Unemployment in South Africa: in search of a spatial model

by

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Abstract

Consistent high unemployment perpetuates inequalities in the South African society. The 2014 growth expectation for the South African economy is 1.5 per cent and this will most certainly not be enough to reduce unemployment. This research aimed to create an understanding of the spatial intricacies related to unemployment and to create a longitudinal dataset since 1991. The challenge with such a dataset is that boundaries of the enumeration and administrative areas have changed continually in the past and makes it difficult to compare unemployment spatially over time.

These particular problems were addressed by aggregating data for 1991 and 1996 census from magisterial districts to the 2005 municipal boundaries. Area based weighted areal interpolation was used and it assumes that data is distributed homogeneously across the area of each source unit. The 2001 census and 2007 community survey data was available at the 2005 municipal level, and therefore a longitudinal socio-economic dataset of four time points could be created.

The results showed that unemployment has been spatially persistent in a number of areas. Furthermore, a spatial grouping of unemployment by municipality showed that metropolitan municipalities had unique unemployment characteristics whereas the remainder of the country could be clustered into five distinct groups. A spatial comparison between unemployment and poverty at municipality level revealed that people can be poor and unemployed, but also poor and employed. Finally, the longitudinal data was used to do spatial forecasting of future unemployment trends and these accounted for up to 60 per cent of change in unemployment. These national and provincial spatial unemployment models consisted of coefficients like the percentage of people employed in mining and agriculture.

This research added new knowledge in terms of the spatio-temporal understanding of unemployment in South Africa. It created a methodology to overcome modifiable areal unit problems (MAUP) and a longitudinal dataset of unemployment and related socio-economic variables. Refined spatial data was this research's main challenge and it recommends that unemployment data should be released at the most detailed spatial level possible - like sub-place or enumeration areas. The quality and timeliness of data remain obstacles for policy-making. Therefore, labour market data at a sub-place level would provide a more meaningful analysis. The results from census 2011 will allow the creation of longitudinal socio-economic trends at a spatially detailed level in South Africa in the future.

Preface

The whole thesis, unless specifically indicated to the contrary in the text, is my own work and has not been submitted, in part or in whole, to any other tertiary institution. The research work was done in South Africa and was a desktop study supervised by Prof. Fethi Ahmed. Where use has been made of work of others, it is duly acknowledged in the text.

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I, G. WEIR-SMITH, declare that

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Declaration 2 - Publications

DETAILS OF CONTRIBUTION TO PUBLICATIONS that form part and/or include research presented in this thesis (include publications in preparation, submitted, in press and published and give details of the contributions of each author to the experimental work and writing of each publication)

1. Weir-Smith. G. 2013. Identifying the jobless: an overview of literature on geography and unemployment in South Africa. *South African Geographical Journal* 95, 2. DOI: 10.1080/03736245.2013.854177.

2. Weir-Smith. G. and Ahmed, F. 2013. Unemployment in South Africa: building a spatio-temporal understanding. *South African Journal of Geomatics* 2, 3: 218-230.

3. Weir-Smith. G. *submitted*. The geographic data of unemployment in South Africa: an overview. *South African Geographical Journal*.

4. Weir-Smith. G, *in preparation*. The changing geography of unemployment: identifying municipalities of high unemployment over time in South Africa. *The Professional Geographer*.

5. Weir-Smith. G, *in preparation*. Changing boundaries: overcoming modifiable areal unit problems related to unemployment data in South Africa. *Transactions in GIS*.

6. Weir-Smith. G, *submitted*. Finding the jobless: trends of spatio-temporal variation in unemployment at sub-provincial level. *The Professional Geographer*.

7. Weir-Smith. G, *in preparation*. Unemployment and poverty: spatial dynamics. *Geografiska Annaler: Series B, Human Geography*.

8. Weir-Smith. G, *in preparation*. Where the jobless will be: a geographically disaggregated predictive model of future unemployment. *Journal of Regional Science*.

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To my friends and family who did not see me frequently, thanks for your understanding and support.

Soli Deo gloria

Chapter 1 General introduction

Global unemployment increased until 2004 and then markedly again after 2008 due to the worldwide recession. The official South African figure for unemployment rose from 21.0 per cent in 1996 to 25.8 per cent in 2001, and is currently at 25.5 per cent (Stats SA 1996, 2003b and 2014). Spatial disparities between regional employment levels and poverty have been persistent in South Africa over past decades. To understand these regional trends better, one needs labour market data at a sub-provincial level.

Although many unemployment trends have been identified from an economic point of view, very little research has been done to compare the patterns spatially over time in South Africa. For example, has urban status, race, gender or education had a constant influence in determining employment status at a municipality level? Of the literature consulted about the South African labour market, only 11 per cent had a spatial focus. In contrast, 57 per cent of the international unemployment literature considered, explored the spatial angle. There is therefore a clear gap in the literature when analysing the South African labour market context, a neglect that can be accommodated by applying a sound geographic focus. Furthermore, a temporal comparison of such unemployment patterns is important to predict future trends at a spatially disaggregated level.

The objectives of this research are:

1. To build a spatial representation of unemployment change for South Africa
2. To create methodologies of overcoming census modifiable area unit problems for South Africa
3. To identify areas of high and low unemployment through time
4. To assess the relationship between unemployment and poverty
5. To analyse trends of spatio-temporal unemployment variation at a local geographical level
6. To build a geographical disaggregated predictive model of future unemployment.

The thesis layout will follow these objectives. Chapters 2 and 3 take care of the literature and data available relevant to building a spatial representation of unemployment in South Africa. Discussion focuses on evaluating various unemployment data sources and makes a final recommendation about the merit of such data.

Chapter 4 looks at a methodology that would overcome census modifiable area unit problems that arise because administrative and census boundaries change between successive censuses. The chapter gives international examples and suggests ways of overcoming these reporting hurdles.

The spatial concentration of unemployment is the theme of Chapter 5. Through the use of a number of statistical techniques, integrated data was devised to highlight areas of high and low unemployment through time.

Chapter 6 assesses the relationship between unemployment and poverty, because many scholars suggest that there is a relationship between the two factors. The chapter also deliberates on the potential impact of migration on unemployment.

In Chapter 7 clear geographical divides across the country are explained through analyses of the trends of spatio-temporal unemployment variation. Cluster analysis groups municipalities according to unemployment characteristics.

A geographical, disaggregated predictive model of future unemployment is presented in Chapter 8, having used a combination of statistical and Geographic Information Systems (GIS) tools to do so. Because unemployment data is only available at municipal level, it was challenging to find enough variability in the data. The final unemployment models were thus created at a national and provincial cluster level.

The major contribution of this research is its detailed spatial interpretation of unemployment in South Africa from 1991 to 2007. For the first time there will be a spatial database relating unemployment to socio-economic variables that will allow for spatial analysis and modelling of unemployment trends.

This thesis comprises a series of standalone papers. Information regarding the underlying article, author and targeted journal appears at the beginning of each chapter.

Chapter 2 An overview of literature on the Geography of Unemployment in South Africa

This chapter is based on:

Weir-Smith. G. 2014. Identifying the jobless: an overview of literature on geography and unemployment in South Africa. *The South African Geographical Journal* 96, 2: 134-152.

Abstract

In South Africa, the figure for unemployment rose from 21.0 per cent in 1996 to 25.8 per cent in 2001 and then slightly decreased to 25.2 per cent in 2010. Literature relating to an analysis of unemployment in South Africa has predominantly focused on the national level, and although some literature refers to spatial aspects that affect unemployment trends, assigning a clear geography to them is not evident. This literature overview draws attention to unemployment and its geographical component, dealing with its broad trends both in the South African economy as well as in international context.

The chapter identifies relevant literature sources through traditional search methodologies, namely library and internet searches, focusing on local and international sources. Snow-balling techniques and cross-scientific searches enhanced the results.

The findings reveal that very few articles on the South African labour market focused on the spatial analysis of unemployment and there is a clear gap in this regard. International literature supports the idea that unemployment is the result of local economic interactions, and is often expressed as a mismatch between demand and supply. One potential solution to address local labour inequalities is geographical targeting and, when applied, it not only reduces intervention spending, but also results in more effective interventions.

Literature recommends that locally adapted policies are better suited to addressing local dimensions and manifestations of the labour market. Furthermore, a study on the geographic patterns of unemployment is a novel and valuable contribution. Such research should consider unemployment data at a municipality level to ensure trends in local labour markets are successfully identified. The originality of geographic unemployment research justifies the importance of further examination and application of spatial modelling.

Key words: unemployment, spatial analysis, geography, census, economy

2.1 Introduction

Unemployment globally has been constantly on the rise the past few years with the current global economic crisis affecting it negatively. Ever-increasing unemployment statistics can be seen in most countries. In South Africa, using the strict definition, the figure for unemployment has risen from 21.0 per cent in 1996 to 25.8 per cent in 2001, and slightly decreased to 25.2 per cent in 2010 (Stats SA 1996, 2003 and 2010). The strict definition refers to those people eligible to work but who could not find employment, and excludes those who became discouraged when looking for employment.

According to the International Labour Organisation (ILO) (2009), sub-Saharan Africa and South Asia stood out as regions with extremely harsh labour market conditions, to such an extent, that around four-fifths of the employed in sub-Saharan Africa formed a separate class described as 'the working poor'. This meant that, although people were employed, they still earned too little to make an adequate existence.

Economic growth in sub-Saharan Africa slowed down from 6.6 per cent in 2007 to 5.3 per cent in 2008, with a more limited growth of 5.0 per cent projected for 2009 (ILO 2009). With these declining growth rates unemployment is bound to increase. Economic growth projections for sub-Saharan Africa anticipated recovery to a pre-crisis rate of 5.5 per cent in 2011 (ILO 2011). Besides the official unemployment statistics, symptoms of severe labour market distress are still evident around the world: falling employment-to-population ratios, increases in vulnerable forms of employment, stagnant labour productivity growth and rising discouragement – particularly among the youth (ILO 2011).

In South Africa, the democratic government inherited a labour market that had been subjected to the long-run effects of both structural shifts and technological change in the domestic economy. The former was represented by the shift in output away from the primary sectors towards the services sectors, while the onset of the micro-electronics revolution, as well as significant increases in capital-labour ratios, affected the latter. The labour market consequence of these changes was an increased demand for highly skilled workers, combined with large-scale attrition at the bottom-end of the labour market. A relatively poor performance in economic growth also marked the post-apartheid period (Bhorat et al. 2001). Contraction in the primary sector and expansion in the manufacturing sector, has led to structural shifts in the economy of South Africa (Van der Berg et al. 2005: 5). Since unemployment is particularly high among the unskilled it is affecting the African population disproportionately (McCord and Bhorat 2003). Meth and Dias (2004) found that 61 per cent of unemployed people live in the poorest households.

The United Nations Development Programme (UNDP) and other international organisations have identified both unemployment and poverty as critical issues. Specific Millennium Development Goals (MDGs) were formulated to measure world progress in implementing them. In South Africa, the target is to cut unemployment by at least half to a maximum of 14 per cent by 2014 (Republic of South Africa 2009). This unemployment target is expanded in Chapter 3. In terms of poverty, statistics from the Human Sciences Research Council (HSRC) indicate that the poverty rate (percentage people living in poverty) declined from 60 per cent in 2001 to 49 per cent in 2006 (HSRC 2006). Although there is a downward trend, the figures are still very high.

Acknowledging the association between unemployment and poverty opens doors to improving both conditions. Van der Berg et al. (2005) indicated that expanding work opportunities would bring much more income to those who are presently poor, raising them above the poverty line

and allowing them to shift into higher income deciles. Increasing employment is therefore a more sustainable solution than social grants.

2.1.1 LIMITED GEOGRAPHICAL ANALYSIS

Since geographic unemployment rates are often regarded as signposts for the socio-economic performance of regions (Cracolic et al. 2007), it is important to understand and address the unemployment problem effectively using detailed spatial data. According to Green (1998), geographical analysis of unemployment is only effective if conducted within regions (similar to provinces in South Africa) and not between regions. Trendle (2006) endorses this stance as he points out that neighbourhood or geographic spillover effects are significant in unemployment analysis, and therefore a spatial perspective is required.

Over the past decades spatial disparities between regional employment levels and poverty have been interminable in South Africa – as is the case in many African countries. The term 'region' can refer to urban/rural divides, inter-provincial and intra-urban space etc., because spatially unemployment is not equally distributed. The persistence of such regional structures of unemployment (Arrufat et al. 1998, Martin 1998) requires investigation.

To date unemployment analysis studies in South Africa have predominantly concentrated on the national situation (Bhorat and Van der Westhuizen 2009, Kingdon and Knight 2003) or, in some instances, at a provincial level (Kingdon and Knight 2005). In the literature references to spatial aspects that affect unemployment trends existed (Wittenberg 2001, McCord and Bhorat 2003, Kingdon and Knight 2001) but the interpretation was not based on sound basic geographical principles. A distinction between rural and urban employment differences is often made, but the geographical extent is not explored. In order to achieve the MDG targets and address the unemployment problem effectively, it is important to focus on sub-provincial data. As Elbers et al. (2007) point out, the more detailed the spatial data, the more effective the intervention.

Table 2.1 South African urban and rural unemployment between 1993 and 2004

	Strict unemployment rate	**Broad unemployment rate**
1993		
Rural	13.1	38.7
Urban	12.4	23.3
All	12.7	29.4
1997		
Rural	26.9	49.5
Urban	21.5	32.6
All	22.9	37.6
2001		
Rural	32.7	51.4
Urban	28.2	35.9
All	29.5	41.6
2004		
Rural	28.5	50.3
Urban	27.5	36.1
All	27.8	41.3

Source: Klasen and Woolard 2008, adapted

Klasen and Woolard (2008) show the difference between urban and rural unemployment for the period 1993 to 2004 (Table 2.1). The data is based on the strict unemployment rate and Section 2.2 distinguishes between the strict and unofficial unemployment rates. Rural locations tend to have a slightly higher unemployment rate over time. In 1997 and 2001 rural unemployment differed by more than 5 per cent from urban rates. The difference between rural and urban rates is much more pronounced when using the broad definition, however, this research will only focus on the official rate, that is, the strict rate. Research by McCord and Bhorat (2003) expanded on this finding by indicating that rural and urban employment are largely the same when using the narrow definition, but when using the broad definition rural unemployment is about 10 per cent higher. Narrow unemployment statistics are therefore likely to understate the extent of non-urban employment. They extended this further and reported that women experienced a higher unemployment rate than men, while race was a more significant determinant of unemployment than gender or urban/rural location.

Research by Kingdon and Knight (2005) discussed the change in unemployment by province between 1995 and 2003. Their research showed that Gauteng had the highest increase in unemployment over this period, an increase of 16.2 per cent. Other provinces with high increases were Free State (14.7 per cent), Limpopo (14.3 per cent) and North West (14 per cent). Eastern Cape (7.4 per cent) and Western Cape (7.3 per cent) had the lowest increases in unemployment during this particular period.

Against this background this chapter will address the following objectives:

- To provide an overview of literature on the definition of unemployment and specifically its application in South Africa
- To identify literature trends related to the geographical analysis of unemployment
- To identify gaps in the literature about the Geography of South African unemployment.

The next section will focus on the definition of unemployment while Section 2.3 considers literature on the geographic analysis of unemployment and potential existing geographic data in South Africa. Section 2.4 concludes and provides some pointers for future research.

2.2 Defining unemployment

Unemployment has economic costs: it reduces economic well-being, lowers output and erodes human capital. It also has social costs: it leads to social exclusion and deterioration in family life, and it fosters grievance and cynicism which may be responsible for the supposed link between unemployment and crime (Kingdon and Knight 2000). Furthermore, most people depend on their jobs for their livelihood and their employment status will affect their subjective sense of well-being too (UNDP 2010).

Traditionally, two rates are used to describe unemployment - the broad and the narrow. The narrowly, or strictly, defined unemployed are jobless persons who looked for work in a given time period, typically the week or month prior to a survey or census inquiry. The broadly defined unemployed are the narrow unemployed plus those who wanted work but did not look for it in the reference period (Kingdon and Knight 2000). The ILO has recommended that, for the sake of objectivity and international comparability, the narrow measure of unemployment should be adopted (Kingdon and Knight 2000). The economically active population contains both employed and unemployed people. The unemployed refers to that component of the population that is still actively seeking work while the unemployment rate refers to the number of unemployed people as a percentage of the total economically active population (Barker 1999).

The international standard definition of unemployment adopted by the 13th International Conference on Labour Statistics (ICLS) is based on three criteria which have to be met simultaneously (Hussmanns 2010). According to this definition, the unemployed comprise all persons above the age specified for measuring the economically active population who, during the reference period, were:
(a) "without work", i.e. were not in paid employment or self-employment as defined by the international definition of employment
(b) "currently available for work", i.e. were available for paid employment or self-employment during the reference period
(c) "seeking work", i.e. had taken specific steps in a specified recent period to seek paid employment or self-employment.

Statistics South Africa (Stats SA) makes use of different employment definitions in their census and Labour Force Survey (LFS) data collections. For census purposes unemployment data derives from a logical series of questions based on the stated official unemployment definition. The types of questions used to calculate unemployment are:

- Work activities in the past seven days
- Temporary absence from work
- Reasons for not working
- Availability for work
- Active steps seeking work.

The LFS captures data for both the restricted and expanded (broad) definitions. The expanded definition of unemployment excludes criterion 'seeking work' (c). The expanded definition therefore includes persons who said they were unemployed but had not taken active steps to find work in the four weeks prior to the interview (i.e. discouraged work seekers). Data from the LFS is, however, represented spatially at a provincial level only. This means there are nine spatial records (one for each province in South Africa) while census data sometimes represents unemployment at an enumeration area (EA) level, and sometimes at a municipality level. The number of municipalities in recent censuses varied between 250 and 300 entities.

The extent and impact of unemployment seem to have a geographical component and it is therefore useful to investigate whether this angle is explored in unemployment research in South Africa. The next section therefore considers literature on spatially analysing unemployment.

2.3 The spatial analysis of unemployment

Economic Geography is a discipline that respects the spatiality of economic activities. Sheppard (2000) maintains that Economic Geography also seeks to understand the interdependence between place and individuals. As such, proximity can be seen as a multidimensional and multifaceted concept, and the relationships among economic actors are not constrained by physical proximity alone (Rodríguez-Pose 2011). Furthermore, Coe, Kelly and Yeung (2007) indicate that the economy is a set of real-world processes, a set of complex social relations that vary enormously across, and because of, geographical space.

Coe, Kelly and Yeung (2007) also aver that the 'new economic geography' has created a geographical approach to the economy that contextualises economic processes by situating them within different social, political and cultural relations. Martin (2000) points out that since the 1980s, the focus of Economic Geography is much more on the geographies of the labour market. Martin takes this further and states that the new approach to Economic Geography sees the labour market as operating intrinsically and being regulated at a local level. This would

include the creation and destruction of jobs, the processes of employment, unemployment and wage setting.

2.3.1 ANALYSING UNEMPLOYMENT BY LOCAL AREA LEVEL

A number of studies support Martin's (2000) view. Green (1998) and Illeris (1985) maintain that unemployment is the result of the interaction of demand and supply factors in different ways and in different areas. Sari (2010) concludes that there is a difference between skills mismatch (mismatch between skills offered by the unemployed and skills required by employers), and spatial mismatch (mismatch between the jobs and where the people are located). Kasarda and Ting (1996) posed the skills mismatch hypothesis that white collar jobs are spatially accessible to people, but functionally inaccessible due to a lack of skills. He concluded that the status of the spatial mismatch hypothesis remains open, because conflicting findings were not able to confirm it. Adding to this debate is the notion of geographic or spatial targeting. Research by Elbers et al. (2007) concerning poverty relief money shows large gains from targeting smaller administrative units, such as districts or villages. Similarly, Hoddinott (1999) points out that geographical targeting works best when geographic units are relatively small districts (smaller than provinces), and were largely homogeneous. Geo-targeting can be done using percentages of the affected population (e.g. percentage unemployed people), absolute numbers (which is sometimes reflected on a density basis) or severity (e.g. the extent of unemployment among the unemployed). These methods would produce different rankings (Hoddinot 1999).

Geographic targeting should be considered to address unemployment effectively in South Africa. However, current data is collected at a municipality level where population is not necessarily homogeneous. For example, within the municipality of the City of Johannesburg, there are large informal settlements, affluent suburbs and the city centre which all have different socio-economic characteristics.

Besides analysing unemployment geographically, research of this nature should also consider the modelling of unemployment. Literature on international spatial models of unemployment shows that spatial models perform better than comparison models in forecasting unemployment (Schanne et al. 2008). In this particular discourse an additional argument is presented, stating that neighbouring or close regional units significantly influence economic development in a particular labour market district. As such, the spatial dependencies are placed in a deterministic time series model.

Working in France, Sari (2010) successfully used spatial regression to model skills, spatial and social mismatch. In this research spatial spillovers definitely existed across neighbourhoods. A spatial two stage least squares model seemed to be more appropriate because it controlled spatial dependence. Oud et al. (2010) introduced spatial dependence in a continuous modelling framework. The results show substantial autoregressive effects for unemployment development. Their study related regional unemployment rates to regional labour supply, economic structure and wages.

The models discussed here provide some indication of factors and approaches that have to be considered. The effect of spatial dependency evidently needs to be incorporated in any South African spatial modelling endeavour. Sari's (2010) study was based on census data and provides a useful overview of specific variables. However, in the South African census not all variables are recorded, e.g. indications of commuting costs and housing prices. Wage data will not be included in this research either because there are no readily available statistics that can be linked to municipalities.

2.3.2 POSSIBLE UNEMPLOYMENT DATA SOURCES

Stats SA, the official producer of statistics in South Africa, offers unemployment data at a municipality level, but only during censuses, and through its LFS at a provincial level. A spatial analysis of the recent unemployment trends could therefore include census data from 1996 and 2001. Two other sources can provide additional data. In 1991 the Human Sciences Research Council (HSRC) produced census data spatially for magisterial districts and EAs, and in 2007 Stats SA conducted the Community Survey (CS) which also presents data on unemployment at municipality level.

Besides the official statistics from Stats SA it is worth considering other data sources to obtain richer data for analysis purposes. The University of Oxford's Centre for the Analysis of South African Social Policy (CASASP) developed multiple deprivation data for South Africa. This data is based on Census 2001, and has been represented at two spatial levels that are relevant to consider here: municipalities and data zones. Municipal data is given in the South African Index of Multiple Deprivation 2007 (SAIMD 2007) and SAIMD 2001. The SAIMD 2007 is a composite index reflecting four dimensions of deprivation experienced by people in South Africa: income and material deprivation, employment deprivation, education deprivation and living environment deprivation (Wright and Noble 2009). The employment deprivation value is based on the number of people who are unemployed (official definition) and the number of people who are not working because of illness or disability.

Data zones are geographical units that were developed to enable deprivation in South Africa to be analysed at a small area level (Avenell et al. 2009). In all, 22 846 data zones were developed, and each contained modelled multiple deprivation data for 2007 that include employment deprivation. The socio-economic data was modelled from the Community Survey 2007.

In the commercial market, the company Global Insight recently released unemployment statistics at a municipality level on the Regional Explorer (ReX) database. Statistics cover the period from 1996 to 2008 and there are selected forecasts for 2010. It is based on Stats SA data and comes at a price of around R240 000.00 per corporate license. Multiple deprivation data is available without cost in the public domain and is thus easier to access.

Weir-Smith and Ahmed (2013) found that, due to changes in spatial boundaries, it is difficult to compare census data over time at a small area level (e.g. enumeration areas) and suggest that unemployment statistics be aggregated to a common boundary. This would be the most uncomplicated way to overcome the modifiable area unit problem (MAUP).

2.4 Conclusion and recommendations

National unemployment statistics perform several functions. They are useful in highlighting the extent of labour under-utilisation in the economy, are employed in economic models to predict the movement of key macro-economic variables and are monitored by governments to inform fiscal and monetary policy. Disaggregated unemployment statistics are often used in funding formulas to target the allocation of public funds in government programmes such as regional assistance, youth training and public works (Kingdon and Knight 2000). Despite their role in all these significant areas, this literature overview has shown that extremely limited literature on geographically disaggregated research on unemployment exists in South Africa. Some sources refer to broad concepts of spatiality, e.g. urban, rural and province however, none examine these in detail. A study on the geographical patterns of unemployment in South Africa would therefore seem to be a novel and valuable.

Based on Martin's observation (2000) that the new approach to Economic Geography sees the labour market as operating intrinsically and being regulated at a local level, spatial analysis of unemployment would therefore have to consider data at a municipality level. The HSRC and Stats SA produced census data sets for 1991, 1996 and 2001 and, together with the CS 2007, these can form the basis of a spatio-temporal series analysis of unemployment in recent years. However, McCord and Bhorat (2003) warn that narrow unemployment statistics are likely to understate the extent of non-urban employment, and this should be borne in mind in any spatial analysis exercise. However, to ensure comparison with international standards, this study adhered to the narrow definition. Since economic growth has considerable poverty-reducing potential, it would be useful to consider growth at the most spatially detailed level. Unfortunately, such data is not readily available.

Future research endeavours should be aware that job insecurity and the sources of economic instability should be included in any social science analysis of vulnerability, especially at a time like this where the world economy struggles to emerge from the deepest recession in decades, and the loss of millions of jobs (UNDP 2010). As Green (1998) argues, besides the fact that geo-targeting optimises the money allocated for interventions, locally adapted policies will better address local dimensions and characteristics of the labour market.

Further research in the spatial analysis of South African unemployment is seen to be necessary. This study focused on the spatial trends of unemployment over time. The relationship between unemployment and poverty was considered, and the determination of socio-economic factors that influence unemployment over time at a municipal level in South Africa was done. The type of modelling that could be used to predict the spatial occurrence of future unemployment, and a forecast of municipalities of high unemployment in the future, was addressed. The applicability of existing international spatial unemployment models to South African context is assessed in subsequent chapters.

Chapter 3 An overview of the geographic data of unemployment in South Africa

This chapter is based on:

Weir-Smith. G. *submitted*. The geographic data of unemployment in South Africa: an overview. *The South African Geographical Journal*.

Abstract

Global unemployment has risen in the past few years and spatial data is required to address the problem effectively. South African unemployment literature focuses mostly on spatial analysis at a national level only. Some literature sources refer to spatial aspects that affect unemployment trends, but they do not assign a specific location to them e.g. a suburb or municipality. Little research has compared spatial patterns of unemployment over time. This chapter sets out to identify the sources of geographic data on this issue.

It provides a synopsis of the available South African geographic data to address the challenge of unemployment. Secondary data analysis is conducted by comparing data sets from official national surveys and censuses according to spatial extent and associated attributes. The representation of change over time is explored. Aggregation to a common boundary such as municipalities is suggested as a method to overcome modifiable areal unit problems. The findings show that census data are spatially more detailed than labour force survey data because it represents unemployment data at a sub-provincial level. Census data from pre-1991 might not reflect the post-apartheid labour trends effectively.

It is recommended that data from census 1991, 1996 and 2001 as well as Community Survey 2007 be used to understand detailed spatial trends of South African unemployment. Knowing the location of the unemployed directs the spending of development funding and job creation interventions.

Key words: unemployment, spatial data, attributes, census, location

3.1 Introduction and problem statement

Global unemployment increased until 2004 and increased again after 2008 due to the recession. The South African figure for unemployment (strict definition) has risen from 21.0 per cent in 1996 to 25.8 per cent in 2001 and decreased to 25.2 per cent in 2010 (Stats SA 1996, 2003b and 2010a). The strict definition of unemployment excludes discouraged workers (see Section 2 for the detailed definition). The United Nations (UN) and other international agencies have identified unemployment as a critical issue as part of the MDGs (UNDP 2005).

The post-2008 recession period is characterised by increased unemployment in most countries (International Labour Organisation (ILO) 2012). Figure 3.1 shows unemployment rate increases in the United Kingdom (UK), the United States of America (USA), France, Italy, Denmark and South Africa. Although all countries have experienced an increase in unemployment rates, South Africa's rate is 15 per cent or higher than them all in the developed world.

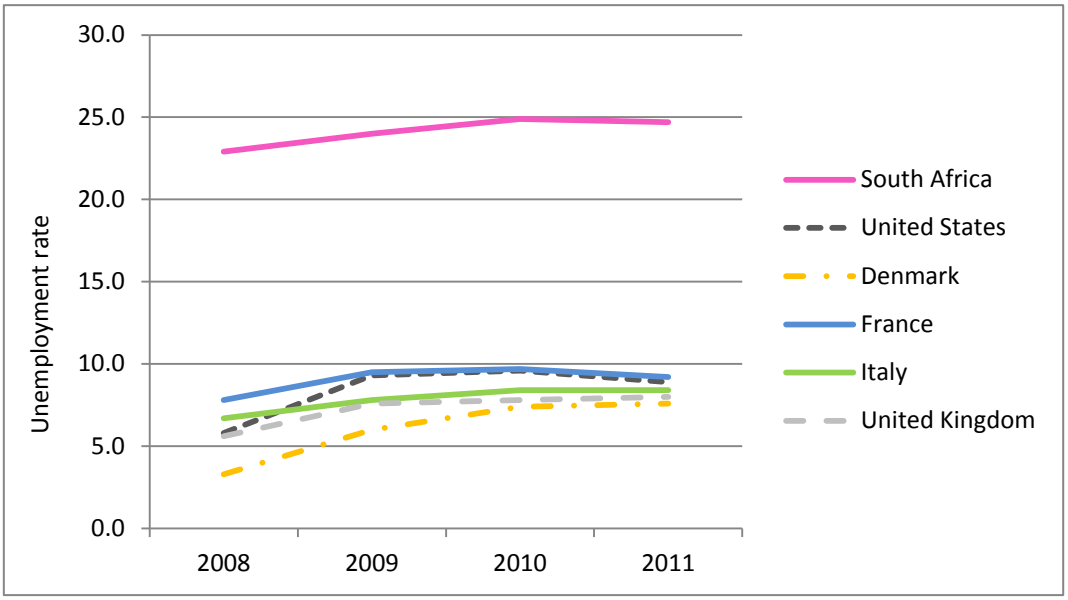

Figure 3.1 Annual unemployment rate in selected countries

Source: ILO 2012

Sub-Saharan Africa and South Asia are regions with harsh labour market conditions. Around four-fifths of the employed are classified as 'the working poor' in sub-Saharan Africa (ILO 2009). Although many of these people are actually employed, they do not necessarily earn a living wage.

According to the *Republic of South Africa* (2009) the specific goal to achieve Millennium Development Goal (MDG) 1 in South Africa, is to reduce the unemployment rate by at least half to a maximum of 14 per cent by 2014 (see Chapter 5 for more detail). The unemployment rate declined from 27.9 per cent in March 2004 to 23.5 per cent in March 2009 (Republic of South Africa 2009). In order to reach a target of 14 per cent unemployment by 2014, a decrease of unemployment by 1.9 per cent per annum would be required.

Table 3.1 emphasises the high unemployment rates found among those young adults between 15 and 24 years old. Unemployment rates among the 35 year olds and older were lower than those in the younger age categories. The table does not reflect the massive job losses South Africa has

witnessed due to the recent recession (Republic of South Africa 2009). The large number of unemployed youths is disturbing.

Table 3.1 Percentage unemployed people

Age group	2001	2002	2003	2004	2005	2006	2007	2008
15-24	53.4	55.9	55.3	51.8	51.4	50.2	46.9	46.6
25-34	34.4	34.1	30.9	29.8	30.3	28.5	25.7	26.2
35-44	19.8	21.0	18.7	18.2	18.2	18.2	14.7	16.6
45-54	13.9	16.1	13.5	11.9	13.0	12.4	11.5	9.3
55-65	10.6	10.0	8.9	7.2	8.3	6.9	6.7	6.5

Source: Republic of South Africa, 2009

South Africa has had persistent spatial gaps between regional employment levels for decades. In this case 'region' can refer to urban/rural divides, inter-provincial, intra-urban etc., as unemployment is not spatially equally distributed. Recent provincial unemployment statistics (Figure 3.2) prove the persistence of regional structures of unemployment (Arrufat et al. 1998; Martin 1998). For analysis, this chapter considers censuses since 1970 and Section 3.3 explores censuses from various years.

Figure 3.2 shows a steep increase in provincial unemployment rates between 1991 and 1996 (excluding Western Cape, Free State and Gauteng). This could be because of under-reporting in 1991, or over reporting in 1996, or a real increase in unemployment. Research done by Koller (2005) indicates that national unemployment increased from 15 per cent in 1991 to 25 per cent in 1996. The provincial trend in Figure 3.2 reflects this national picture.

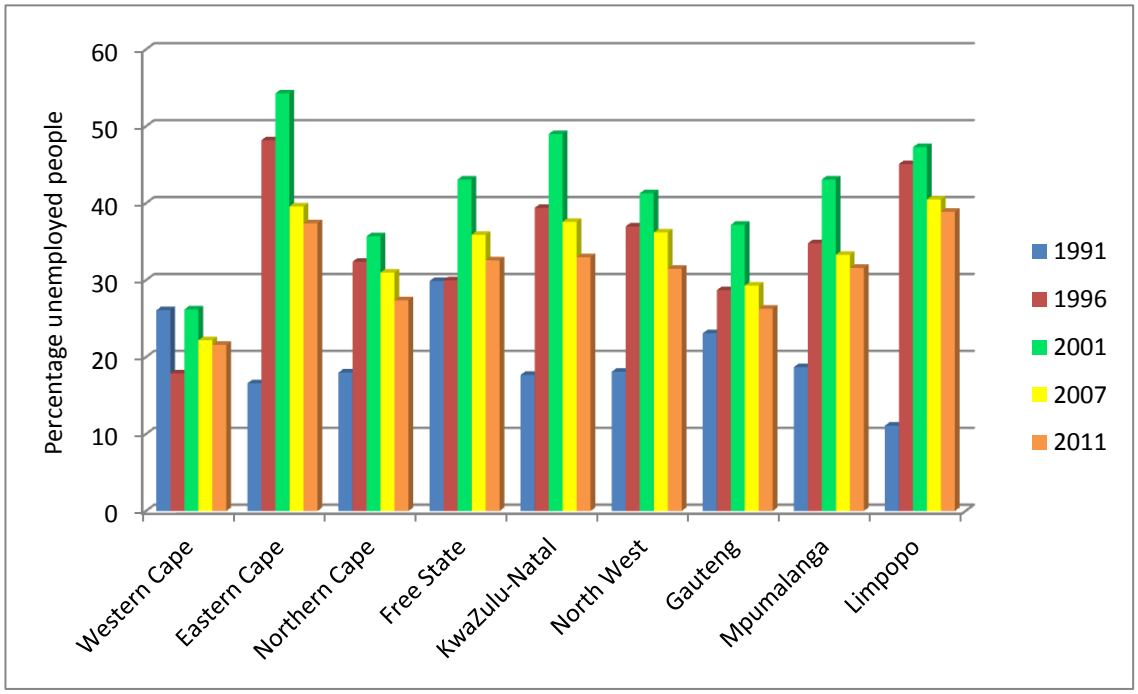

Figure 3.2 Official unemployment rates by province (2001 – 2011)

Sources: Stats SA 2007b, 2009, 2010b, 2011 and 2012b

Many provinces had an official unemployment rate of between 30 and 40 per cent in 2001, while only Western Cape had a rate of below 30 per cent. In 2007, the employment rate was

lower in all provinces, but there were still large differences between provinces. The highest unemployment rate was 40.5 per cent in Limpopo while Western Cape had a rate of 22.2 per cent. In 2011 Western Cape had the lowest unemployment rate of 21.6 per cent. All provinces showed a decrease in unemployment between 2007 and 2011.

