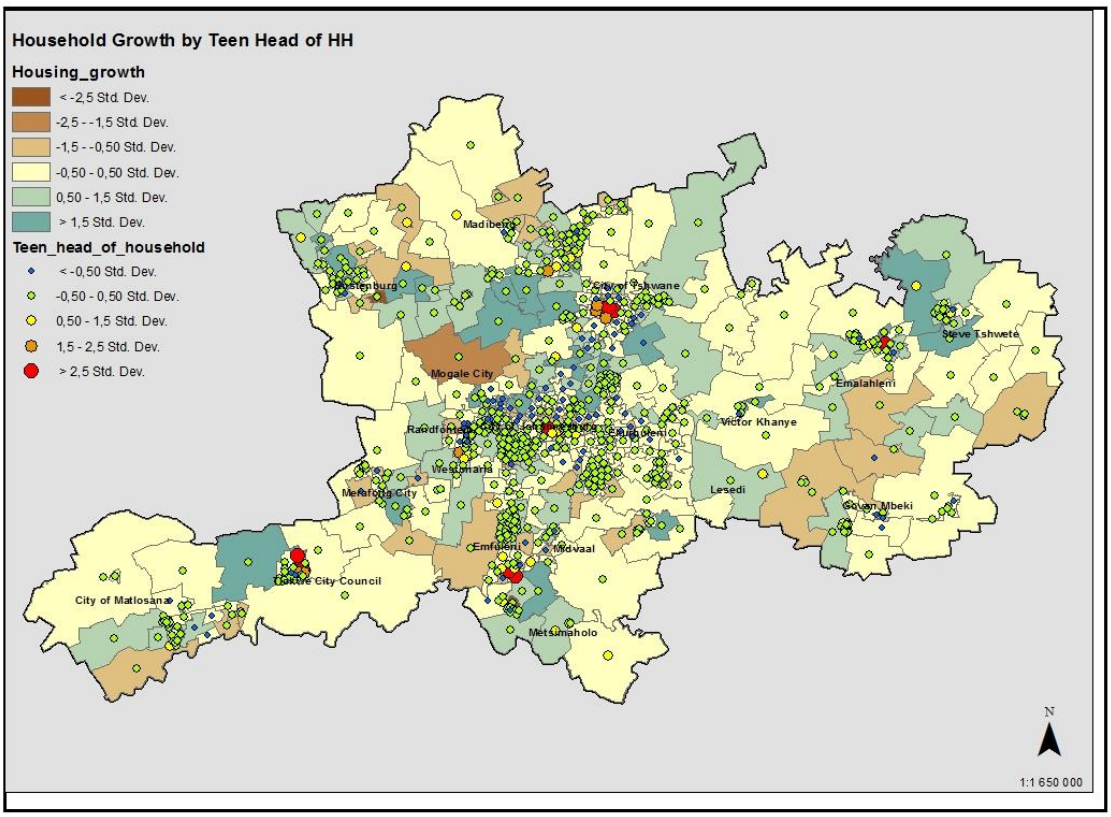

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Figure 29 Household Growth by Adult Head of Household

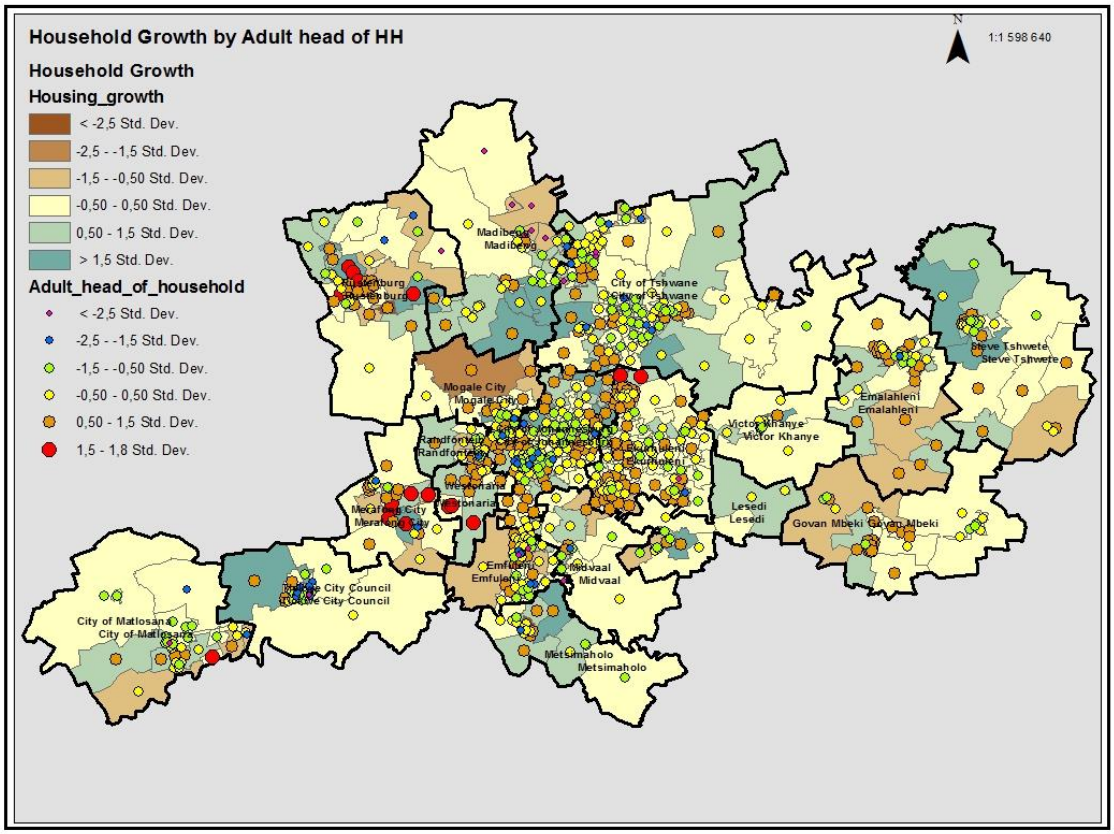
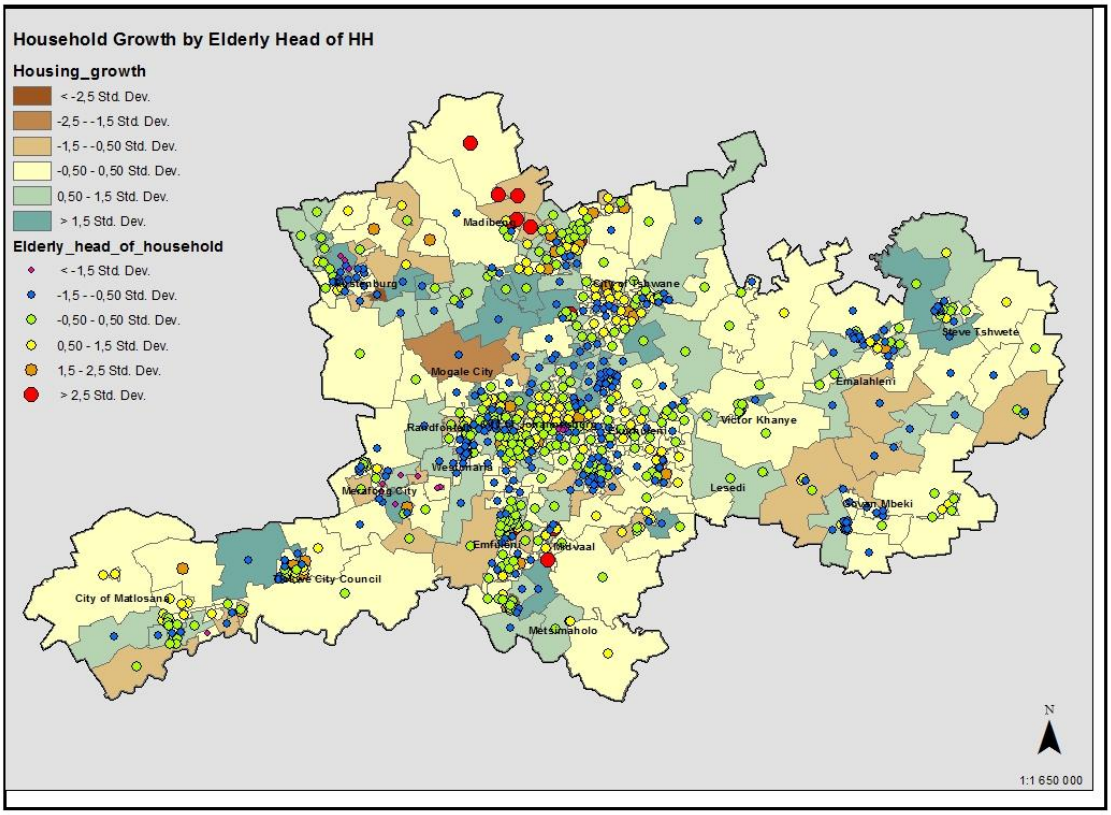


Figure 30 Household Growth by Elderly Head of Household



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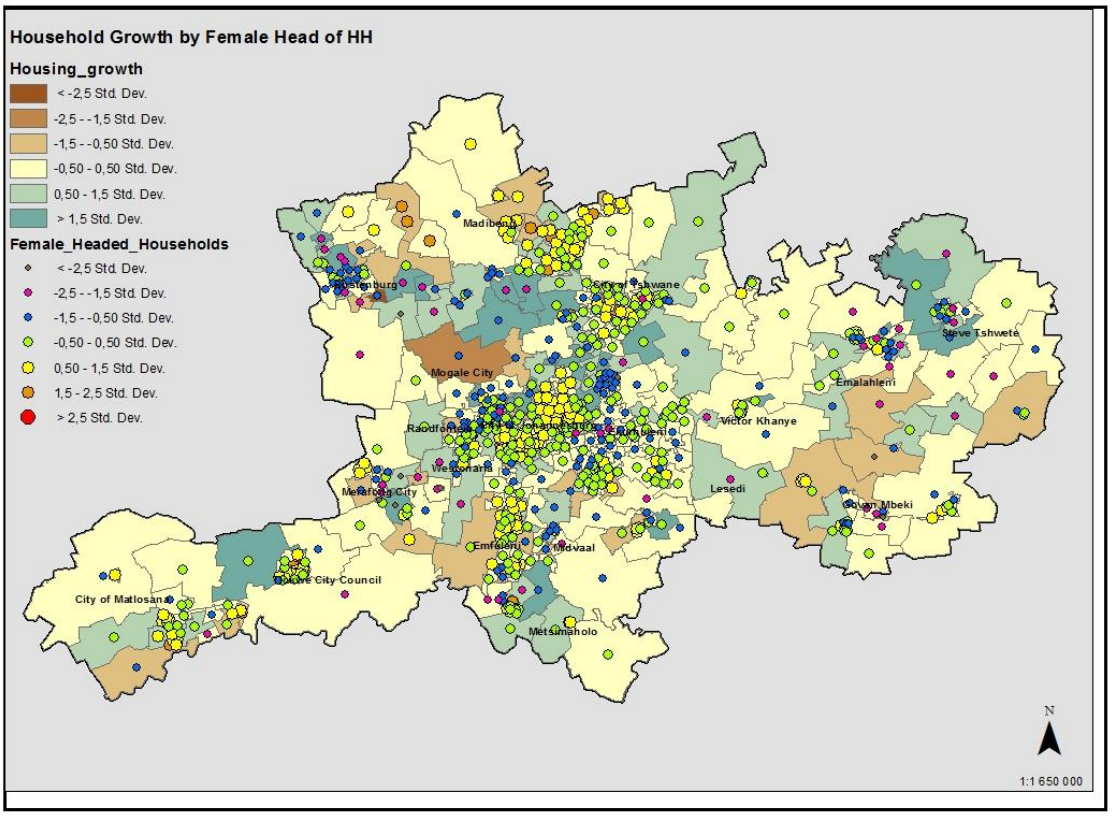
A further indicator which expresses vulnerability are female headed households. The dominant pattern in this instance is the scarcity of female headed households in moderate to high household growth areas around mining towns in the metropolitan fringe and satellite cities.

Figure 31 Household Growth by Female Head of Household



Finally with regard to heads of household the employment status is important to consider. The dominant pattern is that the metros have by and large low levels of unemployment for heads of household but that in the metropolitan fringe and in satellite cities and small towns areas exist with significant amount of unemployed heads of households in wards which are for the most part showing moderate low growth with the exception of those in north-west Tshwane.

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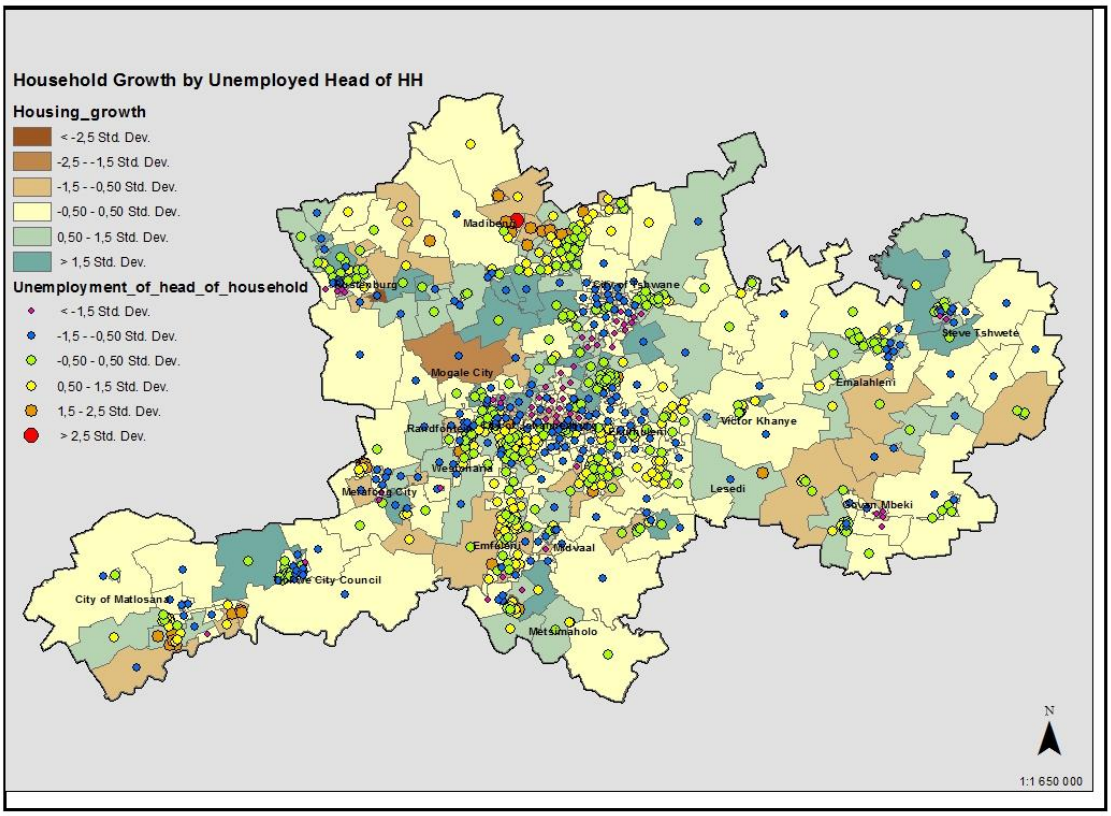
Figure 32 Household Growth by Unemployed Head of Household



Housing plays an important part in terms of growth and quality of life and this too has attracted spatial patterns worthy of consideration. Census classifies housing into three broad categories being formal, informal and traditional housing with various variations within. Formal housing is by far the most dominant category and as expected found widely across the entire GCR. Informal housing is mostly found in areas of high household growth and is essentially the result of inadequate housing for the poorest segment of the population in areas where opportunities to get out of poverty may exist. Traditional housing is limited to where tribal areas exist in the City-Region, predominantly in the eastern part of the GCR.