To fulfil the MDG objective of increasing employment and eradicating poverty, data is needed to identify in what locations interventions, investment and upliftment are required. Therefore, more detailed spatial data is essential. According to Green, Gregg and Wadsworth (1998), geographical analysis of unemployment is only effective if conducted within regions (similar to provinces in South Africa) and not between regions.

The purpose of the chapter is to expound the neglected spatial aspects of unemployment to improve macro- and micro-economic planning, resource allocation and governance. Hence three objectives will be addressed:
(a) Providing an overview of the unemployment spatial data available in South Africa
(b) Assessing the usefulness of such unemployment data for geographical analysis
(c) Recommending data sources that could be used for spatial analysis.

The rest of this chapter comprises four sections. Section 2 considers the literature and explains the theoretical placement of this study in the discipline of Geography. The literature section also includes labour force terminology and definitions of unemployment. Section 3 considers the collection of labour force statistics internationally and in South Africa; while Section 4 pays attention to findings about census data, and focuses on spatial and attribute data. The conclusion and value of this contribution is addressed in Section 5.

3.2 Overview of literature

Labour statistics are essential for macro-economic and human resources development planning and policy formulation (Hussmanns 2010). When such statistics are analysed in conjunction with other economic and social phenomena, evaluating macro-economic policies is enhanced. Census data collection in Africa varies significantly between countries and also between years. Table 3.2 shows, for example, that South Africa conducted two censuses in the 1995 to 2004 period while Somalia last conducted a census in 1987. The majority of African countries did conduct a census in the post-2005 period.

Research by Kingdon and Knight (2003) supports the notion of spatial detail, by indicating that, although unemployment is measured at a macro-economic (national) level, it has a specific micro-level manifestation. Taking note of micro-level characteristics of unemployment, for example, education, gender, etc., is important for solving problems around macro-economic phenomena. Although in recent years many unemployment trends in South Africa have been identified, little research has compared their spatial patterns over time.

Table 3.2 Census data collection in African countries

Countries or areas	1990 round of censuses (1985-1994)	2000 round of censuses (1995-2004)	2010 round of censuses (2005-2014)
Algeria	20 March 1987	25 June 1998	16-30 April 2008
Angola			16-31 May 2014
Benin	15 February 1992	11 February 2002	11-25 May 2013
Botswana	21 August 1991	17-26 August 2001	9-18 August 2011
Burkina Faso	10-20 December 1985	10 December 1996	9-23 December 2006
Burundi	16-30 August 1990		16-31 August 2008
Cameroon	10 April 1987		11-30 November 2005
Cape Verde	23 June 1990	16-30 June 2000	16-30 June 2010
Central African Republic	8 December 1988	8 December 2003	
Chad	8 April 1993		20 May-20 June 2009
Comoros	15 September 1991	16-30 September 2003	(2014)
Congo	20 Nov.-5 Dec. 1994	6 Jun.-30 Jul. 1996	28 April 2007
Côte d'Ivoire	1 March 1988	21 Nov.-20 Dec. 1998	17 March 2014
Democratic Republic of the Congo			
Djibouti			29 May-12 Jun. 2009
Egypt	17-18 November 1986	19 November 1996	21 Nov. 2005-11 Dec. 2006
Equatorial Guinea	4 July 1994	February 2002	
Eritrea			
Ethiopia	11 October 1994		29 May-7 Jun. 2007
Gabon	1-31 July 1993	December 2003	22 May 2013
Gambia	15 April 1993	15 April 2003	8-28 April 2013
Ghana		26 March 2000	26 Sep.-10 Oct. 2010
Guinea		1-15 December 1996	1-21 March 2014
Guinea Bissau	1 December 1991		15-29 March 2009
Kenya	24 August 1989	24 August 1999	24-31 August 2009
Lesotho	12 April 1986	14 April 1996	13 Apr.-13 May 2006
Liberia			21 Mar.-30 Mar. 2008
Libya Arab Jamahiriya		11 August 1995	15 Apr.-7 May 2006
Madagascar	1 August 1993		
Malawi	1-21 September 1987	1-21 September 1998	8-28 June 2008

Countries or areas	1990 round of censuses (1985-1994)	2000 round of censuses (1995-2004)	2010 round of censuses (2005-2014)
Mali	1-30 April 1987	1-14 April 1998	1-14 April 2009
Mauritania	5-20 April 1988	1-15 November 2000	25 Mar.-8 Apr. 2013
Mauritius	1 July 1990	2 July 2000	1-14 July 2011
Morocco	2 September 1994	1-20 September 2004	1-20 September 2014
Mozambique		1-15 August 1997	1-15 August 2007
Namibia	21 October 1991	27-28 August 2001	28 Aug.-10 Sep. 2011
Niger	20 May-3 Jun. 1988	20 May 2001	10-24 December 2012
Nigeria	26 November 1991		21-27 March 2006
Réunion	15 March 1990	8 March 1999	1 January 2006
Rwanda	15 August 1991	16-30 August 2002	16-30 August 2012
Saint Helena	22 February 1987	8 March 1998	10 February 2008
Sao Tomé and Principé	4 August 1991	25 August 2001	13 May 2012
Senegal	27 May 1988	8-22 December 2002	19 Nov.-9 Dec. 2013
Seychelles	17 August 1987	29 August 1997	26-30 August 2010
Sierra Leone	15 December 1985	4 December 2004	
Somalia	15 February 1987		
South Africa	5 March 1985, 7 March 1991	10 October 1996, 10 October 2001	10 Oct.-7 Nov. 2011
South Sudan	15 April 1993		21 Apr.-5 Jun. 2008
Sudan	15 April 1993		21 Apr.-6 May 2008
Swaziland	25 August 1986	11-12 May 1997	28 Apr.-14 May 2007
Togo			6-19 November 2010
Tunisia	20 April 1994	28 April 2004	23 Apr.-15 May 2014
Uganda	12-19 January 1991	12 September 2002	27 Aug.-6 Sep. 2014
United Republic of Tanzania	28 August 1988	24-25 August 2002	26 August 2012
Western Sahara			
Zambia	20 August 1990	25 October 2000	16 Oct.-5 Nov. 2010
Zimbabwe	18 August 1992	17-27 August 2002	18-27 August 2012

Source: UN Stats 2015

In their research done, Elbers et al. (2007) estimated that governments wound save between 33 per cent and 59 per cent on expenditure by delivering poverty interventions at a geographically accurate location on a second tier administrative level. In the case of South Africa, this would be at municipality level. Having knowledge about the location of unemployment can assist government, NGOs and international donor agencies to target job creation interventions at the

correct place, municipality or suburb, to ensure that development funding gets spent in the neediest locations.

Longitudinal research that analyses unemployment at a sub-provincial level has not been undertaken in South Africa. Unemployment literature concerning South Africa has focused predominantly on analysis at the national level (Bhorat and Van der Westhuizen 2009; Kingdon 2003), and in some instances at a provincial level (e.g. LFSs Stats SA 2007c). Some scholarly writings (Wittenberg 2001, McCord and Bhorat 2003, Kingdon and Knights 2001) refer to spatial aspects that affect unemployment trends, but do not assign a clear geography to them.

Numerous representational challenges face research of this nature since the display of socio-economic data over time is difficult. Moreover, the geographical units, such as the boundaries of municipalities and enumeration areas (EAs), have changed and are therefore affected by modifiable areal unit problems (Openshaw 1984). Martin, Dorling and Mitchell (2002, p.82) comment that inconsistencies between censuses can vary from minor to major inconveniences. Major inconsistencies could be the radical change of areal boundaries that makes it impossible to compare statistics for the same local area over time.

3.2.1 THEORETICAL PLACEMENT OF THIS STUDY

A study of the geography of unemployment is rooted in the field of Economic Geography. The mathematical theorisation within this sub-discipline in recent decades has been influenced by the regional political economy approach (Sheppard 2000). The writings of classical economists like Ricardo and Marx as well as Keynes and Kalecki too have influenced this field. The approach of these authors focuses on the spatial dynamics of capitalism, analysis of urban and regional growth, investment strategies, capital flows, labour markets, specialisation and trade and the role of the state and other institutions (Sheppard 2000).

Economic Geography is based on four assumptions. First, that space is heterogeneous, because places differ – both in location and socio-economic characteristics. Second, that distance is a product of societal processes, and not only a metric measure. Third, that space is not separate from time because landscapes are continuously evolving (Sheppard 2000), and fourth, that Economic Geography seeks to understand the interdependence between place and individuals. Brakman et al. (2003) affirm that the decisions of economic agents are determined by Geography. Although all these assumptions underlie the thinking behind this study, the concept of interdependence between place and individuals takes precedence. In this case the ‘place’ would be the local area of spatial analysis, for example, the municipality or something similar, while ‘individuals’ would refer to the labour supply. From a geographical point of view, a study of this nature would embed the economic process of employment in the other societal processes too.

Mainstream Economics focuses on Mathematics, and since a mathematical approach sacrifices complexity for rigour, it is not used among geographers (Sheppard 2000). In contradiction to the stated assumptions of Economic Geography, economists treat space as a homogeneous entity. Similarly, economists see distance as external to the economy, while time is traditionally researched as equilibrium outcomes (Sheppard 2000). Economists also believe that economic processes can be separated from other societal processes. These assumptions result in different outcomes to the study of a topic in Economic Geography. This research entrenches unemployment firmly in a spatio-temporal framework designed from a geographical perspective.

3.2.2 TERMINOLOGY AND CONCEPTS RELATED TO LABOUR STATISTICS

There are different concepts and terms to describe labour statistics. This chapter focuses on the unemployment rate that is seen as an overall indicator of a nation's current performance in its economy (Green, Owen and Winnett 1994). The unemployed make up a considerable proportion of the South African labour market – currently 24.9 per cent (Stats SA 2012a). The scope for labour analysis centres on every person aged 15–65 who resides in a household for at least four nights a week and who has done so for the past four weeks, and any other person who stayed over the previous night as a visitor (Stats SA 2007c).

3.3 Methodology

This section will first consider the methods used for the collection and spatial representation of South African labour force statistics. The second part focuses on the collection procedures in a number of international countries, while the third part evaluates South African sources of spatial data on unemployment.

3.3.1 SOUTH AFRICAN LABOUR FORCE STATISTICS: COLLECTION AND ANALYSIS

Stats SA is the collecting agency of official statistics in South Africa. It collects labour market statistics through the LFS. In general Stats SA collects data through other sources too like the census, the CS, the General Household Survey (GHS) and the Income and Expenditure Survey (IES) (Table 3.3). The objective of the GHS is to determine the progress of development in the country, and it includes questions on education, health and social development, housing, household access to services and facilities, food security and agriculture. The IES collects details of all expenditure by a participating household, and all acquisitions of goods and services for the household's own consumption within a given reference period.

Table 3.3 Potential data sources of official unemployment statistics

Data source	Last year of collection	Frequency of collection	Sample size	Spatial reporting domain
Census 1960	1960	5 – 10 years	Universe	None
Census 1970	1970	5 – 10 years	Universe	None
Census 1980	1980	5 – 10 years	Universe	None
Census 1985	1985	5 – 10 years	Universe	None
Census 1991	1991	5 – 10 years	Universe	EA level
Census 1996	1996	5 – 10 years	Universe	Small area layer
Census 2001	2001	5 – 10 years	Universe	Sub-place
Community Survey	2007	Once	33 000 households	Municipality
Labour Force Survey	2007	Twice a year	32 000 households	Province
Quarterly Labour Force Survey	2009	Quarterly	32 000 households	Province
General Household Survey	2008	Annually	31 346 households	Province
Living Conditions Survey	2008/09	To be established	Not known	Not known
Income and Expenditure Survey	2010	Every five years	24 000 households	Province

Source: Stats SA 2007a, 2007b, 2007c, 2008b and 2010b

The census is conducted every five years and, in the absence of a census in 2006, the CS was carried out in 2007. This was a first time undertaking and it aimed to provide demographic and socio-economic data to fill the gap created by not having a census in 2006 (Stats SA 2007a, p.1). The GHS is done every year, while the IES takes place every five years, the last being 2010/11. The LFS was undertaken twice a year until 2007, and thereafter has been done quarterly, thus renamed the Quarterly LFS (QLFS). The Living Conditions (LC) survey ran in 2008/09 for the first time, and the data had not yet been released at the time of writing this chapter.

According to the UN (2009) the census may not be the best source to obtain the more refined measures of the labour force, and this should be left to labour force and other household surveys. The major value of the census is, however, that it supplies statistics for small areas (for example EAs), and small population groups.

To understand unemployment in South Africa, it is important to use adequate data. According to the sample design, the LFS reports were used as unemployment figures were given at a provincial level, and metro and non-metro data was differentiated within each province. Census reports gave unemployment at a municipal level, 257 records for the 2005 boundaries. Census 1991 and 1996 reported unemployment at an enumeration area level, 34 047 and 94 256 records respectively. According to the UN (2009) the most important consideration in obtaining reliable information on economic activity in a population census is to accurately determine who is economically active and who is not. Statistics on the size and composition of the two groups are fundamental to formulating almost all economic and social policies, planning and research.

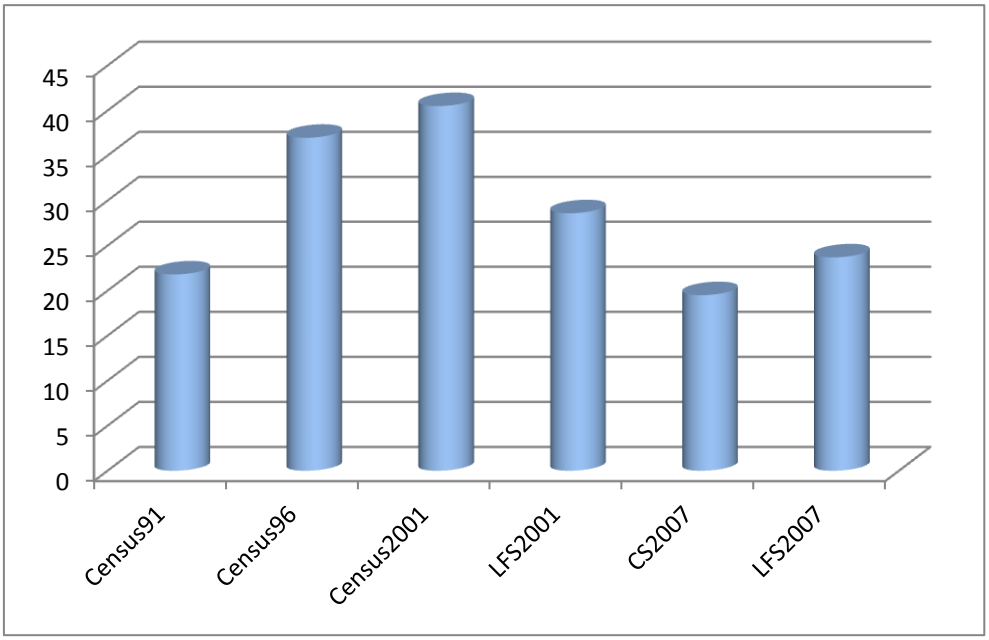

Figure 3.3 Unemployment rates from Census, LFS and CS data

Sources: HSRC 1991 and Stats SA 1996, 2001, 2007.

The 2001 census produced lower estimates of labour force participation than the September 2001 Labour Force Survey. This under-reporting occurred in the informal and subsistence agriculture sectors among those working only a few hours a week. LFS questionnaires included more prompts to clarify these issues, which is not possible during census enumeration. The UN and the ILO note that labour force surveys are expected to produce more reliable estimates of

labour market variables than censuses (Stats SA 2007c, UN 2009). The results from the LFS of September 2001 were therefore accepted as the official labour market statistics at the time of census 2001. Figure 3.3 shows the difference in unemployment rates from various data sources. While the LFS rate was much lower than the census one on 2001 it was slightly higher in 2007.

A national economy reflects regional and sub-regional economies (Green, Owen and Winnett 1994 p.144). The national economy would obscure changes in the regional economies. It is important to get spatially detailed unemployment data to secure a comprehensive picture of trends in the local labour market. The following section evaluates South African census data as a source of spatially detailed unemployment statistics.

3.3.2 INTERNATIONAL COLLECTION OF LABOUR FORCE STATISTICS

The literature confirms that combined methods are used worldwide to report on unemployment. These include LFS, administrative records, official estimates and adjusted LFS (ILO 2012). In instances where unemployment is analysed spatially, this originates from detailed data such as census or administrative records.

In the UK, Green (1998) analysed unemployment spatially by county level, travel to work areas (TTWAs), census wards and local labour markets. Various sources collected such data, being claimant count data from the Department of Employment Gazette, LFS, and the Census of Population which is conducted every ten years and the General Household Survey. The geographical levels that record unemployment in the UK are: census wards (10 000), local authority districts (459), travel to work areas (280), counties (62) and regions (10) (Green, Gregg and Wadsworth 1998).

Schanne et al. (2008) analysed German unemployment data from the German Federal Employment Agency. The data covered the monthly unemployment register and analysed it for labour market districts. There were 178 such districts. French unemployment data was analysed by Sari (2010) based on the population census data of 1991. Towns were the spatial level of analysis. The data was enriched by using neighbourhood census demographics.

In Denmark population registers, unemployment insurance records, labour exchange records, records of employers and records of taxpayers capture employment statistics (Illeris 1985). The data was analysed at regional level and focused on urban and peripheral contrasts. Research in Italy used LFS data, which provided estimates of unemployment at national and provincial levels. Since 1996, the LFS also provided estimates for 686 aggregated municipalities (referred to as Local Labour Market Areas) and these municipal boundaries change at every census. The LFS includes about 70 000 households and 1 350 municipalities in the sample. The last census was conducted in 2001 (Alò et al. 2007).

To determine which unemployment data set to use for a spatial understanding of unemployment in South Africa, the attributes were compared and consideration was given to the completeness of the spatial data, as well as the geographic scale of presentation. The results are discussed in the next section.

3.4 Findings and discussion of the census and community survey data of South Africa

The first census of all population groups in South Africa took place in 1911. Later censuses that covered all population groups took place in 1921, 1936, 1951, 1960, 1970, 1980, 1985, 1991 and 2001. In 1918, 1926, 1931 and 1941 additional censuses counted only Europeans (Khalfani et al. 2005). Labour market dynamics is a fluctuating phenomenon. This is especially the case in the post-apartheid era, so only censuses since 1970 are considered in this study.

This section will evaluate the methods, definitions and changes over time of census data since it is necessary to take note of changes in methodology in capturing population data (Martin and Gascoigne, 1994). South African census data is the data set that represents employment statistics at the most detailed spatial level. Initially data capture for censuses was at enumeration area (EA) level - the smallest spatial units used during the census process. EAs typically contain between 100 and 250 households (Stats SA 2004). EAs should be of approximately equal population size to enable an enumerator to cover each one within the census period (Stats SA 2007c). An EA is therefore an operational unit and not a functional unit.

3.4.1 SPATIAL DATA

South African census data is collected every five to ten years. The 1970 census covered all areas of the country, while the 1980 census was the first census that aimed to count all population groups through a uniform data collection methodology (Stats SA 2007c). Transkei, Bophuthatswana, Venda and Ciskei each conducted a census on the same day as the then Republic of South Africa, but large undercounts were revealed later in the Transkei data (Stats SA 2007c). The 1985 census covered the so-called white areas of South Africa, i.e. the areas in the former four provinces of the Cape Province, the Orange Free State, Transvaal and Natal. It also covered the so-called national states of KwaZulu-Natal, Kangwane, Gazankulu, Lebowa, Qwaqwa and Kwandebele. The 1985 South African census excluded the areas of the Transkei, Bophuthatswana, Ciskei and Venda (Stats SA 2000).

Prior to 1991 the spatial data (EA and census district boundaries) were represented on hard copy maps only and no digital spatial data was captured. This makes electronic spatial comparison over time very difficult. Subsequently, the electronic spatial data was captured for the censuses of 1991, 1996 and 2001 and only these will be compared here.

Table 3.4 Number of enumeration areas (EAs) per province (using 2005 municipal boundaries)

Province	1991	1996	2001
Eastern Cape*	2612	18863	17820
Free State	2487	5845	5183
Gauteng	7550	15962	13177
KwaZulu-Natal*	6423	15967	13300
Limpopo*	2352	11422	9750
Mpumalanga*	2603	7729	6377
North West*	1758	7206	5780
Northern Cape*	1268	2104	1964
Western Cape	5003	7162	7092
Total	34 047	94 256	82 444

*Including cross-border EAs

Source: Own calculations

The primary spatial unit in a census is the EA which is the area demarcated where one enumerator has to distribute and collect census forms. This spatial unit takes into consideration the changes in neighbourhoods, political boundaries, urban development, etc. It is therefore possible that the spatial extent of EAs can vary quite significantly between consecutive censuses. Table 3.4 shows how the number of EAs has increased since 1991 and also the vast differences in the number of EAs per province.

Besides these enumeration changes, South Africa had a major political change in 1994, and most statutory boundaries at the time were affected. The provincial boundaries of South Africa also changed in 2003, 2005 and again in 2009. These changes affected the EA boundaries. The percentage change between EA boundaries was difficult to assess, and since no official record keeping was done by Stats SA about changes, a visual comparison yielded the following result for the three mentioned censuses.

In the 1991 and 1996 censuses, EA demarcation fitted in with magisterial districts. Magisterial districts refer to the subdivision of provinces created to serve the justice system through a network of magisterial offices as proclaimed by the South African Department of Justice (Stats SA 2004). In 2001 municipal boundaries were rather used as a basis for demarcation.

The CS 2007 released data at a municipality level only and therefore spatial analysis could not be conducted at a lower spatial level. In order to compare the spatial units of 1991, 1996 and 2001 census as well as CS 2007 over time, the 2005 municipal and provincial boundaries were used as standardised boundaries. Besides the fact that 2005 boundaries were the standard at the time this research was started, the CS 2007 results were released at this level, and Stats SA also re-calculated results from Census 2001 to fit them. The use of a common boundary allowed for the comparison of spatial and non-spatial trends.

The spatial differences between 1996 and 2001 censuses included the expansion of suburban neighbourhoods and townships alike (Figure 3.4). This figure shows the differences in EA boundaries for different census years in north Gauteng. In 1991 EAs were very large and few in number. By 2001 EAs were smaller and the number of them increased. Detailed spatial data at an EA level was available in 1996. Although the spatial boundaries for EAs were updated during the 2001 census, Stats SA decided not to release attribute data at an EA level to preserve confidentiality.

In Western Cape, between 1991 and 1996, a number of townships were subdivided into smaller blocks e.g. Cross Roads, Nyanga and Langa. In the 1991 census EAs in the former Ciskei and Transkei (Eastern Cape) were very large. There were twelve EAs in the Ciskei and 29 in the Transkei. Between 1996 and 2001 large rural EAs were subdivided and township expansions were demarcated, e.g. Motherwell, KwaNobuhle and Mthatha.

The main spatial difference in Gauteng between the 1991 and 1996 census was that townships were not demarcated in detail in 1991. Traditionally townships are characterised by high density population concentrations with some informal settlements in-between. Due to political unrest at the time of the census, townships were demarcated as one spatial entity, and the census data was provided for the entire entity. Therefore, no census data was provided for smaller spatial units within the townships.

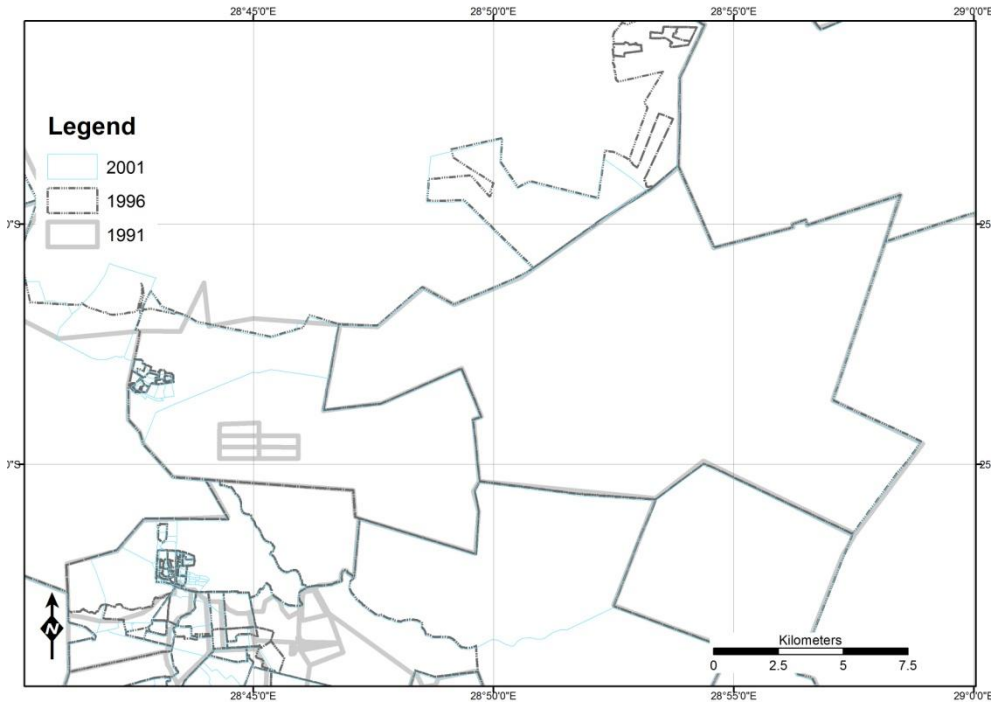

Figure 3.4 Comparison of Enumeration Area boundaries from different years

Sources: HSRC 1991 and 1996; Stats SA 2001

The rural areas of previous self-governing territories (like GaRankuwa and KwaNdebele) were not officially part of the 1991 census, but were included through a sweep enumeration (Stats SA 2007c). This was then merged with the EA census data to obtain a complete picture for the province. The total number of EAs in Gauteng was 7 550 in 1991, 15 962 in 1996 and 13 177 in 2001. Urban densification occurred in most urban places in the country.

3.4.2 ATTRIBUTE DATA

Besides the requirement of more spatial detail, Green, Gregg and Wadsworth (1998) mention that controlling for education does not explain much of the variation in unemployment at a regional (provincial) level. It is therefore not only spatially detailed data that is needed, but also a range of socio-economic variables. Variation in unemployment was much better explained by the percentage of rental housing, the proportion of lower socio-economic groups and the percentage of workforce with higher qualifications (Green et al. 1998). Similar research has not been conducted in South Africa yet and, to assist national, provincial and local programmes targeting the reduction of unemployment, such information would be vitally necessary. Since national economic fluctuations are not felt to the same degree, and at the same time in all parts of the country, spatial patterns of unemployment would start to reveal such trends.

In 1970 employment status was directly recorded during the census while in 1980 and 1985 it had to be calculated by a user counting those people who did not have an employer at that time. The majority of variables from these three censuses overlap with later censuses (Table 3.5). The only major difference is the collection of data on dwelling type and tenure status that was not covered in 1985.

Table 3.5 Attribute data by census and community survey year

Variable/ Year	1970*	1980*	1985*	1991*	1996*	2001*	2007
Province name	✔	✔		✔	✔	✔	✔
Province code	✔	✔		✔	✔	✔	✔
Municipality name						✔	✔
Municipality code						✔	✔
Magisterial district				✔	✔		
Magisterial district code				✔	✔		
Census district			✔				
EA number	✔		✔	✔	✔	✔	✔
Economic region	✔						
Metropolitan area	✔						
Age groups by 1 year intervals	✔	✔	✔	✔	✔	✔	✔
Age groups by 6 year intervals				✔			
Age groups by 4 year intervals				✔	✔	✔	✔
Race	✔	✔	✔	✔	✔	✔	✔
Gender	✔		✔	✔	✔	✔	✔
Employment status	✔	✔	✔	✔	✔	✔	✔
Industry of employment	✔		✔	✔	✔	✔	✔
Occupation	✔		✔	✔	✔	✔	✔
Employee (grouped)			✔				
Education by individual grade and post-secondary	✔	✔	✔	✔	✔	✔	✔
Education by grouped type				✔		✔	✔
Personal income by group	✔	✔		✔	✔	✔	✔
Marital status	✔	✔	✔	✔	✔	✔	✔
Home language	✔	✔	✔		✔	✔	
Religion	✔	✔	✔	✔	✔	✔	
Dwelling type	✔	✔		✔		✔	✔
Urban/rural classification	✔		✔		✔	✔	
Tenure status	✔	✔		✔	✔	✔	✔
Migration	✔	✔	✔	✔	✔	✔	✔
Nationality	✔	✔	✔	✔	✔	✔	

* Census years

Sources: Stats SA 2007c and own calculations

In the 1991 census, unemployment statistics were not directly calculated at EA level. To generate these statistics, the number of employed people was subtracted from the economically active population. In the 1996 census the number of unemployed, employed and economically active people per small area layer (SAL) was provided by Stats SA. The data was re-aggregated by the HSRC, and could then be compared with EA data from other years. The EA data was benchmark weighted to the 2001 sub-places, and the level of accuracy is therefore reflected at

the SAL level. Census 1996 reported an overall undercount of 10.7 per cent (Stats SA 1998 p.2).

The 2001 census attribute data was not released at an EA level. Consequently this made comparisons with the previous two censuses very difficult. However, the spatial boundaries for the EAs were made available, and statistical modelling techniques were used by the HSRC to compute unemployment statistics for these boundaries. Attribute data was released at a sub-place level and the analysis therefore depended on a certain measure of areal interpolation (Gregory 2008), and is the most optimised way of standardising the unit of analysis. CS 2007 released statistics only at a municipality level. The various attributes released during each census and the CS are given in Table 3.5.

Although variables may occur in more than one year, the format or meaning may change from year to year. For example, the EA number changed from four digits in 1991 to eight digits in 2001. Data on employment status was collected during all periods. Although the percentage of unemployed people is not always presented in the data it can be calculated by subtracting the employed from the economically active population. Such a calculation will standardise the presentation of unemployment statistics and make comparison over time easier.

Definitions

The definition of some variables changed between 1996 and 2001, in particular that of disability, urban (and non-urban or rural) and institution. In 1991 ‘urban’ referred to an area with a form of local government. ‘Non-urban’ referred to all areas which were neither urban nor semi-urban, and did not have any form of local government (Stats SA 2004). CS 2007 did not provide any explicit explanation of changes in definition.

Methodologies

Due to the inaccessible nature of certain residential areas, and political and financial problems, the Central Statistical Services decided to use aerial photographs to estimate the population for 83 urban areas and magisterial districts during the 1991 census. Census 1996 was the first census in the post-1994 democracy era that covered the entire country and where all residents were treated equally (Stats SA 2007c p.20). The same methods were used for everyone. Respondents were given a choice of assistance or self-completion of the census questionnaire. The majority of people chose to be interviewed.

The utilisation of computer technology in processing data has changed over the years. In 1960 and 1970 the census results were processed manually. In 1980 a total of 1 000 part-time coders were used to capture the results electronically through optical character recognition. The results had to be transcribed to specially designed, computer-readable forms prior to capturing. In 1985 and 1991 the data was captured and editing was done on dump terminals to produce the census results. For the 1980, 1985 and 1991 censuses post-capture processing was done on mainframes (Stats SA 2007c, p.20). Technology improvement, in the period 1960 to 1985 resulted in a decrease in time required for data processing. In 1960 the results were released nearly 11 years after the collection of data. In 1970 and 1980 eight and five years respectively were required. In 1985 the final results were available in just over one and a half years. The 2001 census results were released in 2003 and similarly the 2011 results were released in 2013.

The CS covered 274 348 dwelling units across all the provinces. Fieldworkers visited the sampled dwelling units and administered the questionnaire. The questionnaires were processed using scanning technology to capture the data. The survey attained a response rate of 93.9 per cent. The adjustment of non-response was based on the classification of dwelling units/households based on the enumeration status.

The changing spatial boundaries

During the 2001 census, Stats SA developed the geography area hierarchical model which classifies geographical areas into a hierarchy from the smallest to the largest unit. Figure 3.5 shows the different levels of the model. The enumeration area is the basic building block of this hierarchy and each EA has a unique eight-digit identifier. This ID code is used to link the enumeration area to the higher-order geographic units such as place names, municipalities, district councils and provinces. The code therefore enables the data related to the enumeration areas to be aggregated and represented at any of the administrative boundaries (Stats SA 2007c).

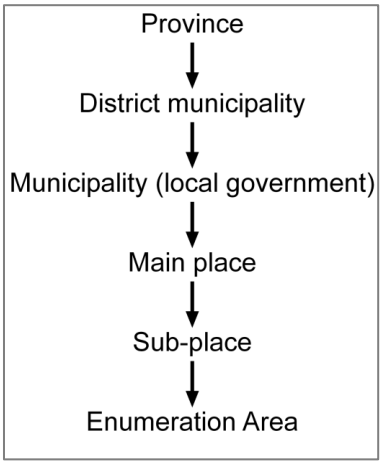

Figure 3.5 Geographical hierarchy of spatial entities in 2001

Source: Stats SA 2004

The most easily recognisable small area geographic entity is a place name that signifies a particular community, village or suburb. Place names were first coded in census 1996. In census 2001 a more complex hierarchy of two place name levels (the main-place name and the sub-place name) was developed. In order to distinguish different settlement types, enumeration areas within the same main-place were merged to create a sub-place. A main-place is the equivalent of a small city, a suburb with subdivisions in a large city or a tribal area in communal or trust land areas. A sub-place is equivalent to a split suburb or merged suburb in urban formal areas, a locality in the informal areas and a village in the traditional areas (Stats SA 2007c). A small area layer is between EA and sub-place and consists of merged EAs. Municipalities include local municipalities, district councils and district management areas. The local municipalities and district management areas make up larger district councils. District management areas were created where the requirements of a local municipality were not met, such as deserts, semi-arid areas, state-protected and conservation areas and special economic areas (Stats SA 2007c).

Metropolitan areas are conurbations featuring high population density, intense movement of people, goods and services, extensive development and multiple districts and industrial areas. Other features of a metropolitan area include a complex and diverse economy, a single area where integrated development is desirable and strong interdependent social and economic linkages among its constituent units (Stats SA 2007c). In census 2001 there were six metropolitan areas, namely City of Cape Town, City of Johannesburg, City of Tshwane (Pretoria), Ekurhuleni (East Rand), eThekwini (Durban) and Nelson Mandela Bay (Port Elizabeth).

Provincial boundaries were obtained from the South African Department of Land Affairs. Between 1996 and 2005 several local municipalities stretched across provincial boundaries. Such cross-boundary local municipalities, district councils, district management areas and

metropolitan areas have to be taken into account when aggregations are calculated from EA data. Despite the hierarchy of 2001, it is still difficult to compare census data at a small area level over time. Due to this problem of incomparable spatial boundaries, the suggested solution is to aggregate the unemployment statistics to a common boundary as the most uncomplicated way to overcome the modifiable areal unit problem (MAUP). The 2005 municipal boundaries could serve as the common denominator for such an aggregation.

The censuses of 1991, 1996 and 2001, and the CS 2007 are compared in Table 3.6 overleaf as the spatially complete unemployment data sources. The evaluation of the data sets was based on their value as a spatial data source. Although the census 1991 and 1996 data is available at an EA and small area level, using it was problematic because of a lack of attribute data. Since the data was created by third parties a long time ago, it was difficult to ascertain what the reasons were for the status. Therefore this data would only be used for analysis once some estimation had been done for missing values. The next best spatial level to access data for 1991 and 1996 is at magisterial district level which could be aggregated to recent municipal boundaries.

The 2001 census and the CS 2007 had unemployment data for the whole country at a municipality level. Although this data is spatially and attributably comprehensive, it cannot be analysed at a sub-municipal level as detail will be lost in the interpretation of the data. For example, in a metropolitan area there might be affluent and poor suburbs where unemployment occurs differently. Analysing this data at a spatial level of municipalities will mask these differences. In contrast to this, the LFS 2001 and 2007 produces unemployment data that can only be spatially analysed at a provincial level and within that province at a metropolitan level.

Stats SA admit that the following factors complicate the work of researchers and academics who wish to do comparative studies using data collected in South African censuses (Stats SA 2007c):
(a) the continuous and comprehensive changing of administrative boundaries
(b) the revision of the set of enumeration areas that was used in census 1996
(c) the decision not to release the census 2001 data at enumeration area level.

Coombes (1995) points out that an enumeration area definition is unique to a particular census. This has severe disadvantages for the study of change and complex issues such as unemployment, poverty and other socio-economic conditions that require the merging of census data with other data sets. The EA boundaries are bound to change again with the 2011 census and researchers will again have to recalculate socio-economic data to fit the new entities. The use of dasymetric mapping could be a possible solution to overcome the challenge of dated data like the census, which takes place every five or ten years. Socio-economic data sets or land cover data at sub-municipal level could possibly be used to create such dasymetric maps.

Table 3.6 Assessing the value of spatial data sets of unemployment

Dataset	Scale of geographic presentation	Unemployment attributes collected	Spatial completeness of data	Spatial usefulness of data	Limitations of data
Census 1991	EA	No. of employed people	3.8% of EAs has insufficient unemployment data (mostly uninhabited space)	Useful for modelling purposes	Should not be used for EA analysis unless estimation done for missing attributes
Census 1991	Magisterial district	No. of employed people, unemployment rate	Spatially covers the whole of South Africa	Useful for spatial analysis at magisterial district level	Has to be interpolated to recent administrative boundaries
Census 1996	Small area layer	No. of unemployed people	26.8% of EAs with insufficient unemployment data	Useful for modelling purposes	Should not be used for EA analysis unless estimation done for missing attributes
Census 1996	Magisterial district	Unemployment rate	Spatially covers the whole of South Africa	Useful for spatial analysis at magisterial district level	Has to be interpolated to recent administrative boundaries
Census 2001	Municipalities 2005	No. of unemployed people	Spatially covers the whole of South Africa	Useful for spatial analysis at municipal level	Cannot be analysed at sub-municipal areas
LFS Sept 2001	Provinces and metropolitan areas 2001	No. of unemployed people	Stratified sample which is spatially representative at provincial level	Useful for analysis for provinces and metros	Can only be analysed at provincial and metropolitan levels
CS 2007	Municipalities 2005	No. of unemployed people	Spatially covers the whole of South Africa	Useful for spatial analysis at magisterial district level	Cannot be analysed at sub-municipal areas
LFS Sept 2007	Provinces and metropolitan areas 2005	No of unemployed people	Stratified sample which is spatially representative at provincial level	Useful for analysis for provinces and metros	Can only be analysed at provincial and metropolitan levels

Source: Own calculations

3.5 Conclusion

The first objective of this chapter was to provide an overview of South African unemployment spatial data sets. Census data and labour force surveys data were found to be the predominant sources of unemployment data. The LFS data can only be analysed for provinces and their metropolitan areas. Census data provides the most geographic detailed data on South African unemployment at either an EA or a municipal level. It is said the census data is not as accurate as the LFS in measuring unemployment as it does not enquire reasons for unemployment. However, from a spatial perspective the census data is extremely useful, because it covers the universe, and not a sample, at a detailed spatial level. Although the unemployment rate seems inflated from census data this error will be consistent over several different censuses.

The second objective of this chapter was to assess the value of unemployment data for the geographical analysis of unemployment. The research recommends that census data since 1991 be used. The census data can be enriched with LFS data between 2001 and 2007 or QLFS after 2007. EA data from census 1996 has large gaps and it is safer to use data at magisterial district level (Table 3.6). Census 1970 covered all areas in the country, but Census 1985 did not. The 1980 census has good migration data (Stats SA 2007c). Since the 1991 census and subsequent ones reflect recent and post-apartheid trends in the labour market, it is recommended that they be used as data sources to obtain long-term spatial trends of unemployment in the country.

The third objective was to recommend data sets that should be used for the spatial analysis of unemployment. Existing unemployment literature for South Africa does not assign a clear geography to unemployment trends, but the more detailed the spatial data the more effective the intervention (Elbers et al. 2007). To build a spatial understanding of unemployment over time it is therefore important to focus on data at a sub-provincial level. The unemployment data sets investigated in this chapter showed that researchers should use census data that has been interpolated to a common administrative boundary to conduct a longitudinal spatial analysis of unemployment in South Africa. The LFS and the later QLFS data sets are not compatible in their definitions so it is recommended that they should be used independently.

The content of this chapter has contributed to an understanding of the spatial data on unemployment in South Africa. This research can be seen as innovative when considering the issues related to spatial data on unemployment in South Africa since no published research could be found on the topic. It has laid a foundation and provided a basic understanding of the issue on which further research can be conducted, particularly regarding the spatial trends of unemployment over a long period, ways to overcome the challenge of modifiable areal unit problems over time and the relationship between unemployment and poverty.

Future research could focus on what the independent socio-economic factors are that determine unemployment over the years at a municipal level in South Africa; the type of modelling that could be used to predict the spatial manifestation of future unemployment; and to forecast the municipalities that could have a high unemployment situation in the future. The applicability of existing international spatial unemployment models to South African context could also be assessed. A thorough investigation of dasymetric mapping as a possible solution to overcoming the challenge of dated census data would be valuable.

Spatial statistics about the labour market are essential for the design and evaluation of government programmes geared towards employment creation, vocational training, income maintenance, poverty reduction and similar objectives. A spatial focus can provide detailed input and direction to policy making and intervention decisions. These spatial data sets on unemployment can therefore be used to evaluate the impact of existing job creation initiatives

like community works programmes (CWPs) or future initiatives on skills development and employment creation. It is also recommended that Stats SA should release unemployment statistics at small area levels like enumeration areas or sub-places to enable researchers to analyse and interpret results in a detailed fashion.

3.6 Acknowledgements

The author would like to thank Fethi Ahmed and colleagues for useful inputs made to this chapter.

Chapter 4 Changing boundaries: Overcoming modifiable areal unit problems related to unemployment data in South Africa

This chapter is based on:

Weir-Smith. G, *in preparation*. Changing boundaries: overcoming modifiable areal unit problems related to unemployment data in South Africa. *Transactions in GIS*.

Abstract
The longitudinal comparison of census data in spatial format is often problematic because of changes in administrative boundaries. Such shifting boundaries are referred to as the modifiable areal unit problem (MAUP).This chapter utilises unemployment data between 1991 and 2007 in South Africa to illustrate the challenge and proposes ways to overcome it.

Various censuses in South Africa use different reporting geographies. Magisterial district data for census 1991 and 1996 was re-modelled to the 2005 municipal boundaries. This chapter shows that areal interpolation to a common administrative boundary can overcome these reporting obstacles.

The results show large increases in unemployment data between 1996 and 2001 statistics, especially in the metropolitan areas. Although such areas are more complex in nature, and therefore more difficult to calculate accurately, the increase could also be due to census taking methods. Furthermore, the results also showed that aggregation methods are more prone to errors in areas with small populations.

The chapter concludes that socio-economic data should be available at the smallest possible geographic area to ensure more accurate results in interpolation. It also recommends that new output areas could be conceptualised to create a seamless database of census data from 1991 to 2007 in South Africa.

Keywords: modifiable areal unit problem, census research, unemployment, areal interpolation

4.1 Introduction

One of the main interests of census and population researchers is the study of socio-economic change (Martin, Dorling and Mitchell 2002). The study of change is especially important to answer questions at a local scale, for example, a suburb or municipality. However, such comparisons over time are difficult because census collection methods and definitions as well as reporting geographies change.

This chapter seeks to find a solution to the problem of shifting boundaries as exemplified in the case of unemployment trends over time in South Africa. The problem of shifting boundaries is referred to as the modifiable areal unit problem (MAUP). Currently there is no literature available on overcoming the MAUP in South Africa using socio-economic data. Although there are some attempts to build historical Geographic Information Systems (GIS) data sets, their methodologies are not yet documented in the literature.

To minimise the effects of the MAUP, administrative units should be as disaggregated as possible (Openshaw 1984). The MAUP, however, affects the results of spatial analyses based on aggregated statistics. The MAUP is composed of two problems: first, the scale problem, where different results can occur when one set of areal units is aggregated into a fewer number of larger units for analysis; and second, the aggregation problem, where different results can be obtained when boundaries of spatial entities are arranged in different ways (Openshaw 1984). In this chapter the MAUP specifically refers to the change in geographical units of analysis.

Given the challenge of enumeration area (EA) and magisterial district boundary changes in South Africa since 1991, this chapter seeks to find a methodological solution for overcoming modifiable areal unit problems in South African census data.

4.1.1 Challenges In Integrating Spatial And Temporal Data Over Time

The historical linking of data in Geographic Information Systems (GIS) faces two major problems. First, available commercial software is ill suited to temporal GIS. Second, and partly in consequence, historical GIS construction is very expensive, especially because of labour costs related to extensively solving challenges (Gregory and Southall 2003). These factors influence any longitudinal spatial analysis of socio-economic conditions in South Africa.

Further challenges in terms of integrating spatial data over time are the scale of administrative units for analysis and the linking of the attribute data from various years to the spatial data (Gregory, Marti-Henneberg and Tapiador 2008, Martin and Gascoigne 1994). Although these two aspects are related, they pose distinct ways of dealing with the problem. The remainder of this section will deal with these two issues separately using unemployment data to illustrate them.

The collation of spatially compatible data

Census data is the only data at a national level that includes all citizens and covers the full geographical extent of the country. Therefore this data will be accepted as the spatially most comprehensive data on unemployment in South Africa. There are, however, arguments that the census is not as accurate as the LFS and QLFS in measuring unemployment because it does not ask questions about the reasons for not being employed. Nevertheless it is important to use the census, which provides the most spatially detailed data in order to build a national understanding of an issue at a spatially disaggregated (sub-provincial) level.

Champion (1995) indicates that the study of change over time through reference to census data is fraught with difficulties because of operational changes made between censuses to improve

their relevance and reliability, and because of differences in the degree to which they achieved their aims. Martin (2000) found that, although aggregation to geographical areas is a near-universal feature of census information, it is fundamentally difficult to accommodate. Gregory and Ell (2006) confirm this by pointing out that data created by interpolation are estimates that will inevitably contain a certain degree of error. The accuracy of areal interpolation, moreover, will vary according to the nature of the variable being interpolated, the nature of the ancillary data and the shape and size of both the source and target units (Gregory and Ell 2006).

4.1.2 MEANS OF ADDRESSING THE MAUP

Spatial solutions

One of the ways to link different census geographies is through areal interpolation. Gregory, Marti-Henneberg and Tapiador (2008) use areal interpolation to create a temporal census database for Europe and used areal weighting specifically to achieve this. Areal weighting is based on the assumption that data are distributed homogeneously across each source unit. Count data for a variable *y* is interpolated from the source zones to the target zones using the formula:

$$\hat{y}_t = \sum [A_{st} / A_s \times y_s] \qquad (4.1)$$

where $\hat{y}_t$ is the estimated value for the target zone, y_s is value for the source zone, A_s is the area of the source zone, and A_{st} is the area of the zone of intersection between the source and target zones (Goodchild and Lam 1980). The assumption of a homogeneous population distribution is, however, unrealistic for most socio-economic applications. Although a number of studies have tried to render this mathematical model more flexible by introducing ancillary data to the model, no matter how good the technique, areal interpolation will inevitably contain some error whose impact will vary from polygon to polygon (Gregory, Marti-Henneberg and Tapiador 2008).

The nature of the data being interpolated also determines the accuracy of the results (Gregory 2002). Some attempts have been made to calculate the interpolation error, but most of these are limited because they show global goodness of fit and do not provide detail at the level of individual data values. In statistical terms "goodness of fit" refers to the confidence with which a model can be presented while "global" indicates the fit of that model at the general level. Martin (2003) found that poorer results are obtained as the scale of the output area is reduced and that more accurate interpolation is achieved in rural areas. Urban areas are complex and there seems to be no easy solution to the challenge. According to Goodchild, Anselin and Deichmann (1993) the choice of an interpolation strategy has a strong influence on model results, and thus on potentially far-reaching policy decisions. It is therefore important to use the correct methodology.

Charlton et al. (1995) offered three types of re-aggregation criteria to create new areal units from census data: first, areas that possess similar levels of heterogeneity for the specific variable of interest; second, areas that are of an approximately equal size and shape; and third, areas that provide an efficient partitioning of space and are of approximate similar nature.

Besides areal interpolation, small area grids and automated zoning can be used. These methods are briefly discussed and some examples given. Using the areal aggregation solution, Martin, Dorling and Mitchell (2002) used the centroids of 1991 Enumeration Districts (ED) in England, Wales and Scotland to aggregate to the 1981 wards. The same was done for the 1971 ED data, whereafter they were aggregated to higher geographies. A controlled public access system was created, which delivers a number of user defined outputs.

Fisher and Langford (1995) used root mean square (RMS) error to quantify the error introduced in their simulations. This was based on the average differences between the estimated values of the variable and its known actual values.

Another solution to represent data from small areas in a re-aggregated format is the use of grids. Duke-Williams and Rees (1998) indicated that small area grids should be more than 1 km (5 km is desired). On the other hand, small grids have the risk of containing below-threshold numbers of people thereby compromising anonymity. Duke-Williams and Rees (1998) concluded that a greater understanding of the uses to which grid-based geographies are put is required in order to assess whether such grids would prove useful.

According to Openshaw (1984) the most appropriate response to the MAUP is to design purpose-specific zonal systems. Noble, Dibben and Wright (2010) used such methods and aggregated data from the household level to small areas (data zones) using the CS 2007 data in South Africa. They used multi-level modelling to calculate a 'best linear unbiased estimator' of multiple deprivation for each data zone in the country. The data zones were calculated based on a data zone code provided to South Africa (Stats SA) and multi-level modelling was used for attribute data. One of the variables Noble, Dibben and Wright produced was unemployment.

Continual boundary revision of census areas in order to retain a degree of equality of population sizes renders the separation of population change from boundary change particularly difficult (Geddes and Flowerdew 2000). It would therefore become difficult to detect real population change, because such change would always be associated with a change in boundaries.

4.2 The effect of census change in South Africa

EAs are essentially used to make the work of the census enumerator manageable, so these boundaries change between censuses. Table 3.3 shows the fluctuation in EA numbers between the last three censuses. From this illustration it is clear that the number of EAs has increased significantly to accommodate changes in population growth, urbanisation and so forth. Most provinces had a moderate decline in the number of EAs between 1996 and 2001. The total number of EAs in the 2011 census increased to around 104 000 (Stats SA 2012).

Figure 4.1 illustrates the differences between the spatial units in the various censuses. In 1991 census data was gathered at an EA level and disseminated at a magisterial district level. In 1996 the situation was much the same except that data was released at an EA level as well. In 2001 Stats SA created the first official census geography with a number of spatial levels; and although the data was collected at an EA level, the information was only released at a sub-place level.

In order to obtain a trustworthy understanding of spatial changes in unemployment patterns over a given time span, we need data from four different periods. Data from only three periods might possibly not show a trustworthy trend in unemployment. The most recent censuses in South Africa were conducted in 2011, 2001, 1996, 1991, 1985, 1980 and 1970.

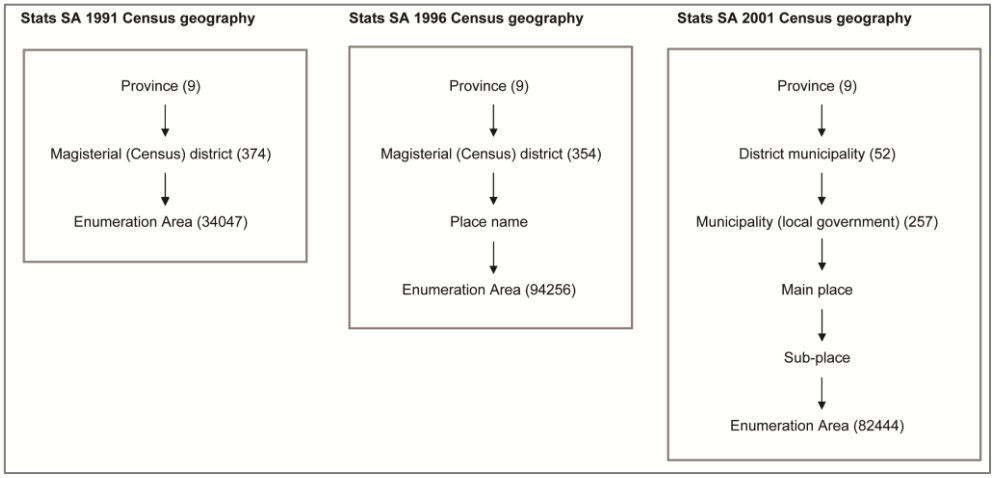

Figure 4.1 Spatial hierarchy of various censuses

Source: Own analysis

The censuses of 1985 and 1980 did not include all South Africans and were therefore problematic for this research. Although the census of 1970 included South Africans of all race groups, labour patterns have changed significantly since then and would not be relevant to current, post-apartheid South Africa. Therefore another data source was considered, the CS 2007, which was a large sample survey that presented results at the level of the local municipal boundaries of 2005 (Stats SA 2008a).

4.2.1 TEMPORAL SOLUTIONS

Stats SA produces all the official data sets for South Africa. These include censuses, LFSs and CSs, among others. Censuses take place every five to ten years and cover the total population, while the QLFS takes place quarterly and relies on a national sample of about 30 000 households (Stats SA 2011). In the absence of a census in 2006, the CS was conducted in 2007. The QLFS reports unemployment figures at a provincial level and distinguishes between metropolitan and non-metropolitan areas within a province, while censuses report unemployment data at an EA, magisterial district or municipality level. The CS also reports data at the municipal level.

Stats SA has admitted that the following factors complicate the use of comparative studies that rely on data collected in South African censuses (Stats SA 2007b). First, the continuous and complete changing of administrative boundaries; second, the revision of the set of EAs that was used in Census 1996; and third, the decision not to release the Census 2001 data at EA level. The fact that spatial units from the various censuses and surveys are not the same at different periods creates problems for researchers attempting to establish a seamless, temporal database for analysis of unemployment.

4.3 Methodology

The challenge of analysing unemployment spatially over time is the incompatibility of various spatial units of data representation. Ideally areal interpolation should be done at the spatially most detailed level, in the case of South Africa, this would be EAs. Since the EA is the smallest geographical unit, it should make aggregation to higher-level geographical units easy and achievable. However, the difficulty in matching attribute and spatial data (1996 census) and the lack of attribute data (1991 census) make this difficult to attain.

For the present study, the linking of different census geographies was achieved through using areal interpolation to transfer data from one set of boundaries to another. The 2005 municipality boundaries were used as the common denominator – part of a spatial hierarchy developed by Stats SA for the 2001 census. This hierarchy starts with the EA as the lowest building block, then sub-place, main-place, local municipality and province (see Figure 4.1). The municipal boundaries for 2005 were chosen as the preferred target area, because they represent a recent administrative division useful for displaying temporal change and they are easily linked to the 2001 and 2007 data.

4.3.1 DATA SOURCES

Census data constitutes the only data source at a national level that aims to include all citizens and all geographical areas. It was therefore accepted that the census was the most comprehensive spatial data set on unemployment in the country. Census and CS data were obtained from Stats SA and the HSRC.

In the 1991 census data, unemployment statistics were not directly calculated; these figures were generated by subtracting the number of employed people from the economically active population. The estimated undercount in 1991 was an average of 12.7 per cent across all race groups (Stats SA n.d.). Stats SA provided the number of unemployed people per magisterial district in the 1996 census. The statistics for these two censuses were therefore in comparable formats. The estimated undercount in 1996 was 10.7 per cent (Stats SA 1998).

The 2001 census attribute data were not released at an EA level for reasons of confidentiality (Stats SA 2007b) but were made available at a sub-place level and could therefore be aggregated to a municipality level. The estimated undercount for people in the 2001 census was 17.6 per cent (Stats SA 2003a). CS 2007 released data on the number of unemployed people as well as the economically active population at a municipality level. The level of analysis was therefore standardised to municipalities and depended on a certain measure of areal interpolation - according to Gregory, Marti-Henneberg and Tapiador (2008) the most optimal way of standardising the unit of analysis.

It was decided to use the CS 2007 rather than the 1970 Census because the CS is closer in time to the other censuses used. Although the CS 2007 was a survey, the sample size of 949 105 persons was large enough to enable reporting of the findings at a municipal level.

The correction of the undercount in census 1996 and 2001 was undertaken during the post-enumeration survey. After the 1991 census an adjustment was made for the undercount and the corrected statistics were released. In the CS 2007 the estimation process was based on the ratio method of projecting geographic subdivisions to determine the populations of district councils and municipalities. This chapter did not investigate the undercount corrections per se, and assumed that the data released by Stats SA was accurate and thus constituted the spatially most complete data available.

4.3.2 AGGREGATING DATA

In Atlas GIS software there are two options to aggregate data from smaller areas to larger containing areas. The first one aggregates by calculating the proportion of an area that falls within the larger area. Figure 4.2 shows that, for example, 20 per cent of EA 4 might fall in municipality A and 80 per cent in municipality B. The software then assigns 20 per cent of a given variable, say for example total population, to municipality A and 80 per cent to municipality B. Although this method might be more accurate area-wise it has the potential for

errors to creep in because there is no way to validate whether the attributes of an EA have been counted or not.

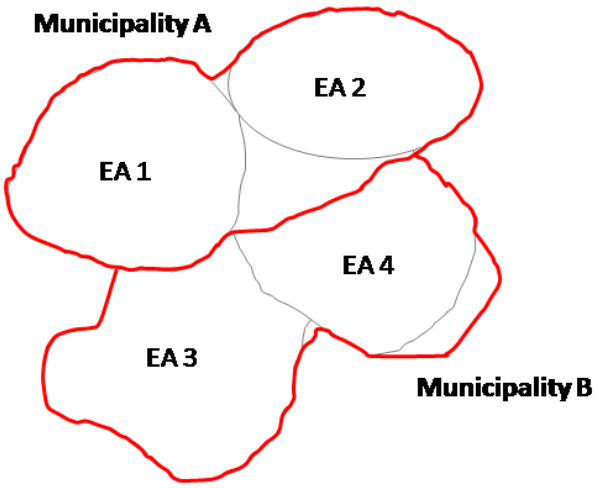

Figure 4.2 Example of areal interpolation between various boundaries

Source: Own calculations

The second method calculates variables by aggregating the values attached to centroids of EAs to the nearest containing municipality. This method ensures that EA attributes are counted only once. The two methods of areal interpolation are juxtaposed in Figure 4.3.

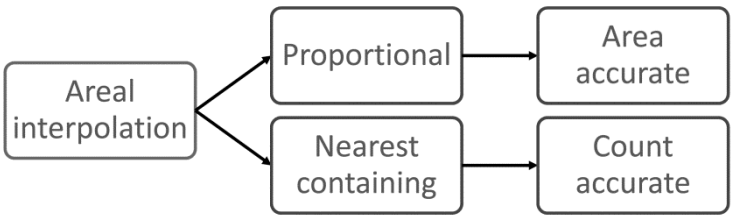

Figure 4.3 Areal interpolation methodologies

Source: Adapted from Atlas GIS

1991 Census

Centroids were created for the 1991 EAs using the ArcMap software of the Environmental Systems Research Institute (ESRI). The 'centre point' option was used and resulted in incomplete data. The AtlasGIS software was tested for creating the EA centroids and aggregating the data using an areal interpolation. The option to aggregate data by centroid to the nearest containing feature resulted in 14.7 per cent of the municipalities not having data.

Since neither of the above methodologies yielded an acceptable result, the data was aggregated proportionally from the 1991 magisterial districts to the 2005 municipal boundaries and,

according to ESRI (1998), this method of areal interpolation is more accurate. Figure 4.4 shows a layout of these boundaries in Western Cape – from which it is evident that magisterial districts were largely within the boundaries of metropolitan areas. In non-metropolitan municipalities, magisterial boundaries sometimes extended beyond those of the municipality.

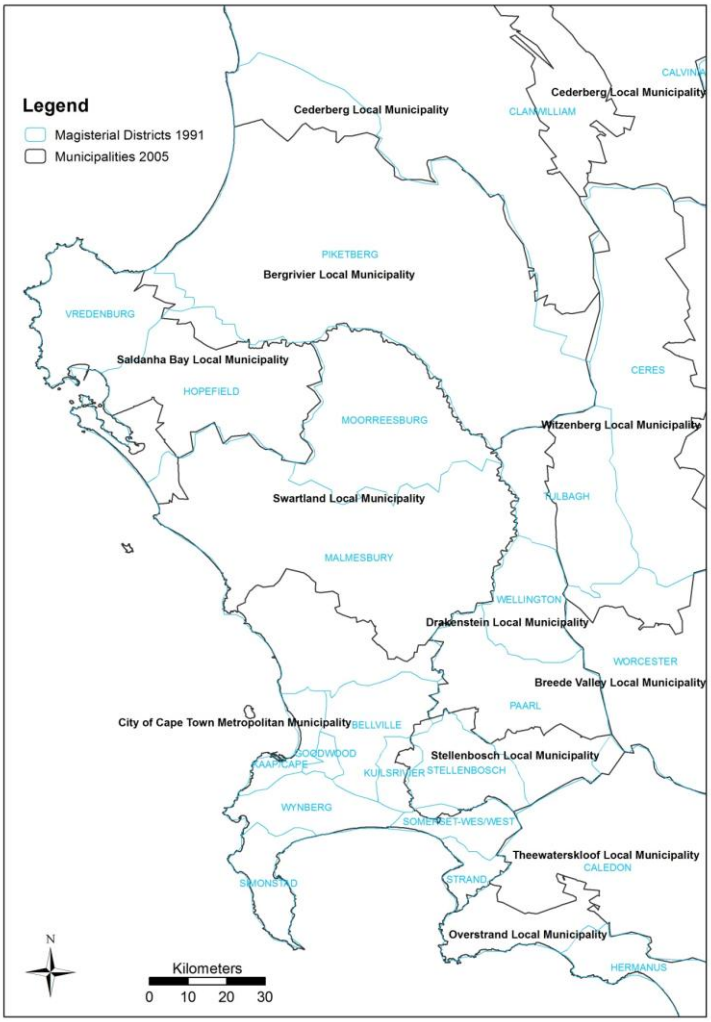

Figure 4.4 Example of magisterial district and municipal boundaries in Western Cape

Sources: Department of Justice 1991 and Municipal Demarcation Board 2005

The software does not provide any indication of accuracy and the only way to verify the results was to compare trends in the data. The aggregation results showed expected trends of unemployment, with Cape Town having the highest unemployment figure (18.1 per cent) in the province.

1996 Census

A similar process of aggregating the 1996 EA centroids to 2005 municipality boundaries yielded problems similar to those encountered with the 1991 data. The resulting data lacked unemployment statistics for 28.8 per cent of EAs. Because of this, the same method was followed for Census 1996 as for 1991. The census data were therefore aggregated proportionally from the magisterial districts to the municipal boundaries of 2005. Table 4.1 indicates the number of magisterial districts in 1991 and 1996 in comparison to local municipalities in 2005.

This illustrates the fact that the 2005 municipalities contained the 1991 and 1996 magisterial districts.

Table 4.1 Number of magisterial districts and municipalities in various years

Year	Boundary type	Number
1991	Magisterial district	374
1996	Magisterial district	354
2005	Municipality	257

Source: Own calculations

2001 Census

To obtain unemployment figures for 2001, data was downloaded from the "Statistics SA Interactive data" website (http://interactive.statssa.gov.za:8282/webview/). Because this data was pre-customised for the 2005 municipal boundaries, there was no need to perform any calculations on the data to re-align them with the 2005 boundaries.

2007 CS

The 2007 CS data was downloaded from the "Statistics SA Interactive data" website. The data reported results at the spatial level of the 2005 municipal boundaries. The unemployment rate was then calculated using the following formula (which excluded institutions like hostels, old age homes, etc. and "Unspecified" responses):

$$[\text{unemployed}/(\text{employed} + \text{unemployed})] \times 100 \qquad (4.2)$$

Data for each year being analysed had to be treated individually since there was no global solution to the spatial problems encountered. The unemployment definitions remained the same and were therefore comparable. Data pre-processing was time-consuming, which confirmed the assertion by Gregory and Southall (2003) that temporal construction in GIS is a costly exercise. In this case the data was obtained free of charge, but it took a considerable amount of time to process the data to a comparable format.

4.4 Findings and discussion

Table 4.2 indicates that, in 1991, five of the 257 municipalities had more than 1 000 EAs. All these municipalities were metropolitan areas. In 1996 eleven of the 257 municipalities (4.2 per cent) had more than 1 000 EAs. Besides the metropolitan areas, a number of municipalities in the Eastern Cape (including the former Transkei) and in Gauteng and KwaZulu-Natal had more than 1 000 EAs each.

If the method used by Martin (2002) was applied (see Section 4.1.2), it would mean that in 4.2 per cent of municipalities in 1996 the aggregation error could be bigger than the census undercount. For the 1991 data, this would be 2 per cent of municipalities. Therefore these simple aggregation techniques would result in an aggregation error in a small percentage of the data and this would be considered acceptable.

Table 4.2 Number of EAs in municipalities with more than 1 000 EAs

Municipality	Province	EAs in 1991	EAs in 1996
Buffalo City	Eastern Cape	379	1767
Cape Town Metro	Western Cape	2950	4760
Ekurhuleni Metro	Gauteng	1344	5027
Emfuleni	Gauteng	340	1404
Ethekwini (Durban Metro)	KwaZulu-Natal	2624	6414
Johannesburg Metro	Gauteng	2215	6148
King Sabata Dalindyebo	Eastern Cape	2	1399
Mbhashe	Eastern Cape	3	1081
Mnquma	Eastern Cape	3	1085
Msunduzi	KwaZulu-Natal	435	1031
Tshwane Metro	Gauteng	2107	3595

Source: Own calculations

The results of the two different methods of aggregation are compared in Table 4.3. The table reveals that aggregation methods are more prone to errors in areas with small populations. A difference of up to 75 per cent in the results was experienced in Area A while differences in Area B (with a larger population) were less than 1 per cent.

Table 4.3 Comparison of selected results of different aggregation methods

	Aggregated proportionally	Aggregated by centroid	Percentage difference
	Total population		
Area A	488	121	75
Area B	36314	36540	0.6
	Number of economically active people		
Area A	242	114	53
Area B	14157	14268	0.7
	Number of people in the occupation group 'services'		
Area A	107	96	10
Area B	2195	2208	0.6

Source: Own calculations

Results from the areal interpolation of the 1991 and 1996 magisterial districts used in this chapter yielded the statistics shown in Table 4.4. Selected municipalities are reflected in the table since there are too many municipalities to portray at once. The table shows results for two municipalities in each of the nine provinces representing different types of entities – urban/ metropolitan and rural. The data in the table is sorted alphabetically by province.

The municipality with the highest unemployment rate discussed here was Nongoma, in KwaZulu-Natal. This municipality showed continuous high levels of unemployment in 1996, 2001 and 2007. There was an increase of about 20 per cent in unemployment between 1996 and 2001, while the figures declined somewhat in 2007.

Table 4.4 Unemployment statistics results from areal interpolation methods

Municipality name	Province	Own calculation 1991	Own calculation 1996	Stats SA 2001	Stats SA 2007	Global Insight 1996
Matatiele	Eastern Cape	17.2	28.8	62.7	38.6	30.9
Nelson Mandela Bay Metro	Eastern Cape	25.8	8.0	46.4	40.0	27.0
Mangaung	Free State	23.7	9.8	40.1	29.9	22.0
Maluti a Phofung	Free State	32.6	20.2	57.5	51.4	37.3
Mogale City	Gauteng	16.5	6.1	34.1	25.7	17.4
City of Johannesburg Metro	Gauteng	20.3	6.7	37.3	29.6	17.9
Nongoma	KwaZulu-Natal	52.2	51.8	71.7	63.2	38.4
eThekwini Metro	KwaZulu-Natal	23.2	10.1	43.0	33.4	24.9
Mkhondo	Mpumalanga	12.7	10.4	45.8	43.3	16.3
Mbombela	Mpumalanga	22.6	9.9	37.8	24.0	9.1
Kamiesberg	Northern Cape	15.8	15.5	32.0	28.4	18.1
Sol Plaatjie	Northern Cape	24.0	9.2	41.5	32.7	18.9
Musina	Limpopo	15.8	7.5	24.9	19.6	5.5
Polokwane	Limpopo	27.9	22.7	41.5	37.2	16.2
Mafikeng	North West	32.6	19.4	49.3	42.8	23.3
City of Matlosana	North West	12.7	7.2	40.0	31.5	14.2
City of Cape Town Metro	Western Cape	18.1	6.9	29.2	24.5	31.2
Beaufort West	Western Cape	21.1	11.3	39.1	32.0	13.5

Sources: Own calculations, Stats SA 2001, 2007a and Global Insight

Large increases are seen between the two sets of 1996 and 2001 statistics, especially in the metros. For example, the City of Cape Town recorded 6.9 per cent unemployment in 1996 (based on the areal interpolation method), while the same figure from Global Insight (2011) was 13.2 per cent. In some metros, for example, Cape Town, Johannesburg and eThekwini, the same differences prevailed in 2001 and 2007. Both the 1996 and 2001 censuses reported a high undercount of between 10.7 per cent and 17.64 per cent. The inflated unemployment rates for 2001 can be ascribed to the misclassification where employment status has shifted some of discouraged job seekers to outside the economically active band (Hakizimana 2011).

Sparsely populated areas like Matatiele (Eastern Cape) and Kamiesberg (Northern Cape) also show stark differences in the percentages of unemployed people. The official statistics (that is, those sourced from Stats SA) show peak unemployment figures in 2001 with moderate declines in 2007.

Considering the different ways of overcoming the census MAUP in South Africa, the ideal solution would be to use the boundaries of existing small area features like EAs or sub-places. The challenge of not having attribute data for all EAs in 1991 and 1996 made this difficult to

attain. The same problem would apply to small area grids and automated zoning, since the lack of underlying data would make it difficult to achieve results at small area levels. Automated zoning could be used at higher-level geographies like municipalities, but since data existed for magisterial districts in 1991 and 1996, it was more opportune to aggregate these to the 2005 municipalities.

4.5 Conclusion and recommendations

Empirical analysis of past trends is vital for extending knowledge of the processes producing change. This chapter aimed to create a spatially comparable unemployment data set from 1991 to 2007. Although there are enormous challenges related to constructing a time-continuous GIS data set, these have been overcome by aggregating data from magisterial district boundaries to municipalities.

Inaccuracies in the 1991 and 1996 EA level data made it difficult to accurately aggregate to higher entities. The compromise was to aggregate data from magisterial districts for these years to municipality boundaries. One of the options to overcome errors in MAUP is to calculate a RMS error for each entity. The Census 2011 data only became available recently and it could be used to calculate such errors for each municipality in the data set. Future research on the South African data could include calculations such as weighting the interpolation process, which would increase the confidence with which one could report reasonable results.