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Figure 33 Household Growth by Formal Housing

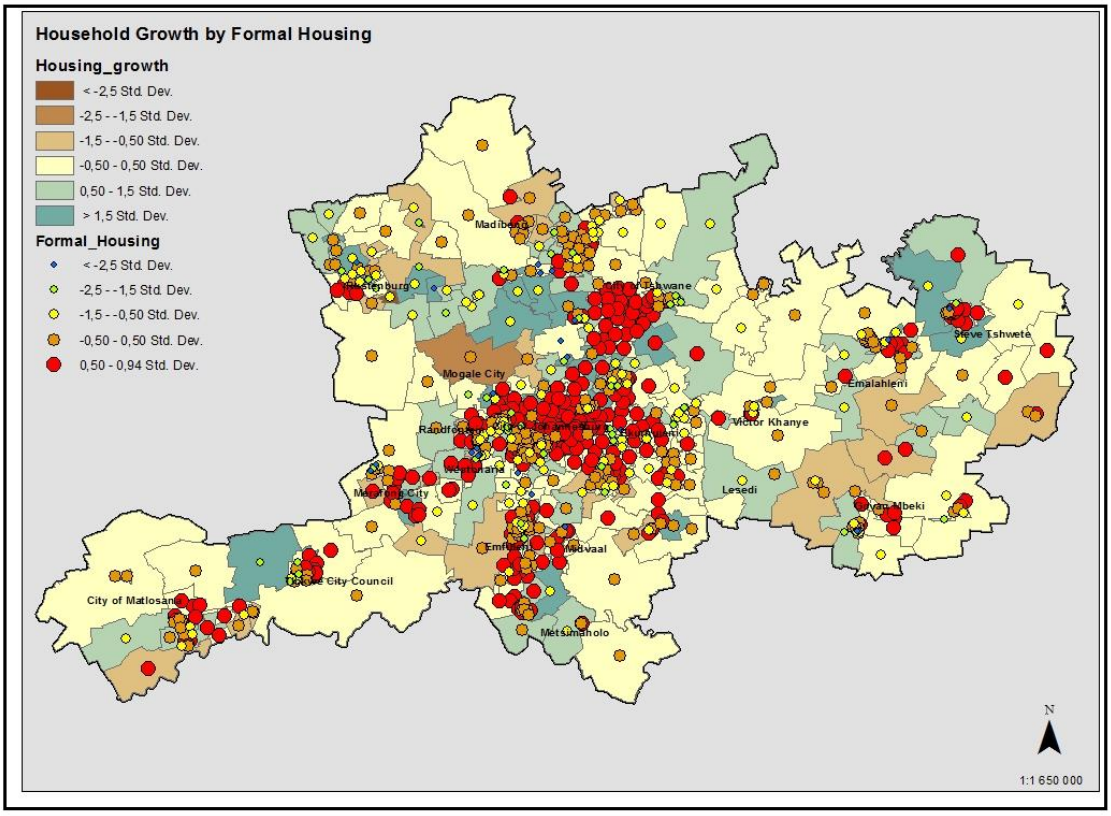

Figure 34 Household Growth by Informal Housing

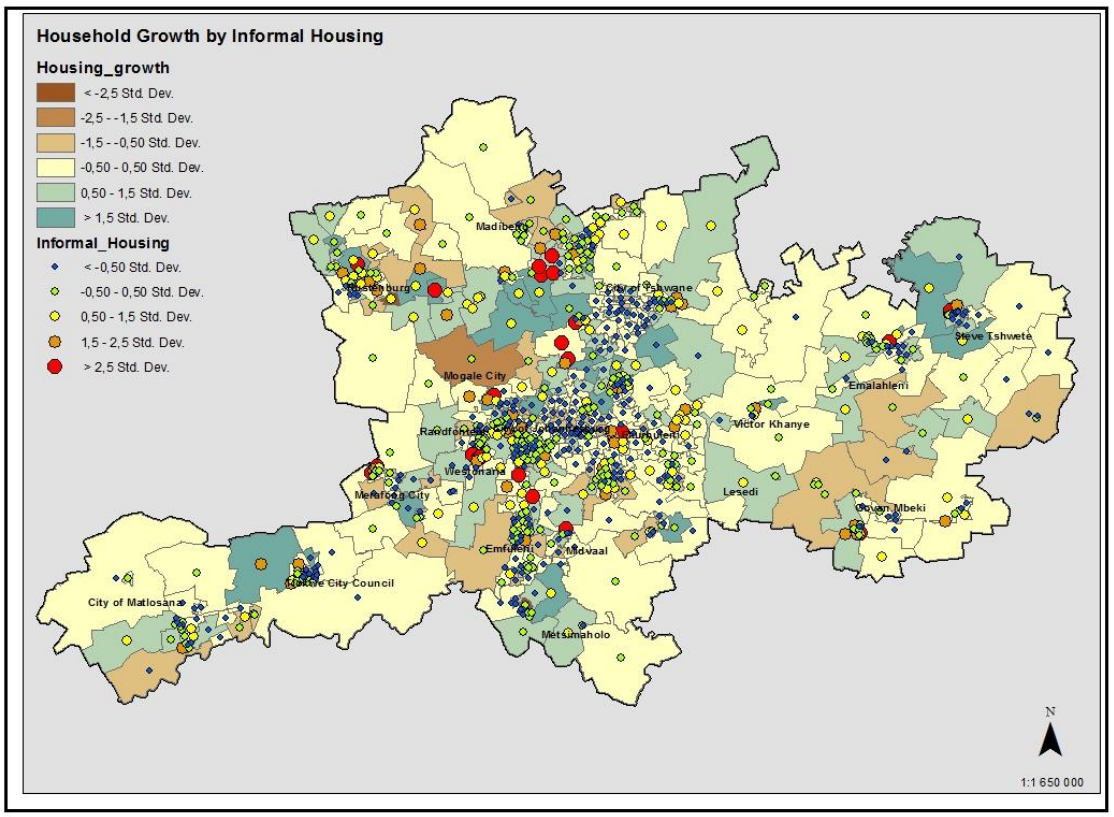

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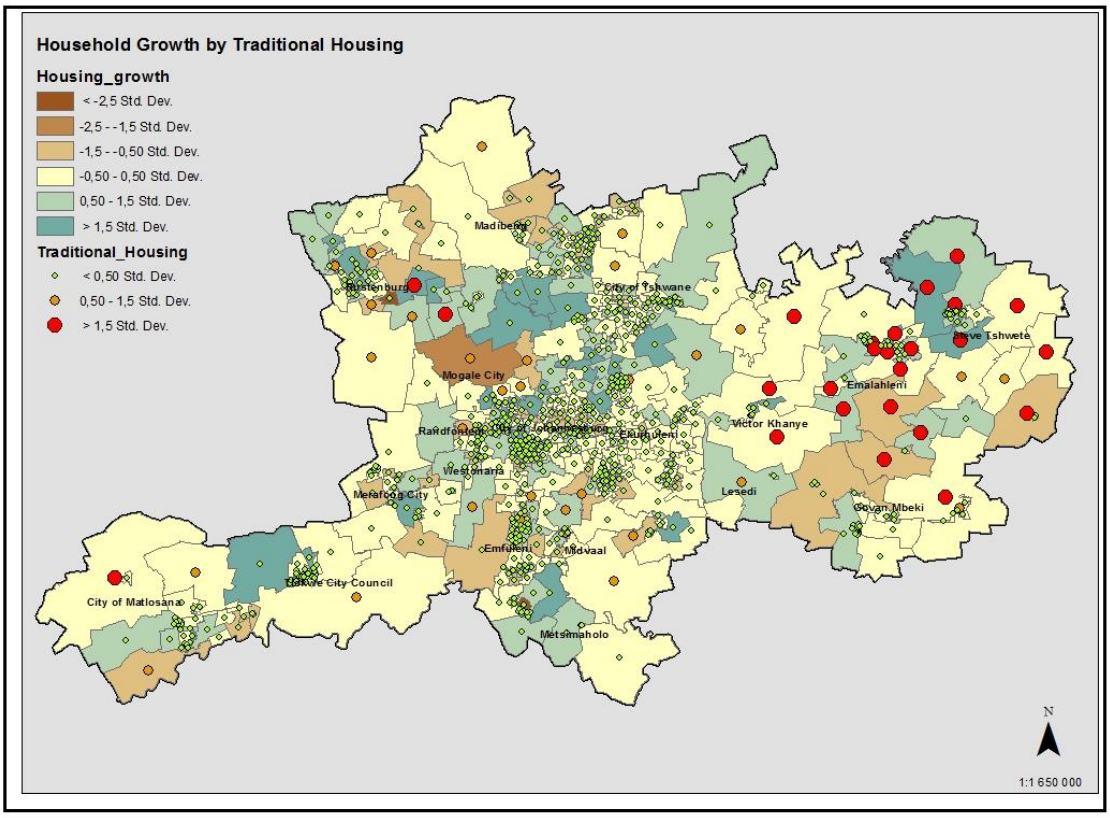
Figure 35 Household Growth by Traditional Housing



One of the derived variables used in this analysis is that of household size. This is an indicator of density and is closely linked to population density which indicates regional growth. Wards with concentration of high household size are found in average growth areas of small towns in northern Tshwane and in non-urban areas in Mpumalanga. It is however not an indicator of household density.

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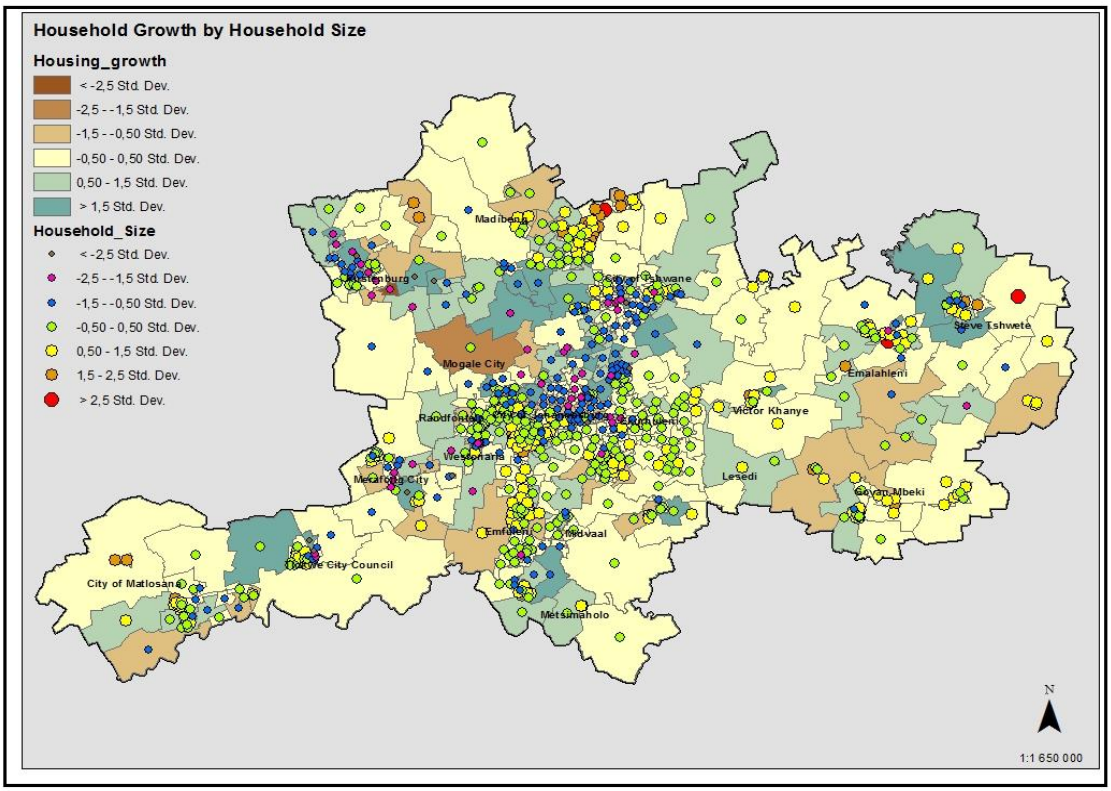
Figure 36 Household Growth by Household Size



Related to household size as well as housing type is tenure of the dwelling people reside in. This is an indicator of stability based on people's attachment to where they live. Those who rent have the lowest level of attachment to where they live either seem to be close to universities such as in Hatfield, Auckland Park and Potchefstroom or in towns of the metropolitan fringe near to mining establishments in the West Rand and the North-West province in areas ranging from average household growth to moderate household growth. The unique case of people living rent-free but not owning their properties seems to occur mostly on the West Rand in a mix of high and low growth areas in the metropolitan fringe up to the satellite towns in North-West. These are in all probability accommodation owned by mining companies for the purpose of housing selected staff. With regards to those who own their property there is a concentration of those still paying it off in the three metros of Gauteng as well as in satellite cities of the Govan Mbeki local municipality as well as the non-urban parts of the Rustenburg municipality. For those who have paid off the metros show an existence of a distribution that is less than average who have paid off. The metropolitan fringe area in eastern parts (non-urban) of the Madibeng local municipality is an area which shows a concentration of households in an area of low growth where their place of residence is paid off more so relative to other areas which indicates that this is an old area where properties have been paid for with 'old money' by people who purchased them many years ago.

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Figure 37 Household Growth by Rented Tenure Status

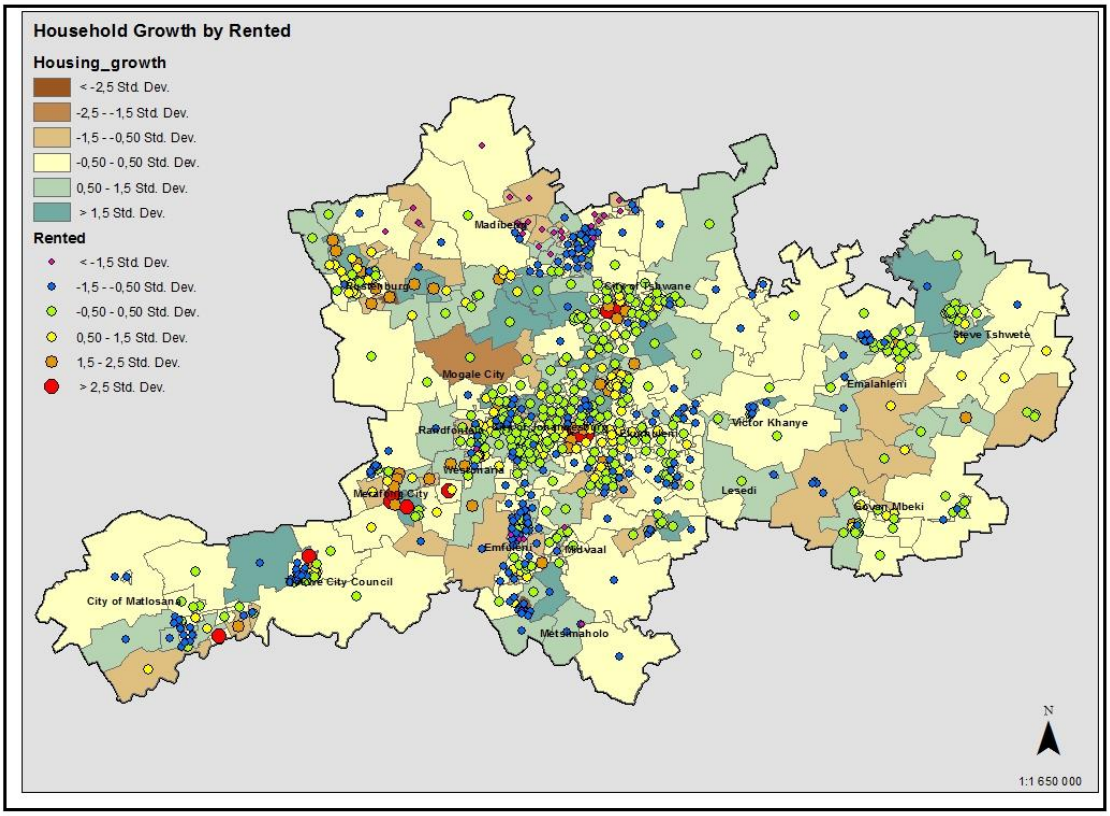

Figure 38 Household Growth by Rent Free Tenure Status

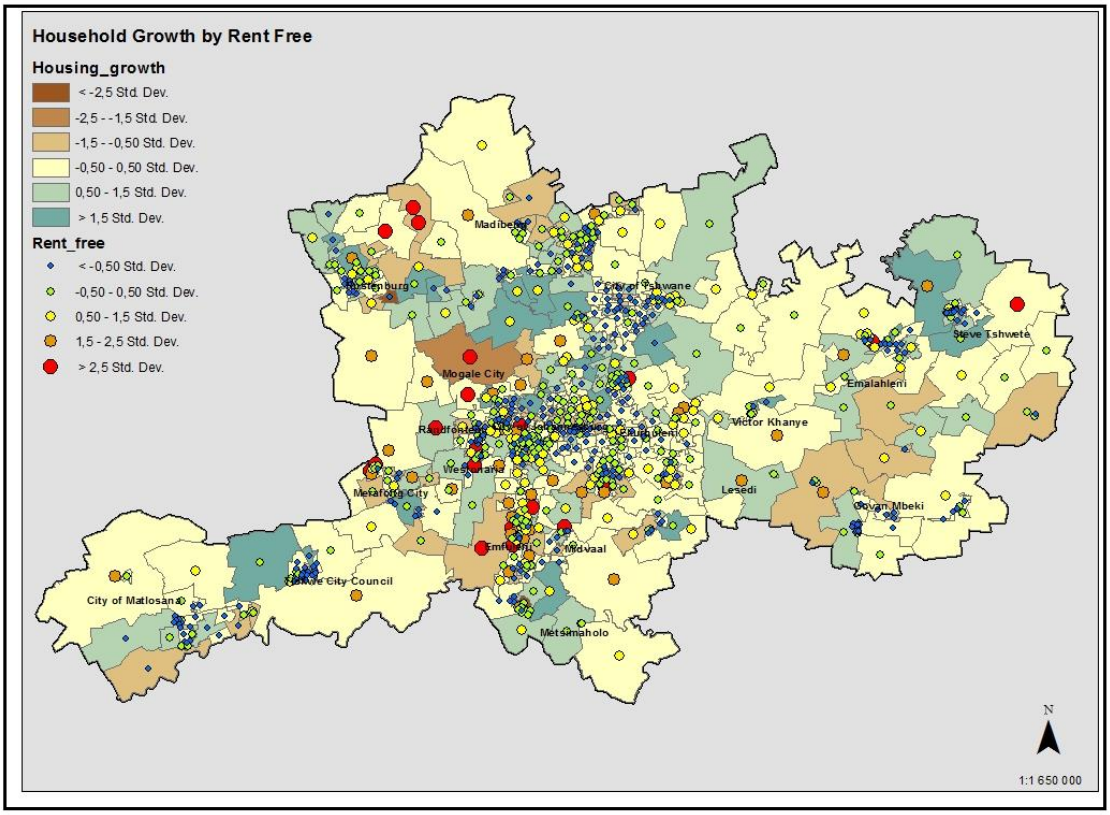

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Figure 39 Household Growth by Owned but not Fully Paid Tenure Status

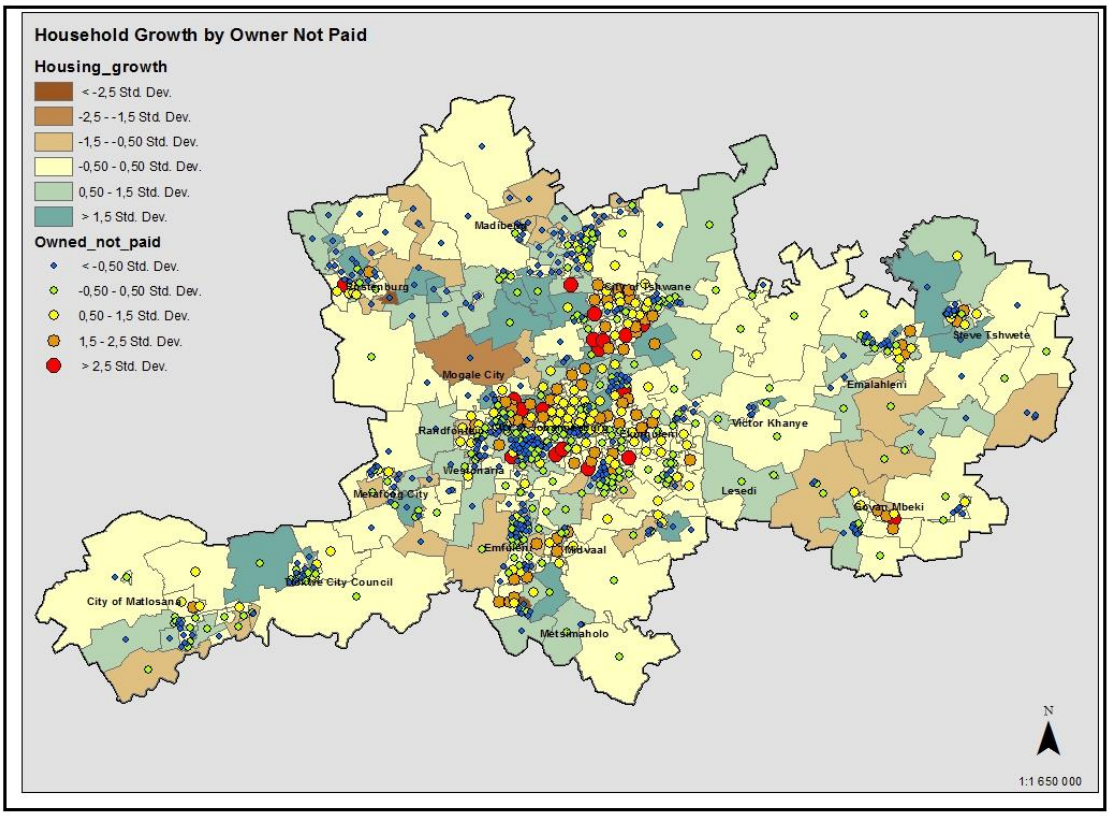
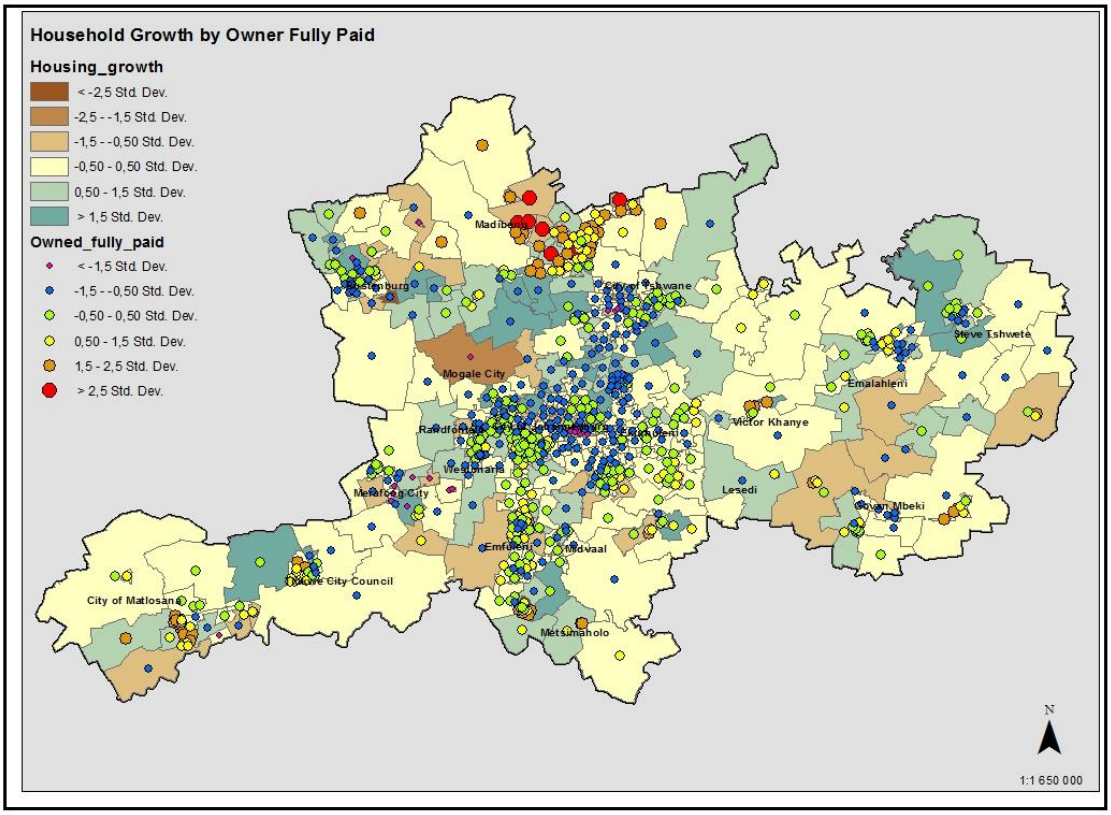


Figure 40 Household Growth by Owned and Fully Paid Tenure Status



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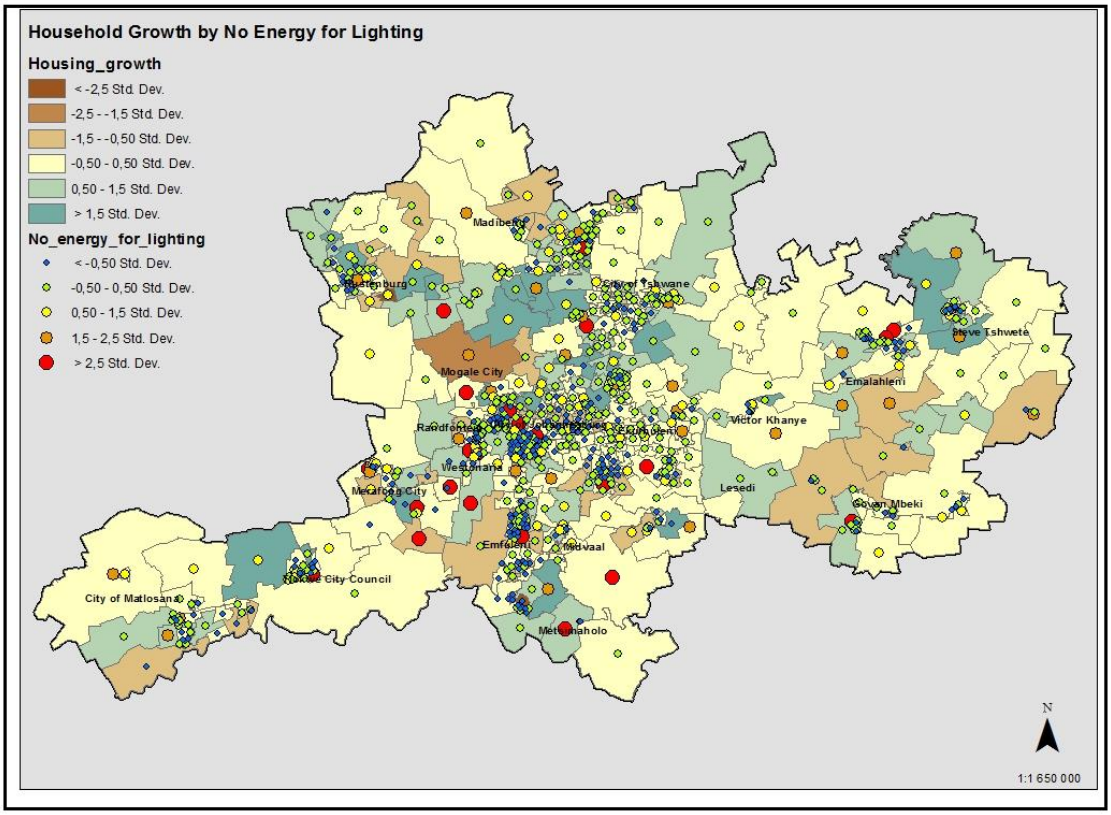
A key distinction at the spatial level is the existence of services to households which the correlation analysis described earlier show has an association with growth as either a push or a pull factor to certain areas. Once more parts of the West Rand along the metropolitan fringe experience wards where there is a concentration of no energy being available for lighting in addition to satellite cities in other parts of the city-region – all of which are areas ranging from average to moderate growth.

Figure 41 Household Growth by No Energy for Lighting



With regards to sanitation, this is one of those household services which ensures good health for its residents and which moderates growth dependent behaviour. The distribution of wards with a concentration of having no form of sanitation in places along the Inner core area as well as in non-metro municipalities in satellite cities and non-urban places, amongst satellite cities and small towns as well as across the Mpumalanga area of the City-Region. For those who use buckets these seem to be concentrated in the metros in suburbs and squatter communities but beyond metros in non-urban areas of satellite cities in Steve Tshwete, Madibeng and Metsimaholo municipalities. In almost all the above cases these occur in areas of positive growth whether it be average, moderate or high. In many cases municipalities will claim that they have eradicated buckets but what happens is that people may have a toilet outside the

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home at varying distances and it becomes uncomfortable or even unsafe to go out at night to make use of these so people rather make use of buckets which they then dispose of in the morning and hence they report on the use of buckets as the main source of sanitation even if it isn't a municipal bucket system. For sanitation connected to a sewerage system is the ideal and this is found across most areas of the city-region across different types of growth patterns. Outside the metros it seems to be focussed around satellite cities and smaller towns.

Figure 42 Household Growth by No Sanitation

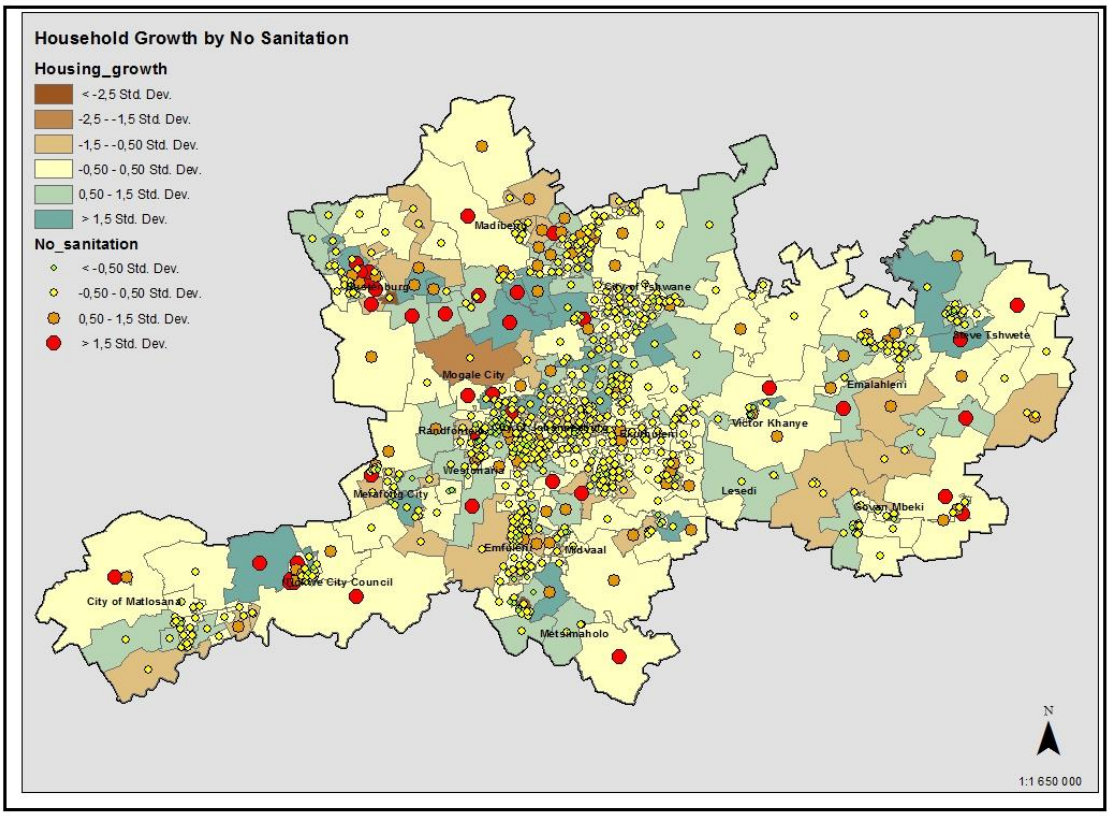

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Figure 43 Household Growth by Bucket Toilets

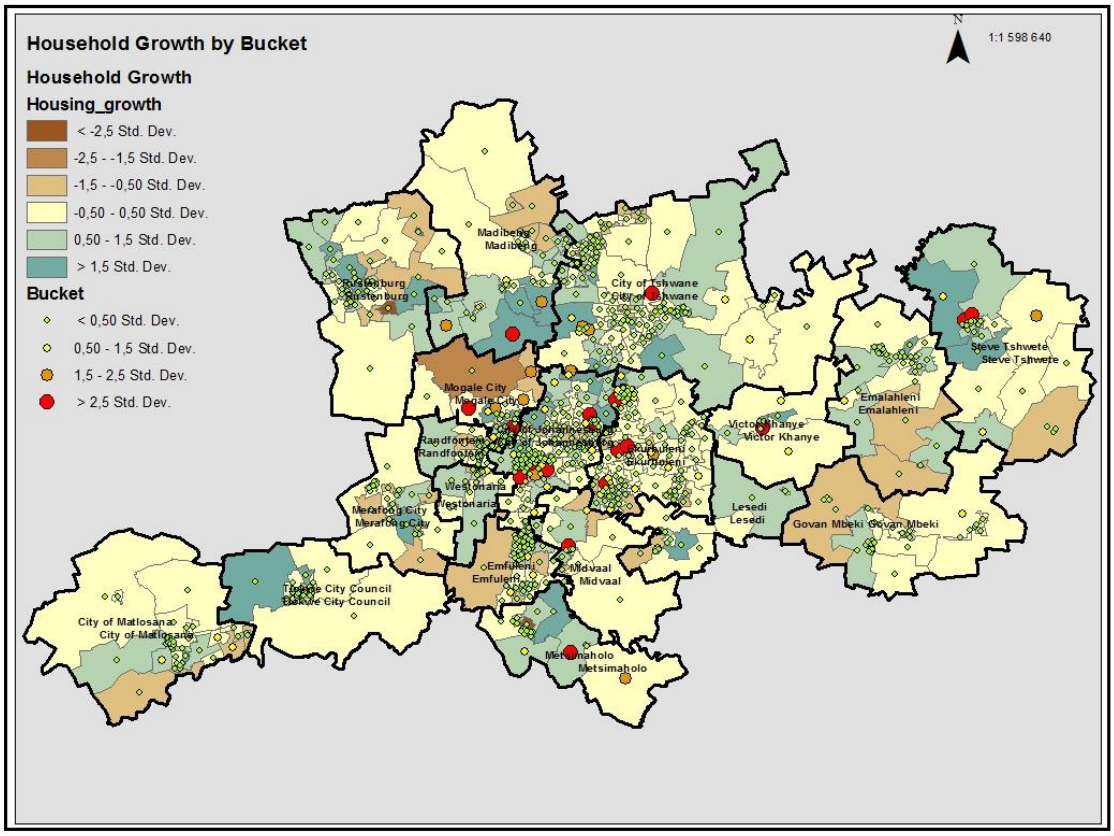
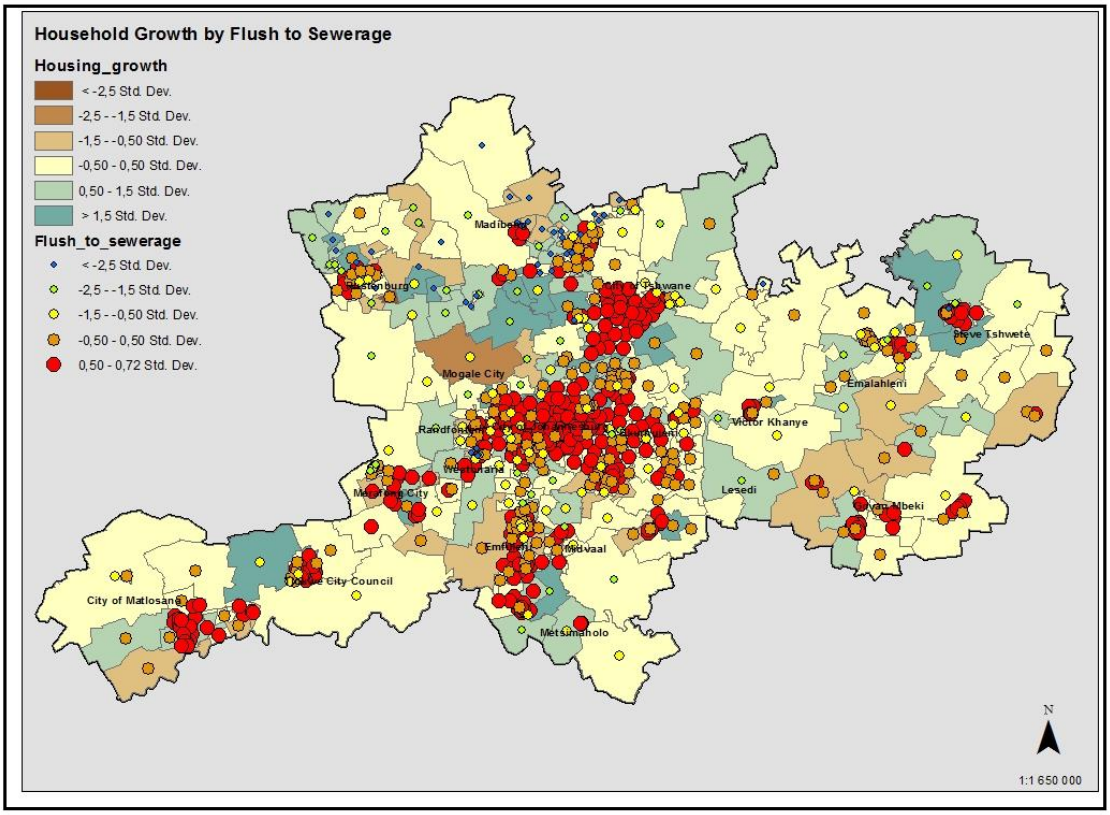


Figure 44 Household Growth by access to Flush to Sewerage Toilet



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With regards to water, the third of the household services, the spatial distribution is more relevant than ever due to the relief of the land which also impacts on population and household growth. Those households who face the vulnerability of having no piped water are mostly in the small towns of Tshwane and Madibeng as well as non-urban parts around satellite cities of the mining belt from the West Rand to the North-West province. Somewhat surprisingly, in the majority of cases it is found in wards with moderate to high household growth. Households with piped water which is available outside the dwelling at varying distances is also found mainly in the metropolitan fringe and satellite towns as well as intermediate towns in the weekly urban system of the GCR with moderate household growth. The spatial pattern for those with piped water in the dwelling takes on a similar pattern to those receiving other services at an optimal level. These households are mostly in the metros and in proximity to satellite cities and small towns and for the most part in wards with household growth that ranges from 0.5 to 1.5 standard deviations above the mean to those that are even beyond 1.5 standard deviations and in so doing indicating a preference for living in areas where critical services are delivered.