It is recommended that aggregated data on unemployment should be created from the smallest spatial unit, that is, EA or sub-place. However, in the South African case, EA boundaries changed again with Census 2011, which means that researchers would have to recalculate socio-economic data to fit the new features.

A further possible solution could be to impute unemployment data for 1991 and 1996 EAs in cases where such data is missing. This will allow the aggregation of unemployment and other census data to larger geographical units.

Another solution to overcome incompatibilities in the data would be to create new output areas that would be able to serve as target areas for areal interpolation from the 1991 census onwards. Alternatively, Census 2011 EA centroids could be used to interpolate attribute data from EAs of earlier years.

By highlighting and addressing the spatial and attribute data challenges of publicly available unemployment data in South Africa, this chapter has created a base for future research using the same data sources.

This chapter has shown that there are still a number of hurdles to overcome in creating a seamless database of census data from 1991 to 2007. Hopefully the results from Census 2011 will allow the creation of a long-term time series of spatial socio-economic trends in South Africa.

4.6 Acknowledgements

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Chapter 5 Identifying municipalities of high unemployment over time in South Africa

This chapter is based on:

Weir-Smith. G, *in preparation*. The changing geography of unemployment: identifying municipalities of high unemployment over time in South Africa. *The Professional Geographer.*

Abstract
The spatial representation of change over time remains a challenge in Geography. Census data is the only data source that includes all citizens and is spatially comprehensive in terms of unemployment in the country. However, it is difficult to depict temporal change because measuring units (e.g. administrative boundaries), spatial extent or attributes change.

This chapter focuses on the spatial representation of unemployment in South Africa. Statistical analysis included spatial autocorrelation that measures feature similarity based on both feature locations and attribute values simultaneously, and therefore establishes the spatial randomness of a trend. Further methodologies included correlation coefficient analysis and a combined ranking displayed spatially by municipality. The correlation coefficient analysis was used to identify the strength of relationships between the number of people unemployed in succeeding years.

The analysis shows that unemployment is spatially concentrated which confirms the notion that unemployment has a strong regional character. The results show that the spatial clustering of unemployment increased between 1991 and 2007. The national labour absorption rate was 40 per cent in 2007, while provincial figures ranged between 31 and 58 per cent. There was a positive, non-perfect, linear relationship between municipalities that had a high number of unemployed people in 1991 and subsequent years.

Based on the fact that combined unemployment shows high values in Eastern Cape, Limpopo and KwaZulu-Natal, it is recommended that spatial development policies, job creation policies and skills development should focus especially on municipalities in these provinces especially the northern part of KwaZulu-Natal.

Key words: combined ranking, South Africa, spatial analysis, unemployment

5.1 Introduction

Unemployment globally has been gradually on the rise up and until around 2004, and increased again after 2008 due to the recent global recession. In South Africa the figure for unemployment (strict/official definition) has risen from 21.0 per cent in 1996 to 25.8 per cent in 2001 and slightly decreased to 25.2 per cent in 2010 (Stats SA 1996, 2003b and 2010a). Since 1994 the country's strict unemployment rate was less than 25 per cent for only six years, while the broad definition of unemployment has not been below 30 per cent for all of this time (Koller 2005). The broad definition includes people who are eligible to work, but who are not searching for work anymore – i.e. discouraged work seekers. The United Nations and other international agencies, as part of the MDGs, have identified both unemployment and poverty as critical issues to address by 2015.

Unemployment in South Africa is measured regularly at different spatial levels yielding national or sometimes provincial statistics. Since data at provincial level is not expected to provide meaningful variations in unemployment for a specific period, this chapter will use census data that is available at municipal level although it is collected less frequently. The census data is the only data source that includes all citizens and is spatially comprehensive in terms of unemployment in the country. The census definition of unemployment focuses on the narrow (official) definition of unemployment, because it excludes discouraged work seekers. Many economists believe that the broad definition is a more accurate reflection of unemployment (Kingdon and Knight 2005; Kingdon and Knight 2000; Klasen and Woolard 2008). Although it is acknowledged that there are differences in the measurement, for the purposes of this analysis, the narrow definition, which is comparable with international statistics, will be used to ensure a spatially comprehensive, sub-provincial comparison.

The first MDG aims to eradicate extreme poverty and hunger. Both of these aspects have specific targets. Target 1B relates to employment and it aims to achieve full and productive employment and decent work for all, including women and young people (UNDP 2005). The specific indicators to measure this are

- Growth rate of Gross Domestic Product (GDP) per person employed
- Employment-to-population ratio
- Proportion of employed people living below $1 per day
- Proportion of own-account and contributing family workers in total employment.

By analysing the employment-to-population ratio over time, one can determine whether this indicator is decreasing or not.

In order to obtain a longitudinal understanding of the spatial aspects of unemployment, this chapter will consider census data from recent years. Ideally these patterns should be analysed at the spatial scale where policy intervention may be designed (Trendle 2006). Rusanen et al. (2001) add to this argument that administrative areas, their sub-areas and postal code areas for example, are designed for a specific administrative function, and do not always lend themselves readily for examining socio-economic issues like unemployment. In the South African context, at the time when this research was initiated, the spatially most detailed level of unemployment statistics available was the municipality.

International literature suggests that there is a geographical coincidence between levels of unemployment and gross domestic product per capita (Suedekum 2005). This hints at the complexity of unemployment statistics, and the fact that unemployment cannot be analysed in isolation. Trendle (2006) also noted that there are important linkages between the socio-economic status of neighbourhoods and their labour market performance.

As highlighted by Gardiner et al. (2013), the long-term effects of spatially imbalanced development and growth may bias or even compromise national economic policy. It is therefore important to identify such inequalities in order to address them in a timely manner. Trendle (2006) confirms that the unemployment rate is not randomly distributed across geographic space in Brisbane, but some spatial clustering occurs.

This chapter addresses the following objectives:

- To briefly explore methods of displaying socio-economic data spatially over time
- To consider South African labour force trends over time
- To identify spatial patterns of unemployment over time
- To identify municipalities of high and low unemployment through time
- To briefly analyse trends of spatio-temporal unemployment variation at a sub-provincial level.

Having introduced the topic of this chapter, the remainder of the presentation is structured in the following way: Section 5.2 considers the methodologies used to analyse unemployment and labour force trends while Section 5.3 discusses these results. Section 5.4 concludes the chapter with a summary of the findings and recommendations for future research.[1]

5.2 Methodology

A number of methodologies were used to analyse data spatially and statistically and these were spatial autocorrelation, Pearson correlation and combined unemployment ranking.

5.2.1 STATISTICAL METHODS

Spatial autocorrelation measures feature similarity based on both feature locations and attribute values simultaneously. It establishes the spatial randomness of a trend. Positive spatial autocorrelation means that geographically nearby values of a variable tend to be similar on a map: high values tend to be located near high values, medium values near medium values, and low values near low values (Griffith 2002). For this chapter spatial autocorrelation was calculated for unemployment rates at a municipality level for the whole country. A separate autocorrelation was run for each year under investigation. The ESRI ArcMap software tool was used and it calculates the Moran's I Index value and both a z-score and p-value evaluating the significance of that index. The z-score indicates measures of standard deviation. For example, if a value of +2.5 is calculated, it is interpreted as "+2.5 standard deviations away from the mean". Besides this a Moran's I value is also calculated and it indicates whether a pattern is random, clustered or dispersed. A value close to +1.0 indicates clustering while a value close to -1.0 indicates dispersion (ESRI 2009). Zero spatial autocorrelation means geographically random phenomena and chaotic landscapes (Griffith 2002).

In order to calculate the effect of neighbouring municipalities, a distance calculation was done. In this case the "inverse distance" method meant that all municipalities impact or influence all other municipalities, but the farther apart municipalities are, the smaller the impact. An Euclidean counting method calculated the distance "as the crow flies" – the shortest distance between two points (which would be the centroid of the municipality).

A Pearson correlation measures the extent to which paired scores occupy the same or opposite positions within their own distributions (Pagano 2004). A correlation analysis between the actual number of unemployed people in 1991 and subsequent years showed a strong, positive

[1] At the time when this research was done, the census 2011 data was not available yet.

relationship in the majority of instances. This trend was the same for representations expressed in percentages of unemployed people.

In order to obtain an understanding of which municipalities had persistently high unemployment rates over time, a ranking score was developed. For each individual year (i.e. 1991, 1996, 2001 and 2007) municipalities were ranked according to the percentage of unemployed people for that year. In instances where municipalities had the same unemployment value, an equal ranking was assigned. In other words, there might be more than one municipality with the same ranking in a specific year. After ranking a combined rank value was obtained by adding the ranked values for each year. The lowest value in the combined ranking identified the municipality with the lowest unemployment over the period being examined, while the highest value indicated the converse. The full table is displayed in Appendix A.

5.2.2 DISPLAYING CHANGE OVER TIME

In order to compare change in socio-economic variables over time it is important to ensure the measuring units, namely the polygons of analysis, are the same. Since the delineation of EAs is primarily concerned with the management of enumerator workloads, changes in the landscape of EAs that result from residential development, the demolition of buildings, different occupational densities and residential structures have to be taken into consideration. It is to be expected that EA boundaries will change over time (Martin, Dorling and Mitchell 2002). There are three ways to overcome the problem:

- Re-model the data to some underlying surface-based representation
- Use areal interpolation to transfer data from one set to another
- Use lookup tables to make best-fit assignments of one set of areal units into another

(Martin, Dorling and Mitchell 2002)

The first option refers to the aggregation of old enumeration areas to new boundaries and this task is relatively simple if there is a set of boundaries that are identical in both censuses - that is, as the "lowest common denominator". For instance, in the most recent census, only the EA boundaries may have changed but not the sub-place or main-place boundaries. Population data can then be compared for sub-places simply by aggregating the EA data. However, EAs may have been reassigned to different sub-places in the period between the censuses without actually changing the boundaries. In such a case one would have to determine into which sub-place in census 1 each census 2 EA falls. GIS polygon overlay operations can assist in this task (United Nations 2000).

Option two refers to instances where the boundaries of reporting units for the two censuses are not nested at some geographic level of aggregation. In these cases then some form of areal interpolation is required to obtain compatible census data. Areal interpolation is the process of transferring data - for example, population totals - from one set of areal units to another set of units that are incompatible. It is important to note that no interpolation method can provide error-free estimates of target zone socio-economic indicators. In fact, the errors may often be unacceptably large for applications requiring high accuracy. Areal interpolation should thus be seen as a method of last resort, where more accurate options - such as re-aggregation of small data collection units - are unavailable (United Nations 2000).

In order to ensure comparability of unemployment data between the various censuses the data in this instance was analysed using the 2005 municipal boundaries. EA data from 1991 and 1996 were aggregated to these boundaries. For census 2001, data fashioned for the 2005 boundaries was downloaded from the Stats SA website, while CS 2007 data was originally produced at this level and did not require any further calculation.

The display of temporal change is challenging, and the United Nations (2000) suggests the arranging of data in several maps to present dynamic information. An example of the provincial contribution to GDP over three periods is shown as Figure 5.1. To allow comparisons over time, the class limits (or so-called ideographic classification) need to be the same on all maps (Cromley 1996). This means that classification schemes that are based on the data distribution (e.g. natural breaks) are not appropriate. The different classes were therefore: 2.3-3.0 per cent (lightest grey), 3.1-6.0 per cent, 6.1-8.0 per cent, 8.1-16.0 per cent and 16.1-33.9 (darkest grey).

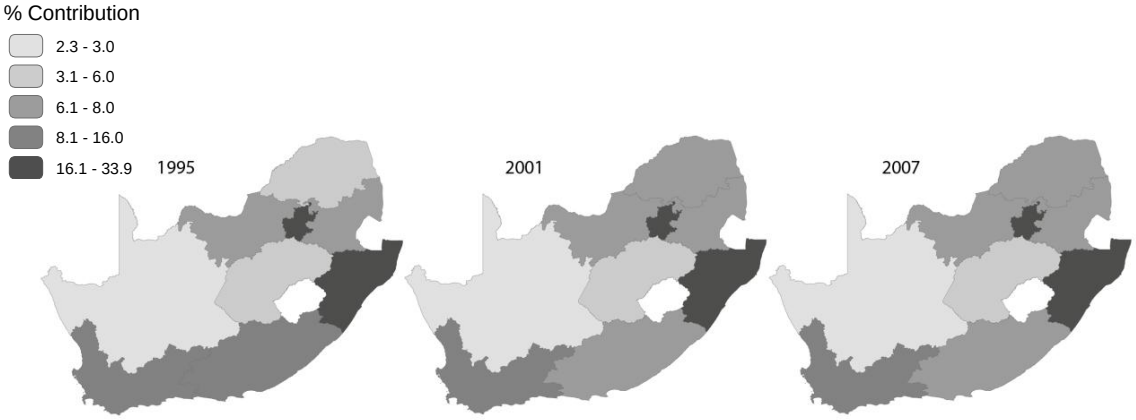

Figure 5.1 Example of provincial contribution to GDP over time

Source: Stats SA 2008c, adapted

This section focused on the spatial depiction of change over time and found that it is important to compare measuring units that are the same for each period in the time span. In order to display the South African unemployment data spatially over time these two methods would be used.

5.3 Findings and discussion

This section will discuss findings from recorded labour force trends and spatial analysis of unemployment data.

5.3.1 LABOUR FORCE TRENDS

The labour market has become increasingly uncertain, insecure, risky and unequal since the 1980s (Martin 1998) hence it is important to take note of its trends. A number of labour force trends will be investigated in this section and these statistics will be analysed at the national level. Census and CS data for the specific years will be used.

Figure 5.2 shows an overall summary of South Africa's population characteristics for the age groups under investigation. In 1991 the 0-14 year olds were about 8.6 million and increased to almost 15 million by 2007. Similar trends were observed in the other age groups, namely an increase from 22 million to 31 million in the 15 – 64 year olds, the economically active groups, and an increase from 1.6 million to 2.6 million in the oldest age group.

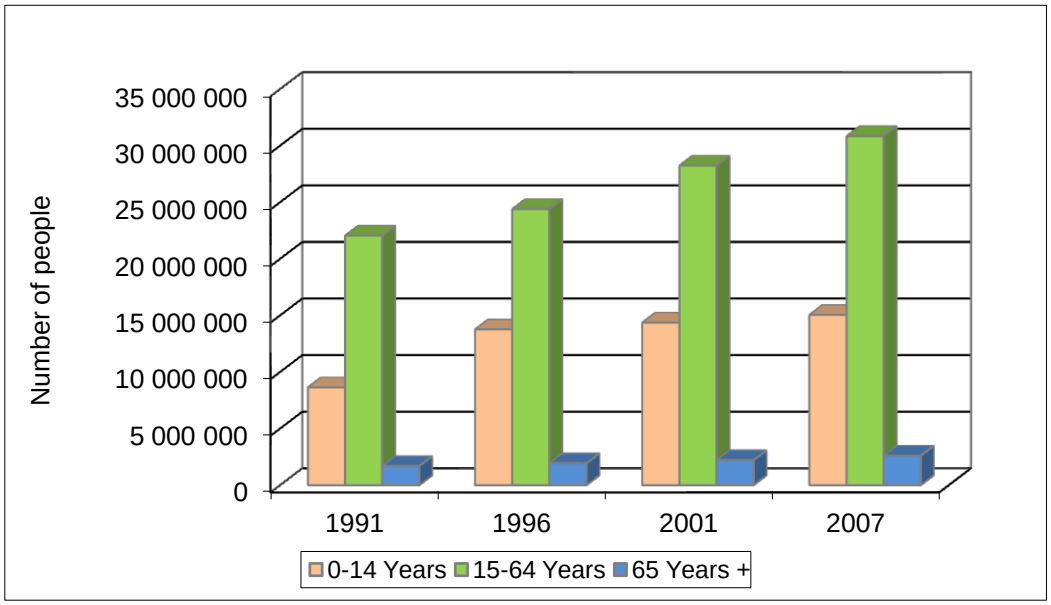

Figure 5.2 Total population by age group by year

Sources: HSRC 1991 and Stats SA 1996, 2001 and 2007

In their South African study, Kingdon and Knight (2005) found that the labour force grew remarkably rapidly between 1995 and 2003. The growth rate of over 4 per cent per annum was extremely unusual in international terms for which there are three possible explanations. First, in-migration, second, a rapid natural increase in the number of working age people and third, increased labour force participation. Hodge (2002) adds that the high and rising rates of unemployment in South Africa during the 1990s appear to be the result of large increases in the natural rate of unemployment with large increases in the economically active population, and the shedding of jobs by the mining sector, particularly gold mining. Bhorat et al. (2001) supports this by documenting that employment growth was insufficient relative to the growth in the labour force between 1995 and 2002.

Trends in the potential labour force (Figure 5.3) show that the unemployment rate increased from 1991 till 2001 and then slightly decreased in 2007. Furthermore, the percentage employed people decreased since 1991 (44 per cent) and, despite an increase to 2007 (40 per cent), it is still lower than in 1991. The population that is not economically active remained steady around 40-44 per cent. The latter could be linked to the equilibrium rate of unemployment, which depends critically on the institutional features of the economy and may vary depending on demographics and institutions (Grant 2002) or to the fact that the proportion of the population employed was extremely stable during the 1995 to 2004 period (Branson 2006).

The labour absorption rate is calculated as the percentage of the working age population that is employed (Stats SA 1998). The labour absorption rate was 40 per cent in 2007 and although it had increased since 2001 it was still low as it means that only 40 per cent of the potential labour force was employed. Expanding on this specific data on the labour absorption rate, data per province (Table 5.1) shows that it remained high in some provinces.

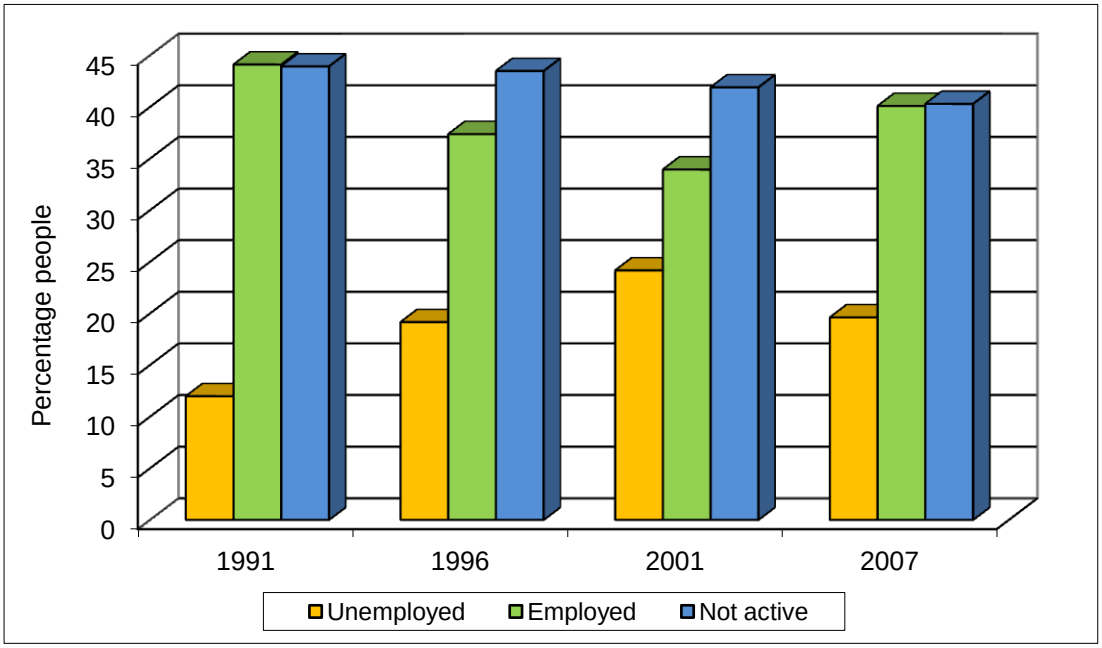

Figure 5.3 Potential labour force over time

Sources: HSRC, 1991 and Stats SA, 1996, 2001 and 2007

Western Cape and Gauteng consistently absorbed more than 50 per cent of their respective labour forces; however, a downward trend can be seen from 2008 due to the economic recession. Labour absorption rates remained below 40 per cent in Eastern Cape and Limpopo. The 2009 rates were below 40 per cent in six provinces and significant decreases occurred in Gauteng, Northern Cape and Free State.

Table 5.1 Labour absorption rate by province in September of each year

	2002	2003	2004	2005	2006	2007	2008	2009
Western Cape	52.6	54.2	53.2	54.7	56.9	55.1	53.9	53.3
Gauteng	52.3	52.4	52.9	57.0	58.1	57.8	57.3	51.9
Free State	46.5	47.1	44.1	45.5	44.6	45.9	45.3	40.6
Mpumalanga	40.6	41.5	40.6	41.8	42.3	43.7	42.2	39.7
KwaZulu-Natal	40.8	38.5	38.1	39.4	43.0	39.8	41.0	38.5
North West	37.4	35.3	37.8	40.7	38.6	39.8	40.0	36.1
Northern Cape	48.1	45.3	41.2	41.8	44.4	43.0	43.8	36.1
Eastern Cape	30.9	29.0	31.3	33.4	34.6	34.0	33.2	31.4
Limpopo	28.4	27.9	30.6	29.3	28.9	30.8	28.9	28.8

Source: Republic of South Africa 2010

The labour force participation rate refers to the ratio of the labour force to the labour supply (Stats SA 2007b). It is calculated by dividing the number of people presenting their labour for remuneration in the labour market (economically active population or labour force) by the population of working age people (labour supply), and expressed as a percentage (Bergene 2010). Brazil was the only country with a slight upward trend in 2010. In comparison, the labour force participation in the United States of America (USA) was somewhat higher than that of Brazil. The latest figures from the ILO show a global downward trend (Table 5.2) and the effect of the current economic downturn is evident.

Table 5.2 Labour force participation in selected countries

Country/ Year	2008	2009	2010
South Africa	57.8	55.8	54.3
Brazil	57.0	56.7	57.1
USA	66.0	65.4	64.7
Germany	59.7	59.9	59.5

Source: ILO 2011

The gender composition of the South African labour force changed slightly between 1991 and 2007. In 1991 there were slightly more females (51.4 per cent) than males in the labour force. This figure decreased in 1996 and increased again to 46.9 per cent in 2007. Kingdon and Knight (2005) found that female participation rose by 15 per cent between 1995 and 2003 while male participation increased by 5.2 per cent in the same period. They also ascribed the high growth in female participation to a decline in women's access to male income due to increased unemployment among males, the HIV epidemic and increased female headship due to changes in household structure.

Industry refers to the type of economic activity in which a person is involved (Stats SA 2007b) and Bhorat et al. (2001) found that the share of unskilled workers in the labour force declined by 4 per cent between 1995 and 2002, while that of skilled and semi-skilled workers increased. McCord (2003) substantiates this by finding that in the 1970 to 1995 period the labour demand became more skills biased and favoured skilled occupations at the expense of unskilled elementary occupations.

A recent skills development initiative coming from the South African Department of Science and Technology (DST) has embarked on a knowledge economy drive which aims to deploy satellites for specialised scientific services, to be a player in the global pharmaceutical market and to have a diversified, supply secured sustainable energy sector (DST 2008). Such economic activities require a highly skilled labour force and this seems to be lacking since the highest education level in 2007 for the majority of South Africans (40.1 per cent) was "some secondary education" (Stats SA 2007a).

The labour statistics in the preceding paragraphs show that the South Africa's labour force has changed between 1991 and 2007 in terms of gender division and decreased in the rate of people employed in most sectors. Chapter 7 provides more detail on this trend. Furthermore, the labour absorption rate fluctuated between 41 and 45 per cent while the labour force participation rate declined. Statistics discussed here exclude figures later than 2007 and will therefore not reflect trends after the 2008 economic downturn. The next section will focus on unemployment figures for the period 1991 to 2007, and considers possible spatial characteristics of unemployment.

5.3.2 UNEMPLOYMENT TRENDS

Although unemployment is low in sub-Saharan Africa, South Africa shows exceptionally high figures. Table 5.3 indicates that unemployment rates in sub-Saharan Africa fluctuated between 7.7 per cent in 1998 and 7.9 per cent in 2008. For the same period the figure for North Africa was somewhat higher at 13.1 per cent in 1998 and 10.3 per cent in 2008. In South Africa the official unemployment rate was 23.2 per cent in September 2008 (Republic of South Africa 2010) – almost three times higher than that of sub-Saharan Africa.

Table 5.3 Unemployment rates in the world and selected regions

	World	Developed Economies and European Union	North Africa	Sub-Saharan Africa
1998	6.1	7.1	13.1	7.7
1999	6.2	6.9	13.6	8.1
2000	6.1	6.7	14.2	8.2
2001	6.1	6.7	13.7	8.3
2002	6.1	7.4	13.6	8.4
2003	6.3	7.3	13.2	8.5
2004	6.3	7.2	11.9	8.2
2005	6.2	6.9	11.6	8.1
2006	6.0	6.3	10.5	8.1
2007	5.7	5.7	10.4	7.9
2008	6.0	6.4	10.3	7.9

Source: ILO 2009

The unemployment rate is the number of unemployed people as a percentage of the total economically active population (Barker, 1999). The difference between the unemployment rate and the number of unemployed people is that the latter reflects the increase in discouraged work seekers too. The unemployment rate is therefore a useful measure to compare unemployment over time, because it uses a standardised value. Figure 5.4 indicates that the unemployment rate in South Africa increased from 1991 to 2001 and slightly decreased to 19.6 per cent in 2007.

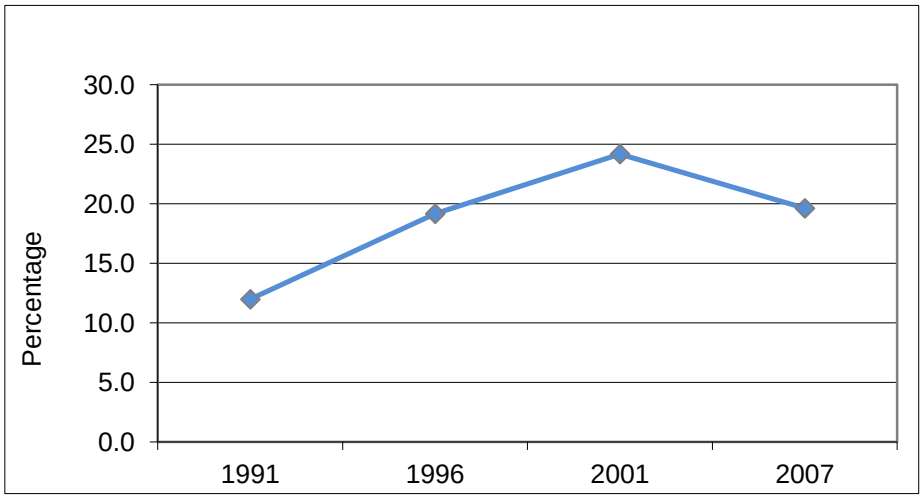

Figure 5.4 Unemployment rate (strict definition) over time

Sources: HSRC, 1991 and Stats SA, 1996, 2001 and 2007a

According to Grant (2002) unemployment may exist even when the economy is at full sustainable capacity due to difficulties in matching job seekers and job vacancies (frictional unemployment) or mismatches in job training, experience or education (structural unemployment).

The remainder of this section is divided into two: first, the spatial analysis of sub-provincial trends of unemployment and, second, their statistical analysis.

Spatial analysis of sub-provincial trends of unemployment

The spatial patterns of unemployment differ greatly over time and this relates to population characteristics. Unemployment patterns in this section are analysed at a municipality level which is the most spatially detailed level of unemployment statistics available at a sub-provincial level. Furthermore, spatial statistics will be used to identify concentrations of such unemployment patterns. It is expected that most social science variables tend to be moderately positively spatially autocorrelated because of the way phenomena are geographically organised (Griffith 2002).

Green (1998) suggests that unemployment is a function of the interactions of changes in labour supply and labour demand. It is therefore important to consider how supply and demand factors interact in different ways in different areas to produce such change. Based on the unemployment figures from census data, North West experienced the highest increase in unemployment for the period 1991 to 2007, namely 19.2 per cent. Table 5.4 shows that Free State had the second highest increase at 18.6 per cent while Western Cape (5.9 per cent), Gauteng (8.0 per cent) and KwaZulu-Natal (8.5 per cent) had increases of below 10 per cent.

Table 5.4 Percentage unemployed people per province between 1991 and 2007

Province	**1991**	**1996**	**2001**	**2007**
Eastern Cape	26.1	29.5	52.4	40.4
KwaZulu- Natal	29.9	25.5	53.3	38.4
North West	18.7	17.1	41.9	37.9
Limpopo	23.1	26.5	43.8	37.0
Free State	16.6	12.3	38.5	35.2
Mpumalanga	17.7	11.6	40.3	32.2
Northern Cape	18.1	16.2	30.9	28.9
Gauteng	18.0	7.2	32.1	26.0
Western Cape	11.1	8.6	20.2	17.0

Source: Own calculations

In the 1991 data the *Moran's I index* was 0.61 for the percentage unemployed people. The z-score was 25.87 standard deviations and the spatial distribution of unemployment was not random. Similar statistics were found for subsequent years (Table 5.5).

Table 5.5 Spatial clustering of unemployment[2]

	Moran's I	**Z-score**	**Spatial Concentration**
1991	0.61	25.87	Clustered
1996	0.50	21.25	Clustered
2001	0.71	30.08	Clustered
2007	0.71	29.92	Clustered

Source: Own calculations

[2] Values were calculated at a 99 per cent confidence level

The unemployment data for all years was clustered and not randomly distributed. In fact, the spatial clustering of unemployment increased between 1991 and 2007 and the Moran's I value was 0.71 for the 2007 data. There was a slight decrease in 1996 which indicates that the spatial distribution of the percentage unemployed people was less clustered than in other years. In all years, the z-score was high and fell outside the normal distribution range. It indicates a statistically significant spatial pattern.

Schanne et al. (2008) investigated the economic growth rate together with the unemployment rate, and found that the economic growth rate is more volatile than the unemployment rate and shows positive or negative growth for a specific year. The South African economy never attained the projected economic growth rate of 10 per cent during the period 1992-2009 (Koller 2005). In order to create jobs and reduce poverty, the economy should grow by at least 7 per cent per annum for the next 20 years. However, the economy only achieved a 5 per cent growth and might not reach the target of 7 per cent growth in the next decade. The country experienced negative growth in 1991, 4.3 per cent in 1996, 2.7 per cent in 2001 and 5.6 per cent in 2007 (World Bank 2011).

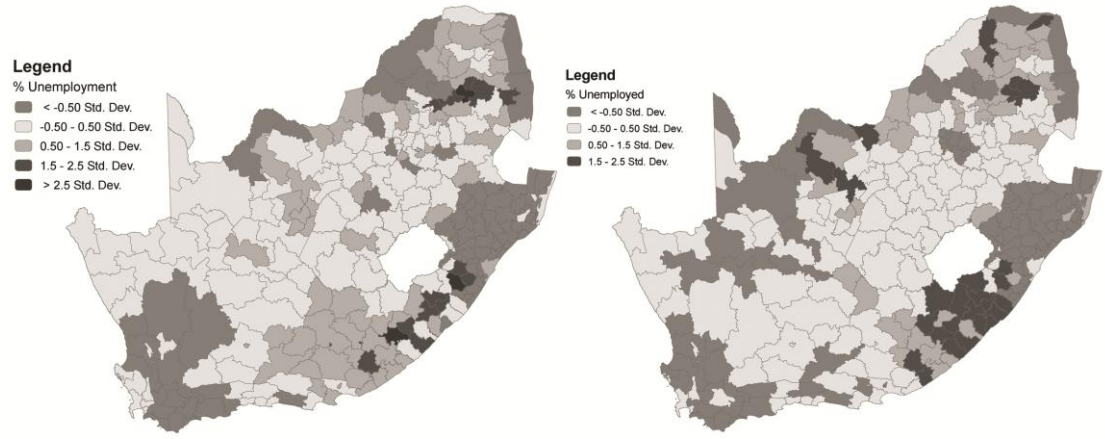

Figure 5.5 Standard deviation intervals for unemployment data in 1991 and 1996

Source: Own calculations

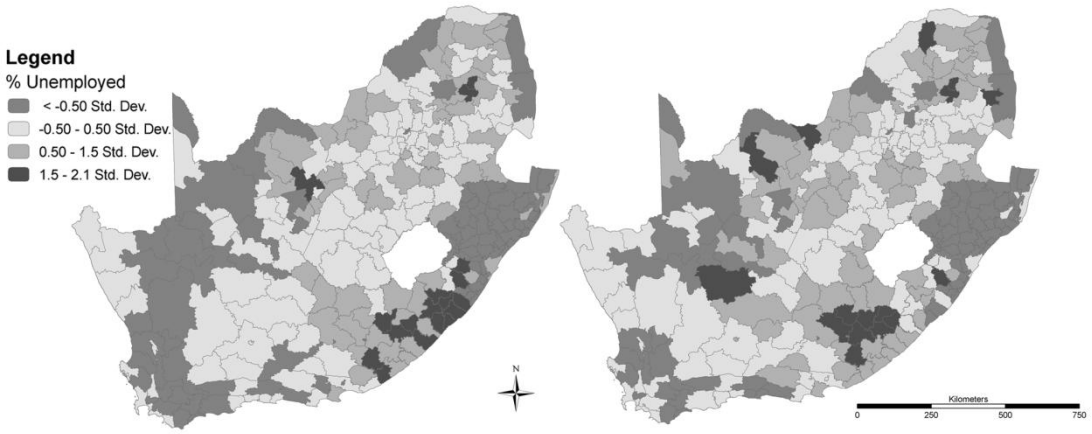

Figure 5.6 Standard deviation intervals for unemployment data in 2001 and 2007

Source: Own calculations

The standard deviation intervals of the percentage of unemployed people for the different years under investigation are mapped as Figures 5.5 and 5.6. The standard deviation provides a measure of dispersion relative to the mean (Pagano 2004). Class breaks were created by using standard deviations from the mean. Light colours show unemployment values close to the mean while dark colours show unemployment values far from the mean with the darkest colour being an intensely positive difference. Municipalities in KwaZulu-Natal were consistently in the 0.5 to 1.5 standard deviation class, indicating that unemployment remained high for a prolonged period. Municipalities within the highest standard deviation class are outliers in relation to the mean and municipalities in the north-eastern part of the Eastern Cape remained in this class.

In 1991 few municipalities were grouped in the dark grey category (highest above the mean). This category indicates the municipalities that had the highest deviation from the mean, that is, were the worst off. In 1996 many municipalities in Eastern Cape, Limpopo, Mpumalanga and North West were in this category. In 2001 more municipalities in Eastern Cape and Free State became part of this interval, while some municipalities in the Northern Cape became part of this interval for the first time in 2007.

Municipalities in Western Cape, Northern Cape, Free State, Gauteng and most of KwaZulu-Natal were consistently in the standard deviation class that is best off in terms of unemployment. High unemployment rates were concentrated in the southern parts of KwaZulu-Natal, the north-eastern parts of Eastern Cape and selected municipalities in Limpopo and North West.

Statistical analysis of sub-provincial trends of unemployment

In order to consider unemployment trends over time at a sub-provincial level, the data was analysed in the same spatial unit. This means the data was standardised to the 2005 municipal boundaries so that the measuring unit was consistent. In 2005 there were 257 municipalities in the country. Previous research (Kingdon and Knight 2005) showed an increase (varying between 7.3 per cent and 16.2 per cent) in unemployment rates in all provinces between 1995 and 2003. According to Arrufat et al. (1998) the relative regional unemployment rates at a given point in time display a certain "structure". The extent to which this structure changes or is maintained over time may be measured by means of correlation coefficients between unemployment rates in different regions for separate moments over time (Arrufat et al. 1998).

There is a positive, non-perfect, linear relationship between municipalities that had a high number of unemployed people in 1991 and in 1996 (Figure 5.7). Similar graphs were produced for 1991 and 2001, as well as 1991 and 2007. A Pearson correlation yielded the results seen in Table 5.6.

Table 5.6 shows that the correlation between the number of unemployed people in 1991 and subsequent years is very high and positive. Unusually high correlations were recorded in the Western Cape and KwaZulu-Natal and all values were significant at a 0.01 level. The exception to these high correlations was the Northern Cape and in some years the North West.

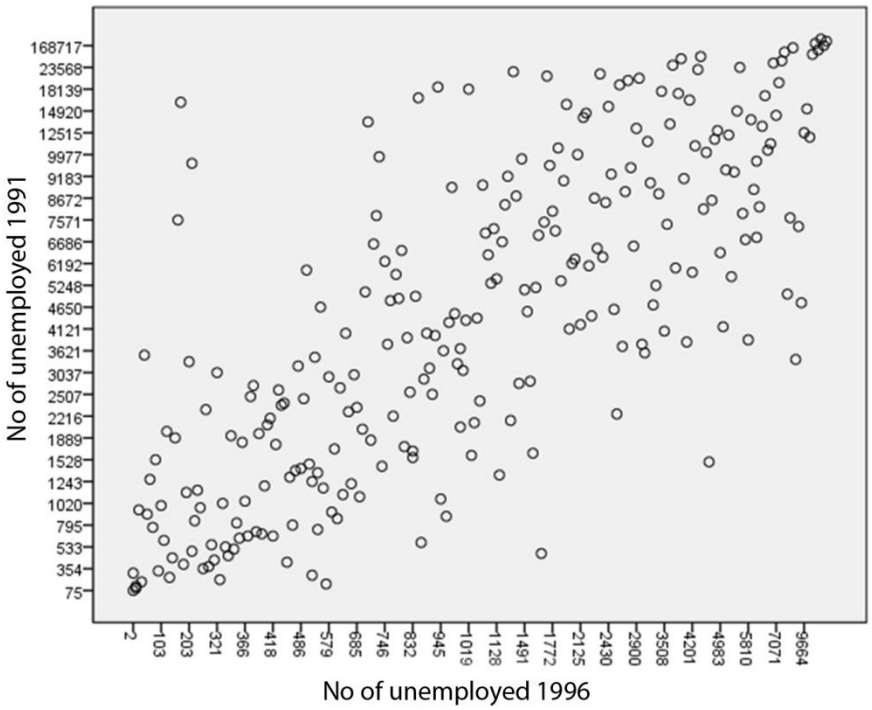

Figure 5.7 Scatter plot of number of unemployed people in 1991 and 1996

Source: Own calculations

In Eastern Cape and North West the correlation between unemployment in 1991 and 1996 was lower than the later years. The standard deviation of the percentage unemployed people in the Eastern Cape increased significantly between 1991 (9.12) and 1996 (16.29) which means that unemployment statistics became more varied after 1991. In the years after 1996 the standard deviation remained stable.

Table 5.6 Pearson's bivariate correlation between 1991 unemployment figures and subsequent years

	1996	**2001**	**2007**
South Africa			
Eastern Cape	0.528*[3]	0.948*	0.963*
Free State	0.973*	0.942*	0.950*
Gauteng	0.918*	0.973*	0.969*
KwaZulu-Natal	0.971*	0.979*	0.976*
Limpopo	0.819*	0.751*	0.767*
Mpumalanga	0.857*	0.869*	0.776*
North West	0.518**[4]	0.865*	0.797*
Northern Cape	0.293	0.407**	0.374**
Western Cape	0.998*	0.998*	0.999*

Source: Own calculations

[3] Correlation is significant at the 0.01 level (2-tailed)
[4] Correlation is significant at the 0.05 level (2-tailed)

Northern Cape showed low, but sometimes significant correlations in unemployment figures between 1991 and all subsequent years. This indicates that unemployment in the previous period was not necessarily the best predictor of unemployment in the next period. Extremely high correlations (> 0.9) occurred in the Free State, Gauteng, KwaZulu-Natal and Western Cape throughout all time periods. This indicates that most of the variability in unemployment (more than 80 per cent) in the previous period is accounted for by unemployment in the next time period. Even though these provinces experienced different levels of unemployment, the high correlation also indicates that the unemployment trend remains constant.

Table 5.6 emphasises the regional persistence of unemployment, because provinces with high unemployment rates remained high over time. This type of regional persistence is also experienced in European unemployment trends (Martin 1998) whereas unemployment rates in the USA seem very different. Some of these differences can be ascribed to the inflexibility of the West European labour markets.

According to Martin (1998), the persistence of regional unemployment disparities has two origins: the first is that it is based on slow or weak labour market equilibrating mechanisms; while the second option is that it is due to structural equilibrium phenomena. Sluggish or incomplete inter-regional movements of labour and capital and relative wage adjustments will result in the perpetuation of regional unemployment differences of the first type. In comparison, the structural equilibrium phenomenon is based on the argument that different regions equilibrate at different levels of relative unemployment (Martin 1998). There could be two components to such an equilibrium type: a nationwide average equilibrium component which varies over time; and an equilibrium differential which is assumed to be constant for quite long periods.

During the period under investigation the Gross Geographic Product (GGP) was the greatest in Gauteng, Western Cape and KwaZulu-Natal (HSRC 1996), yet unemployment was high in all provinces. South Africa therefore experienced a structural equilibrium phenomenon since all its regions did not adjust at the same rate.

Table 5.7 indicates first the ten best and thereafter the ten worst off municipalities in terms of combined unemployment ranking. Although the worst off municipalities were geographically dispersed across the country, they were concentrated in the provinces of Eastern Cape, Limpopo and KwaZulu-Natal. In the case of KwaZulu-Natal, there were three adjacent municipalities among the ten worst off in the country. A number of the better off municipalities are district management areas (DMA), which are usually sparsely populated areas. Six of the better off municipalities are located in Western Cape while five of the worse off municipalities are in KwaZulu-Natal.

From these calculations, clear priorities for geo-targeting arise. Based on research done by Elbers et al. (2007), it was estimated that governments saved up to 15 per cent on expenditure by delivering poverty interventions geographically accurately. Spatial development policies, job creation policies and skills development should therefore focus on the municipalities with the highest ranking unemployment levels, especially those in the northern part of KwaZulu-Natal. The findings of this section are confirmed by similar statistics from Wright and Noble (2009) who found that the highest rates of employment deprivation in 2007 were in Eastern Cape (47.2 per cent), Limpopo (45 per cent), KwaZulu-Natal (43.2 per cent) and Free State (42.6 per cent). The least deprived provinces for this domain were Western Cape (26.4 per cent) and Gauteng (31.8 per cent) during the period under review.

Table 5.7 Combined unemployment ranking

Municipality Name	Province	Combined Unemployment Rank
Mopani	Limpopo	12
Cape Winelands	Western Cape	13
Ehlanzeni	Mpumalanga	17
Sisonke	KwaZulu-Natal	20
Overberg	Western Cape	24
Cederberg	Western Cape	53
uMgungundlovu	KwaZulu-Natal	54
Cape Agulhas	Western Cape	58
Swellendam	Western Cape	58
Bergrivier	Western Cape	61
Fetakgomo	Limpopo	733
Nkonkobe	Eastern Cape	734
Umzumbe	KwaZulu-Natal	740
Engcobo	Eastern Cape	741
Makhuduthamaga	Limpopo	755
Intsika Yethu	Eastern Cape	756
Nongoma	KwaZulu-Natal	761
Msinga	KwaZulu-Natal	766
Nkandla	KwaZulu-Natal	781
Nquthu	KwaZulu-Natal	781

Source: Own calculations

5.4 Conclusion and recommendations

The first objective of the research was achieved by showing that socio-economic data can be spatially displayed over time using a number of methods. These include bar graphs and similar class limits in polygon data. Furthermore, it was found that unemployment has a spatial pattern over time in South Africa (objective three). The regional persistence in unemployment trends seem to be similar to that of Europe. High unemployment tends to recur in specific municipalities through different forms of analysis, e.g. Fetakgomo and Makhuduthamaga in Limpopo.

Objective two considered labour force trends and found that the persistence of regional unemployment disparities has two origins: the first is that it is based on slow or weak labour market equilibrating mechanisms. The second option is due to structural equilibrium phenomenon. Although the South African economy has been classified as having structural breaks there is also an element of weak labour market equilibrium. The spatial pattern of unemployment was persistent along provincial boundaries and showed an increasing strong positive relationship.

A correlation coefficient analysis showed that unemployment figures persisted across all provinces except in the Northern Cape and, in some years, in North West. This means that over time the unemployment situation remained the same in most provinces. Very high correlations existed over time in other provinces and confirmed the notion that unemployment has a strong

regional character. A spatial autocorrelation analysis also showed that unemployment patterns cluster spatially.

In terms of the fourth and fifth objectives of identifying municipalities of high and low unemployment through time, the research was able to identify such municipalities. This was done through developing a rank indicator which compared unemployment for the period 1991 to 2007. The indicator showed that unemployment was specifically high in municipalities located in the Eastern Cape, Limpopo and KwaZulu-Natal, while municipalities of low unemployment tended to be those with low population densities. Spatial development policies, job creation policies and skills development should focus on the higher-ranking municipalities, especially those in the northern part of KwaZulu-Natal.

In terms of further research on this topic the relationship between migration and employment needs to be investigated. It would be of no import to geo-target specific municipalities with job creation initiatives while such municipalities are actually depopulating. A more detailed statistical analysis at municipality level is also required to understand the changing geography of unemployment between municipalities.

In order to become a knowledge economy a highly skilled labour force is required. Detailed spatial analysis of existing skills in municipalities can indicate where skills development is required to better equip local people for lucrative and meaningful employment. Further research should investigate specific interventions required for each municipality in terms of job creation and skills development.

This chapter has shown that geo-targeting for unemployment interventions should focus on high-ranking municipalities in Eastern Cape, Limpopo and especially those in the northern part of KwaZulu-Natal. Municipalities which are better off in terms of unemployment over time tend to be spatially concentrated in Western Cape, Northern Cape, Gauteng and most parts of KwaZulu-Natal. Since supply side policies, such as improving the training and education levels of local residents, as well as demand side policies, for example, the provision of local job creation strategies may both be beneficial in reducing urban unemployment.

Since most people depend on their jobs for their livelihood and their employment status affects their subjective sense of well-being, unemployment is an important social factor too. This is more so at this time of a global economic crisis where the world economy struggles to emerge from the deepest recession in decades and the loss of millions of jobs.

Chapter 6 Unemployment and poverty: spatial dynamics

This chapter is based on:

Weir-Smith. G, *in preparation*. Unemployment and poverty: spatial dynamics. *Geografiska Annaler: Series B, Human Geography*

Abstract
In this chapter the spatial relationship between unemployment and poverty is portrayed using South African census data from 1991, 1996 and 2001 and the 2007 Community Survey. The data was analysed at a municipality level and the area of analysis was standardised according to the administrative boundaries of 2005.

The type of poverty considered is based on the lack of income and refers to the percentage of people living in households with an income less than the poverty income line. Spatial concentration was measured using Moran I, while a Spearman rank correlation determined the correlation between poverty and unemployment. In-depth case studies of six selected municipalities also provided information.

The findings show that both poverty and unemployment were spatially concentrated over time, with the spatial concentration of unemployment increasing. Despite both phenomena being spatially concentrated, the calculated correlation between the two data sets was not consistent. In the 1991 and 1996 data this correlation was high in the more rural and sparsely populated areas, while in the 2001 and 2007 data the correlation was high in metropolitan areas. Poverty and unemployment therefore became more urban phenomena during the particular period under review.

Case studies done in a number of municipalities revealed a structural break in the local economies. What emerged was evidence that people with lower skills levels are not equipped to participate in the newly dominant economic sectors that were emerging. This could lead to unemployment, but not necessarily always to poverty.

It is recommended that policies to address poverty and unemployment should be spatially divergent. Those that focus on income transfers and asset reinforcement should be combined with policies that favour mobility across regional markets. Anti-poverty policies could also focus on linking poor villages with more dynamic regional markets.

6.1 Introduction

South Africa's official unemployment rate is 25.5 per cent (Stats SA 2014) and opinion in the field expects unemployment to reach 45.5 per cent by 2020 (Downing 2010). Besides this, the country has recorded high levels of poverty. In 2009 26.3 per cent of the total population was regarded as poor (food poverty line and adjusted for food based on the value of the dwelling unit) (Stats SA 2012b). To achieve the Millennium Development Goal (MDG) of reducing poverty by half in 2015, there is agreement among economists that a minimum pace of growth in the mean per capita consumption must be attained (De Vreyer, Herrera and Mesple-Somps 2002).

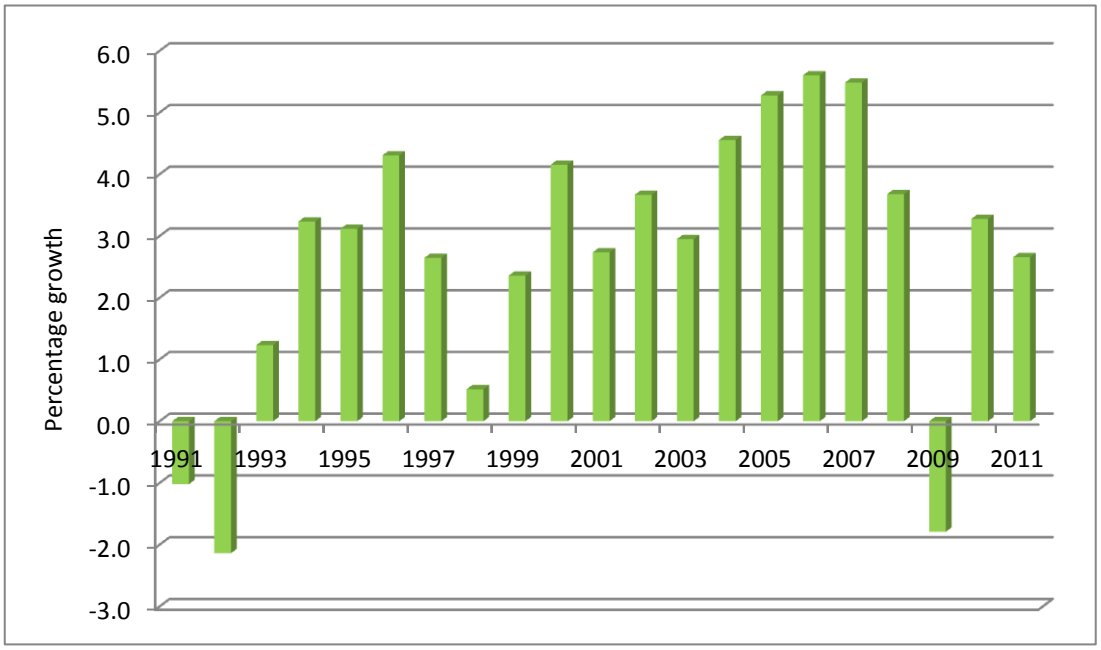

Figure 6.1 South African Gross Domestic Product (GDP) growth rate between 1991 and 2011

Source: OECD 2011

Figure 6.1 shows the economic growth rate in South Africa from 1991 to 2011. The rate was negative in 1991, 1992 and 2009. Only in the 2005 to 2007 period did the country reach a growth rate of more than 5 per cent, and yet during that time unemployment failed to drop below 22 per cent (Bisseker 2012). Growth dropped below 3 per cent in 2011 (Figure 6.1) and the current forecast is 1.2 per cent for 2013/14 (Reserve Bank 2014). The growth rate needs to be between 4 and 5 per cent to ensure that employment remains constant (Mafiri 2002). Based on the current low growth rate, it is expected that unemployment will remain high.

6.1.1 POVERTY

Since employment is seen as a possible solution to reduce poverty (Van der Berg *et al.* 2005), it is important to explore the link between poverty and unemployment. Keeton (2014) concluded that reducing inequality in South Africa boils down to having jobs. The definition of poverty has moved away from a resource-based subsistence focus to definitions that are relevant and multi-dimensional (Wright *et al.* 2007). It therefore not only refers to a lack of income, but also to a lack of resources to earn a decent living. For example, multiple deprivation studies combine deprivation in income, employment, education and within the living environment (Wright and Noble 2009).

Gradin (2012) established that an overrepresentation of Africans in poor rural areas in South Africa is associated with high poverty levels, also finding that important spatial inequalities persist and that migration has been mostly temporal. Gelderblom (2007) indicates that the poor are constrained in their migration desires owing to the costs and risks involved in migration. In conjunction with these assertions, Kingdon and Knight (2005, p. 10) draw attention to the fact that the search for jobs is hampered by poverty, by the cost of the job search process from remote rural areas and that local unemployment is prevalent and high.

Vermaak (2005) points out that between 1995 and 2003 increases in the amount, depth and severity of earnings poverty took place. Households reliant on income sources were therefore worse off in 2003 in comparison to 1995. On the other hand, Leibbrandt *et al*. (2010) found that aggregate poverty improved marginally between 1993 and 2008, while urban poverty increased.

6.1.2 REGIONAL DISPARITIES

Spatial trends in poverty have emerged from some research, namely Eastern Cape was the poorest province in 2001, while KwaZulu-Natal and Limpopo accounted for 19 per cent and 17 per cent of the chronically poor respectively (May and Meth 2004). Research in England and Wales (Gregory, Southall and Dorling 2000) showed that high poverty persisted geographically in peripheral areas in the previous century. Major conurbations also showed higher poverty than their neighbouring rural areas.

Harmse, Blaauw and Schenck (2009) found that South Africa has geographically unbalanced patterns of economic growth due to economic activities concentrating in a few locations. The SACN (2011) highlighted that the employment rate in the metropolitan areas increased despite sizeable in-migration of job seekers from elsewhere who have added to the supply of labour. Furthermore, recent research by Weir-Smith and Ahmed (2013) has shown that unemployment exhibited spatial persistence in specific municipalities in South Africa and that the spatial clustering of unemployment increased between 1991 and 2007.

6.1.3 MIGRATION

This chapter will briefly focus on migration in terms of employment and poverty since there is an expected interplay between these factors. Tomlinson et al. (2003) found that there was a net move away from the economically declining Eastern Cape and Northern Cape regions to the Western Cape and to the north-eastern part of the country. This was supported by Todes et al. (2010) who found that, for example, economic restructuring and subsequent job losses in mining and manufacturing in the Eastern Cape led to large-scale movement to more accessible small towns in the same province. Large-scale migration was towards Gauteng and to a lesser extent to Western Cape. Further to this, Kok and Aliber (2005) found that migration is driven by expectations of employment and not necessarily actual employment.

6.1.4 THE SPATIAL RELATIONSHIP BETWEEN UNEMPLOYMENT AND POVERTY

Literature sources that hint at a spatial link between poverty and unemployment abound, and endorse the need for a more thorough understanding of the spatial relationship between poverty and unemployment. McCord (2002) points out that poverty data correlated closely with unemployment figures since the poorest encountered unemployment rates of more than 70 per cent. Lack of employment is the primary cause of income inequality. Barker (1999) adds the observation that the high unemployment rate is actually also a direct contributing factor to inequality and poverty in South Africa. A different view, on the other hand, comes from Mafiri (2002) who argues that, although there might be a connection between poverty and unemployment, it is incorrect to assume that all the unemployed are poor and vice versa.

This author further claims that limited evidence could explain the lack of certainty about there being a link between poverty and unemployment.

Existing literature is not clear about a spatial relationship between unemployment and poverty. Wang et al. (2012) is one source that agrees that poverty in metropolitan areas is different to that of central cities and remote rural places. Klasen and Woolard (2008) found that rural unemployment rates in South Africa exceed those of most developing countries. Gregory, Dorling and Southall (2001) focused on poverty in Wales and England and showed that poverty persisted in some areas over the past century. They also found that although poverty has declined over time, inequality increased. In all this literature, however, the spatial link between unemployment and poverty remains unexplored. Hence the objective of this chapter is to determine whether there is a statistically significant relationship between unemployment and poverty spatially over time or not.

6.2 Methodology

A Spearman rank correlation was used to calculate the correlation between unemployment and poverty. This method was used rather than a Pearson correlation, because scatter plots showed that the relationship between the two variables was neither a perfect fit nor linear in all cases. The null hypothesis is therefore that there is a positive linear relationship between unemployment and poverty.

The data used for this study originates from recent censuses in South Africa, namely 1991, 1996 and 2001. Due to the absence of a census in 2006, Statistics South Africa conducted the Community Survey (CS) in 2007. This survey sampled 33 000 households and was large enough to report the results at a municipal level (Stats SA 2008a). The CS was the fourth data set used for this analysis. Census 2011 data was in the public domain when this research started, but was excluded because it was used as a benchmark to test unemployment forecasting (Chapter 8). The attribute data of the 1991 and 1996 censuses was aggregated to the 2005 municipal boundaries in order to ensure that the data is spatially compatible. Data from census 2001 and CS 2007 was already available for the 2005 administrative boundaries and no re-calculation was required.

The spatial concentration of poverty and unemployment was determined before conducting a statistical comparison between the two variables. Such an analysis in GIS (Geographic Information Systems) indicates whether the spatial distribution of these variables is random or not. The type of poverty that is considered here is based on a lack of income and refers to the percentage of people living in households with an income less than the poverty income line. The poverty income line (or minimum living level) is defined as the minimum monthly income needed to sustain a household and varies according to household size (Landman et al. 2003). The larger the household the larger the income required to keep its members out of poverty (Global Insight 2011).

A direct poverty measure was not available from the census 1991 data. Hence a proxy variable, namely the number of adults with primary education as their highest education level, was used. This was the variable closest to functional literacy, and it displayed similar linear trends for each census year in relation to unemployment.

Data on migration was not readily available in a spatial format. To obtain an understanding of migration trends a range of data sources were consulted. The HSRC created migration variables from the 1991 and 1996 census data. Stats SA was not able to produce similar variables on request census 2001 or CS 2007 for the 2005 spatial boundaries. Together with

these two data sets, a third data set from the Independent Electoral Commission (IEC) based on voters' registration data was used.

The IEC data could not be used for absolute comparison, because its underlying database differed from that of census. Voter registration refers to the adult population of people aged 18 years and older in South Africa and only includes those adults who registered to vote. The basis is therefore completely different. The current number of registered voters in South Africa is 25.3 million out of a total population of 51.8 million (IEC 2014). According to Stats SA (2012a) the approximate number of people aged 18 years and older was 47.7 million. So the pool of data used by the IEC is significantly smaller than that of the census.

Net migration (the difference between the number of persons entering and leaving an area during a year) trends were therefore deduced from the HSRC, Stats SA (census) and IEC (voters' registration) data at a municipal level; and from the HSRC and Stats SA at a provincial level. A positive value means that there were more people entering than leaving the country and a negative value reflects the converse. Statistics do not reflect those who migrate illegally, because these movements are not captured on formal systems. Information from other sources like the United Nations World Population Prospects (2012) enhanced the clarification of the identified trends.

The Human Development Index (HDI) measures human development based on a long and healthy life, knowledge and a decent standard of living (UNDP 2013). This approach was used in the analysis of case studies and the data was sourced from Global Insight (2011). HDI data from Global Insight tends to have lower values than those of the HSRC for 1996 (e.g. HSRC 1996 for Peddie indicates a HDI of 0.55 while Global Insight indicates 0.42). HSRC data was based on census 1996 while Global Insight adjusted census data for 1996, census 2001 and the CS 2007 results (Global Insight 2011). Since HSRC data was only available for 1996, the Global Insight data was used to ensure consistency over time.

6.3 Results and discussion

The spatial distribution of both poverty and unemployment showed concentrations over time (Table 6.1). Poverty was spatially less concentrated and remained steady over the study period, while unemployment increased in spatial concentration from 0.61 to 0.71.

Table 6.1 Spatial clustering of poverty and unemployment

	Moran's I	**Z-score**	**Spatial Concentration**
Poverty			
1991			
1996	0.57	23.92	Clustered
2001	0.52	21.84	Clustered
2007	0.53	22.55	Clustered
Unemployment			
1991	0.61	25.87	Clustered
1996	0.50	21.25	Clustered
2001	0.71	30.08	Clustered
2007	0.71	29.92	Clustered

Source: Own calculations

Table 6.2 shows the results of a Spearman's rank correlation application between the poverty rate and unemployment rate from 1991 to 2007. The table reflects trends and clearly

indicates that the relationship between the two variables is not the same over a specific period. In Western Cape and Free State the correlation was negative in 2001 and 2007. The correlation was also very low in the various years for Eastern Cape, Free State, Gauteng, Limpopo, Northern Cape and Western Cape. This indicates that there are factors other than employment that have a bearing on poverty.

Table 6.2 Spearman's rank correlation for poverty and unemployment per province (including all municipalities)

Province	**1991**	**1996**	**2001**	**2007**
Eastern Cape	.13	.85*	.77*	.11
Free State	.95*	.47	-.13	.35
Gauteng	.97*	.56	.11	.46
KwaZulu-Natal	.94*	.87*	.67*	.40*
Limpopo	.76*	.91*	.35	.17
Mpumalanga	.95*	.92*	.64*	.64*
Northern Cape	.78*	.57*	.28	.32
North West	.20	.66*	.38	.44
Western Cape	.84*	.37	-.23	-.18
Total	**.74***	**.86***	**.71***	**.54***

* Significant at 0.05

Source: Own calculations

The relationship between the poverty rate and unemployment rate at a national level was positive and imperfect in 1991, 1996, 2001 and 2007. Provincial trends showed that the relationship between poverty and unemployment in the Western Cape was imperfect and positive in 1991 and 1996 (however, Cape Town metropolitan area was an outlier in 1991). In 2001 and 2007 the relationship was negative in this province. In the Eastern Cape the relationship was positive and imperfect for all years, except in 2007 when there was no relationship.

In the Northern Cape the relationship between poverty and unemployment was positive over all the years. Moshaweng municipality (low population density and high unemployment) was an outlier in 1996 and 2001. In the Free State, the relationship was positive except in 2001 and was curvilinear in 1996. Outliers in the data were: Mangaung (the largest urban municipality in the province); Maluti a Phofung (Harrismith and in the former QwaQwa - high population density and more than 50 per cent unemployment); Matjhabeng (Welkom - second largest urban area in the province) in 1991; and Golden Gate (a district management area (DMA) with low population density and low unemployment) in 2001 and 2007.

In KwaZulu-Natal, eThekwini (Durban) was an outlier in 1991 with a very large number of unemployed people. In 1996 and 2007 the relationship between unemployment and poverty was curvilinear while it was linear and imperfect in 2001. In the 2001 and 2007 data outliers were uMgungundlovu, Uthukela and Sisonke - all DMAs. These municipalities have very low unemployment but very high poverty rates.

In Limpopo the relationship between poverty and unemployment was imperfectly linear in 2001 and 2007. Outliers included Mopani, a DMA, with a low unemployment rate, but fairly high poverty level. In Limpopo, Makhado was an outlier in 1991 (high unemployment and low number of people with completed primary education). In 1996 the relationship between the two variables was curvilinear, in 2001 imperfect linear, and in 2007 the relationship was

not clear. The relationship between poverty and unemployment in Mpumalanga was not clearly linear in 2001 and 2007. In 1996 the relationship was curvilinear. In 2001 and 2007 the Ehlanzeni (a DMA) municipality had very low unemployment, but high poverty and was therefore an outlier in the data.

The spatial distribution of poverty in 2007 (Figure 6.2) shows that most metropolitan areas had a poverty rate of between 20.1 and 30 per cent. The most severe poverty (more than 60 per cent) occurred in the Eastern Cape, KwaZulu-Natal, North West and Limpopo.

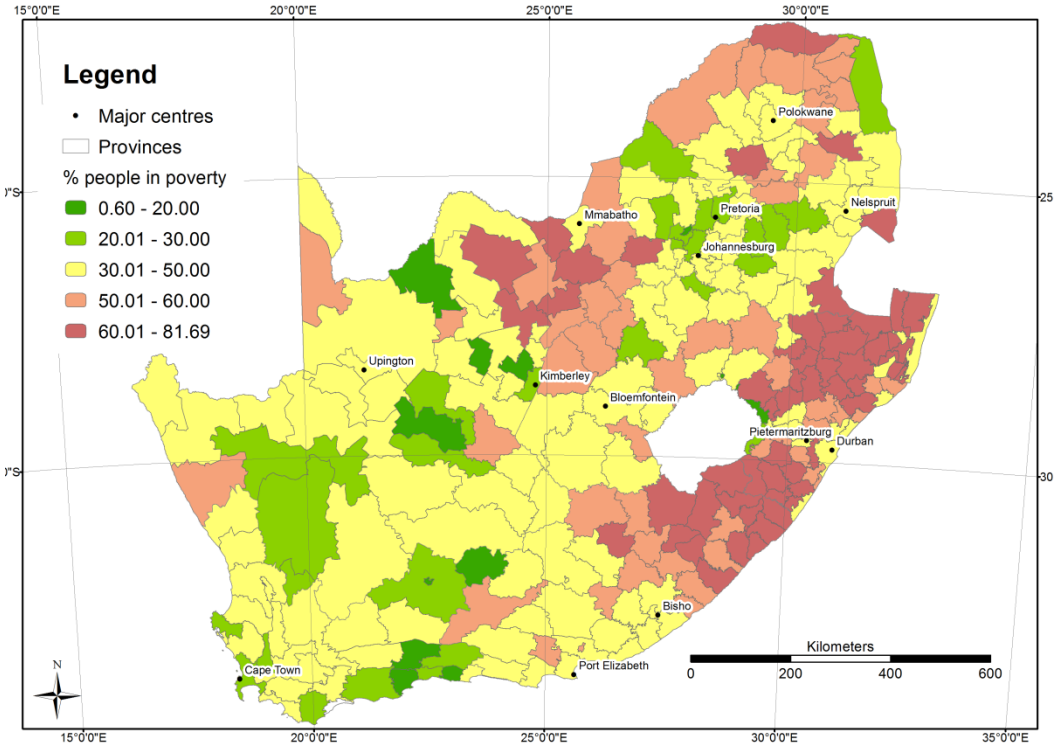

Figure 6.2 Spatial distribution of poverty in 2007

Source: Adapted from Global Insight 2011

Municipalities in the second highest category of poverty (between 50 to 60 per cent) were adjacent to the worst off ones, and this illustrates the spatial concentration of poverty. Twelve municipalities had a poverty rate below 20 per cent and six of these were district management areas (DMA). DMAs are areas of low population density, and often have large open spaces like land set aside for national parks or conservation areas. The other six municipalities were located in Northern Cape and Western Cape. The Northern Cape municipalities were areas of fairly low population density while the Western Cape municipalities were all located in the southern part of the province.

6.3.1 Analysing Specific Sub-Groups

Data for metropolitan areas and DMAs were excluded from the next level of analysis as the results differed. Table 6.3 shows that correlation values were much lower, especially for Gauteng, KwaZulu-Natal and Mpumalanga. In provinces like Northern Cape, North West and the Western Cape the correlation between poverty and unemployment was negative.

Table 6.3 Spearman's rank correlation for poverty and unemployment per province (excluding metropolitan areas and District Management Areas)

Province	1991	1996	2001	2007
Eastern Cape	.08	.83*	.79*	.07
Free State	.11	.39	-.30	.25
Gauteng	.45	.43	-.05	.50
KwaZulu-Natal	.40*	.85*	.62*	.26
Limpopo	-.07	.90*	.27	.06
Mpumalanga	.15	.91*	.60*	.67*
Northern Cape	.12	.59*	.08	.15
North West	-.51*	.66*	.38	.44*
Western Cape	-.46*	.50*	-.35	-.22
Total	**.04**	**.85***	**.70***	**.49***

* Significant at 0.05

Source: Own calculations

In 1996 the relationship between poverty and unemployment at a provincial level was much stronger, and only Free State and Gauteng did not have significant values for this particular year. In 2001 the relationship between poverty and unemployment was only significant (and positive) in Eastern Cape, KwaZulu-Natal and Mpumalanga. This reduced to two provinces showing a significant relationship in 2007, namely Mpumalanga and North West.

This exercise of excluding outlier values from the analysis, showed very different results. Overall the correlation values were much lower, except in 1996 when seven out of the nine provinces had high correlations between poverty and unemployment. Metropolitan provinces like Gauteng, which consists of three metros covering most of the province's area, showed much weaker and often negative correlations. Gauteng and Free State did not have significant correlations between poverty and unemployment for any of the census periods, while the Western Cape had mostly negative values. The provinces which had three or more periods of significant correlations were KwaZulu-Natal, Mpumalanga and North West. To search for further clarification on the relationship between poverty and unemployment the next analysis extracted all the metropolitan areas and most of the DMAs from the original data set and analysed it separately, because they were consistently outliers in this first analysis.

Metropolitan municipalities

The relationship between unemployment and poverty in the metropolitan areas was imperfect and curvilinear in all years. The relationship was only significant in 2001 and 2007 at R^2= 0.943 and 0.886 respectively.

District management areas

Contrary to the metropolitan findings, the relationship between unemployment and primary education/poverty in the DMAs was only significant in 1991 and 1996. R^2 values of 0.944 and 0.562 were recorded. In 2001 the relationship was negative and insignificant while it was positive and non-significant in 2007.

6.3.2 SELECTED CASE STUDIES

To analyse the socio-economic characteristics for the 257 municipalities meaningfully is a challenge, therefore specific municipalities were selected through inspection. Spatial categorisation of unemployment (Chapter 7) and a geographic spread across the country

informed the process. The selected municipalities (Table 6.4.) represent one municipality from each category.

Table 6.4 Selected municipalities for in-depth analysis

Unemployment group	Municipality (main town)	Province
Category 1	eThekwini (Durban)	KwaZulu-Natal
Category 4	Makhado (Louis Trichardt)	Limpopo
Category 8	King Sabata Dalinyebo (Mthatha)	Eastern Cape
Category 12	Ngqushwa (Peddie)	Eastern Cape
Category 13	Khara Hais (Upington)	Northern Cape
Category 15	Dihlabeng (Bethlehem)	Free State

Figure 6.3 shows that unemployment rates peaked in 2001 and thereafter reduced, but they did not return to their lowest level. At the same time, poverty also rose across all municipalities over time and unemployment rates were higher than poverty in Mthatha and Peddie. After 2001, poverty rates dropped but not as low as their value in 1996.