Figure 45 Household Growth by No Access to Piped Water

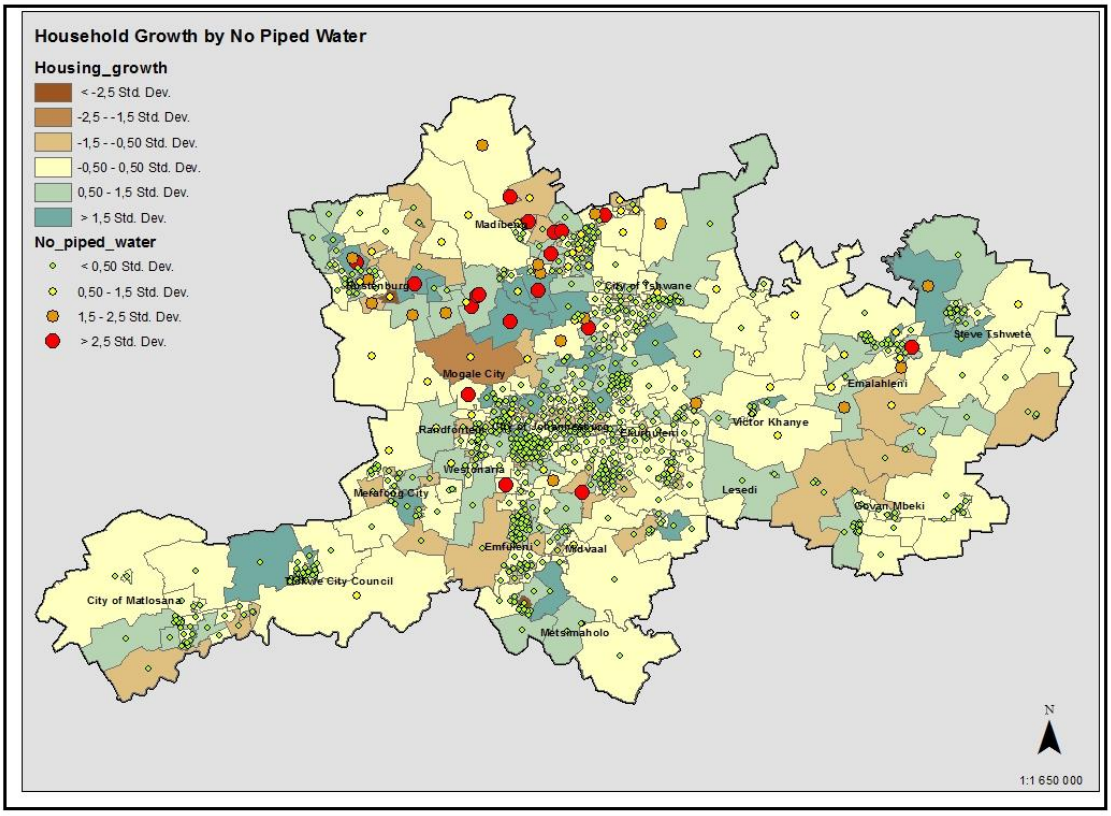

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Figure 46 Household Growth by Access to Piped Water Outside Dwelling

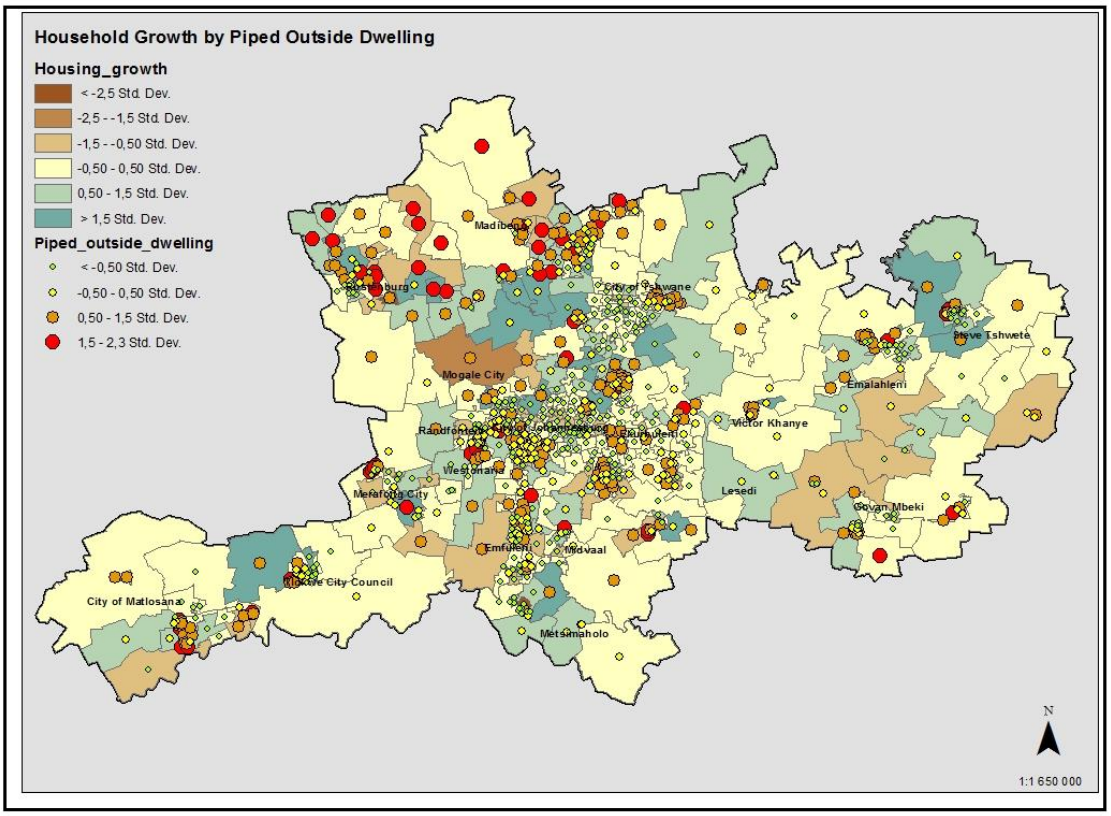
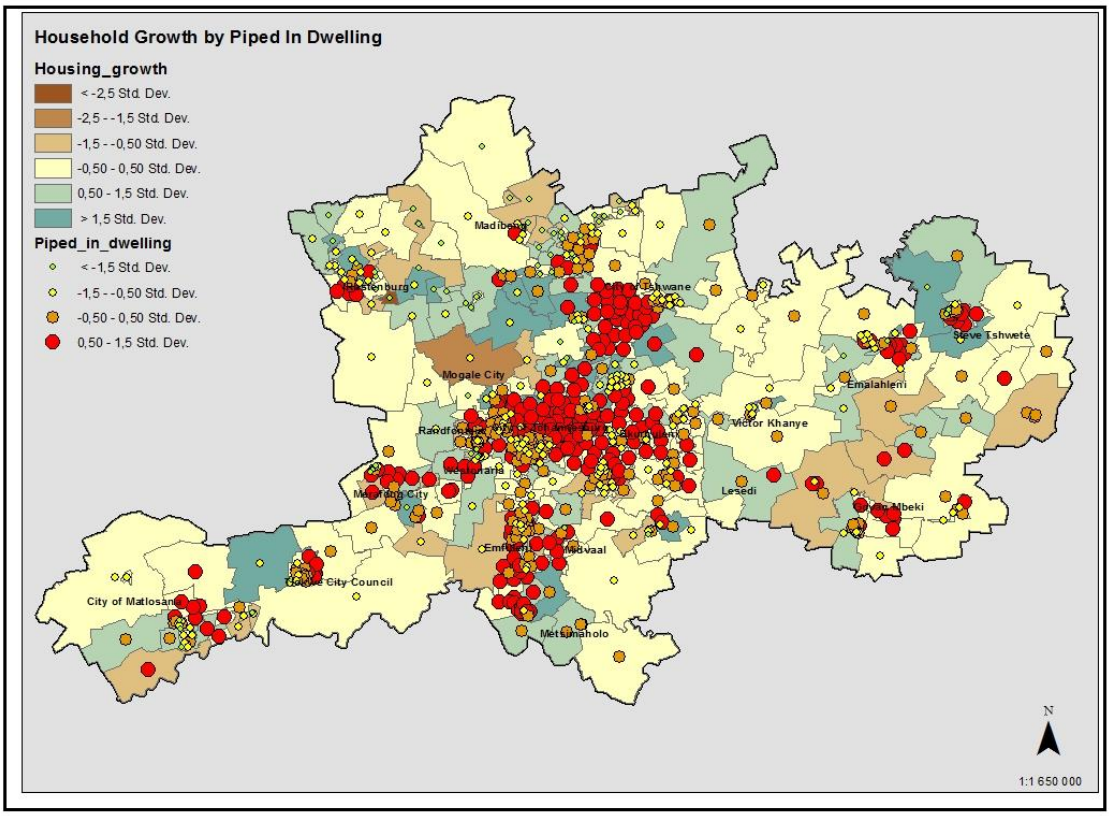


Figure 47 Household Growth by Access to Piped Water in Dwelling



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The final household service is that of refuse collection which also contributes towards a healthy environment. The scourge of vulnerability persists when looking at places with no refuse collection and these occur in the metropolitan fringe of Tshwane, the non-urban areas of Madibeng and Rustenburg, west rand areas along the metropolitan fringe as well as across intermediate cities of Mpumalanga of the City-Region. Those with weekly refuse removal are like any other optimal service, distributed across the metros for the most part but also close to satellite cities across the city-region. These places are mixed across growth profiles but mostly fall in wards that experience household growth of some degree. Wards in Rustenburg and Govan Mbeki are the exception to this growth profile.

Figure 48 Household Growth by No Refuse Removal

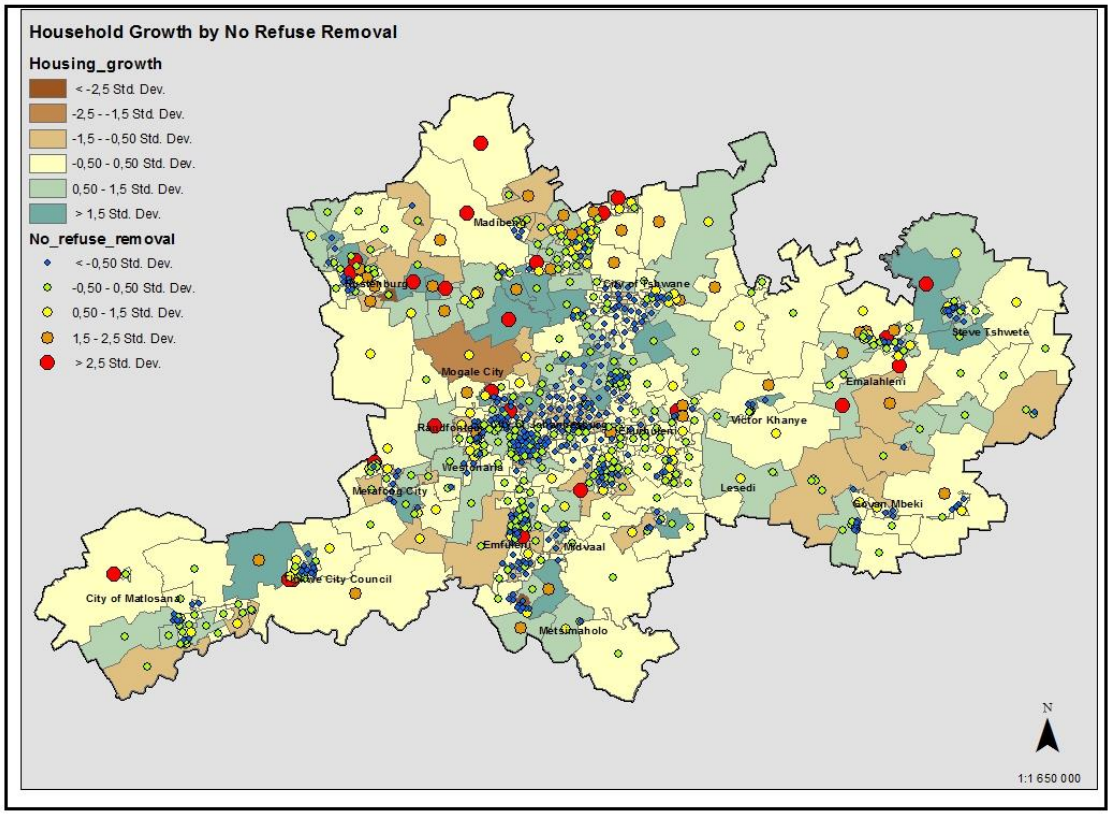

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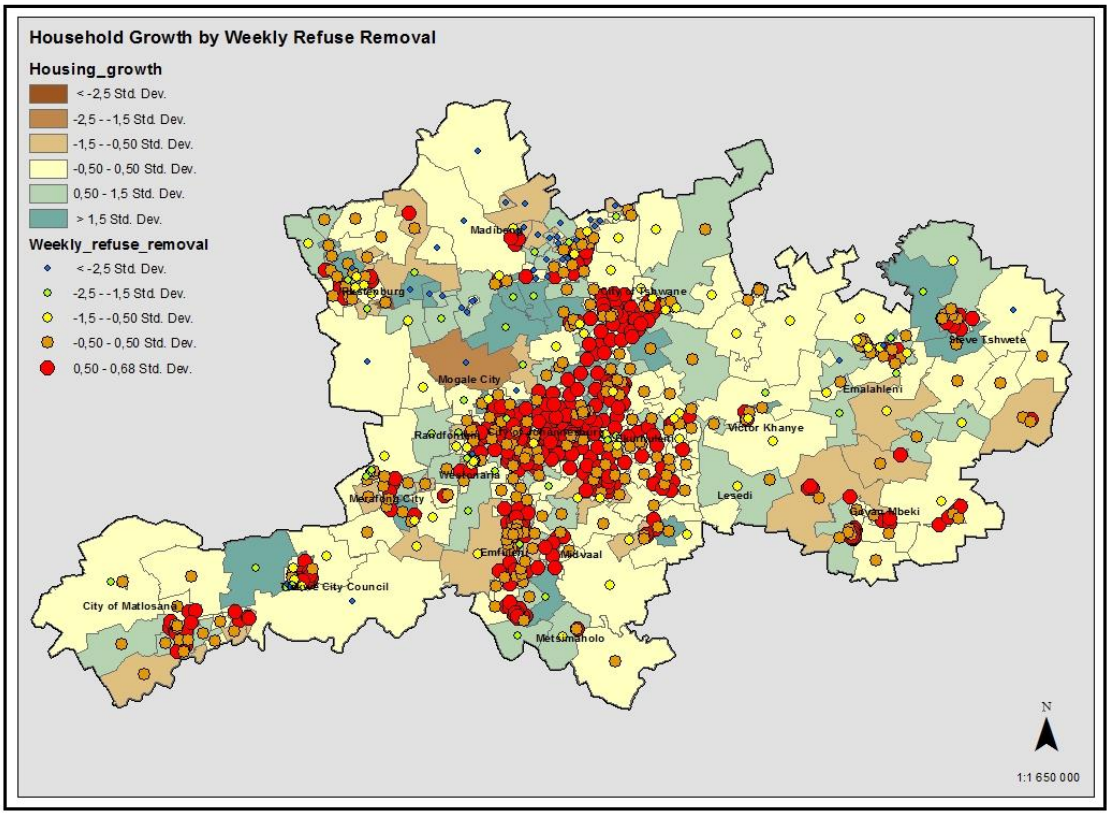
Figure 49 Household Growth by Weekly Refuse Removal



The final set of variables to be considered in this descriptive analysis relates to household goods that are relevant towards growth, economic development and spatial patterns. The first of these is access to internet. In terms of accessing information and opportunities internet access is important and internet access is available in various guises. Access to internet at home is limited to the inner core. This confirms one of the public misconceptions that almost all of Gauteng or even the metros are connected at home.