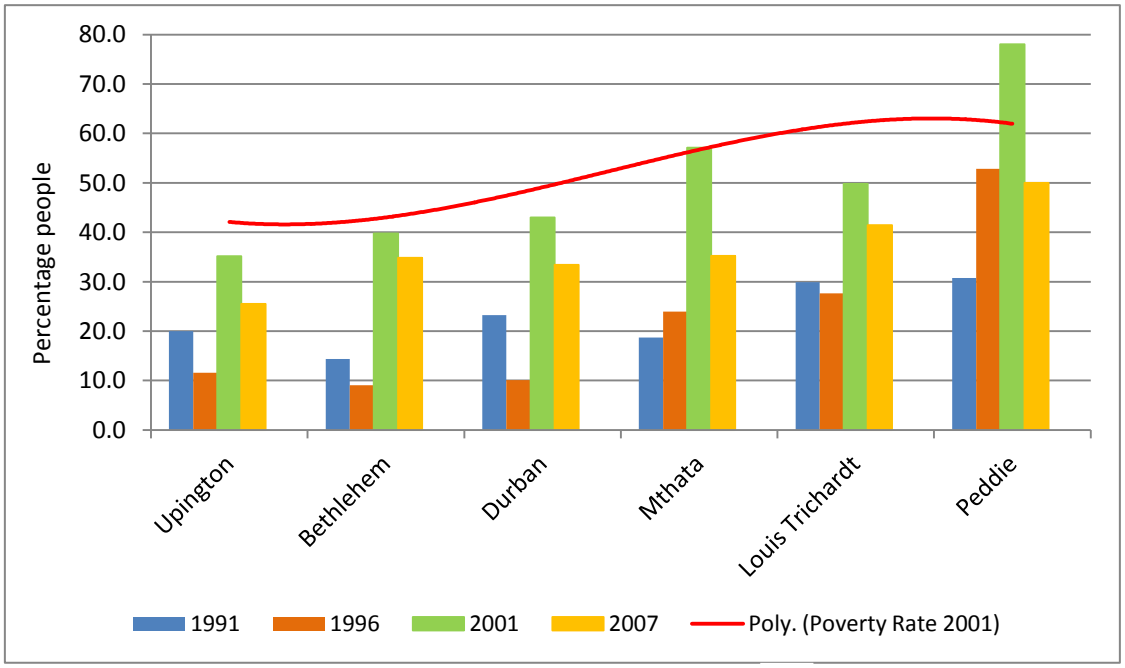

Figure 6.3 Unemployment and poverty rates in six municipalities

Source: Own calculations

Provincial trends of migration in Table 6.5 show that only Gauteng and Western Cape had positive net migration statistics (🡅) throughout the research period. In comparison, Eastern Cape and Limpopo had negative net migration statistics (🡇) for all years. The net migration for the six selected municipalities showed that all municipalities had a net loss of population in 1991 and 1996 (HSRC, 1991 and 1996). The same trends for the 2001 to 2011 period have continued, however, Bethlehem in the Free State had a slight influx of people. Emigration from Mthatha, Louis Trichardt and Peddie was very marked. The Durban metropolis had slightly negative net migration statistics for this period.

Table 6.5 Provincial trends of net migration

	1991	1996	2001	2007
Eastern Cape	↓	↓	↓	↓
Free State	↑	↓	↓	↓
Gauteng	↑	↑	↑	↑
KwaZulu-Natal	↓	↓	↑	↓
Limpopo	↓	↓	↓	↓
Mpumalanga	↑	↓	↑	↓
North West	↑	↑	↓	↓
Northern Cape	↑	↓	↑	↑
Western Cape	↑	↑	↑	↑

Sources: Stats SA 2007b, 2012b and HSRC 1991 and 1996.

The overall net migration for South Africa is reflected in Table 6.6 and shows a positive inflow of people for all years of this study. There was a decrease in net migration figures between 1995 and 2000, but the number increased again between 2000 and 2005.

Table 6.6 Net migration rate per 1 000 population in South Africa

Year	**1990-1995**	**1995-2000**	**2000-2005**	**2005-2010**
Rate	4.115	0.737	4.607	5.628

Source: United Nations 2011

Further to local migration, economic growth is also important in understanding local unemployment. Sustained economic growth of more than 3 per cent per annum results in the creation of employment opportunities (Mafiri 2002; McCord 2002). Figures 6.4 - 6.8 show economic growth rates together with unemployment and poverty rates for the selected municipalities and these are now discussed in more detail.

Bethlehem

In Bethlehem economic growth rates were cyclical to unemployment and poverty rates, although the poverty rate did not decrease in 1996. It remained between 36 and 50 per cent. Despite an increase in the economic growth rate in 2007, the unemployment rate remained more than 30 per cent in the same year. Further statistics show that most people, 36.8 per cent, had primary schooling in 1991 and this increased to 49.3 per cent in 2007. The population increasingly urbanised and the urban population was 52.4 per cent of the total in 1991 rising to 72.4 per cent in 2007 (Global Insight 2011).

The local economy of the Bethlehem area employed most people in the community services sector (31 per cent of all people employed in 2007) and wholesale sectors. In 2001 most people were employed in community services and finances while in 1991 most people were employed in agriculture and community services. Of the selected case study areas, Bethlehem employed the highest percentage of people (7 per cent) in the agriculture sector (in 2007).

The HDI was 0.54 in 1996, decreased slightly in 2001 and was 0.55 in 2007 (Global Insight 2011). The figure is slightly above average. The HDI has a value between 0 and 1 with 1 indicating perfect development. Bethlehem experienced an outflow of people between 1991 and 1996 (HSRC 1991 and 1996) and a slightly positive inflow of people since 2001 (IEC 2011). It was the only area in the case study with a positive inflow.

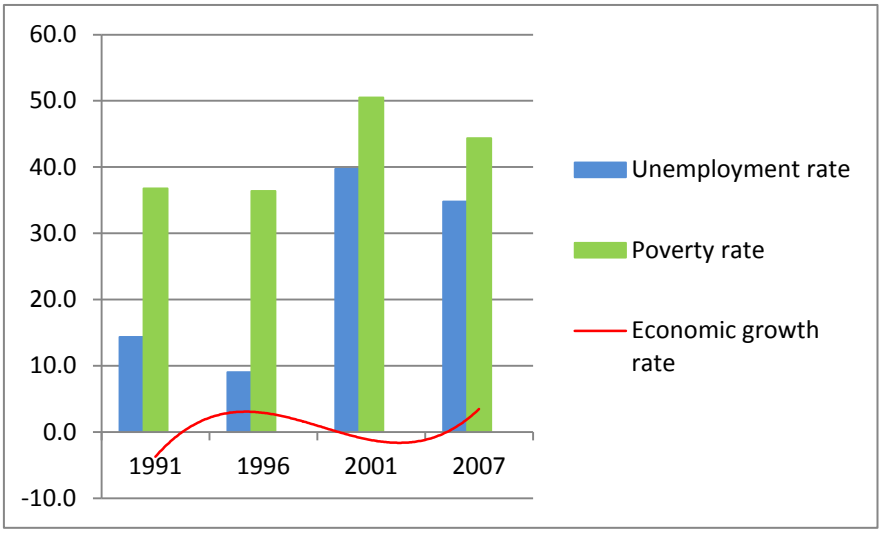

Figure 6.4 What is where when: Bethlehem

Sources: Own calculations and Global Insight 2011

Economic growth rates fluctuated in the opposite direction to unemployment and poverty rates, the expected pattern - when economic growth was poor, unemployment was high. In 1991 and 1996 unemployment was below 15 per cent and yet poverty was around 37 per cent. The poverty rate was 50 per cent in 2001 and decreased to 44 per cent in 2007 (Global Insight 2011).

The local economy changed from an agricultural dominant one to a wholesale one between 1991 and 2007. The decrease in the agriculture and community services sectors concurs with national trends. The manufacturing and the wholesale and retail sectors employed more people by 2007 and this is contradictory to the national trend. The local economy developed strongly in the latter two sectors and this indicates a structural break. Since the majority of people (49.3 per cent) only had primary education in 2007, there is a skills mismatch in the area. Harmse, Blaauw and Schenck (2009) classified this area as downward transitional.

The inflow of adults from 2001 can be ascribed to the development of niche towns like Clarens nearby, and the development of the wholesale and manufacturing sectors. Despite economic growth of around 3 per cent, the local economy still suffered from unemployment rates of over 30 per cent in the last two years of the study period.

Durban

The statistics for Durban showed that unemployment and poverty were within 10 per cent of each other in all years, except 1996. Furthermore, the unemployment rate was high even when the economic growth rate was high. The city experienced an increase in population density from 983 people per km² in 1991 to 1 503 people in 2007.

In 1991, 44.7 per cent of the city's adult population had completed their secondary schooling (own calculations). By 2007 this had decreased to 40.7 per cent with most people (45.5 per cent) having primary schooling as their highest education level. Of the selected municipalities, Durban had the highest percentage of adult population (8.9 per cent) with tertiary education in 2007.

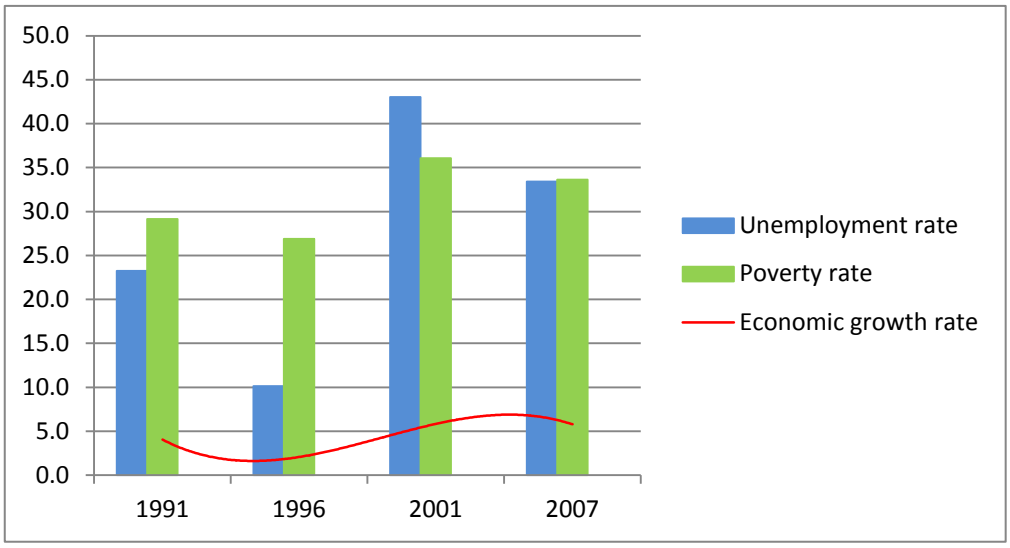

Figure 6.5 What is where when: Durban

Sources: Own calculations and Global Insight 2011

Between 1991 and 1996 the city showed an increased outflow of people. This stabilised and since 2001 there was only a slight outflow of people. Most people in the city were employed in community services (30 per cent) and the manufacturing sector (26 per cent) in 1991. This trend changed around by 2007 when the finance sector employed most people (20 per cent) followed by the trade (17 per cent) and transport sectors (16 per cent).

The poverty rate of this metropolitan area remained above 30 per cent. It experienced a slight outflow of people (below 500) between 2001 and 2007 (IEC, 2011) while the province as a whole showed negative outflows in all years, except 2001 (Stats SA 2012b).

The local economy experienced economic growth of almost 6 per cent in 1996 and 2001 and unemployment and poverty reduced accordingly in subsequent years. Growth rates were expected to decrease in 2011 and this situation should therefore change around. The local economy followed national trends in terms of the number of people employed by each sector.

Despite having the highest per capita income of the case study areas, the area still suffered high percentages of poverty. Todes et al. (2010) concluded that KwaZulu-Natal and Gauteng were the two provinces that had the highest inflow of displaced farm workers. This group of people are usually relatively unskilled. The continuing migration to cities and urban areas does not necessarily translate into employment.

Mthatha

In Mthatha the poverty rate remained consistent around 60 per cent irrespective of the trend of the economic growth rate. The unemployment rate more than doubled between 1996 and 2001. This area experienced a strong outflow of people in 1991 and the outmigration increased and remained negative over time.

The percentage urban people in Mthatha remained low throughout the study period. In 1991 it was 13.8 per cent (own calculations) and increased to 25 per cent in 2007 (Global Insight 2012). No data on education levels were recorded in 1991 and in 1996, although 36 per cent

of the adult population had not completed any schooling. By 2007 the majority of the adult population (50 per cent) had completed primary school while 42 per cent also completed secondary school. Despite improved education levels, unemployment increased and remained high.

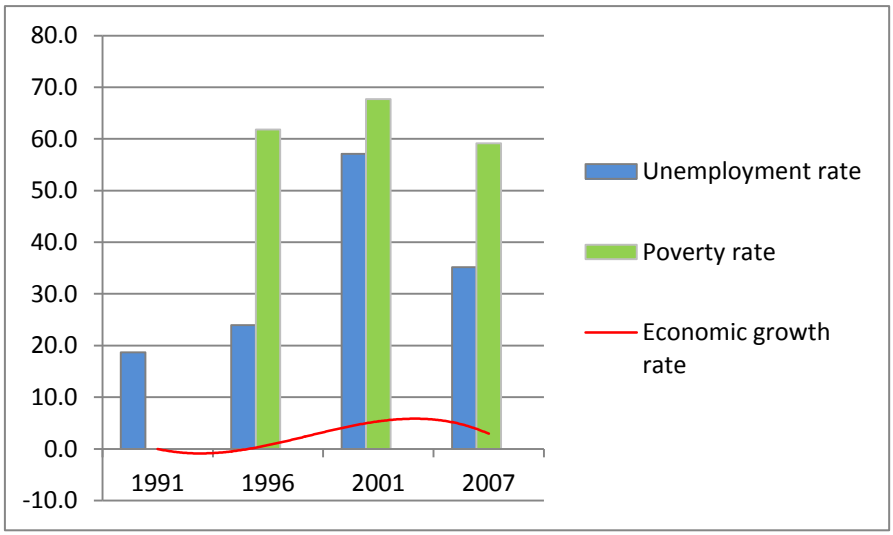

Figure 6.6 What is where when: Mthatha

Sources: Own calculations and Global Insight 2011

Lack of data makes it difficult to identify all trends in this municipality. The dominant economic sector in 2007 was community services, which employed 43.7 per cent of the local population (this was the second highest of all case study areas). Despite a low urban population less than 1 per cent of the economically active population was employed in the agricultural sector. There is a clear skills mismatch in this area, which leads to high poverty rates (around 60 per cent). Furthermore, Mthatha lost population by outward migration to more viable locations. Todes et al. (2010) refer to this as the move to "leading towns".

Louis Trichardt

Louis Trichardt was the only municipality in the case study selection whose economic growth rate continually declined from 1991. Besides this, the municipality also had constantly high poverty rates (above 50 per cent). About 2 000 adults emigrated from the area between 2000 and 2011 (IEC, 2011). In 1991, the majority of people (45.7 per cent) had no education. This trend changed by 2007 since 49.1 per cent of adults had completed their secondary education. However, there was still a significant number (43.8 per cent) of people with primary education as their highest education level. The urban population was 3.6 per cent of the total population in 1991. This rate slightly increased in 1996 and reduced again to 4.6 per cent in 2007.

This is a largely rural municipality with more than 90 per cent of the population being non-urban. Of those employed in the formal economy, most were employed in agriculture (41.8 per cent) in 1991. This trend changed with most people (40.2 per cent) being employed in community services in 2007. The area experienced a counter-cyclical trend because more people were employed in the community service sector by 2007 than agriculture which indicates a structural break in the local economy.

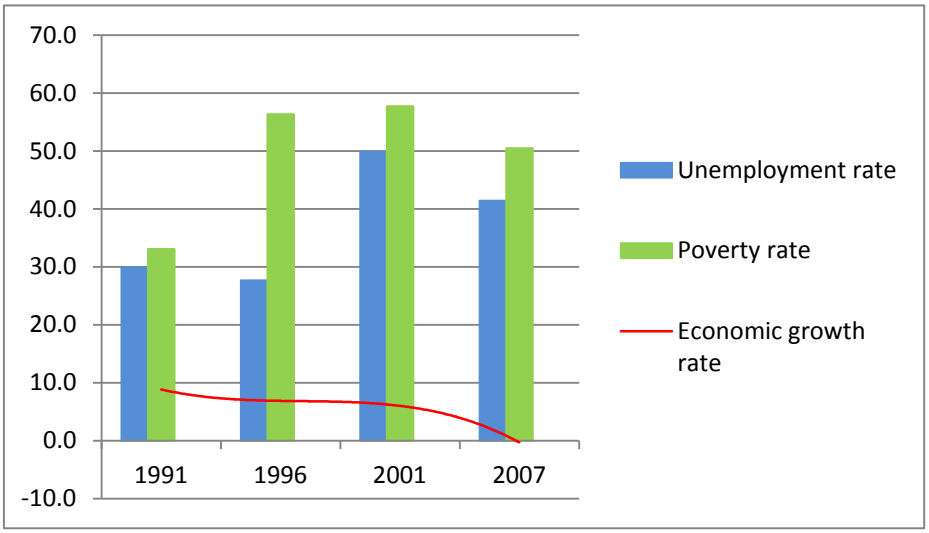

Figure 6.7 What is where when: Louis Trichardt

Sources: Own calculations and Global Insight 2011

Besides this, 43.8 per cent of the adult population had completed a primary education by 2007 while 49 per cent had completed secondary education. The area also had a continuous outflow of people from 1991 onwards. Despite the fact that the area has very arable land, employment in the agricultural sector was only 2.8 per cent in 2007 (below the national average). Increased mechanisation and restrictive labour laws have accelerated this decrease.

Peddie

Directions of economic growth, poverty and unemployment rates were as expected. The poverty rate steadily increased from 1991 and peaked at 62.6 per cent in 2001. It slightly decreased in 2007. In 1991, 30.2 per cent of the adult population had a secondary education while this figure increased to 51.3 per cent in 2007. However, a large proportion of the adult population (45.9 per cent) still only had primary education.

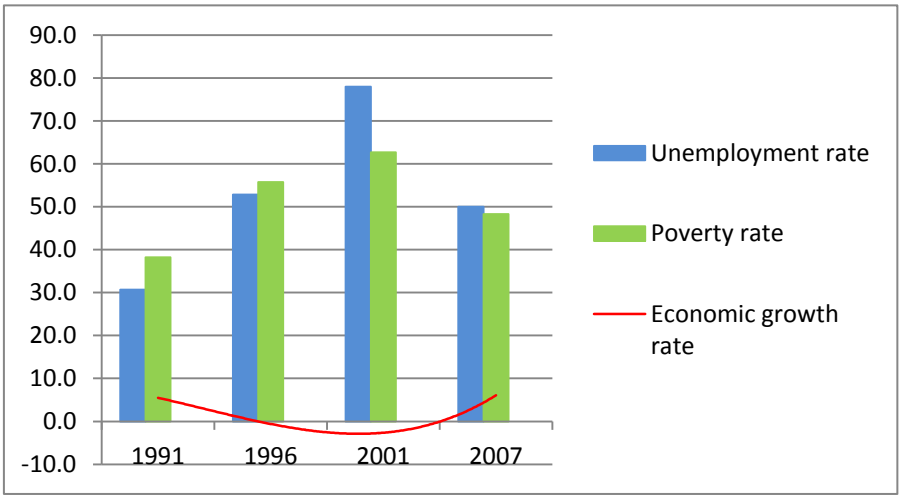

Figure 6.8 What is where when: Peddie

Sources: Own calculations and Global Insight 2011

Fewer than 10 per cent of the total population are urbanised (own calculations). In 2007, 58.7 per cent of the adult population was employed in the community services sector and this large percentage indicates an imbalance in the local economy. In 1991, this sector employed 39.1 per cent, while agriculture employed 31.3 per cent of the working adult population. The increase in people employed in the community services sector, is counter-cyclical to the national trend.

This remains a very poor area with both poverty and unemployment remaining around 50 per cent over time. Since the HDI was also below 0.50 in all years, this is a point of concern. The Peddie area had the worst unemployment ranking among the case study areas over all the years being considered.

Specific drives to educate the population and diversify the local economy are required. The possibility is strong that the majority of people are employed in the informal sector. Since the agricultural sector has basically collapsed, other economic sectors should be stimulated to create jobs for the local population. However, more than 90 per cent of the population is rural and this will be a challenge. The recreation of an agricultural specific market might provide a solution. However, Harmse, Blaauw and Schenck (2009) classified this as a downward transitional area.

Upington

Despite economic growth increasing in 2001 and 2007, both unemployment and poverty increased. In comparison to other municipalities the poverty rate was somewhat lower at 36 per cent in 2007. This area is semi-dessert and the population is predominantly urban (92 per cent) (Global Insight 2011).

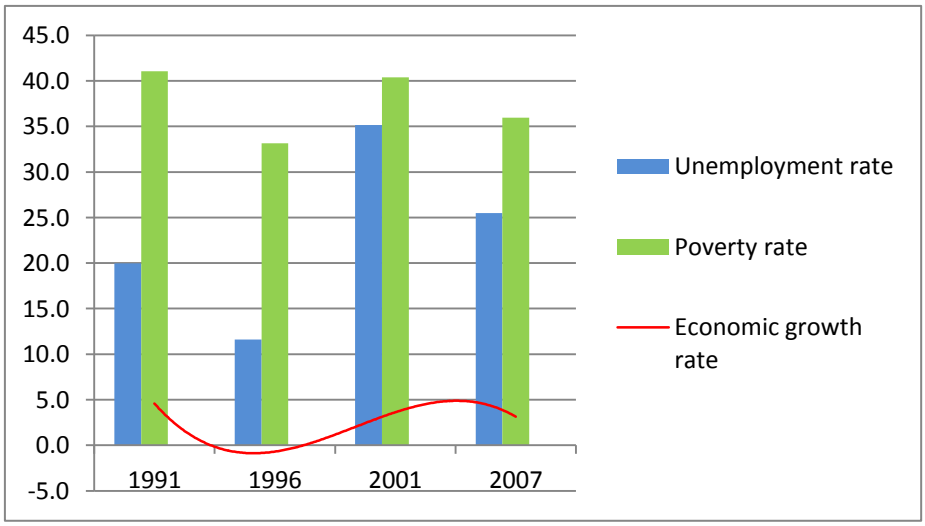

Figure 6.9 What is where when: Upington

Sources: Own calculations and Global Insight 2011

In 1991, 41 per cent of the adult population had completed a primary education and by 2007 this had risen to 51 per cent. Forty per cent of the adult population had secondary education in 2007 (own calculations). In 2007, 28 per cent of the population was working in the finance sector while another 23 per cent worked in the community services sector. In 1991, 41 per cent of the population worked in the agricultural sector. This reduction of

employment in the agricultural sector as well increased employment in the financial sector is similar to national trends.

The Northern Cape had an inflow of people in all the years this study was considering, except 1996. The HDI increased steadily and was at 0.61 in 2007 (Global Insight 2011). The Orange River (now Gariep River), which flows through the area, provides many work opportunities. Over time, these opportunities changed from agricultural to financial in nature, showing that the local economy has diversified.

The Upington area had the lowest unemployment rate of the selected case studies and the best ranking in terms of unemployment - better than the Durban metropolitan area. The diversified economy is a positive trend. To continue efforts to increase the level of secondary education is required. This will strengthen the local economy.

In general

Significant observations from the analysis of the case studies are noted. In Peddie and Durban the unemployment rate was higher than the poverty rate in 2001. In Peddie, however, the unemployment rate was close to 80 per cent. The economic growth rate in these two areas was also at its highest in 2001. The dominant trend shows that the poverty rate was consistently higher than the unemployment rate.

Durban, Peddie and Upington had a slump in economic growth rates between 1991 and 1996. In Peddie, the growth rate dropped further between 1996 and 2001 and increased to 6.1 per cent in 2007. In Upington, unemployment and economic growth rates fluctuated in the same direction over the research period. The sub-group analysis shows that the correlation between poverty and unemployment was significant in the metropolitan areas only in 2001 and 2007. This could be ascribed to the intensifying of poverty in urban areas. In 2005, the proportion of urban people nationally was around 59 per cent of the total population (United Nations 2011).

The metropolitan findings in 2001 and 2007 showed an inverse trend in comparison to the DMAs in 1991 and 1996 and this indicates that poverty shifted from low population density municipalities to high population density municipalities during the time of the study period. In other words, poverty became more of an urban phenomenon. This trend stands out as Western Cape and Gauteng received a large number of in-migrants during the study period (Stats SA 2012b). It is, however, counter-intuitive to findings like that of McCord (2002) who believes that unemployment and poverty are closely linked (6.1.4) and can be ascribed to the fact that this research considered the spatially detailed extent of both phenomena. The national, unfiltered results of this study would have reached the same conclusion as the study.

In 1991 the percentage people with primary schooling as their highest completed education level was used as a proxy for poverty. Although the variable might have shortcomings, it did serve as a basis for longitudinal analysis.

Insight into local unemployment trends came from economic growth information. However, it has to be borne in mind that usually there is a time lag between higher economic growth and evidence of less unemployment resulting from it. The significant growth in 2007 did not equal lower unemployment rates immediately, but rather a quarter later. It is therefore difficult to reconcile the latest economic growth rates with employment realisation. Furthermore, the global post-2008 economic slowdown did not bode well for the reduction

of unemployment. Areas like Bethlehem and Peddie, which had upward economic growth trends in 2007, might not have necessarily benefitted from this in 2011.

Three areas in the case study had more than 4 per cent growth in one year only. Louis Trichardt and Durban had more than 5 per cent growth twice, while Upington did not experience such growth at all. Despite this, Upington still had relatively low poverty rates (between 33 and 41 per cent) - the second lowest after Durban.

This research has shown that spatial disparities do exist in socio-economic development and the unemployment and poverty rates of the country. These patterns tend to be related and are spatially clustered. Furthermore, the results show that people can be not only poor and unemployed, but also poor and employed. Poverty is therefore not determined by employment status – employment status is not a determinant of poverty.

The null hypothesis is accepted for KwaZulu-Natal, Mpumalanga and North West where there was a positive linear relationship between unemployment and poverty in most years. It is also accepted for metropolitan municipalities in 2001 and 2007.

The null hypothesis is rejected for Free State, Gauteng, Limpopo, Northern Cape and Western Cape as well as for district management areas (DMAs) where there was a negative or non-linear relationship between unemployment and poverty.

In Eastern Cape the relationship between unemployment and poverty was significant twice during the study periods and non-significant in the remaining periods. It can therefore neither be accepted nor rejected in this case.

6.4 Conclusion

This chapter set out to determine the statistical relationship between poverty and unemployment. High-level findings indicated that both phenomena were spatially clustered and the spatial concentration of unemployment increased over time. Extending this contention further is that the statistical analysis showed that the correlation between poverty and unemployment was continuously strong only in KwaZulu-Natal, Mpumalanga and North West. In other words, as unemployment increased in these provinces, so did poverty. It would make sense to address poverty in these provinces by increasing employment opportunities.

In Western Cape the relationship between poverty and unemployment was mostly negative, but not significant. In Gauteng and Free State there was no significant correlation between poverty and unemployment and poverty. It appears that here poverty is determined by factors other than employment. The statistical correlation between poverty and unemployment therefore does exist at national level but in some provinces only.

Policies to address poverty and unemployment should be spatially divergent. Those that focus on income transfers and asset reinforcement (particularly human capital) should be combined with policies that favour mobility across regional markets. They would then therefore have to address both socio-economic and geographic shortcomings.

Anti-poverty policies could also focus on poor villages and link them to more dynamic regional markets. Given the fact that the unevenness of wealth and development across space is not an anomaly that economic processes will eventually iron out, policymakers will have to decide on the most important areas to target.

The issue of labour laws was not investigated in this research. However, it is safe to assume from the results of this research that their spatial impact will be homogeneous, as labour laws will have the same impact at the national, provincial and sub-provincial levels. The labour market company Adcorp, believes that high unemployment rates will in future be caused by labour laws and regulations and therefore this aspect should be acknowledged.

The value of this research is that it has underlined the tremendous need for spatially refined data to fully understand the complexities of the South Africa labour market. Many decisions are made at a national level without considering local labour market conditions. Census data rather than Labour Force Survey (LFS) data, was used throughout this study so the results should be consistent. Census data on unemployment was seen as having considerably more in-depth than statistics from the LFS.

Since poverty has shown sharp increases in metropolitan areas and these areas are clearly outliers in the data, it will be important to investigate their occurrence within sub-municipal geographies in future research. Moreover, the exclusion of district management areas from such an analysis should be considered since these only constitute 0.01 per cent of the total population.

This research has added new knowledge in terms of the spatial relationship between unemployment and poverty and has contradicted two commonly held views: first, that unemployment and poverty are strongly correlated; and second, that employment could be a solution to poverty. Although employment could reduce poverty it is seemingly not the only remedy to the poverty problem. Equally significantly, this research has also illustrated that there can be no blanket approach to addressing poverty.

Acknowledgements
The author would like to thank the Independent Electoral Commission (IEC) of South Africa for access to voter migration patterns between 2000 and 2011.

Chapter 7 The spatio-temporal variation of South African unemployment trends at sub-provincial level

This chapter is based on:

Weir-Smith. G, *submitted*. Finding the jobless: trends of spatio-temporal variation in unemployment at sub-provincial level. *The Professional Geographer*

Abstract

Constructing a spatio-temporal understanding of the labour market is difficult because of the problems and vagueness related to data, and issues of changing spatial boundaries. Even though it is widely used as an economic and social indicator, it is difficult to define in a clear way.

A combined database of unemployment between 1991 and 2007 at municipal level was used to group municipalities spatially according to unemployment levels. The spatial grouping was done using ArcMap software. A dissimilarity index between the unemployed and the employed was created and this indicates what proportion of the unemployed need to move their existing location in order to obtain an equal spatial distribution of the two groups.

The results showed that metropolitan municipalities had unique unemployment characteristics and, contrary to findings elsewhere, an overall decrease in the dissimilarity between the unemployed and employed was seen to have taken place since 1991. Segregation between the unemployed and the employed increased in a few district municipalities and these areas consisted of a mix of small urban areas with a large hinterland of low population density. In-migration was low or non-existent.

Dissimilarity increased in a few district municipalities and this reflects an increase in inequality. Unemployment needs to be addressed in these areas to prevent inequality from rising. The spatial clustering of municipalities by unemployment identified metropolitan areas as unique and therefore polices to address unemployment throughout the country needs to be divergent.

Key words
Spatial grouping, dissimilarity, unemployment, South Africa

7.1 Introduction

Labour market data is a type of statistical data that is full of problems (Illeris 1985), and the unemployment rate is no exception. Even though it is widely used as an economic and social indicator, it is difficult to define in a clear way (Green 1998). Thus a detailed temporal understanding of unemployment is potentially challenging to construct. The South African labour force grew rapidly between 1995 and 2003 - over 4 per cent per annum, which is extremely unusual in international terms (Kingdon and Knight 2005). This trend slowed down between 2008 and 2012. The year-on-year change in the labour force between 2008 and 2009 was -1.4 per cent and it increased to 3.1 per cent between 2011 and 2012 (Stats SA 2008d, 2012c).

The three possible explanations for the high labour force growth up to 2003 that Kingdon and Knight (2005) offer are: in-migration; rapid natural increase in the number of working-age people; and increased labour force participation. In-migration is difficult to quantify as much of it is informal or illegal. Part of the explanation is a rapid rate of increase in the adult population, due either to natural increase or net in-migration. The adult population grew by 2.7 per cent per annum over the period 1995-2003, whereas the labour force grew by 4.2 per cent per annum. The labour force participation rate rose from 48 to 54 per cent over the eight years. Kingdon and Knight (2005) concluded that labour force growth could be exaggerated by changing definitions, changing coverage or sampling errors. Branson (2006) maintained that increased labour force participation between 1995 and 2004 is based on increased youth participation and not due to a decline in the availability of jobs.

The high and rising rates of unemployment in South Africa during the 1990s appear to be the result of large increases in the natural rate of unemployment (NAIRU) or large increases in the economically active population, and the shedding of jobs in the mining sector, particularly gold mining (Hodge 2002). In a similar situation, the mismatch between the demand for and the supply of employment resulted in economic restructuring in the United States of America (Wilson 1987).

Different types of unemployment provide an indication of the possible reasons for unemployment which would give some idea of how the problem could be addressed (McConnell and Brue 1995). The different types of unemployment are frictional, cyclical and structural (Mafiri 2002). Normal labour turnover in a dynamic market results in frictional unemployment, and is a result of time lags in employing people. It is usually of short duration. Cyclical unemployment exists during recessionary periods when few or no jobs are created for new entrants into the labour market. Existing workers might also lose their jobs through retrenchments (Mafiri 2002). In South Africa cyclical unemployment is superimposed on structural unemployment and is therefore complex to address (National Manpower Commission 1994). Structural unemployment refers to the inability of the economy, due to structural imbalances, to provide employment for the total labour force (Mafiri 2002). This type of unemployment exists when the economy is at full employment. Besides structural unemployment, South Africa's labour market is also characterised by an accompanying skills mismatch (Chadha 1994). Since structural unemployment is part of the natural rate of unemployment in a country, it has a longer-term effect (McConnell and Brue 1995).

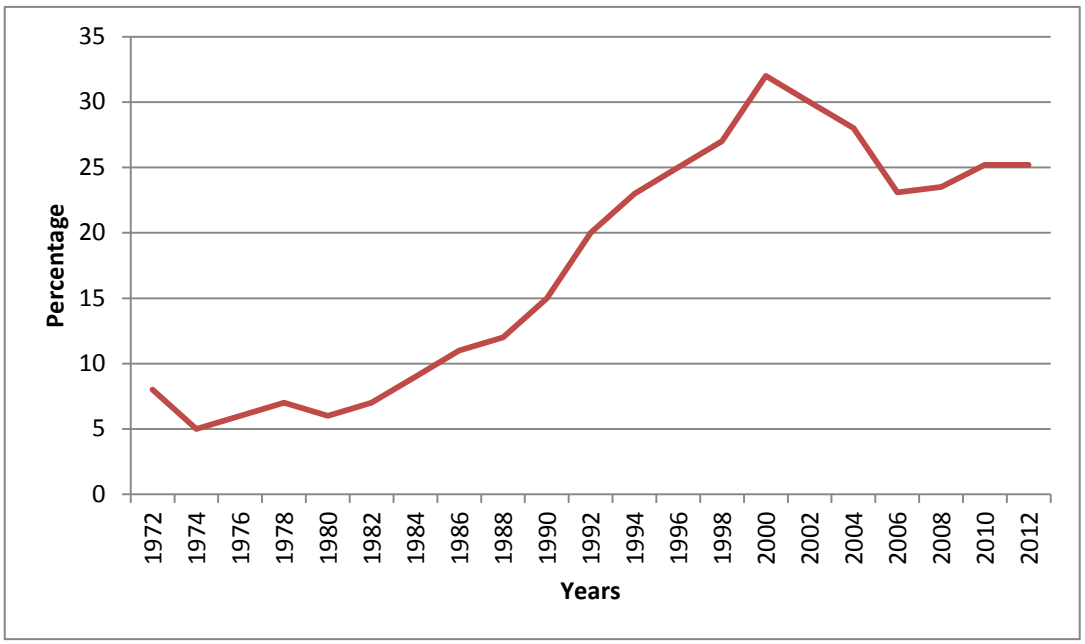

Figure 7.1 Unemployment (strict definition) in South Africa between 1972-2012

Sources: United Nations Development Programme 2004, Statistics South Africa 2006-2012

The South African unemployment rate for the period 1974 to 2012 is shown in Figure 7.1. The strict definition excludes persons who said they were unemployed but had not taken active steps to find work in the four weeks prior to the interview (i.e. discouraged work seekers). Unemployment has increased since the 1980s and reached more than 30 per cent in 2000. It then declined to below 25 per cent and increased again after the 2008 global meltdown. Very little research has been conducted on a geographical understanding of unemployment over time in South Africa. This study presents the trends revealed in the country's census data spatially, and this will enhance an understanding of unemployment. Regional data offers a potentially valuable source of information for investigating the causes of unemployment (Taylor and Bradley 1997). Among other things, the sector mix and employment density were identified as statistically significant determinants of regional unemployment disparities in Germany, Italy and the United Kingdom (Taylor and Bradley 1997).