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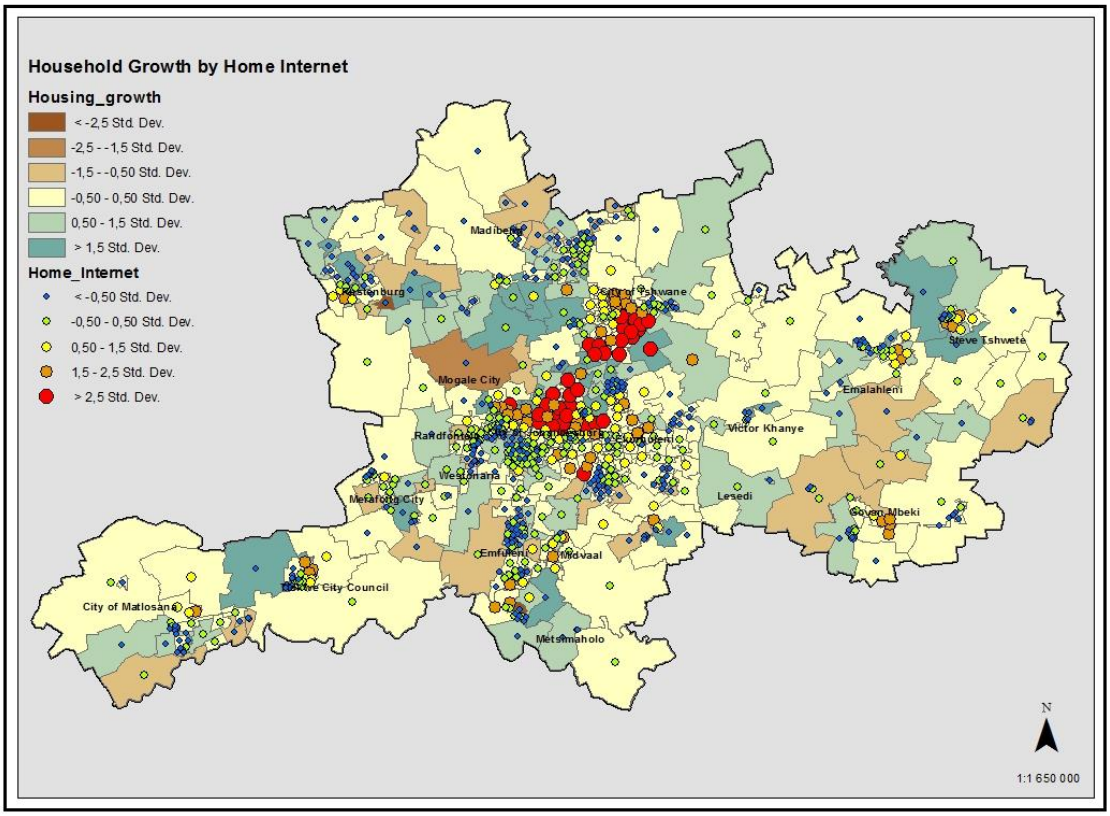
Figure 50 Household Growth by Access to Internet at Home



4.4 SPATIAL STATISTICAL ANALYSIS

4.4.1 GCR level analysis

The next phase of this analysis deals with more indepth spatial analysis making use of spatial statistics. The first of these techniques to be dealt with is the Getis Ord Gi* hotspot and coldspot analysis for person and household growth. This technique considers the distribution of a reference variable (growth) and indicates where its occurrence is most concentrated and where the opposite holds true. This is done at a 90, 95 and 99 percent confidence interval. For the purpose of this analysis the 95% confidence interval will be used. The results of this technique add a lot of value to the preceding section that describes the existence of various indicators for categorised groups of growth. The results for person growth hotspots and coldspots are provided in Figure 51.

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Figure 51 Getis-Ord Gi* Hotspot and Coldspot analysis of person growth for Gauteng City-Region for 2001-2011

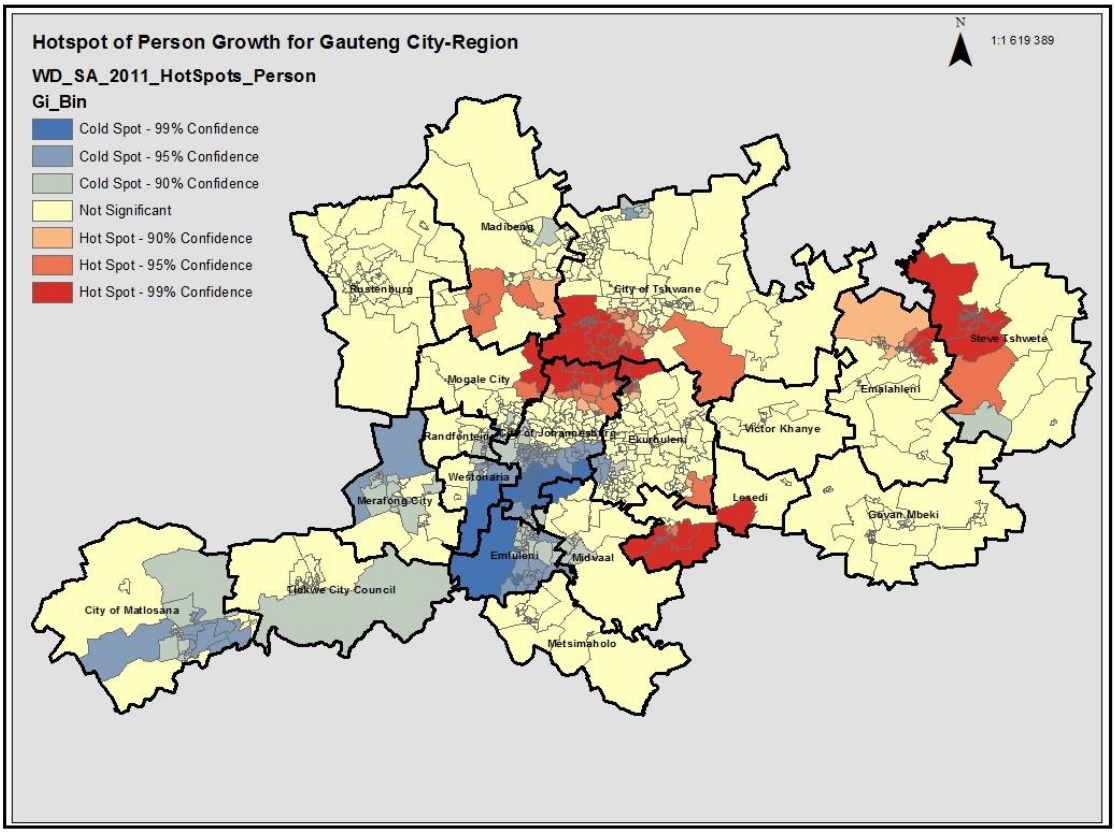
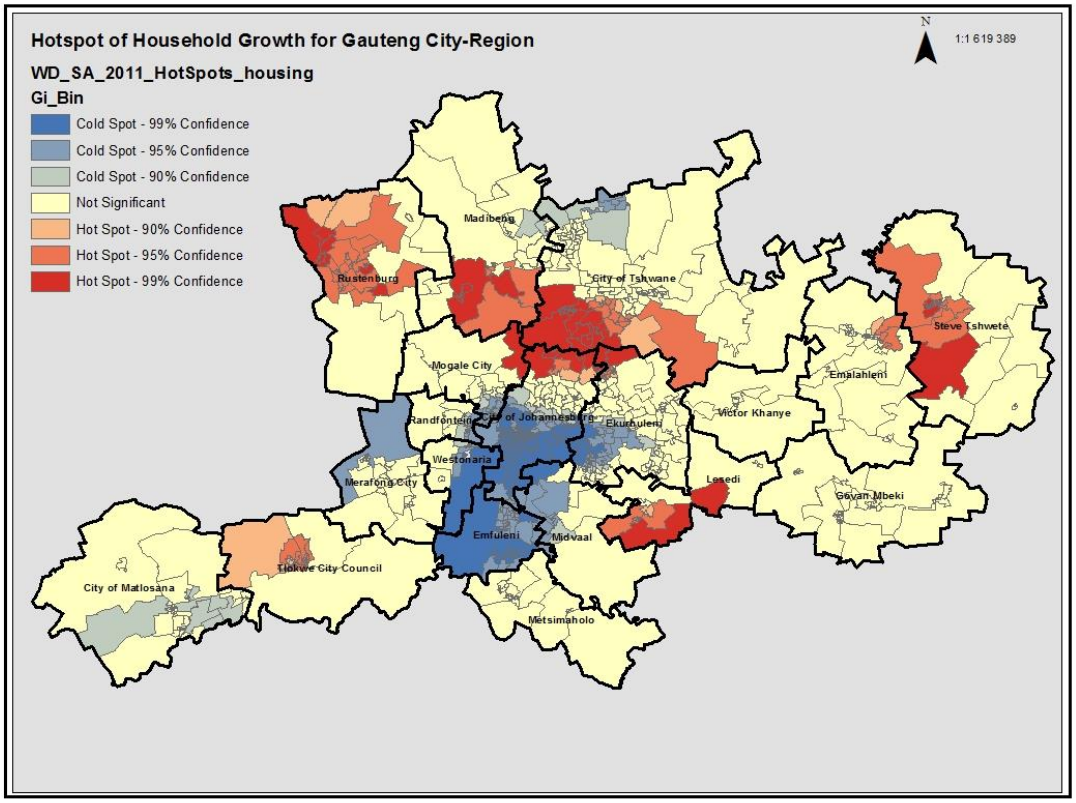


Figure 52 Getis-Ord Gi* Hotspot and Coldspot analysis of household growth for Gauteng City-Region 2001-2011



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The output of this technique shows us where clusters of high values (hotspots) are located and where clusters of low values are located (coldspots). From the results above we can see that the person growth is centred in the inner core areas of northern Johannesburg as well as Southern parts of Tshwane. Other areas showing hotspots of growth are parts of metropolitan fringe to the north-west of the city-region as well as the satellite and intermediate cities in the east and south-east of the city region. Cold spots include the southern parts of the Johannesburg metro and the Emfuleni LM and the metropolitan fringe to the south west of Johannesburg, as well as the satellite cities in the south and south-west of the city-region. The epicentre of cold spots of growth where growth is least prevalent is located in the industrialised south and south-west of the City-Region where areas of industry occur. From the hotspot analysis it is clear to see there are signs of the emergence of deconcentration of population growth to the east, west and south of the primary inner core regions. This can be as a result of movement of people to such areas due to new industrial and economic opportunities as well as the development of secondary towns.

The analysis at household level (figure 52) shows a fairly similar pattern to person growth. In addition to the inner core areas of the southern parts of Tshwane and the northern parts of Johannesburg, the intermediate cities of Brits, Rustenburg, Potchefstroom and Middelburg also represent hotspots of household growth whereas the other coldspots apart from the southern parts of Johannesburg and Emfuleni occur much deeper into the metropolitan fringe of the GCR.

The next spatial analysis technique to be considered is the Anselin Local Moran's I. It is a local statistic because it considers spatial patterns and variation for individual spatial entities and not the study area as a whole. This technique looks for clusters high growth as well as low growth but in addition to that it looks for outliers of high growth within clusters of low growth as well as the counterside of outliers of low growth within clusters of high growth. The results of the Anselin Local Moran's I are shown in Figure 53.

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Figure 53 Anselin Local Moran's I for Person Growth in the Gauteng City-Region for 2001-2011

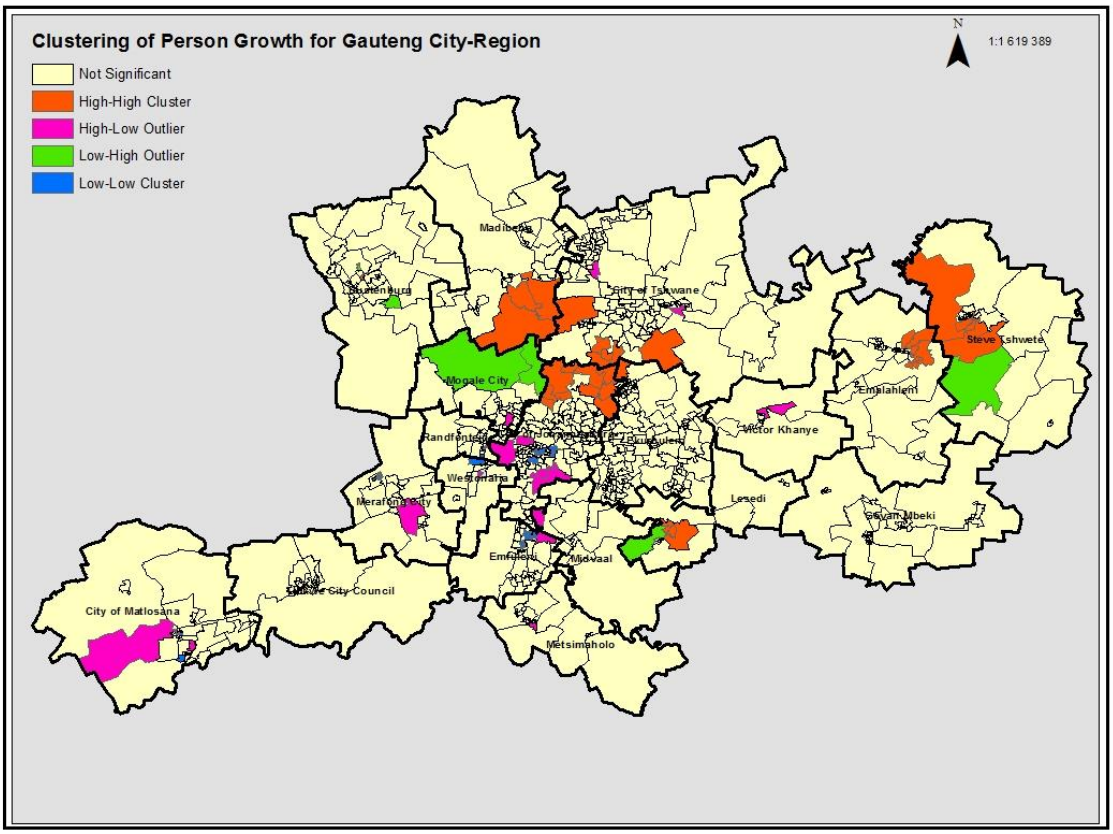
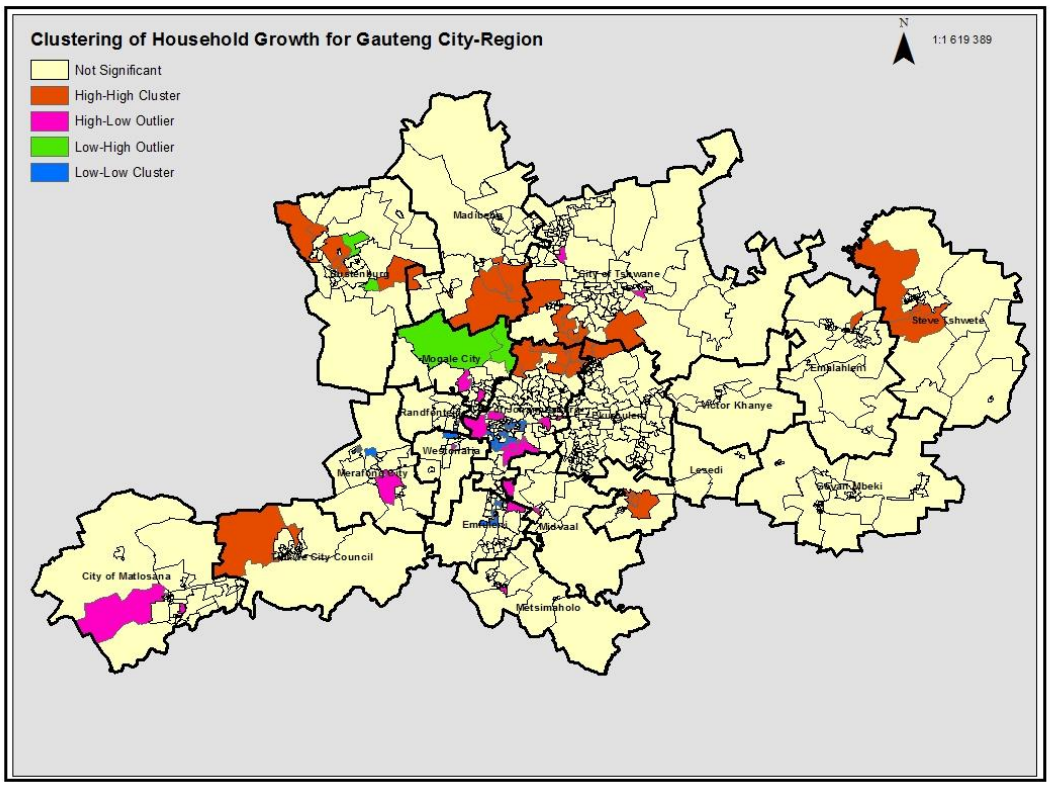


Figure 54 Anselin Local Moran's I for household growth in the Gauteng City-Region for 2001-2011



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The result of this technique show similar patterns with high-high clusters located in the inner core in the northern part of Johannesburg and the southern and eastern suburbs of Tshwane as well as the intermediate cities of Middelburg and Emalahleni in eastern Mpumalanga. Cluster of low-low growth are found mostly in the older suburbs to the south-east of Johannesburg such as Soweto and other parts of the West Rand. The main value of this output however points to the pockets (outliers) of growth within these clusters and in this regard we can see high pockets of growth within low growth clusters in mostly non-urban parts of the metropolitan fringe to the south-west of Johannesburg, the Inner core around Johannesburg, suburbs in the same area as well as small towns in the eastern part of the GCR. On the other hand outliers of low growth in clusters of high growth occur in non-urban areas in the metropolitan fringe as well as in suburbs close to the inner core. This is indicative of the dynamic changes that are prevalent at small areas where the surrounding area is not always indicative of the characteristic of an entire area as per its clustering properties. Compared to the previous analysis of hotspots and coldspots the clusters and high growth and low growth do for the greater part, lie in similar areas with the difference that the Anselin Local Moran's I also highlights outliers within those clusters as elucidated above. Instead of assuming an area to have concentration of growth (or lack thereof) this method is showing us that there is variability even within such clusters wherein outliers of either high or low growth occur.

At household level (Figure 54), the cluster-outlier analysis reveal similar patterns to the hotspots with an extension of high growth clustering into intermediate cities and small towns in the Rustenburg municipality and the non-urban parts of Tlokwe. The outliers of high growth in low growth clusters are found in non-urban areas of the Merafong City in the mining belt and the Vaal area, the Inner core of Johannesburg as well as suburbs close to the mining belt as well as suburbs in Tshwane. The pockets of low growth in high growth areas can be found in the metropolitan fringe along the West Rand as well as small towns, mostly mining towns in the Rustenburg municipality. Low-low growth clusters are located in the southern area of Johannesburg as well as parts of suburbs like Soweto, Sebokeng and Evaton as well as in parts of the mining belt in Westonaria and Merafong City. This analysis points out the congruence in growth between persons and the households they live in and where such differences lie between the two domains. It once more also points out to the dynamic spatial patterns that exist even within clusters that have some exception to the main characteristic of the said cluster.

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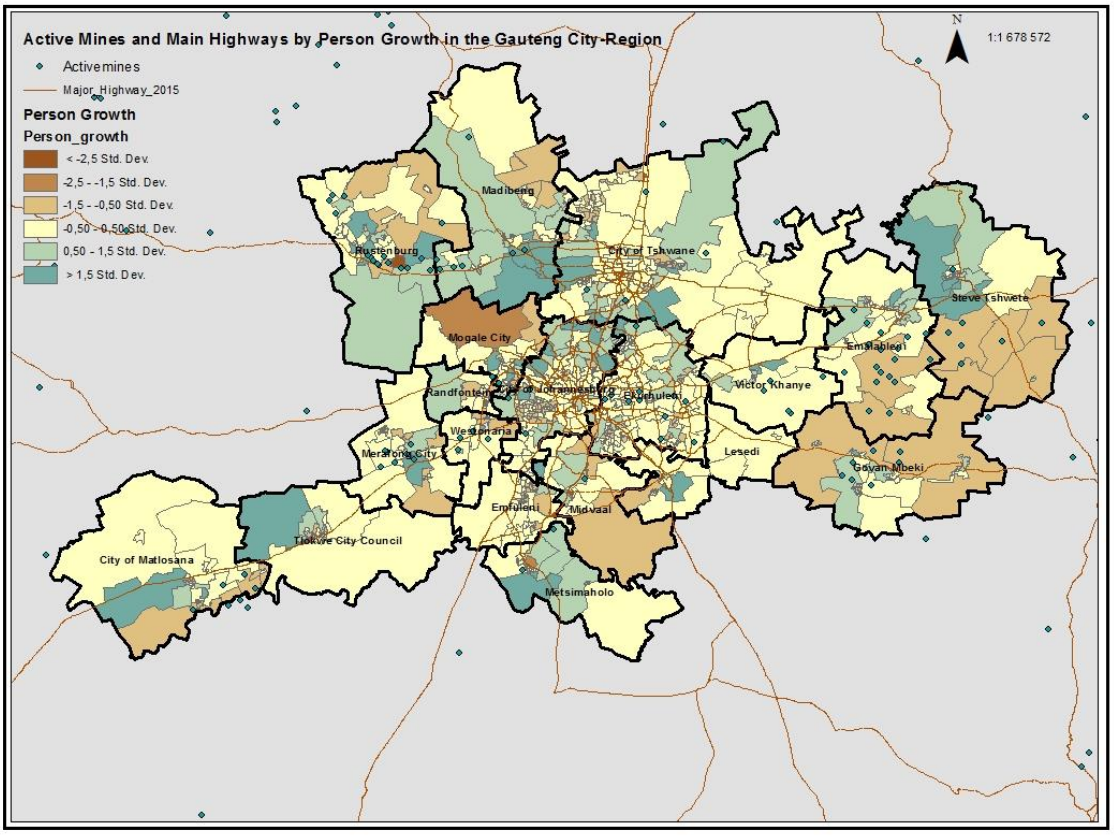
A point of interest throughout this research is the role of the mining industry in attracting growth of towns and of people who would work in them as well as the role of access to main roads that might reflect the motorisation and move away from compact cities. The results of this study are inconclusive with regards to these two factors as far as the degree towards which they influence growth and further investigation may be required to ascertain their influence on the urban form. Figure 55 represents the spatial distribution of main highways and thoroughfares as well as of active mines in the Gauteng City-Region and in neighbouring areas and this shows a mix of growth type in areas with active mines as well as in areas with access to main roads.

Figure 55 Main roads and Active Mines by Person Growth for Gauteng City-Region 2001-2011



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4.4.2 Spatial Statistical Analysis for Metro's in Gauteng

A final part of the analysis to consider is to isolate the metros of Gauteng from the rest of the City-Region and identify in these core parts of the GCR. The metros of Tshwane, Johannesburg and Ekurhuleni make up 70% of the population of the City-Region as well as 70.5% of the households in growth and further investigation may be required to ascertain their influence on the urban form. Figure 55 represents the spatial distribution of main highways and thoroughfares as well as of active mines in the Gauteng City-Region and in neighbouring areas and this shows a mix of growth type in areas with active mines as well as in areas with access to main roads.

Figure 56 Getis Ord Gi* Hotspot and Coldspot analysis for person growth in Gauteng Metros, 2001-2011

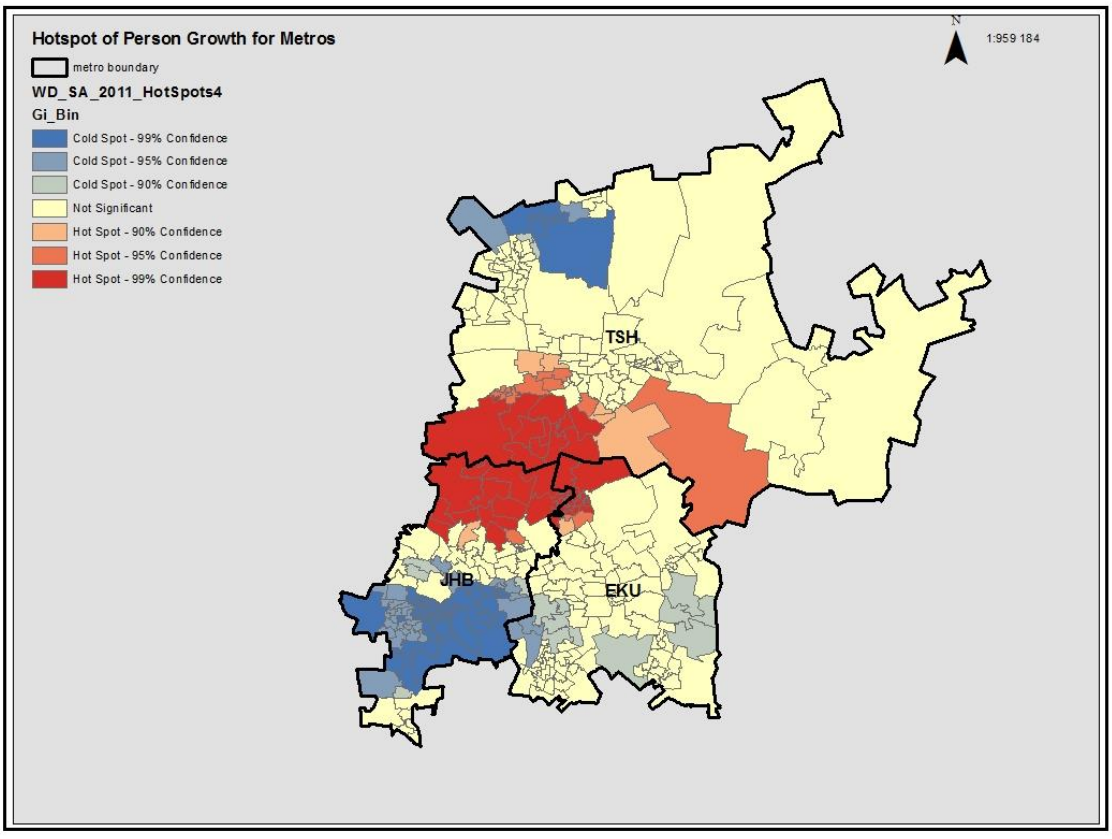

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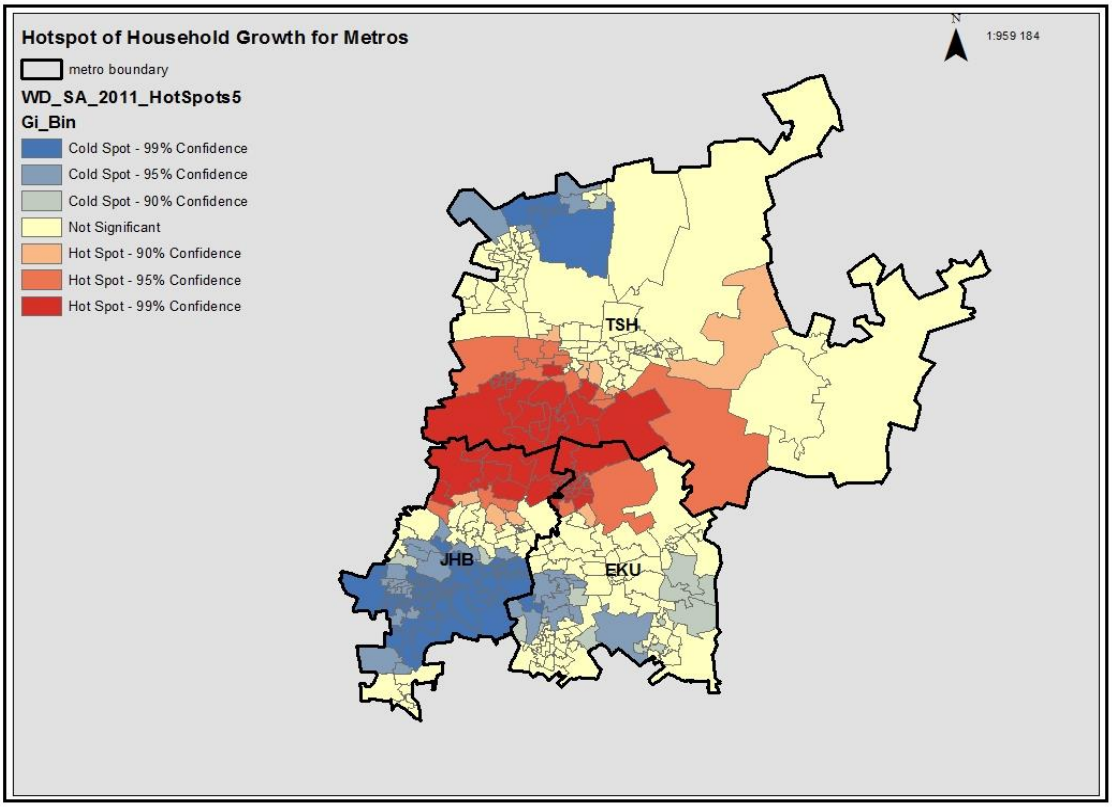
Figure 57 Getis Ord Gi* Hotspot and Coldspot analysis for household growth for Gauteng metros, 2001-2011



This section will thus not only look at spatial patterns for the metros alone but will try to make some broad comparisons to the spatial patterns for the City-Region at large.

Starting with a Getis-Ord Hi* hotspot analysis it is evident that very similar hotspot areas exist in Tshwane although in the south of this metro the affected region extends further eastwards to also include township of Tembisa and nearby areas and the inner core of Johannesburg. Compared to the GCR level analysis In the metro model the extreme south is excluded from coldspots but there seems to be a wider spread of coldspots at the 90% confidence level to also include the Inner core in the south of Ekurhuleni. Coldspots are in the metropolitan fringe of north-western Tshwane.

At household level, hotspots occur along the inner core of northern Johannesburg into southern Tshwane stretching from east to west as well as into the traditional township areas of Tembisa and non-urban areas of Ekhuruleni. The metro model appear to extend hotspots, compared to the non-metro model, to the east of the Tshwane metro as well. The central and southern parts of Johannesburg including Soweto cover most of the coldspots, as they did in

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the full GCR analysis. It once more excludes the extreme south but spreads out to neighbouring Ekhuruleni as well amongst Inner core areas. Coldspots also occur in the north-west of Tshwane in the same areas as person growth. It is hence evident that as far as hotspots are concerned the pattern is very similar for the City-Region as it is for the metros on their own with evidence of more extension of spatial patterns into Ekurhuleni.

The results of the Anselin Local Moran's I analysis at the level of the three metros revealed very similar patterns for both person and household growth. High-high clustering occurs in the inner core of northern Johannesburg and southern Tshwane and extends to also include townships such as Tembisa in Ekurhuleni. The opposite low-low clusters are located almost exclusively in suburbs such as Soweto and the northern parts of Tshwane. High-low clustering refers to outliers of high growth within clusters of low growth and are found in newer developments around older townships such as areas around the Inner core of Johannesburg and around Mamelodi and Soshanguve in Pretoria.

Figure 58 Anselin Local Moran's I for person growth in Metros of Gauteng, 2001-2011

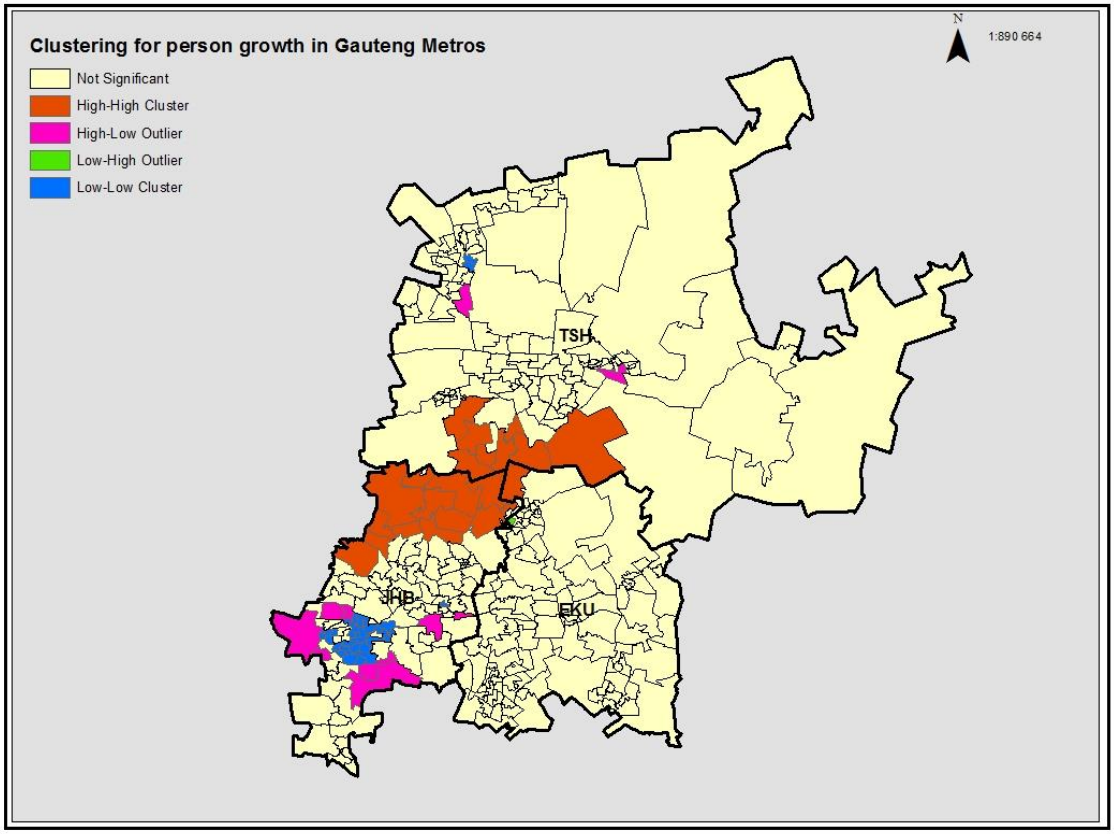

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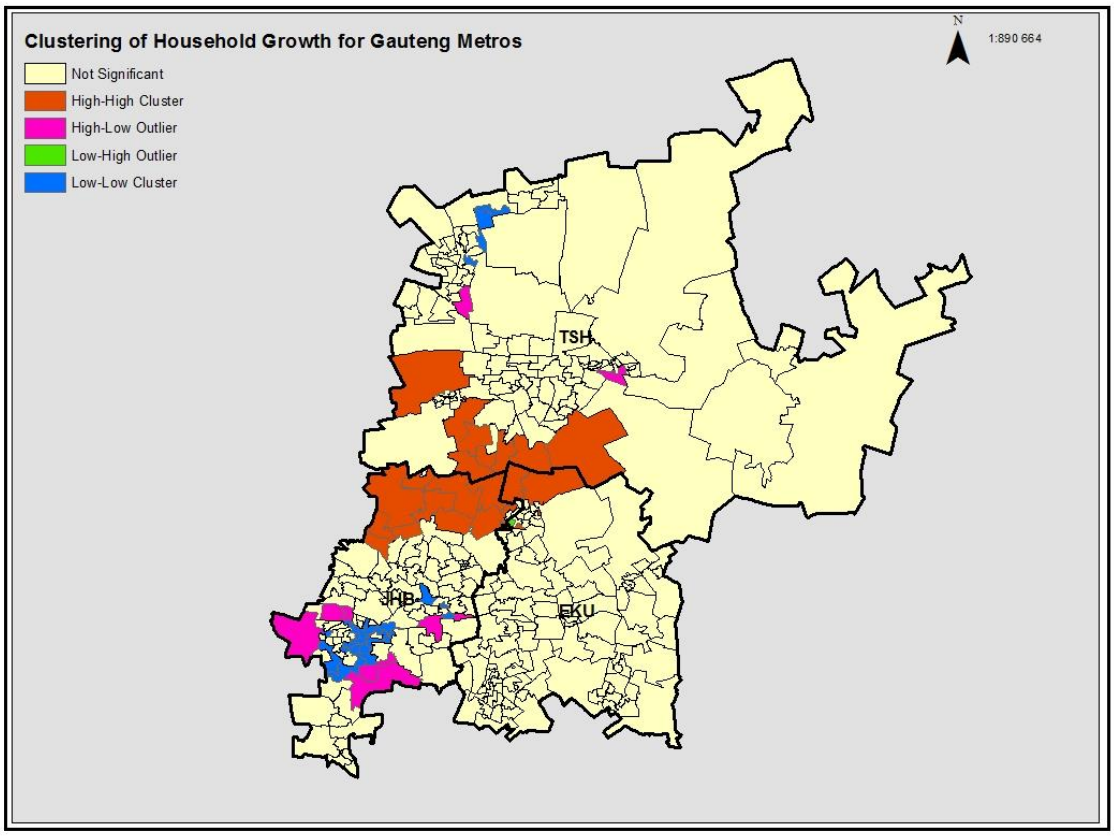
Figure 59 Anselin Local Moran's I for household growth in Metros of Gauteng, 2001-2011



The analysis limited to the metro areas would appear to cover similar parts of the province as opposed to the results for the full GCR area with the high-high cluster be more widespread among the areas neighbouring the border between Johannesburg, Tshwane and Ekurhuleni.

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CHAPTER 5: CONCLUSION AND RECOMMENDATION

5 CONCLUSION AND RECOMMENDATION

5.1 SUMMARY OF FINDINGS

This study started out as an attempt to understand growth dynamics at the person and household level for the Gauteng City-Region. Various findings and patterns with regards to key indicators at person and household level have been highlighted and spatial patterns of growth at the City-Region level and metro level have been explained. However, some salient points from the research need to be highlighted.