The relationship between migration and unemployment too is an important consideration in a geographical analysis of unemployment. Several authors have justified this association. Musterd and Deurloo (2002) indicated that migration is the result of global and economic restructuring, especially when it is due to declines in the industrial sector and growth in services. Boyle, Halfacree and Robinson (1998) found that, according to the human capital model, unemployment significantly affected migration in the short term, but in the long term the rate of employment growth was more important (OECD 2005).

Boyle, Halfacree and Robinson (1998) distinguished between labour migration in the developed and developing world. Developing countries usually have a considerable informal economy that is not acknowledged in official employment statistics. In South Africa, however, employment in the informal sector is recorded as part of the employed (Stats SA 2012a). South Africa's urban population is increasing, 61.5 per cent in 2010 (United Nations 2011), and migration patterns tend to be towards cities and major metropolitan areas (Kok et al. 2003; Van der Berg et al. 2002; Green, Gregg and Wadsworth 1998). The urbanisation

rate between 1991 and 2011 in South Africa ranged from 0.8 to 0.7 (United Nations 2011). Such an urbanisation scenario adds a burden to urban infrastructure and services (Zezza, Carletto and Davis 2005).

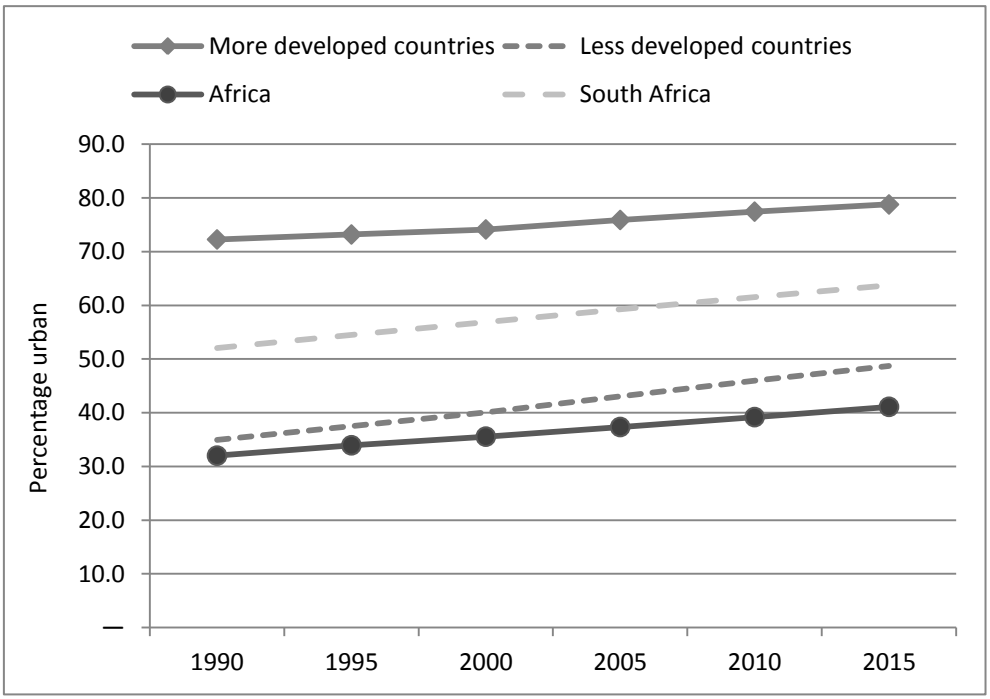

Figure 7.2 Urban population in South Africa between 1990 and 2015

Source: Adapted from United Nations 2011

Figure 7.2 indicates changes in the percentage of the population in urban areas in South Africa between 1990 and 2010, with a forecast for 2015. The proportion of urban dwellers in South Africa is lower than that of more developed countries, but more than less developed countries. The urban population in South Africa is also about 20 per cent more than the average for Africa. Trends in South Africa show that the percentage urban population is on the increase and is expected to be around 64 per cent by 2015 (United Nations 2011). Green (1998) found that inequality increased within regions in the United Kingdom rather than between regions. Therefore an urban-rural split in unemployment better explains social exclusion. Similarly, South Africa has high levels of inequality, and using unemployment as an indicator of segregation can provide even further insight.

Educational attainment continues to determine who moves and who does not. In fact, people with more education are more likely to migrate within their own country (World Bank 2009; Van der Berg et al. 2002). Education opens employment opportunities further afield and shortens the job search at migrants' destinations (World Bank 2009). To add to this understanding, Van der Berg et al. (2002) found that migration in rural environments in South Africa tends to be among lesser-educated males (no education or some level of primary schooling). In Romania, Dachin and Popa (2011) found that, through cross-regional variation of employment by education levels and age structure, areas with high ratios of tertiary education had lower levels of unemployment.

In the South African labour market immigrants get the jobs, because there is a critical shortage of persons with the necessary skills to meet the demands of the economy (Zuberi

and Sibanda 2005). Immigrants and internal migrants were also more likely to be employed than non-migrants, with immigrants from other countries and the SADC region having the highest employment rates (Zuberi and Sibanda 2005; Wentzel, Viljoen and Kok 2006).

From a geographical viewpoint, it is indeed increasingly difficult to categorise migration patterns (Bauder 2006). Before the 1980s migration patterns were dominated by stereotypical and easily understood migrations, while recent migrations are complex and varied. Migration now includes more countries, more social groups, more causal factors and more people (Boyle, Halfacree and Robinson 1998). Migration data needs to relate very specifically to spatial and temporal comparability (Bell et al. 2002) that has to be considered in geographical analysis. Although it is important to deal with migration together with unemployment, geographic mobility does not always contribute to reducing regional disparities (OECD 2005).

Based on research about migration patterns from the previous Transkei to the Western Cape, it is expected that rural populations will have a lower probability to be employed than their urban counterparts (Van der Berg et al. 2002), hence their migration to urban places will possibly be less likely. Zezza, Carletto, and Davis (2005) found that internal migration was positively associated with poverty and negatively with expenditure. Kok et al. (2003) found that areas of low employment are related to low migration levels in South Africa.

Based on the literature presented here, the objectives of this chapter are to:

- Determine whether segregation has increased between the unemployed and employed since 1991
- Cluster municipalities spatially based on unemployment data between 1991 and 2007
- Identify structural breaks in municipal economies through changes in the composition of industry
- To build a spatial understanding of urban-rural differences in unemployment.

7.2 Data and methodologies

Municipalities with high unemployment levels are expected to be areas of low migration (Kok et al. 2003). Since data on migration at a municipality level was not readily available for this research, the spatial relationship between unemployment and migration was not analysed, and it was assumed that the findings by Kok et al. (2003) and Van der Berg et al. (2002) held true.

The data used for dissimilarity calculations originated from South African census statistics and ranged from 1991 to 2007. Census data from 2011 was released after this research commenced and was not included in the analysis. The data is subject to the problem of modifiable areal unit problems (MAUP) since the recording units of census data, namely enumeration areas (EAs), changed from one census to the next. A common administrative boundary was used to overcome this and all data from underlying spatial units was aggregated to the municipal boundaries of 2005. Analysis done in this study is based on the interpolated municipal data.

The first part of the statistical analysis used a method of segregation based on unemployment statistics for district municipalities. This method of segregation was expressed using the index of dissimilarity which compares the spatial distribution of two population sub-groups (Green, Gregg and Wadsworth 1998). The two sub-groups, the unemployed and the employed, were compared and the index indicated what proportion of the unemployed need

to move their existing location in order to obtain an equal spatial distribution of the two groups. The index refers to a number of areas contained in a larger area (for example, local municipalities within a district municipality), and was calculated for all district municipalities (using 2005 boundaries). The formula is:

$$D = 0.5\sum |P_{ig}/P_g - P_{ih}/P_h| \quad (7.1)$$

The value ranges between 0 and 100 and the higher the value the more segregated is the sub-group of interest (Green, Gregg and Wadsworth 1998). P_{ig} is the population of group *g* in municipality *i*, P_{ih} is the population of group *h* in municipality *i*, P_g is the total population of group *g* and P_h is the total population of group *h*. In a number of cases employment data had to be estimated for 2007 since no data was released for these entities. These areas include Chris Hani (Eastern Cape), Golden Gate (Free State), uMgungundlovu, Uthukela and Sisonke (KwaZulu-Natal) and Mopani (Limpopo). Most of these areas have small populations and are referred to as district management areas. Missing values were estimated by first calculating the unemployment growth rate between two periods; then multiplying it by the number of unemployed of the previous period.

The spatial level of the building blocks determines the spatial level at which the dissimilarity analysis can be done. If, for example, the building units were sub-places, an analysis could be done at municipality level. However, in this case, the units were municipalities and therefore the analysis could only be done for district municipalities. This is a higher administrative and geographical level (Figure 4.1). Since the index of dissimilarity is calculated for a specific area, and metropolitan municipalities consist only of themselves, and they were excluded from the original calculations.

It is important for results to be interpreted with care. Robinson (1998) points out that the size of the administrative unit on which calculations are based can affect the value of the index, and that the number of areas used for purposes of calculation influences the absolute level of the index. Cognizance is taken of this in this chapter. Data at a sub-municipal level would have been more ideal to analyse, but since it was not consistently available for all years, data from a higher geography level was used. Another drawback to be noted is that the dissimilarity index measures only two groups at a time. However, if there are only two groups dominating the population in a place, the index is very powerful (Miyares 2012).

A spatial factor analysis was used to group municipalities into categories to explain unemployment better. The method used is called "grouping analysis" in the ArcMap 10.1 software. The "grouping analysis" algorithm performs a classification procedure that tries to find natural clusters in the data (ESRI 2012). Following the spatial groupings identified by Harmse, Blaauw and Schenck (2009) in their South African study of unemployment, the data was grouped into five categories namely, core regions, upward transitional region, downward transitional region, special problem region and district management areas. The grouping analysis looks for a solution where all the features within each group of the five specified groups are as similar as possible, and all the groups themselves are as unique as possible.

From each of these groups, seed municipalities were selected beforehand. A seed municipality is one that represents the group and which the algorithm uses as a starting point to grow groups. Feature similarity is based on the set of attributes specified and can include incorporate spatial properties. For this grouping, the unemployment rate was used. The results of the initial algorithm did not produce a separate class for DMAs and the upward

transitional areas were grouped with the special problem regions. Therefore a second approach was followed.

For the second approach, the analysis fields were the number of unemployed people in 1991, 1996, 2001 and 2007. Delauney triangulation with a Euclidean distance spatial constraint was used to ensure that each municipality had at least one neighbour. The results grouped the municipalities (N = 257) into 15 categories and yielded R^2 values of more than 0.85. Further manual analysis showed that municipalities in groups 1, 2, 3, 5, 6, 7, 9, 10, 11 and 14 were all metropolitan areas. Based on this they were grouped manually as one group to make the analysis and description process easier. The Calinski-Harabasz pseudo F-statistic was also produced as it measures the grouping effectiveness and reflects the within-group similarity and between-group differences (ESRI 2012).

Structural breaks in the municipal economy were identified by considering changes in the percentage of people employed in the nine official sectors (see Figure 7.6 for details). Structural breaks in the local economy could be the cause of unemployment. All data was aggregated to the 2005 municipal boundaries to ensure comparability and the different sectors were agriculture, mining, manufacturing, electricity, construction, finance, trade, transport and community services.

Information regarding of urban and rural population data came from the HSRC counts based on the 1991 and 1996 census. Neither the 2001 census nor the CS 2007 had such data. Urban-rural population counts were calculated for the 2001 data using the "geography" type of enumeration areas and the total population per type. The counts per municipality were summed, then modelled to fit the 2005 municipal boundaries. Data on urban-rural populations is missing for 2007; however, trends could be identified from studying data of the other years. Thus the four analysis fields were covered.

This study assumes that unemployment and other socio-economic data provided by Stats SA is accurate and has been corrected for under- and over-counting.

7.3 Findings and discussion

This section is structured around the four themes described in the methodology section, namely, comparison of unemployed and employed population groups spatially over time, creating spatial clusters of municipalities based on unemployment, analysis of employment sectors and urban-rural characteristics of unemployment over time.

7.3.1 DISSIMILARITY IN UNEMPLOYMENT

The index of dissimilarity, as demonstrated in this chapter, indicates an uneven geographic spread of two groups within the country's population structure, the unemployed and the employed. Table 7.1 shows the results for district municipalities and Figure 7.3 shows population density. District municipalities that reflect an increase in dissimilarity suggests that the segregation between the unemployed and the employed increased. This is evident in the following municipalities:

- Cacadu (the hinterland of Port Elizabeth; most people are employed in the formal sector; unemployment is moderate at 17–31 per cent; there are two areas of population concentration, namely Jeffreys Bay and Grahamstown, and outside these the population density is below 20 people/km²)

Table 7.1 Dissimilarity index per district municipality in South Africa

Municipality	1991	1996	2001	2007
Alfred Nzo	23.03	24.72	2.12	7.03
Amajuba	13.18	37.43	8.01	4.93
Amatole	10.29	33.43	12.26	12.87
Bojanala	15.45	15.30	15.89	10.78
Bophirima	19.71	34.47	22.54	10.87
Cacadu	11.25	11.79	18.05	23.11
Cape Winelands	14.87	7.14	11.41	14.14
Capricorn	7.60	17.39	15.55	10.33
Central	20.58	11.87	11.07	6.53
Central Karoo	8.96	4.47	7.66	6.21
Chris Hani	15.14	28.79	15.41	12.50
Eden	15.83	5.76	11.21	8.94
Ehlanzeni	20.69	18.65	19.98	29.79
Frances Baard	5.41	13.90	6.97	4.74
Gert Sibande	21.94	22.36	10.01	20.08
Greater Sekhukhune	12.31	14.53	17.39	19.23
iLembe	30.13	64.74	54.14	34.65
Kgalagadi	31.09	37.22	22.80	20.14
Lejweleputswa	23.44	11.85	6.31	6.59
Metsweding	11.26	1.85	3.85	9.03
Mopani	14.21	17.35	11.29	6.61
Motheo	3.44	6.47	1.53	2.47
Namakwa	8.01	9.24	15.12	7.18
Nkangala	30.37	21.91	16.93	13.45
Northern Free State	11.46	7.38	6.89	17.37
O.R.Tambo	19.80	23.13	12.76	24.07
Overberg	24.34	2.54	5.92	17.81
Pixley ka Seme	8.17	7.85	17.23	9.81
Sedibeng	3.88	2.54	10.83	12.52
Sisonke	26.79	29.96	23.70	27.02
Siyanda	3.87	12.03	24.83	11.92
Southern	17.67	9.05	10.78	10.22
Thabo Mofutsanyane	24.31	19.40	18.22	15.58
Ugu	16.41	32.93	23.21	26.21
Ukhahlamba	8.87	21.48	16.34	12.44
uMgungundlovu	12.31	14.25	6.64	19.88
Umkhanyakude	16.22	11.72	16.51	26.54
Umzinyathi	44.15	39.09	39.49	31.74
Uthukela	25.89	33.42	23.90	17.03
Uthungulu	12.33	26.76	18.21	15.28
Vhembe	9.62	8.40	13.46	7.95
Waterberg	37.75	28.61	28.28	18.66
West Coast	12.40	5.36	20.65	12.18
West Rand	6.70	6.87	2.98	1.87
Xhariep	6.70	6.98	5.32	21.10
Zululand	23.47	29.36	12.78	15.03

Source: Own calculations

- Capricorn (the majority of the population is employed in the formal sector; unemployment is extremely high - up to 53 per cent)
- Frances Baard (greater Kimberley; most people staying in this district municipality are employed in the formal sector; unemployment is between 37 and 42 per cent; outside Kimberley the population density is very low)
- Namakwa (is a large area; population density is very low and the area is a semi-desert; most people are employed in the formal sector; unemployment ranges between 11–30 per cent)
- Ukhahlamba (mountainous area, low population density, unemployment ranges between 25–46 per cent, most people are employed in the formal sector)
- Uthungulu (fairly high unemployment ranging between 33–48 per cent, population density is between 21 and 500 people/km², most people are employed in the formal sector, concentration of industries in Richard's Bay)
- Vhembe (very high unemployment in three of the four municipalities – up to 48 per cent, the majority of people are employed in informal sector)
- West Coast (large area of low population density and high employment in agriculture)
- Xhariep (0–20 people/km² and high employment in agriculture).

These district municipalities consist of a mix of small urban areas with a large hinterland of low population density (Figure 7.3). In-migration is low or non-existent. In most of these areas the increase in dissimilarity was small and values remained under twenty.

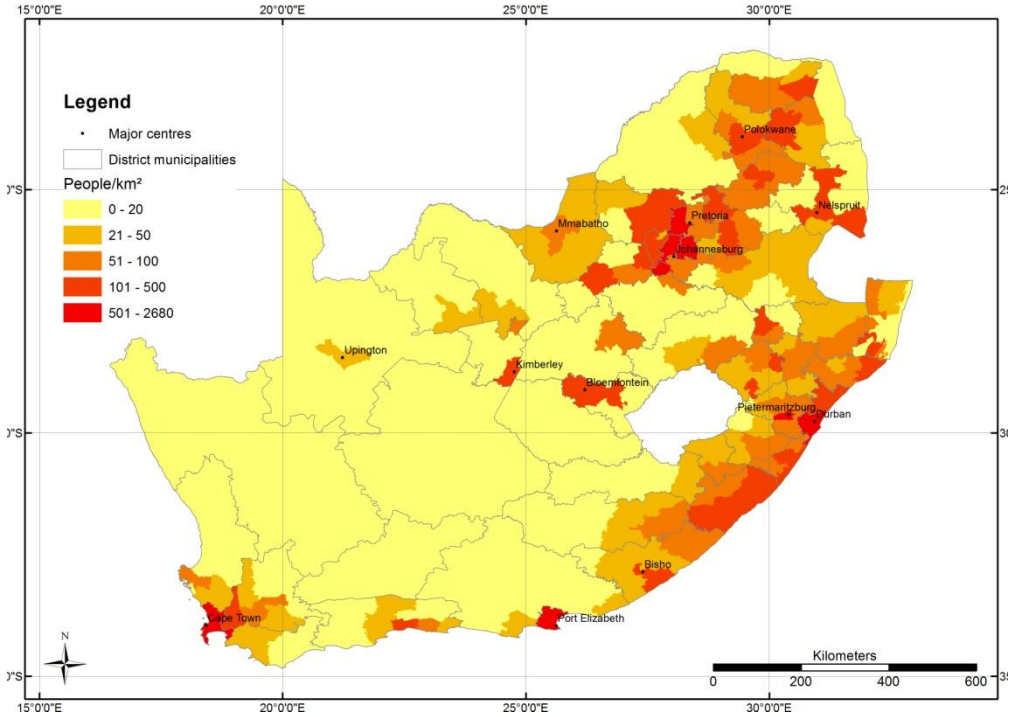

Figure 7.3 Population density in South Africa in 2011

Source: Own calculations adapted from Stats SA 2012c

The trend in dissimilarity between the unemployed and employed in the majority of district municipalities (74 per cent) was downward. In other words, segregation between the two groups decreased markedly after 1991. This finding contradicts trends in the United Kingdom where dissimilarity increased between 1981 and 1991 (Green 1998). Four district

municipalities, namely Ehlanzeni, Sisonke, Kgalagadi and Waterberg, were in the top quartile both in 2007 and in 1991. In Ehlanzeni and Sisonke the dissimilarity remained static for this study period.

Since metropolitan areas are often areas of high labour market disadvantage and concentrated poverty (Green 1998), it is expected that the dissimilarity index would be high in cities. Processes that foster spatial segregation, like industrial restructuring, decentralization of jobs and in-migration are more advanced in cities (Harloe, Fainstein and Gordon 1992; Musterd and Deurloo 2002) and this adds to intensifying segregation.

7.3.2 SPATIAL GROUPING

The variable with the highest R^2 value was the number of unemployed people in 2001 and was therefore the best discriminating variable to group local municipalities. Table 7.2 indicates that very high R^2 values were obtained for all years and unemployment in 1996 was the worst discriminating variable at 0.87.

Table 7.2 Discriminating variables of grouping analysis

Variable	R^2
Number of unemployed in 2001	0.97
Number of unemployed in 2007	0.97
Number of unemployed in 1991	0.96
Number of unemployed in 1996	0.87

Source: Own calculations

The spatial grouping analysis classified metropolitan areas on their own as separate categories (Figure 7.4). Group 1 consisted of municipalities that are currently classified as metropolitan areas, except for Emfuleni and Pietermaritzburg. These are areas of high concentrations of people, a wide variety of industries and a large number of people with tertiary education. In many of these municipalities, the highest Gross Geographic Product (GGP) contribution comes from the finance, community services and manufacturing sectors. The agricultural sector contributes a low percentage to the GGP.

Group 8 contains most of the previous Transkei area, but excludes Port St Johns, and is similar to the special problem regions of Harmse, Blaauw, and Schenck (2009). Agriculture and community services provide most of the employment opportunities in these municipalities. The per capita annual income was below R7 000 in 2007 and the highest education level of the majority of people in 2007 was a completed primary education. The majority of the people in this group stay in rural localities. Together with Group 12 these municipalities have some of the highest unemployment rankings throughout the period under investigation.

Group 12 contains municipalities adjacent to Group 8 in the Eastern Cape. In these municipalities people work predominantly in the primary or tertiary sectors. The highest level of education was completed primary school and the unemployment rate was higher than that of Group 8. Municipalities in Groups 8 and 12 correspond to previous findings on the standard deviation of unemployment values, which showed that high unemployment rates were concentrated in the north-eastern parts of the Eastern Cape over time (Weir-Smith and Ahmed 2013).

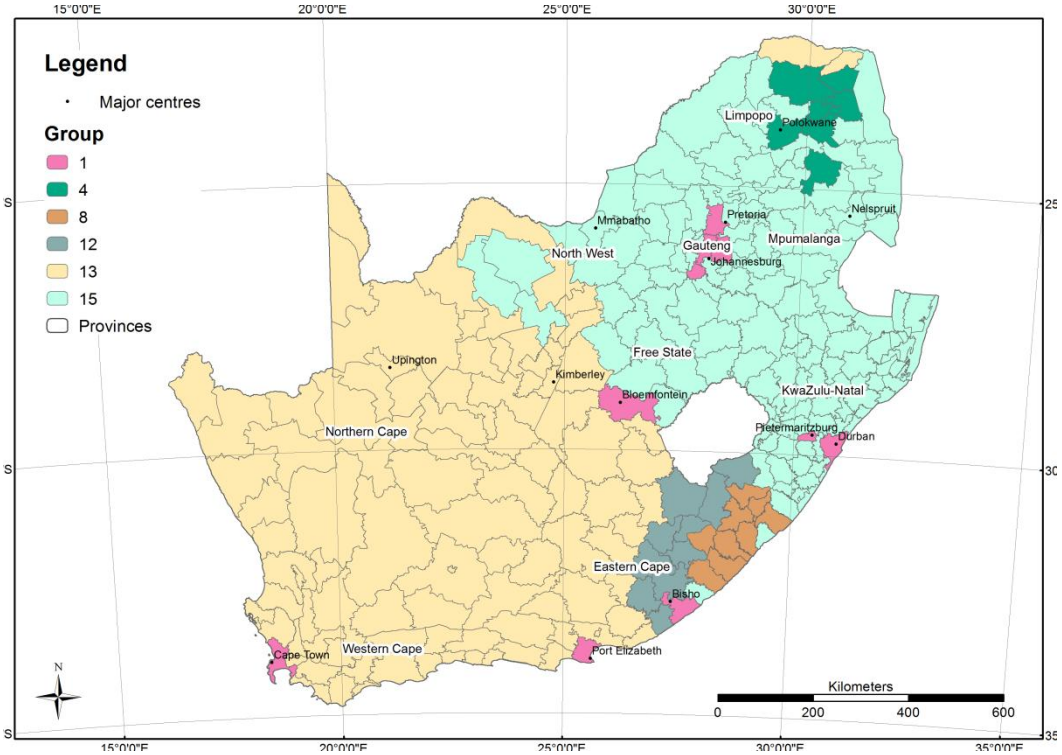

Figure 7.4 Grouping analysis results for unemployment in South Africa from 1991 to 2007

Source: Own calculations

Municipalities in Group 4 are located in a small area in the northern part of the country. In 1991 the population was largely rural and there are number of very remote villages in this group. Generally, a secondary education was the highest level of education achieved by most of the people although Polokwane and Greater Tubatse had more people with only a completed primary education. The mining, manufacturing and community services sectors were the largest employers in 2007 when the annual per capita income ranged between R4 900 and R27 300.

The largest two groups in the classification were Groups 13 and 15. Group 13 covers the western part of South Africa and many of these municipalities are sparsely populated and are predominantly agricultural areas. Population densities of fewer than 100 people per km² characterise much of Group 13's area. Per capita income ranged between R5 500 and R60 500 (2007 data). Agriculture, some in mining, manufacturing, trade and community services employed many people.

Group 15 covers the eastern part of South Africa. This part of the country has a higher rainfall, higher population density, different agricultural production and more mining activities. In many municipalities the highest level of education was secondary schooling. The range of per capita income is very large, between R1 200 and R83 000 per annum. Population density is still fairly low in these municipalities, but there are a few places with more than 100 people per km².

High ratios of people with tertiary education lived in Cape Town and the George vicinity; in Port Elizabeth and East London; Durban (eThekwini) and the metropolitan areas of Gauteng. Many municipalities in the Western Cape, the KwaZulu-Natal Midlands, North Coast and

Drakensberg areas, had high ratios of tertiary educated people at some point between 1991 and 2007.

During the period 1991 to 2007, the relationship between per capita income and unemployment is not clearly linear, but is definitely negative in trend. In other words, as unemployment increased per capita income decreased. Unemployment is positively associated with no or low-level education, and the relationship between unemployment and the level of education becomes less distinct as education levels increase.

7.3.3 Economic Structural Changes

National trends in sector contribution to the GDP show that agriculture, manufacturing, trade and transport decreased over time (Figure 7.5). Mining, finance and community services increased their contribution to the national GDP. Municipal trends that are different to these indicate structural changes in the local economy.

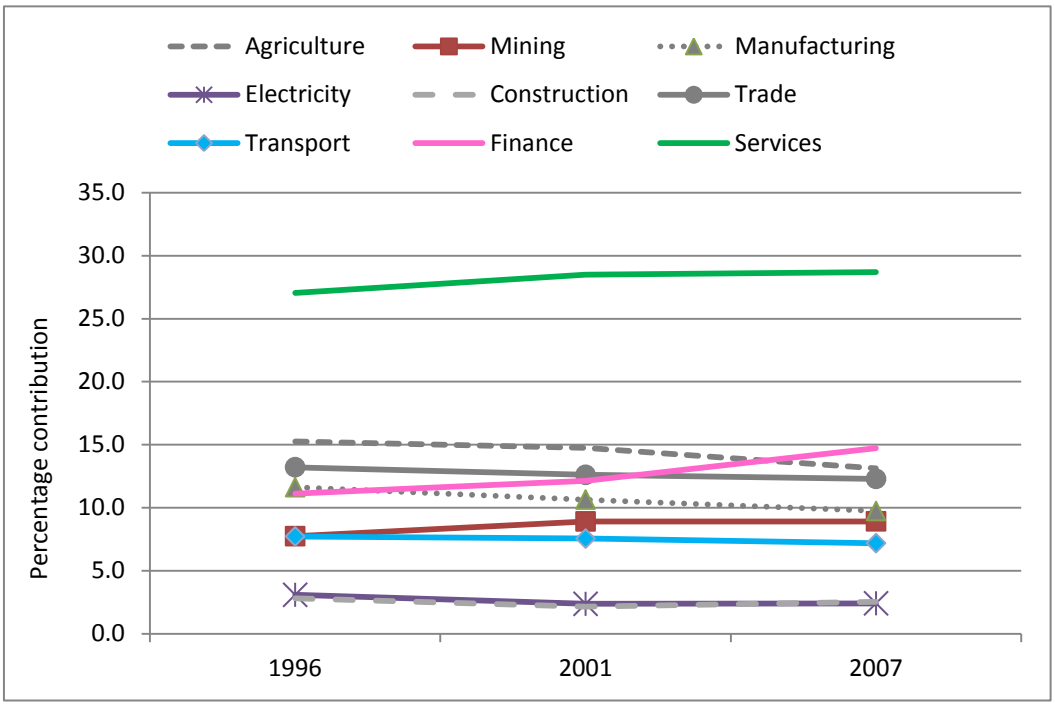

Figure 7.5 Sector contribution to GDP in South Africa between 1996 and 2007

Source: Global Insight 2011

Figure 7.6 indicates the percentage of people employed in each sector and in some instances the trends slightly differ from the sector GDP contribution in Figure 7.5. Fewer people were employed in all sectors, except the finance and construction sector. Despite the financial contribution being bigger in the community services and mining sectors, the number of people employed in these sectors reduced over time.

People in municipalities in Group 8 (Figure 7.4) were mostly employed in agriculture and community services and these sectors experienced downward growth nationally in terms of the number of people employed. Other local sector trends were, however, consistent with national trends.

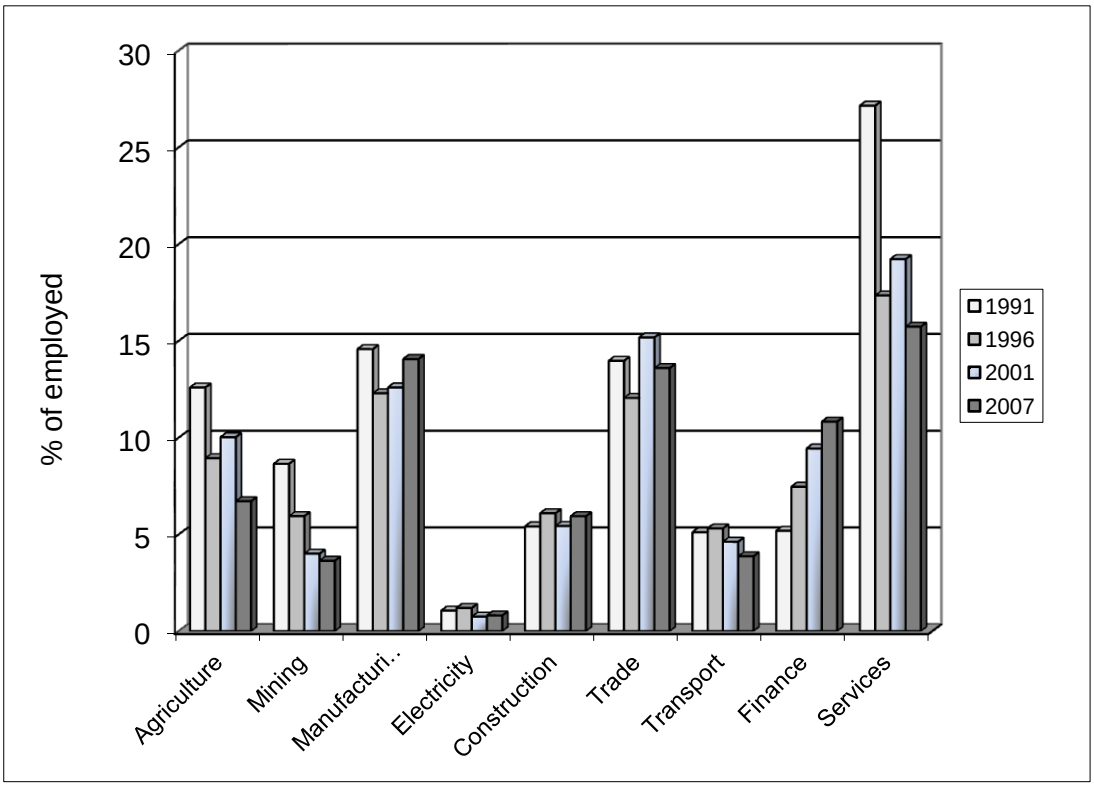

Figure 7.6 Percentage people employed per sector in South Africa between 1991 and 2007

Source: Own calculations

Trends for municipalities in Group 12 showed that more people were employed in finance, construction and manufacturing. The number of people employed in mining and community services also increased slightly over time and this is counter-cyclical to the national trend.

Two trends in Group 4 differed from the national pattern. Three municipalities, Makhado (formerly Louis Trichardt), Polokwane and Thulamela, had a significant increase in the number of people employed in the community services sector. The Greater Tubatse municipality also had an increase in the number of people employed in the mining sector. This municipality lies in a mountainous, inaccessible area and mining was the major economic sector in 2007.

Structural changes in the sector composition were seen in municipalities in Group 1 (Figure 7.4). These are the metropolitan areas and large regional cities where there is a constant inflow of people. In Johannesburg the finance and community service sectors swopped places during the period under review (1991-2007), and finance became the sector that employed the most people. The number of people who work in the finance sector more than doubled. In Port Elizabeth the finance and community service sector changed places in this period. In Bloemfontein people employed in the financial sector increased considerably, but community services remained the biggest employer after manufacturing and wholesale.

In the City of Tshwane (Pretoria) the number of people employed in community services decreased, but it remained the number one sector in terms of the number of people employed. There was therefore no structural change in the economy of Pretoria. The same pattern was evident in eThekwini (Durban). Cape Town experienced a number of counter-

cyclical trends, namely, the number of people employed in construction and retail increased, while manufacturing became the largest sector employing people in the local economy.

In Ekurhuleni the number of people employed in manufacturing and trade increased while in Buffalo City (East London) the number of people employed in community services also increased. In 2007 the number of people employed in trade and manufacturing was more than those in the financial sector. Although this is counter-cyclical to the national trend it is a local pattern which remained the same over time.

In Emfuleni (Vanderbijlpark) the economy showed the same trends as the national economy, but the local economy has a particularly strong manufacturing component. In Msunduzi (Pietermaritzburg) there was an increase in the number of people employed in manufacturing which is contrary to national trends, but is consistent with local trends.

7.3.4 URBAN-RURAL DIFFERENCES

The relationship between unemployment and urban population data is not clear. However, between unemployment and the number of rural people there is a positive, linear relationship. In 1991 the R^2 between these two variables was 0.494 and it was significant at a 0.01 level. In 1996 the value was 0.479 and 0.203 in 2001. Although the R^2 values are low, they are all significant at a 0.01 confidence level.

All municipalities in Group 8, excluding Engcobo and King Sabata, had an increase in the rural population between 1991 and 2001. In some municipalities the increase was very steep, e.g. Nyandeni and Mhlontlo. The rural population in municipalities in Group 12 remained the same or showed a slight decrease for the same period. Group 4 municipalities in Limpopo also showed an increase in rural population until 2001, except for Greater Tubatse and Greater Giyani. Among the metropolitan municipalities, Pretoria (City of Tshwane) and Pietermaritzburg (Msunduzi) had an increase in rural population in their hinterlands.

7.4 Conclusion

The four objectives of this chapter aimed to measure different spatial aspects of unemployment in South Africa. The first objective determined whether segregation between the unemployed and employed had increased since 1991 and showed that dissimilarity decreased in most district municipalities. This is contradictory to international trends and could possibly be ascribed to the large-scale integration that took place during the post-apartheid transition in 1994. Another reason could be the accuracy of spatial data provided by Stats SA (2012b). The analysis, however, excluded metropolitan areas and it is expected that dissimilarity would be high in these areas. These are areas where marked extremes in terms of equality and employment exist. Those few district municipalities where dissimilarity increased indicate increased inequality.

The second objective focused on clustering municipalities spatially based on unemployment figures between 1991 and 2007. The results showed a spatial divide between the western and the eastern part of the country. Further clusters were identified in metropolitan areas and this clustering provides a unique way to easily understand the spatial patterns of unemployment in South Africa.