This discussion of findings will be related to the objectives of the research that were shared in chapter 1 along with a general discussion of the findings and the research at large. Thereafter a discussion will ensure around the implications and recommendations of this research before the limitations and recommendations for future research are shared.

Objective 1: To determine areas of fast and slow growth (or negative) in the Gauteng City Region

By making use of Census data from 2001 and 2011 harmonised to 2011 ward boundaries it was possible to identify growth of persons and of households over the period in question. Making use of the standard deviation measure it was then able to categorise growth into six categories ranging from those more than two standard deviations less than the mean on the one extreme to those more than two standard deviations more than the mean on the other. This was illustrated in Figure 4 and the summation of person and household growth rates for the municipalities that make up the GCR can be found in Table 2. In essence, it was established that satellite cities within the metropolitan daily catchment area and intermediate cities within the weekly urban system of the GCR like Steve Tshwete, Rustenburg and Madibeng experienced the highest person and household growth. The results however also revealed that growth is not uniform within these municipalities just as it is not uniform throughout the City-Region. Table 7 hence identifies those wards in the GCR that experienced the highest growth (more than 2 standard deviations more than the mean) and the slowest growth (more than two

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standard deviations less than the mean). This provided the base for further analytical techniques which followed herein.

Objective 2: Establish a socio-demographic profile for different growth rate categories in order to understand its urban makeup and urban form

This part of the research involved superimposing the socio-demographic variables categorised by means of the standard deviation measure in the same way as the household or population growth was on the maps indicating population and household growth. For this purpose the standard deviation cut offs were determined by the mapping software which used half standard deviations measures. In other words the cut offs were at 0.5, 1.5 and 2.5 standard deviations away from the mean on both the positive and negative side respectively. This part of the research applied a functional categorisation of placenames in order not to refer to individual place names but by referring to broader functional areas within the GCR that they belong to. These results described the existence and the characteristics and patterns that occur in different types of growth. Many of the characteristics are evidenced by the urban form as well as by the activities that the area concerned is dominated by. The results indicated that there is a movement away from places of poor service delivery to places where higher levels of service delivery prevails. Table 8 summarises some of the key socio-demographic characteristics which this research revealed for each functional geographic group.

Objective 3: To establish patterns of spatial clustering for each of the groups in the Gauteng City Region with the view to understand the dynamics of each of these groups.

The spatial statistical analysis was an important feature of this research in the sense that it provided details to the descriptive trends identified in the earlier sections. The two techniques that were used were the Getis-Ord* Gi hotspot analysis which enabled the research to identify hotspots and coldspots of person or household growth and the Anselin Local Moran's I which was used to identify clustering and outliers of person or household growth. Both of these revealed the spatial dimension of different categories of growth which goes hand in hand with the socio-demographic characteristics above which provide the context which often explains such spatial patterns. These findings are summarised in Table 9 summarising the clusters of person growth in the study area.

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This research posits that urban planning systems need to consider different growth levels of different types of urban spaces, as well as the characteristics of these places in order to accommodate for such growth or lack thereof.

A summary of the category of places where high person growth and low person growth occurred is described in Figures 7 and 9 and for household growth in Figures 8 and 10. Areas of low person growth is very sparsely distributed in the GCR and is constituted by a limited number of cases. Areas of high growth is much more widely distributed across the City-Region. A common feature of places of high growth is its occurrence in areas classified as non-urban. These are main places in the geographic hierarchy which combine areas which are not classified as urban or traditional. These areas generally seem to constitute ward/s that represent high growth area but for the purpose of fitting with the typology I will refer to the main town/city of the municipality they belong to in Table 7.

Table 8 summarises the socio-demographic characteristics of places of high and low person and household growth by making use of the functional geographic areas described in Table 5. This table reveals the spatial diversity and complexity within the GCR as revealed by the socio-demographic explanatory variables.

Table 9 summarises the clustering and outlier analysis in terms of the functional geographic groups referred to earlier in this research. As mentioned in the previous chapter this can be viewed hand in hand with the hotspot analysis in terms of where growth is occurring but it has the added value of being able to identify outliers of opposing growth patterns within a cluster of a dominant growth pattern. By spatially locating such patterns and trends across the GCR a richer picture which enables policy and planning interventions more effectively.

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Table 7 Person Growth Type Areas in the Gauteng City Region, 2001-2011

Growth Type	Ward	Settlement Type	Main Place	Main Town	Municipality
High Person Growth (greater than 2.5 standard deviations above the mean)	**4**	Intermediate city/town within weekly urban system	Matlosana NU	Klerksdorp	City of Matlosana
	1	Intermediate city/town within weekly urban system	Tlokwe City Council NU	Potchefstroom	Tlokwe
	1,13	Satellite towns within metropolitan daily catchment areas	Metsimaholo NU Zamdela	Sasolburg	Metsimaholo
	14	Satellite towns within metropolitan daily catchment areas Intermediary cities	Elandsfontein Merafong City NU	Carletonville	Merafong City
	14,24,31 ,37	Intermediate city/town within weekly urban system	Mathopestand Rustenburg NU	Rustenburg	Rustenburg
	29,30,33	Satellite towns within metropolitan daily catchment areas	Madibeng NU Brits	Brits	Madibeng
	8,12,14, 28,29	Intermediate city/town within weekly urban system	Steve Tshwete NU Middelburg	Middelburg	Steve Tshwete
	15	Intermediate city/town within weekly urban system	Emalahleni NU Emalahleni	Emalhaleni (Witbank)	Emalahleni
	7,11	Satellite towns within metropolitan daily catchment areas	Lesedi NU Heidelberg	Heidelberg	Lesedi
	14,27,28	Metropolitan Fringe	Krugersdorp	Krugersdorp	Mogale City
	6, 10	Metropolitan Fringe	Midvaal NU Meyerton	Meyerton	Midvaal
	7	Satellite towns within metropolitan daily catchment areas	Simunye	Westonaria	Westonaria
	19	Satellite towns within metropolitan daily catchment areas	Mohlakeng	Randfontein	Randfontein
	16,32	Satellite towns within metropolitan daily catchment areas	Mbalenhle Kinross	Secunda	Govan Mbeki

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	3	Satellite towns within metropolitan daily catchment areas	Botleng	Delmas	Victor Khanye
	1	Suburbs	Centurion		Ekurhuleni Metro
	32, 49, 97, 100, 112, 113	Inner core, Suburbs	Soweto Midrand Sandton Roodepoort Johannesburg		City of Johannesburg Metro
	7, 40, 77,90,91	Inner core, Suburbs	Centurion Pretoria Mamelodi Soshanguve		City of Tshwane Metro
Low Person Growth (greater than 2.5 deviation less than the mean)	**33**	Intermediate city/town within weekly urban system	Rustenburg	Rustenburg	Rustenburg
	59	Inner Core	Johannesburg		City of Johannesburg Metro
	3	Intermediate city/town within weekly urban system	Kwa-Guqa	Emalahleni	Emalahleni

The above table is able to summarise the type of growth and identify the location of growth within the typology of functional categories that exists in the Gauteng City-Region. The high growth refers to growth beyond 2.5 standard deviations of the mean growth for the city-region and low growth refers to 2.5 standard deviations less than the mean growth for the city-region.

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Table 8 Socio-Demographic Characteristics of places of high and low person growth in the Gauteng City-Region

Person Growth Type	Ward	Municipality	Functional Area	Socio-Demographic Characterstics of Person Growth by location in GCR, 2001-2011										
High Person Growth (more than 2.5 standard deviations greater than the mean	4,22	City of Matlosana	Intermediate city/town within weekly urban system	Under 15	Dependency	No Schooling	Some Primary	Low Income	GCR Neighbour	Flush to sewerage				
	1,20	Tlokwe	Intermediate city/town within weekly urban system	Under 15	Dependency	Some Primary	Low income	GCR Neighbour	No sanitation	No refuse removal				
	1,13	Metsimaholo	Satellite towns within metropolitan daily catchment areas	Under 15	Dependency	Some Primary	Low income							
	14	Merafong City	Satellite towns within metropolitan daily catchment areas	Age 15-64	Sex Ratio	Medium Income	Adult Head	Female Headed *	Formal Housing	Household size *	Rented	Piped outside dwelling	Weekly refuse removal	
	14,24,31,37	Rustenburg	Intermediate city/town within weekly urban system	Sex Ratio	Adult Head	Formal Housing	Household Size *	No sanitation	Flush to sewerage	No piped water	Piped outside dwelling	Piped in dwelling	No refuse removal	Weekly refuse removal
	29,30,33	Madibeng	Satellite towns within metropolitan daily catchment areas	No sanitation	Bucket	No piped water	No refuse removal							
	8,12,14,28,29	Steve Tshwete	Intermediate city/town within weekly urban system	Under 15	Dependency	No Schooling	Some Primary	Formal housing	No sanitation	Flush to sewerage	Piped in dwelling	No refuse removal	Weekly refuse removal	
	15	Emalahleni	Intermediate city/town within weekly urban system	No energy for lighting										
	7,11	Lesedi	Satellite towns within metropolitan daily catchment areas	GCR Neighbour	Weekly refuse removal									
	14,27,28	Mogale City	Metropolitan Fringe	High Income	Formal Housing	Flush to sewerage	Piped in dwelling	Weekly refuse removal	Home Internet					
	6,10	Midvaal	Metropolitan Fringe	Under 15	Dependency	Some Primary	No income	GCR	Formal Housing	Rent free	Piped in dwelling	Weekly refuse removal		
	7	Westonaria	Satellite towns within metropolitan daily catchment areas	Some Primary	Formal Housing	Flush to sewerage	Piped in dwelling	Weekly refuse removal						
	19	Randfontein	Satellite towns within metropolitan daily catchment areas	Youth unemployment	Unemployment	Owned not paid	Flush to sewerage							
	16,32	Govan Mbeki	Satellite towns within metropolitan daily catchment areas	No Income	Flush to sewerage	Weekly refuse removal								
	3	Victor Khanye	Satellite towns within metropolitan daily catchment areas	Under 15	Dependency	Some Primary								
	1	Ekurhuleni Metro	Suburbs	Adult Head										
	32,49, 97, 100, 112, 113	City of Johannesburg Metro	Inner core, Suburbs	Higher Education	High Income	Formal Housing	Flush to sewerage	Piped in dwelling	Weekly refuse removal					
	7,40,77,90,91	City of Tshwane Metro	Inner Core and Suburbs	Higher Education	High Income	Formal Housing	Owned not paid	Flush to sewerage	Piped in dwelling	Weekly refuse removal				
Low Person Growth (more than 2.5 standard deviations less than the mean	33	Rustenburg	Intermediate city/town within weekly urban system	Non-Neighbour										
	59	City of Johannesburg Metro	Inner Core and Suburbs	Rented	Flush to sewerage	Weekly refuse removal								
	3	Emalahleni	Intermediary cities within weekly urban system of the agglomerations											

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The contents of table 8 are designed to display a selection of sociodemographic characteristics of wards with high person growth (more than 2.5 standard deviations above the mean) as well as low person growth (more than 2.5 standard deviations below the mean). The socio-demographic variables selected are also based on those greater than those that are more than 2.5 standard deviation above the mean. Only those marked by an asterisk (*) refer to those variables which lies 2.5 standard deviation below the mean. Furthermore because there was a substantial overlap between the wards showing high and low person growth compared to high and low household growth, this table only refers to person growth but with the socio-demographic characteristics of both person and household growth. It is important to realise that the existence of a characteristic in any one of the wards identified results in that characteristic being applied to its corresponding functional geographic classification. It is therefore possible that a given municipality with a given functional geographic area may have two contradictory characteristics because of the fact that these may be referring to different wards that fall under the same typology. Of the 19 municipalities in the GCR, only Emfuleni did not have any wards which were either high or low person growth wards as described above, but all others had at least one ward with such a characteristic.

Table 9 Summary of clustering of person growth in the Gauteng City Region

	High-High	High-Low	Low-High	Low-Low
Inner Core	✓	✓		
Suburbs		✓		✓
Metropolitan Fringe	✓	✓	✓	
Satellite Town (daily urban catchment area)	✓	✓	✓	✓
Intermediary cities (weekly urban system)		✓	✓	✓

Table 9 succinctly summarises and identifies the location of different levels of clustering in the GCR by their functional geographic areas. Essentially this represents the urban form of the city-region. As was the case with table 7 and 8 this only refers to person growth since the patterns of clustering compared to household growth are very similar.

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5.2 Implications and recommendations

What is evident from the analysis is that there is no one size fits all approach to planning and resource allocation. It is evident that population and household growth varies even within small places and that the characteristics and outputs of spatial statistics techniques also corroborate such dynamic relationships. An example of this is the Anselin Local Moran's I which tests for clusters and outliers and is indicative of how dynamic the differences in spatial patterns and distributions can be within the same place. The impetus of the research is hence not to establish the existence of growth, because this is beyond dispute, but to explore patterns, relationships and trends related to such growth. It is evident that population growth trends are not uniform and varies even within a limited geographic space such as the Gauteng City-Region. These variations within a functional region have implications for planning of housing provision as well as service delivery. This can manifest itself through health facilities, household services such as sanitation and refuse removal as well as provision of electricity, water, schools and road infrastructure. Furthermore, this variation can differ by gender or age groups depending on what attracts people to such areas and this must be borne in mind when developing and implementing regional development plans.

Migration is also very topical given the developments in various parts of the world. In South Africa the ugly face of xenophobia dominates discussions over migration and in particular the legal status of some of the migrants in South Africa. Migration is known to be driven mostly by the youth aged 15-34. This is the age when people are positioning themselves to maximise what they can benefit from access to resources and opportunities. The research shows very clearly that the attraction of migrants varies depending on where they come from and that the settlement with in the GCR is not directed towards the inner core areas as many would believe but towards the satellite cities in the metropolitan daily catchment area as well as along the metropolitan fringe. Hence efforts towards integrating migrants with those local communities and integrating these areas with other areas closer to the inner core areas should be emphasised.

Finally, a very pertinent finding is that people in the City-Region are attracted by service delivery and that poor service delivery manifests itself as a push-factor in the mobility of people in the City-Region. Mobility is hence used very strategically as a tool of empowering communities to receive adequate service delivery. It is hence incumbent upon local authorities

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to ensure that those areas address the backlog around service delivery issues in order to enhance the development of those areas as well as to ensure healthy living conditions in those areas.

5.3 Limitations of Study and recommendations for future research

This study has focussed on overall growth at ward level in the city-region and not according to sub-sectors of the population such as by age group. The nature of the study requires low level data and as a result only Census data is suitable for the needs of this study. However as mentioned, an update of this paper would be a worthy effort when 2016 municipal and electoral boundaries are harmonised to the 2001 and 2011 Census. The findings of this study nonetheless can robustly serve the purpose of integrated regional planning for the benefit of realising the country's inclusive developmental agenda and potential.

Some population processes that need furthermore be understood in terms of spatial development and planning in the Gauteng City-Region include the fact that in terms of density approximately 27% of the country's population lives in the City-Region as of 2011 and this points to the critical role of population distribution in the country. Whilst many prior studies have focussed on national population growth by looking at the Gauteng region as a single entity (SACN, et al. 2009) this study breaks this down into smaller electoral ward units within the City-Region in order to determine dynamic elements of growth within the City-Region and in so doing it is able to determine the parts of the City-Region which are responsible for most growth and areas where growth is most robustly experienced in terms of its impact. This research also goes a long way into showing that there is no uniformity with regards to growth or with regards to the characteristics that different levels of growth are associated with. Neither is there uniformity with regards to the location of spatial trends such as its hotspots or its level of clustering when analysing this by functional geographic areas. This lack of uniformity should drive policy makers and planners to ensure that interventions are appropriate for the area in which they are intended and that a one size fits all type of approach is not ideal or productive. The use of spatial statistics and analysis should also be something which local authorities need to make use of in order to make decisions which benefit their constituents more effectively.

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APPENDIX A

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Person_growth (Binned)	766	3	6	3.47	0.778	1.743	0.088	2.474	0.176
Housing_growth (Binned)	766	3	6	3.50	0.797	1.628	0.088	2.029	0.176
Under_15 (Binned)	766	2	6	3.50	0.968	0.814	0.088	0.427	0.176
15_64 (Binned)	766	2	6	3.50	0.968	0.560	0.088	-0.006	0.176
Over_65 (Binned)	766	2	6	3.51	1.002	0.977	0.088	0.523	0.176
Dependency (Binned)	766	1	6	3.50	1.020	-0.048	0.088	0.261	0.176
Black (Binned)	766	2	6	3.52	0.983	0.872	0.088	0.237	0.176
Coloured (Binned)	766	3	6	3.22	0.614	3.273	0.088	10.753	0.176
Indian (Binned)	766	3	6	3.23	0.634	3.027	0.088	8.942	0.176
White (Binned)	766	3	6	3.49	0.913	1.798	0.088	1.974	0.176
Moved since 2011 (Binned)	766	3	6	3.51	0.840	1.599	0.088	1.595	0.176
GCR (Binned)	766	3	6	3.49	0.829	1.647	0.088	1.759	0.176
GCR Neighbour (Binned)	766	3	6	3.47	0.793	1.809	0.088	2.672	0.176
Non Neighbour (Binned)	766	3	6	3.49	0.813	1.702	0.088	2.175	0.176
No Income (Binned)	766	2	6	3.50	1.000	0.737	0.088	0.119	0.176
Low income (Binned)	766	2	6	3.50	0.953	0.918	0.088	0.631	0.176
Medium Income (Binned)	766	2	6	3.52	0.966	0.843	0.088	0.245	0.176
High Income (Binned)	766	3	6	3.36	0.800	2.325	0.088	4.389	0.176
No Schooling (Binned)	766	2	6	3.48	0.944	0.952	0.088	0.804	0.176
Some Primary (Binned)	766	2	6	3.47	0.981	0.788	0.088	0.407	0.176
Primary (Binned)	766	2	6	3.50	0.942	0.966	0.088	0.732	0.176

Continued overleaf

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Appendix A continued

Appendix A

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Some Secondary (Binned)	766	2	6	3.51	0.930	0.990	0.088	0.646	0.176
Matric (Binned)	766	2	6	3.50	0.988	0.510	0.088	-0.208	0.176
Higher (Binned)	766	3	6	3.46	0.860	1.821	0.088	2.211	0.176
Youth Unemployment (Binned)	766	2	6	3.54	0.929	1.064	0.088	0.626	0.176
Unemployment (Binned)	766	2	6	3.53	0.949	1.006	0.088	0.504	0.176
Sex Ratio (Binned)	766	2	6	3.42	0.681	1.704	0.088	3.061	0.176
Teen head of household (Binned)	766	3	6	3.42	0.735	1.898	0.088	3.298	0.176
Adult head of household (Binned)	766	2	6	3.53	0.889	0.858	0.088	0.569	0.176
Elderly head of household (Binned)	766	2	6	3.51	1.022	0.733	0.088	-0.018	0.176
Female Headed Households (Binned)	766	2	6	3.50	0.972	0.586	0.088	0.040	0.176
Unemployment of head of household (Binned)	766	3	6	3.55	0.852	1.483	0.088	1.286	0.176
No household income (Binned)	766	2	6	3.54	0.859	1.431	0.088	1.434	0.176
Low household income (Binned)	766	2	6	3.51	0.895	1.237	0.088	1.164	0.176

Continued overleaf

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Appendix A continued

Appendix A

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Medium household income (Binned)	766	2	6	3.52	0.910	0.746	0.088	0.552	0.176
High household income (Binned)	766	3	6	3.40	0.831	2.063	0.088	3.162	0.176
Household Size (Binned)	766	1	6	3.51	1.044	-0.156	0.088	-0.107	0.176
Formal Housing (Binned)	766	2	6	3.52	0.979	0.689	0.088	0.029	0.176
Informal Housing (Binned)	766	3	6	3.41	0.774	1.971	0.088	3.210	0.176
Traditional Housing (Binned)	766	3	6	3.43	0.737	1.849	0.088	3.063	0.176
Rented (Binned)	766	3	6	3.51	0.818	1.613	0.088	1.860	0.176
Owned not paid (Binned)	766	3	6	3.48	0.864	1.714	0.088	1.814	0.176
Rent free (Binned)	766	3	6	3.50	0.860	1.664	0.088	1.758	0.176
Owned fully paid (Binned)	766	2	6	3.50	0.999	0.685	0.088	0.220	0.176
Piped in dwelling (Binned)	766	2	6	3.53	0.930	1.045	0.088	0.506	0.176
Piped outside dwelling (Binned)	766	3	6	3.52	0.825	1.642	0.088	2.010	0.176
No piped water (Binned)	766	3	6	3.29	0.686	2.653	0.088	6.696	0.176
Flush to sewerage (Binned)	766	3	6	3.40	0.772	2.078	0.088	3.687	0.176
Other toilet (Binned)	766	2	6	3.52	0.953	0.685	0.088	0.122	0.176

Continued overleaf

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Appendix A concluded

Appendix A

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Bucket (Binned)	766	3	6	3.45	0.829	1.921	0.088	2.813	0.176
No sanitation (Binned)	766	3	6	3.26	0.664	2.840	0.088	7.721	0.176
Electricity for lighting (Binned)	766	2	6	3.52	0.960	0.676	0.088	0.158	0.176
Other energy for lighting (Binned)	766	3	6	3.37	0.758	2.221	0.088	4.248	0.176
No energy for lighting (Binned)	766	3	6	3.47	0.796	1.763	0.088	2.425	0.176
Weekly refuse removal (Binned)	766	2	6	3.52	0.925	0.740	0.088	0.303	0.176
Other refuse removal (Binned)	766	3	6	3.42	0.807	1.979	0.088	3.004	0.176
No refuse removal (Binned)	766	3	6	3.43	0.818	1.957	0.088	2.947	0.176
Home Internet (Binned)	766	3	6	3.42	0.858	2.006	0.088	2.838	0.176
Elsewhere internet (Binned)	766	2	6	3.56	0.910	0.919	0.088	0.442	0.176
No internet (Binned)	766	2	6	3.50	0.876	1.161	0.088	1.190	0.176
Computer (Binned)	766	3	6	3.48	0.870	1.695	0.088	1.708	0.176
Satellite TV (Binned)	766	3	6	3.51	0.870	1.626	0.088	1.588	0.176
Motor Car (Binned)	766	3	6	3.51	0.882	1.644	0.088	1.568	0.176
Valid N (listwise)	766								

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APPENDIX B

```
DATASET ACTIVATE DataSet1.
CROSSTABS
  /TABLES=Person_growth_cat BY Under_15_cat @15_64_cat Over_65_cat Dependency_cat Black_cat
    Coloured_cat Indian_cat White_cat Moved_cat GCR_cat GCR_neighbour_cat Non_neighbour_cat
    No_income_cat Low_income_cat Medium_income_cat High_income_cat No_schooling_cat Some_primary_cat
    Primary_cat Some_secondary_cat Matric_cat Higher_cat Youth_unemployment_cat Unemployment_cat
    Sex_ratio_cat
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT ROW COLUMN TOTAL
  /COUNT ROUND CELL.
```

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Crosstabs

Notes

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Comments		
Input	Data	C:\Users\DiegoI\Google Drive\CRUISE\9 Thesis\Analysis\Cruise2.sav
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	Weight	<none>
	Split File	<none>
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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.
Syntax		CROSSTABS /TABLES=Person_growth_cat BY Under_15_cat @15_64_cat Over_65_cat Dependency_cat Black_cat Coloured_cat Indian_cat White_cat Moved_cat GCR_cat GCR_neighbour_cat Non_neighbour_cat No_income_cat Low_income_cat Medium_income_cat High_income_cat No_schooling_cat Some_primary_cat Primary_cat Some_secondary_cat Matric_cat Higher_cat Youth_unemployment_cat Unemployment_cat Sex_ratio_cat /FORMAT=AVALUE TABLES /CELLS=COUNT ROW COLUMN TOTAL /COUNT ROUND CELL.
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Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Person_growth (Binned) * Under_15 (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * 15_64 (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Over_65 (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Dependency (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Black (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Coloured (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Indian (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * White (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Moved since 2011 (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * GCR (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * GCR Neighbour (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Non Neighbour (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * No Income (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Low income (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Medium Income (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * High Income (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * No Schooling (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Some Primary (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Primary (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Some Secondary (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Matric (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Higher (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Youth Unemployment (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Unemployment (Binned)	766	100.0%	0	0.0%	766	100.0%
Person_growth (Binned) * Sex Ratio (Binned)	766	100.0%	0	0.0%	766	100.0%

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Person_growth (Binned) * Under_15 (Binned) Crosstabulation

			Under_15 (Binned)					
			-1867 - 1302	1303 - 4472	4473 - 7643	7644 - 10813	10814+	Total
Person_growth (Binned)	-.732749521826751 - 3.282674145913360	Count	49	266	148	40	10	513
		% within Person_growth (Binned)	9.6%	51.9%	28.8%	7.8%	1.9%	100.0%
		% within Under_15 (Binned)	64.5%	70.4%	72.9%	57.1%	25.6%	67.0%
		% of Total	6.4%	34.7%	19.3%	5.2%	1.3%	67.0%
	3.282674145913361 - 7.298097813653471	Count	17	80	40	25	15	177
		% within Person_growth (Binned)	9.6%	45.2%	22.6%	14.1%	8.5%	100.0%
		% within Under_15 (Binned)	22.4%	21.2%	19.7%	35.7%	38.5%	23.1%
		% of Total	2.2%	10.4%	5.2%	3.3%	2.0%	23.1%
	7.298097813653472 - 11.313521481393582	Count	8	16	13	2	7	46
		% within Person_growth (Binned)	17.4%	34.8%	28.3%	4.3%	15.2%	100.0%
		% within Under_15 (Binned)	10.5%	4.2%	6.4%	2.9%	17.9%	6.0%
		% of Total	1.0%	2.1%	1.7%	0.3%	0.9%	6.0%
	11.313521481393584+	Count	2	16	2	3	7	30
		% within Person_growth (Binned)	6.7%	53.3%	6.7%	10.0%	23.3%	100.0%
		% within Under_15 (Binned)	2.6%	4.2%	1.0%	4.3%	17.9%	3.9%
		% of Total	0.3%	2.1%	0.3%	0.4%	0.9%	3.9%
Total		Count	76	378	203	70	39	766
		% within Person_growth (Binned)	9.9%	49.3%	26.5%	9.1%	5.1%	100.0%
		% within Under_15 (Binned)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	9.9%	49.3%	26.5%	9.1%	5.1%	100.0%

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```
CROSSTABS
  /TABLES=Housing_growth_cat BY Teen_head_cat Adult_head_cat Elderly_head_cat Female_headed_cat
    Unemployed_hh_cat No_hh_income_cat Low_hh_income_cat Medium_hh_income_cat High_hh_income_cat
    hh_size_cat Formal_housing_cat Informal_housing_cat Traditional_housing_cat Rented_cat
    Owned_notpaid_cat Rentfree_cat Owned_paid_cat Piped_dwelling_cat Piped_outside_cat
    No_piped_water_cat Flush_cat Other_toilet_cat Bucket_cat no_sanitation_cat electricity_lighting_cat
    Other_energy_cat No_energy_cat Weekly_refuse_cat Other_refuse_cat No_refuse_cat Home_internet_cat
    Elsewhere_internet No_internet_cat Computer_cat SatelliteTV_cat Car_cat
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT ROW COLUMN TOTAL
  /COUNT ROUND CELL.
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Crosstabs

Notes

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	Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.
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Resources	Processor Time	00:00:00,05
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	Cells Available	524245

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Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Housing_growth (Binned) * Teen head of household (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Adult head of household (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Elderly head of household (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Female Headed Households (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Unemployment of head of household (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No household income (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Low household income (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Medium household income (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * High household income (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Household Size (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Formal Housing (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Informal Housing (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Traditional Housing (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Rented (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Owned not paid (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Rent free (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Owned fully paid (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Piped in dwelling (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Piped outside dwelling (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No piped water (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Flush to sewerage (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Other toilet (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Bucket (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No sanitation (Binned)	766	100.0%	0	0.0%	766	100.0%

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Housing_growth (Binned) * Electricity for lighting (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Other energy for lighting (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No energy for lighting (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Weekly refuse removal (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Other refuse removal (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No refuse removal (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Home Internet (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Elsewhere internet (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * No internet (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Computer (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Satellite TV (Binned)	766	100.0%	0	0.0%	766	100.0%
Housing_growth (Binned) * Motor Car (Binned)	766	100.0%	0	0.0%	766	100.0%

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Housing_growth (Binned) * Teen head of household (Binned) Crosstabulation

			Teen head of household (Binned)				
			-18 - 60	61 - 139	140 - 218	219+	Total
Housing_growth (Binned)	-.361854474033070 - 3.946096067297268	Count	367	110	11	7	495
		% within Housing_growth (Binned)	74.1%	22.2%	2.2%	1.4%	100.0%
		% within Teen head of household (Binned)	69.5%	62.1%	31.4%	26.9%	64.6%
		% of Total	47.9%	14.4%	1.4%	0.9%	64.6%
	3.946096067297269 - 8.254046608627606	Count	121	41	16	10	188
		% within Housing_growth (Binned)	64.4%	21.8%	8.5%	5.3%	100.0%
		% within Teen head of household (Binned)	22.9%	23.2%	45.7%	38.5%	24.5%
		% of Total	15.8%	5.4%	2.1%	1.3%	24.5%
	8.254046608627608 - 12.561997149957945	Count	23	18	4	6	51
		% within Housing_growth (Binned)	45.1%	35.3%	7.8%	11.8%	100.0%
		% within Teen head of household (Binned)	4.4%	10.2%	11.4%	23.1%	6.7%
		% of Total	3.0%	2.3%	0.5%	0.8%	6.7%
	12.561997149957946 +	Count	17	8	4	3	32
		% within Housing_growth (Binned)	53.1%	25.0%	12.5%	9.4%	100.0%
		% within Teen head of household (Binned)	3.2%	4.5%	11.4%	11.5%	4.2%
		% of Total	2.2%	1.0%	0.5%	0.4%	4.2%
Total		Count	528	177	35	26	766
		% within Housing_growth (Binned)	68.9%	23.1%	4.6%	3.4%	100.0%
		% within Teen head of household (Binned)	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	68.9%	23.1%	4.6%	3.4%	100.0%

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APPENDIX C

```
NONPAR CORR
  /VARIABLES=Person_growth_cat Under_15_cat @15_64_cat Over_65_cat Dependency_cat Black_cat
    Coloured_cat Indian_cat White_cat Moved_cat GCR_cat GCR_neighbour_cat Non_neighbour_cat
    No_income_cat Low_income_cat Medium_income_cat High_income_cat No_schooling_cat Some_primary_cat
    Primary_cat Some_secondary_cat Matric_cat Higher_cat Youth_unemployment_cat Unemployment_cat
    Sex_ratio_cat
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
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Nonparametric Correlations

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Person_growth_cat Under_15_cat @15_64_cat Over_65_cat Dependency_cat Black_cat Coloured_cat Indian_cat White_cat Moved_cat GCR_cat GCR_neighbour_cat Non_neighbour_cat No_income_cat Low_income_cat Medium_income_cat High_income_cat No_schooling_cat Some_primary_cat Primary_cat Some_secondary_cat Matric_cat Higher_cat Youth_unemployment_cat Unemployment_cat Sex_ratio_cat /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00,03
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	Number of Cases Allowed	108473 cases[a]

a. Based on availability of workspace memory

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Person Growth Correlations

			Person growth (Binned)	Under_15 (Binned)	15_64 (Binned)	Over_65 (Binned)	Dependency (Binned)	Black (Binned)	Coloured (Binned)	Indian (Binned)	White (Binned)	Moved since 2011 (Binned)	GCR (Binned)	GCR Neighbour (Binned)	Non Neighbour (Binned)	No Income (Binned)	Low income (Binned)	Medium Income (Binned)	High Income (Binned)	No Schooling (Binned)	Some Primary (Binned)	Primary (Binned)	Some Secondary (Binned)	Matric (Binned)	Higher (Binned)	Youth Unemployment (Binned)	Unemployment (Binned)	Sex Ratio (Binned)
Spearman's rho	Person_growth (Binned)	Correlation Coefficient	1.000	.091*	.092*	-.115**	-.115**	.038	.094**	.160**	.165**	.317**	.294**	.346**	.313**	.036	-.016	.145**	.188**	.131**	.070	.089*	.035	.034	.177**	.003	.003	.167**
		Sig. (2-tailed)	.	.012	.011	.001	.001	.292	.009	.000	.000	.000	.000	.000	.000	.323	.662	.000	.000	.000	.054	.013	.337	.350	.000	.930	.945	.000

```
NONPAR CORR
  /VARIABLES=Housing_growth_cat Teen_head_cat Adult_head_cat Elderly_head_cat Female_headed_cat
    Unemployed_hh_cat No_hh_income_cat Low_hh_income_cat Medium_hh_income_cat High_hh_income_cat
    hh_size_cat Formal_housing_cat Informal_housing_cat Traditional_housing_cat Rented_cat
    Owned_notpaid_cat Rentfree_cat Owned_paid_cat Piped_dwelling_cat Piped_outside_cat
    No_piped_water_cat Flush_cat Other_toilet_cat Bucket_cat no_sanitation_cat electricity_lighting_cat
    Other_energy_cat No_energy_cat Weekly_refuse_cat Other_refuse_cat No_refuse_cat Home_internet_cat
    Elsewhere_internet No_internet_cat Computer_cat SatelliteTV_cat Car_cat
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
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Nonparametric Correlations

Notes

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	N of Rows in Working Data File	766
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Housing_growth_cat Teen_head_cat Adult_head_cat Elderly_head_cat Female_headed_cat Unemployed_hh_cat No_hh_income_cat Low_hh_income_cat Medium_hh_income_cat High_hh_income_cat hh_size_cat Formal_housing_cat Informal_housing_cat Traditional_housing_cat Rented_cat Owned_notpaid_cat Rentfree_cat Owned_paid_cat Piped_dwelling_cat Piped_outside_cat No_piped_water_cat Flush_cat Other_toilet_cat Bucket_cat no_sanitation_cat electricity_lighting_cat Other_energy_cat No_energy_cat Weekly_refuse_cat Other_refuse_cat No_refuse_cat Home_internet_cat Elsewhere_internet No_internet_cat Computer_cat SatelliteTV_cat Car_cat /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
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	Number of Cases Allowed	78643 cases[a]

a. Based on availability of workspace memory

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Household Growth Correlations

			Housing_growth (Binned)	Teenhead of household (Binned)	Adulthead of household (Binned)	Elderly head of household (Binned)	Female Headed Households (Binned)	Unemployment of head of household (Binned)	No household income (Binned)	Low household income (Binned)	Medium household income (Binned)	High household income (Binned)	Household Size (Binned)	Formal Housing (Binned)	Informal Housing (Binned)	Traditional Housing (Binned)	Rented (Binned)	Owned not paid (Binned)	Rent free (Binned)	Owned fully paid (Binned)	Piped in dwelling (Binned)	Piped outside dwelling (Binned)	No piped water (Binned)	Flush to sewerage (Binned)	Other toilet (Binned)	Bucket (Binned)	No sanitation (Binned)	Electricity for lighting (Binned)	Other energy for lighting (Binned)	No energy for lighting (Binned)	Weekly refuse removal (Binned)	Other refuse removal (Binned)	No refuse removal (Binned)	Home Internet (Binned)	Elsewhere internet (Binned)	No internet (Binned)	Computer (Binned)	Satellite TV (Binned)	Motor Car (Binned)
Spearman's rho	Housing growth (Binned)	Correlation Coefficient	1.000	.193**	.169**	-.236**	.025	.117**	.147**	.057	.108**	.094**	-.298**	.070	.198**	.195**	.183**	.092*	.185**	-.069	.068	.100**	.263**	.227**	.048	.222**	.146**	.054	.278**	.251**	.041	.220**	.233**	.107**	.066	.163**	.106**	.053	.113**
		Sig. (2-tailed)	.	.000	.000	.000	.494	.001	.000	.112	.003	.009	.000	.052	.000	.000	.000	.011	.000	.057	.059	.005	.000	.000	.187	.000	.000	.136	.000	.000	.252	.000	.000	.003	.069	.000	.003	.141	.002
		N	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766	766