The third objective identified structural breaks in municipal economies through changes in the sectoral composition. Structural breaks are important indicators of why local economies experience unemployment. Such breaks were evident in all metropolitan areas, except Emfuleni, Pretoria and Durban. This trend indicates that factors, other than sectoral mix,

influence unemployment in these three metropolitan areas. An increase in the number of people employed in the community services sector, construction, manufacturing and mining sectors in non-metropolitan municipalities differs from the national trend. The findings on structural breaks reflect that a large proportion of South Africa's working-age population is unemployable given the modern, capital- and skills-intensive nature of employment in South Africa, since they have the wrong skills, inadequate qualifications or live far from work opportunities.

The fourth objective was to build a spatial understanding of urban-rural differences in unemployment. Findings showed that municipalities in Group 8 experienced an increase in its rural population and also an increase in the number of people employed in agriculture. Unemployment was more strongly related to rural populations than to urban ones. Hence unemployment intervention policies should apply to municipalities with an increasing rural population. Education levels also showed that high ratios of people with tertiary education are concentrated in the metropoles. The population outside of metropolitan areas might therefore not have the required skills to adapt to a changing labour market.

In terms of migration it is important to consider that migration flows are likely to magnify spatial disparities in unemployment rates rather than mitigate them. One can therefore not accept that migration will have an equilibrating effect and the spatial relationship between unemployment and migration in South Africa remains unclear. Research by the World Bank supports special policies to encourage the emigration of labour and in South Africa it would mean that policies to improve basic education would have to be put in place and technical skills will have to be improved so that people do not have to work in the informal sector under precarious conditions.

The main contribution of this research is the spatial grouping using census data which created a spatial understanding of unemployment clusters over time. This research has shown that the same areas continue to remain characteristically devoid of adequate employment opportunities. The persistence of regional disparities in employment and unemployment could also be symptomatic of policy failure and the inadequate functioning of labour markets. Geographic mobility does not necessarily reduce regional disparities therefore policies need to bring jobs to depressed areas through tax concessions and other methods to support local economic development. It is recommended that sustainable policies that consider all factors be implemented in Groups 8 and 12 municipalities, and selected municipalities in Groups 13, 15 and 4, to stimulate economic growth.

Future research could apply the spatial grouping done here to smaller areas like sub-places or data zones. This will enhance the understanding of local socio-economic trends and allow more accurate planning for local economic development. It is also recommended that a trustworthy unemployment data source for sub-places should be established and the dissimilarity analysis technique should be expanded to include the 2011 census data as well as metropolitan areas. This will contribute significantly to the long-term spatial understanding of unemployment in South Africa.

More detailed spatial analysis is required in terms of urban and rural differences because municipalities mask these divides, and a true reflection could not be discovered through this high-level analysis of available data. Research has shown that regions are tightly linked by migration, commuting and interregional trade and socio-economic changes between neighbouring municipalities should also be investigated.

Acknowledgements
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Chapter 8 A geographically disaggregated predictive model of future unemployment

This chapter is based on:

Weir-Smith. G, *in preparation*. Where the jobless will be: a geographically disaggregated predictive model of future unemployment. *Journal of Regional Science*

Abstract

This chapter focuses on geographical areas, namely clusters of municipalities, to predict future trends in unemployment. Since there is not one simple explanation of unemployment, but a number of factors that coincide and cause a reaction, it is important to identify these factors.

Research has shown that the assumption does not hold true that the labour force profile at provincial level remains the same across the municipalities. Sub-provincial forecasting is therefore warranted. The square root of unemployment was applied and since unemployment is spatially clustered, a geographically weighted regression (GWR) was used. Euclidean distance was used for the GWR and the spatial relationships were conceptualised by inverse distance, that is, the influence of one feature on another feature decreases with distance. One national, three provincial clusters and one provincial model resulted.

At a national level, unemployment for 2011 was best predicted by the following series of variables: the Human Development Index value of 1996; the ratios for the economically active people employed both in the agricultural sector and the mining sectors in 1991; the ratio of people older than 20 years with no formal schooling in 2007; the number of females staying in rural locations in 1991; and the number of rural people in 1996. The unemployment forecast model for the second cluster of provinces was predicted by three co-efficients: the area's unemployment ranking in 2007; the per capita income in 2007; and the ratio of economically active people employed in the agricultural sector in 1991.

In conclusion the chapter showed that unemployment is intimately linked with other socio-economic problems and that local labour market supply and demand factors are spatially unique. There is therefore a need to view labour market policies in a much broader context than was traditionally done, and to integrate them with ranges of social issues like education policies, fights against crime and development.

Key words
Forecasting, unemployment, South Africa, labour market

8.1 Introduction

Geographic differentiation of unemployment can be done by broad trends, like urban and rural differences, or by specific administrative boundaries, like provinces or municipalities. This chapter focuses on geographical areas, clusters of municipalities, to predict future trends in unemployment.

In South Africa rural and urban unemployment numbers are largely the same when using the narrow definition, but when using the broad definition rural unemployment particularly is about 10 per cent higher (McCord and Bhorat 2003). Narrow unemployment statistics are therefore likely to understate the extent of non-urban employment. The narrowly defined unemployed are jobless persons who looked for work within in a given time, typically the week or month prior to the official inquiry. The broadly defined unemployed are the narrow unemployed plus those who wanted work but did not look for it in the reference period (Kingdon and Knight 2000). McCord and Bhorat (2003) point out that women experience higher unemployment than men while race was a more significant determinant of unemployment than gender and location (urban/rural). Klasen and Woolard (2008) draw attention to the fact that rural unemployment is slightly higher than urban unemployment. In 1997 and 2001 rural unemployment differed more than 5 per cent from urban rates. In accord with this observation, Ntuli and Wittenberg (2013) note that urban women are more likely to participate in the labour force than rural women.

Brenner (2011) expressly acknowledges that differences in the geographical landscape were the result of historical political-economic processes. Illeris (1985) further explains that there is not one simple explanation of unemployment in advanced capitalist countries, but a number of factors that concur and cause a reaction. Each local labour market has its own unique combination of forces on the demand and supply side. These views support the geographical emphasis given to this study.

Forecasting is defined as the prediction of future events based on known past values of relevant variables (Makridakis et al. 1998). The literature overview looks at different aspects related to forecasting unemployment spatially. Forecasting unemployment is important because it provides an idea of what the future economy holds and also informs government in terms of decision and policy making (Nasir et al. 2008).

8.1.1 MODELLING UNEMPLOYMENT

Sari (2010) used a Spatial Two Stage Least Squares model (STSLS - a form of spatial regression) instead of Spatial Ordinary Least Squares (OLS) or Spatial Maximum Likelihood (SML) model to provide consistent unemployment estimates at a neighbourhood level. Geographical areas, e.g. neighbourhoods, are affected by spillover from adjacent areas and unemployment in one area is therefore not independent from unemployment in the bordering area.

Schanne, Wapler and Weyh (2008) used a spatial Global Vector Auto Regressive (GVAR) model to forecast monthly unemployment figures for German labour market districts. Since there was a strong interdependency between regions, they found that the spatial model performed better than a univariate time series model.

Alò et al. (2007) used small area estimators to forecast unemployment in local labour market areas in Italy. They found that the spatial structure of the data helped them improve the accuracy of the estimates as measured by the empirical mean squared error (MSE). The MSE is the average of the squared error values and is the most commonly used lack-of-fit

indicator in statistical fitting procedures (Statsoft 2014). Alò et al. (2007) defined spatial interaction as spatial coordinates of the centroids of the small areas as covariates in the models. Floros (2005) developed a macroeconomic forecasting model of United Kingdom (UK) unemployment, which did not consider spatial autocorrelation. The author found that different models work best for different periods.

8.1.2 FACTORS TO CONSIDER IN UNEMPLOYMENT FORECASTING

Illeris (1985) concluded that each local labour market has its own of supply and demand dynamics and therefore national models are not suitable for local forecasting. Furthermore, local concentrations of unemployment might be due to oversupply of labour or a lack of demand or a combination of both. This finding held true when Hakizimana (2011) used synthetic unemployment estimations for South Africa unsuccessfully, because they were based on the assumption that the labour force profile at provincial level remains the same across the municipalities. He finally used a two stage model estimate where the outcome from a discriminant model was the input for a multinomial logistic model.

Besides the uniqueness of local labour markets, the standard neoclassical growth model implies that the long-run growth rate and the rate of unemployment are independent, even in the presence of an imperfect labour market (Carmeci and Mauro 2002). Figure 8.1 reflects this by comparing unemployment and Gross Domestic Product (GDP) growth rates for South Africa. In the 1990s these indicators moved independently, for example, the increased growth rates in the early nineties did not result in decreased unemployment at the same time. By the late nineties, unemployment was at its highest, while one would expect a low GDP, it was rising rapidly too. From 2000 until 2006, the GDP growth rate steadily increased and unemployment decreased - showing a more dependent movement between the two indicators.

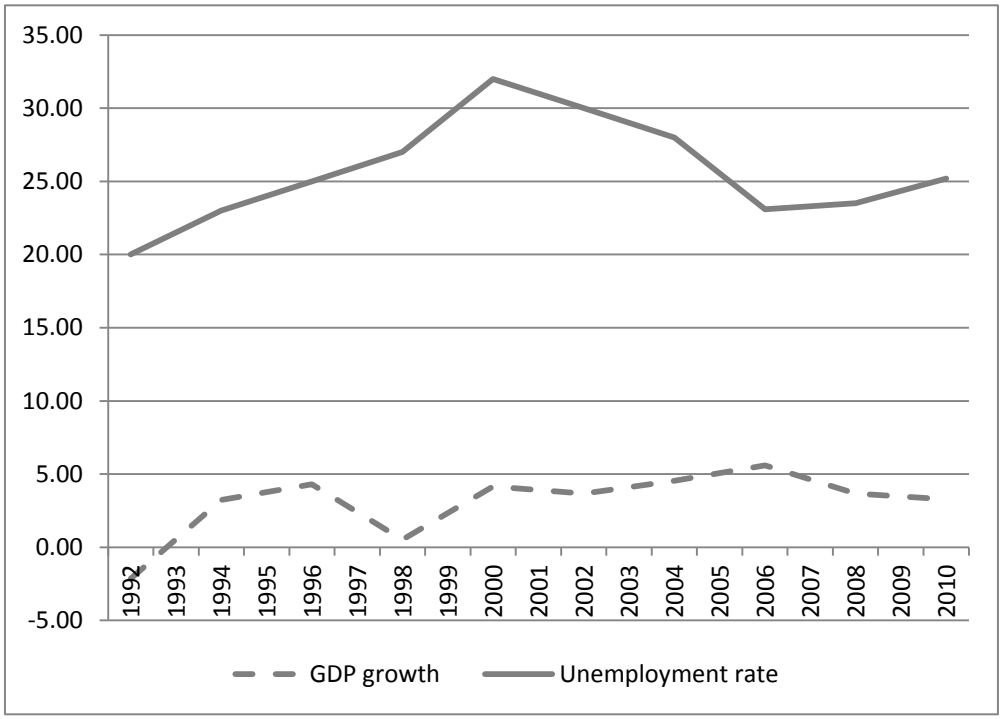

Figure 8.1 GDP growth rates and unemployment rates in South Africa since 1992

Sources: OECD 2011; Stats SA 2006-2012 and Koller 2005

Labour market rigidity negatively influences the growth of the economy during the convergence of regions and per capita output (Carmeci and Mauro 2002). The interaction between unemployment and the growth rate of per capita output is reflected in the post-1992 South African situation in Figure 8.1.

Niehbuhr (2003) asserts that regional spillovers are most likely to exist in regions that are tightly linked by interregional migration, commuting and trade. Furthermore, Mitchell and Bill (2004) found that, if one region experiences a rising unemployment rate, this will spill over significantly into neighbouring regions until the distance decay is exhausted.

Schanne, Wapler and Weyh (2008) modelled the connectivity of regions using spatial weights and a distance decay function - the further regions are apart, the more reduced is the influence. They did not use mean squared error to test their model, because it does not take size difference of districts into account. Instead they used mean squared absolute percentage forecast error (MAPFE).

Oud et al. (2010) used a regional unemployment model and their conclusion was that locally set wages were expected to reduce unemployment. Statistics on wages are not available in a spatially disaggregated format in South Africa, and many sectors do not have a central bargaining council. Thus wages were not considered in this study.

Regions marked by high unemployment as well as areas characterised by low unemployment, that is, favourable market conditions, tend to cluster in space (Niebuhr 2003). Furthermore, metropolitan areas are spatial niches for the agglomeration of capital and labour (Brenner 2011). Both of these trends result in uneven spatial development and South Africa's economic landscape reflects this. For example, in 2006 Gauteng contributed 33.6 per cent to the economy of South Africa, double that of the next highest contributing province, KwaZulu-Natal (Stats SA 2007a).

Fisher and Langford (1995) used root mean square (RMS) error to quantify the error introduced in their simulations. The RMS was based on the average differences between the estimated values of the variable and its known actual values.

8.1.3 THE FUTURE OF UNEMPLOYMENT IN SOUTH AFRICA

Post-2008 unemployment rates show that up to Quarter 2 in 2010 unemployment increased in seven of the nine provinces (Ngandu et al. 2010). The exceptions were KwaZulu-Natal and Limpopo. Furthermore, the unemployment rate for women slightly increased from 26.5 per cent in 2000 to 27.6 per cent in 2010. For the same period, the unemployment rate among men rose from 20.4 per cent to 23.3 per cent. By 2013 these figures were 26.7 per cent for women and 23.1 per cent for men (Stats SA, 2013a). Almost 75 per cent of those who became unemployed between 2009 and 2010 were younger than 34 years old, and did not have a Grade 12/Matric qualification (Ngandu et al. 2010). These figures indicate that unemployment is expected to remain high for the foreseeable future.

Furthermore, South Africa has a highly mobile labour force (Stats SA 2012b) and Dennett (2014) noticed that even small changes in regional economic and labour market inequalities can result in large changes in migration volumes. This mobility needs to be considered in unemployment research. Spatially disaggregated analysis of the labour market appears to provide beneficial insights into internal forces (Maierhofer and Fischer 2001). It is this interplay of factors that this chapter is investigating.

The objectives of this chapter are:

- to build national and sub-national models of unemployment in South Africa for 2011
- to verify these models using the Census 2011 unemployment data.

8.2 Methodology

The data used for this research originates from three sources: the first is census data for 1991, 1996, 2001, and the second is CS 2007. The third data source is IHS Global Insight that provided some economic growth rates and per capita income variables. External factors like international economic trends were excluded, a point of merit mentioned in the work of Carmeci and Mauro (2002). Therefore this model was an endogenous unemployment model. External factors are difficult to include since their impact is not the same throughout all municipalities.

In the initial regression analysis, the unemployment rate was the dependent variable. This led to non-satisfactory results and closer investigation showed that the unemployment rate was not normally distributed. Therefore, the square root of unemployment was used in the final analysis. Since unemployment is spatially clustered a geographically weighted regression (GWR) was used. An ordinary least squares (OLS) model would have been inappropriate because it does not account for spatial autocorrelation and will result in biased results (Sari 2010). In the GWR the Euclidean distance was used and the spatial relationships were conceptualised by inverse distance, that is, the influence of one feature on another feature decreases with distance. To test the results, an OLS was run on the same data set and the result was basically the same as that of the GWR. So the findings reported here, represent both methods.

The official unemployment rate was used so that results can be compared with international studies. A number of models were developed, namely one at a national level and three for clusters of local municipalities. All provinces, except KwaZulu-Natal, contain less than 45 local municipalities and it was statistically challenging to create models with fewer than 45 records, because there was not enough variability. The same happened with models at district municipality level and Figure 4.1 explains the spatial hierarchy of these levels. Therefore provinces were grouped by GGP contribution. The first cluster consisted of local municipalities in Gauteng, Western Cape and KwaZulu-Natal which contributed most to GGP in 2007. Cluster 2 included local municipalities from Eastern Cape, Limpopo and Mpumalanga, while Cluster 3 consisted of municipalities in North West, Free State and Northern Cape.

All models were accurate within a 95 per cent confidence interval. Residual values were calculated to identify the difference between the observed and the predicted values and the values were small (between -3.6 and 2.7).

8.3 Results and discussion

8.3.1 National Model

At a national level, unemployment for 2011 was best predicted by a series of co-efficients. These were the HDI value of 1996; the ratio of economically active people employed in the agricultural sector in 1991; the ratio of economically active people employed in the mining sector in 1991; the ratio of people older than 20 years with no formal schooling in 2007; the number of females staying in rural locations in 1991; and the number of rural people in 1996.

Table 8.1 Multiple regression results for national model

		B	SE B	β
Step 1	(Constant)	2.99	0.62	
	Human Development Index 1996	-2.66	0.77	-0.77*
Step 2	(Constant)	3.09	0.58	
	Human Development Index 1996	-2.62	0.72	-0.76*
	Percentage people employed in agriculture in 1991	-0.17	0.06	-0.63*
Step 3	(Constant)	3.06	0.56	
	Human Development Index 1996	-2.46	0.70	-0.71*
	Percentage people employed in agriculture in 1991	-0.19	0.06	-0.68*
	Percentage people employed in mining in 1991	-0.18	0.07	-0.54*
Step 4	(Constant)	2.88	0.71	
	Human Development Index 1996	-2.20	0.82	-0.64*
	Percentage people employed in agriculture in 1991	-0.19	0.06	-0.69*
	Percentage people employed in mining in 1991	-0.18	0.07	-0.54*
	Percentage people with no schooling in 2007	0.14	0.09	0.38*
Step 5	(Constant)	2.79	0.75	
	Human Development Index 1996	-2.07	0.85	-0.60*
	Percentage people employed in agriculture in 1991	-0.19	0.06	-0.67*
	Percentage people employed in mining in 1991	-0.18	0.07	-0.53*
	Percentage people with no schooling in 2007	0.14	0.09	0.38
	Number of females in rural areas in 1991	0.00	0.00	0.32
Step 6	(Constant)	2.80	0.74	
	Human Development Index 1996	-2.08	0.84	-0.61*
	Percentage people employed in agriculture in 1991	-0.19	0.06	-0.67*
	Percentage people employed in mining in 1991	-0.17	0.07	-0.52*
	Percentage people with no schooling in 2007	0.15	0.09	0.39*
	Number of females in rural areas in 1991	0.00	0.00	0.75*
	Number of people in rural areas in 1996	0.00	0.00	-0.69*

Note: R^2 = .36 for Step 1; R^2 = .51 for Step 2; R^2 = .59 for Step 3; R^2 = .60 for Step 4; R^2 = .60 for Step 5; R^2 = .62 for Step 6

Source: Own calculations

Table 8.1 shows the coefficient values and the R^2 for the final model was .62 and the adjusted R was .61. The standardised Beta value was negative for all predictors except percentage of the population 20 years and older with no schooling and the number of females staying in rural locations in 1991. The regression equations for the national model for unemployment rate in 2011 therefore are:

$$\gamma = b_0 + b_{1\,HDI1996} + b_{2\,Percentage\ \ in\ agriculture\ \ 1991} + b_{3\,Percentage\ \ in\ mining\ 1991} + b_{4\,Percentage\ \ with\ no\ schooling\ 2007} + b_{5\,Females\ \ in\ rural\ \ locations\ 1991} + b_{6\,Rural\ \ people\ 1996} \quad (8.1)$$

which becomes

$$\gamma = 2.8 + (-0.61 * 0.63) + (-0.67 * 12.6) + (-0.52 * 8.6) + (0.39 * 14.1) + (0.75 * 10099182) + (-0.69 * 18795302) \quad (8.2)$$

As the HDI count for 1996, the percentage of employed in the agricultural sector in 1991, the percentage of employed in the mining sector in 1991 and the number of people in rural areas in 1996 decreased, the 2011 unemployment rate increased. The positive relationship between unemployment in 2011 and the percentage of people with no schooling in 2007 and the number of females staying in rural areas, indicates that as these two factors increase, so does unemployment. For every decrease in the HDI, unemployment increased by 0.37 units (if the effects of all other factors are held constant).

By comparison, very few studies internationally tried to determine the predictors of unemployment nationally. The supporting literature evidence is therefore limited and often the variables used were different. One study that supports these findings is that of Taylor and Bradley (1997). They found that having a high proportion of people employed in the agricultural sector was highly disadvantageous for unemployment in Italy. At the same this was a positive factor in the unemployment statistics of Germany and the UK.

8.3.2 PROVINCIAL CLUSTER MODELS

The Cluster 1 model focused on the three provinces contributing most to the national GGP, namely Gauteng, KwaZulu-Natal and Western Cape. Unemployment was predicted by the ratio of people older than 20 years with no formal schooling in 2007, the ratio of economically active people employed in the agricultural sector in 1991 and the ratio of economically active people employed in the mining sector in 1991. R^2 was .73 and adjusted R^2 .72. These three provinces have less than 4 per cent of their population employed in the agricultural or mining sector (Global Insight 2011).

The relationship between unemployment and the ratio of people with no education in 2007 was positive (Table 8.2). In other words, as the number of people with no education increased, so did unemployment. The unemployment relationship with the other two predictors was negative. The regression formula for these three provinces is:

$$\gamma = b_0 + b_{1\ Percentage\ \ with\ no\ schooling\ \ 2007} + b_{2\ Percentage\ \ in\ agriculture\ \ 1991} + b_{3\ Percentage\ \ in\ mining\ \ 1991} \quad (8.3)$$

Table 8.2 Multiple regression results for Cluster 1

		B	SE B	β
Step 1	(Constant)	1.81	0.44	0.00
	Percentage people with no schooling in 2007	0.32	0.11	0.80
Step 2	(Constant)	2.13	0.43	
	Percentage people with no schooling in 2007	0.30	0.09	0.75
	Percentage people employed in agriculture in 1991	0.22	0.07	-0.74
Step 3	(Constant)	-2.17	0.44	
	Percentage people with no schooling in 2007	0.30	0.09	0.75
	Percentage people employed in agriculture in 1991	-0.23	0.07	-0.76
	Percentage people employed in mining in 1991	-0.18	0.12	-0.35

Note: R^2 = .41 for Step 1; R^2 = .71 for Step 2; R^2 = .73 for Step 3

Source: Own calculations

An increase of one unit in the number of people with no education in 2007 led to an increase of 0.75 in unemployment; a decrease in one unit of people employed in the agricultural sector in 1991 resulted in an increase of 0.76 in unemployment.

The determinants of unemployment in 2011 correspond to findings from Schanne, Wapler and Weyh (2008) who noted that the share of people working in the services sector in relation to those working in the industrial sector is higher in the cities. The three provinces in this cluster had the highest proportion of urbanisation in the country, namely between 43 and 96 per cent (own calculations based on census 2001).

Cluster 2 comprised Eastern Cape, Limpopo and Mpumalanga. Besides having the second highest contribution to GGP, these provinces also have the highest poverty rates. The unemployment forecast model was predicted by the area's unemployment ranking in 2007, the per capita income in 2007 and the ratio of economically active people employed in the agricultural sector in 1991. The unemployment ranking in 2007 was positively correlated to unemployment forecasting for 2011, while the Beta values of the other two predictors were negative. The R^2 was .67 and adjusted R^2 .66, and 66 per cent of the variance in this prediction is explained by these variables. For every increase in unemployment ranking in 2007, the unemployment rate for 2011 increased by 0.72. And for one decrease in the per capita income in 2007, the unemployment rate for 2011 increased by 0.58. The regression model for Cluster 2 is:

$$\gamma = b_0 + b_{1\ Unemployment\ \ ranking\ \ in\ 2007} + b_{2\ Per\ capita\ \ income\ \ in\ 2007} + b_{3\ Percentage\ \ in\ agriculture\ \ 1991} \quad (8.4)$$

Provinces in this cluster had the lowest per capita income of below R22 000 per annum in 2007 (Global Insight 2011).

Cluster 3 included North West, Free State and Northern Cape. Unemployment 2011 was best predicted by the dependency ratio in 1991, the ratio of economically active people employed in the mining sector in 1991, the ratio of economically active people employed in the agricultural sector in 1991, the number of people in rural areas in 2001 and the dependency ratio in 1996. The R^2 = .63 and adjusted R = .61. The relationship between unemployment in 2011 and the dependency ratio in 1991 and 1996 and number of people in rural areas in 2001, was positive. In other words, as these increased, so did unemployment. For every decrease in the ratio of economically active people employed in the mining sector in 1991, unemployment increased by 0.76. The regression model for Cluster 3 is:

$$\gamma = b_0 + b_{1\ Dependency\ \ ratio\ \ in\ 1991} + b_{2\ Percentage\ \ in\ mining\ \ 1991} + b_{3\ Percen\ tage\ \ in\ agriculture\ \ 1991} + b_{4\ Rural\ \ people\ \ in\ 2001} + b_{5\ Dependency\ \ ratio\ \ in\ 1996} \quad (8.5)$$

In 2001 about 62 per cent of the North West population was rural while the comparative figures for Free State and Northern Cape were between 27 and 36 per cent. South Africa's dependency ratio had decreased since 1996 from 65 to 56 in 2005 (UN 2011).

8.3.3 PROVINCIAL MODEL

The only province with 45 or more records was KwaZulu-Natal and a separate unemployment model was developed for this province. A very high R^2 of .85 was recorded

and the adjusted R was .84. The predictors were: the ratio of economically active people employed in the agricultural sector in 1991, the dependency ratio in 1991 and 2007 as well as economic growth rate in 2007. The provincial growth rate was 6.35 per cent in 2007 and was the second highest in the country.

$$\gamma = b_0 + b_1\, Percentage\ \ in\ agriculture\ \ 1991 + b_2\, Dependency\ \ ratio\ 1991 + b_3\, Dependency\ \ rat\, io\ 2007 + b_4\, Economic\ \ growt\, h\ rate\ 2007 \quad (8.6)$$

The correlation with the first and last variable was negative and positive with the dependency ratio. In other words, for every decrease in the number of people employed in the agricultural sector in 1991, unemployment increased by 0.69. The economic growth rate is noteworthy, because after 2008 international growth rates declined and such declining rates will have a greater impact on unemployment rates.

Naudé and Serumaga-Zake (2001) found that location, whether urban or rural, played a major role in determining employment status in North West. For example, people located in the eastern part of this province had a higher probability of being employed since these regions were the most urbanised and industrialised.

8.3.4 VERIFYING PREDICTIONS

The residual values were mapped to verify whether predictions were accurate or not. Figure 8.2 shows that the residual values for were randomly distributed. It also shows municipalities where the national model over- and under-forecasted. Most of the metropolitan areas were in the first class of standard deviation while those municipalities with the highest amount of under-forecasting were mostly areas of low population density (< -2.5 standard deviations).

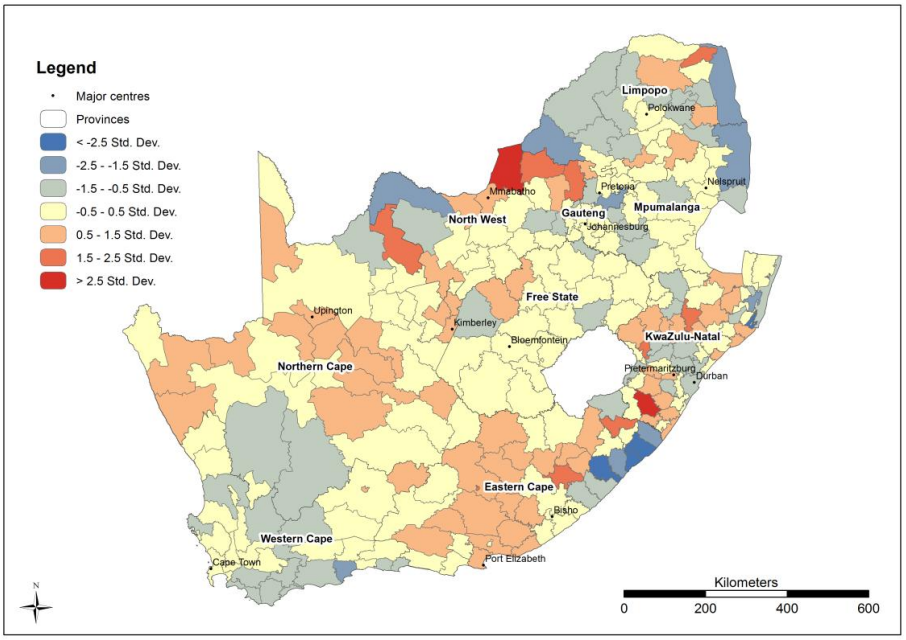

Figure 8.2 Residual values of the national unemployment model

Source: Own calculations

Municipalities where the over-prediction was high (1.5 to > 2.5 standard deviations) were located in KwaZulu-Natal, Eastern Cape and North West. However, there was only one area,

namely Umzimkulu in KwaZulu-Natal, in the > 2.5 Standard deviation category. All other areas were between -2.5 to -1.5 standard deviations and 1.5 to 2.5 standard deviations. The forecast values were between 0.4 and 0.6 different from the actual value.

In Cluster 2 the Mopani area (Kruger National Park) had a value larger than -2.5 standard deviations. All other municipalities were between -2.5 and 2.5 standard deviations from the predicted value. Municipalities in Cluster 3 lay between -2.5 and 2.5 standard deviations from the predicted value. The town of Sasolburg was the only area outside this range and had a standard deviation of -2.8. In KwaZulu-Natal provincial model all residual values were within -2.02 and 1.82 standard deviations from the predicted value. Further verification plotted the Z residual values against Z predicted values to identify any occurrence of heteroscedasticity in the data. The plots showed a random distribution of points and the assumptions of linearity and homoscedasticity were therefore met.

Van der Berg et al. (2005) propagated that the expansion of jobs is more likely if there is high economic growth. Findings in this research show that, despite reasonable economic growth rates, unemployment remained either steady or increased. This finding underscores the current South African situation of jobless growth. Economic growth below 5 per cent does not guarantee increased employment.

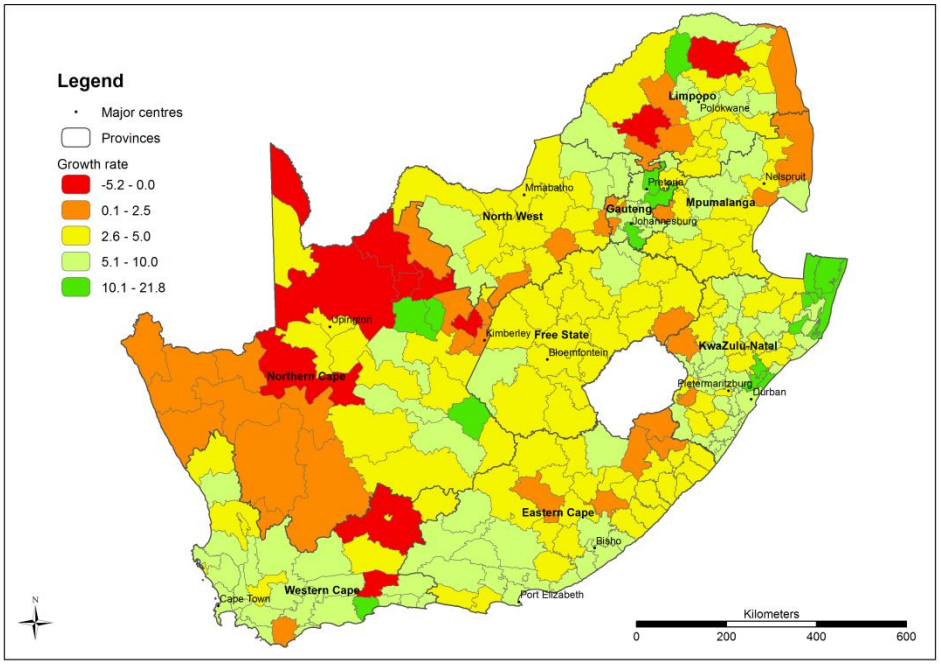

Figure 8.3 Economic growth rates in 2007

Source: Adapted from Global Insight 2011

Figure 8.3 shows economic growth rates in 2007 and 0 per cent or less growth was recorded in many DMAs and rural areas with no supporting industrial activities, like Beaufort West, Modimolle and Makhado. Even municipalities in the 2.6 per cent to 5 per cent growth band had a decrease in employment between 2001 and 2007. Mitchell and Carlson (2003) found that regions of low growth experience stagnant labour markets and negative shocks appear to endure for a long time. In South Africa 16 per cent of all municipalities had low growth rates in 2007 (Global Insight 2011 adapted) but these were not the same as the municipalities with persistent high unemployment rates. Such municipalities were located in the eastern part of the country while those with low growth rates were in the western part.

This research also found that sub-provincial unemployment rates can be predicted by socio-economic variables other than race or gender. KIasen and Woolard (2008) emphasised race as a more important predictor of unemployment than any other factor. Green, Gregg and Wadsworth (1998) found that worker qualifications, housing types and urban/rural variables were the best predictors of unemployment in the UK. Although this study did not set out to rank predictors in terms of importance, it has shown that socio-economic factors other than race or gender, can spatially forecast unemployment effectively.

Regional clusters of unemployment forecasts showed that regions have unique labour markets. Unemployment in Cluster 1 (municipalities with the highest GGP) was predicted by the ratio of people older than 20 years with no formal schooling in 2007, the ratio of economically active people employed in the agricultural sector in 1991 and the ratio of economically active people employed in the mining sector in 1991. In Cluster 2 unemployment forecast was done by ranking the unemployment statistics for 2007, the per capita income in 2007 and the ratio of economically active people employed in the agricultural sector in 1991. Unemployment was predicted by a number of socio-economic factors in Cluster 3 (municipalities with the lowest GGP). The dependency ratio in two different periods was the most important element in this case. The national dependency ratio has improved since 1991 and is currently at 54 people per 100 economically active people (UN 2011).

The common predictor in all the models was the ratio of economically active people employed in the agricultural sector in 1991 and the relationship with unemployment was always negative. The ratio has declined almost by half since 1991 and the ratio was not significant in forecasting unemployment in later years.

8.4 Conclusion

The two objectives of this chapter were to build national and sub-national models of unemployment in South Africa for 2011 and verify these using the Census 2011 unemployment data.

The first objective was achieved by building a national forecasting model of unemployment. The national model consisted of six coefficients that originated from different census periods. The model accounted for 61 per cent of the change in unemployment at national level. Sub-national models were built for groups of municipalities (groupings based on GGP). These models showed a variety of coefficients and the percentage of people employed in mining and in agriculture in 1991 featured in more than one than one model. Each model was, however, unique, because the area it represents has its socio-economic characteristics. All of the models were accurate within a 95 per cent confidence level.

The second objective was to verify the accuracy of the models by comparing them to the actual unemployment rate for 2011. In the national model there were only seven municipalities that fell outside the < -2.5 standard deviation and > 2.5 standard deviation categories. The sub-national models showed smaller deviation values and outlier areas were limited to Umzimkulu in KwaZulu-Natal and Mopani in Limpopo. The predictor values of these models were therefore within a smaller margin of error.

This study showed that unemployment problems are intimately linked with other socio-economic problems and that local labour market supply and demand factors are spatially unique. There is, therefore, a need to view labour market policies in a much broader context

than was traditionally done. They need, therefore, to integrate them with a range of other issues especially education policies, fights against crime, environmental resources and development initiatives. Further research recommended different growth strategies for different towns. Local growth strategies should not be developed in isolation, but existing development priorities, planned interventions and programmes of the various spheres of government should be considered.

These findings re-emphasise that unemployment cannot be solved in isolation, but various policies on education, labour market regulation and skills creation should collaboratively address unemployment. Labour market flexibility will be essential for securing full employment in the twenty-first century. The over-regulation of the South African labour market puts strain on the economy and reduces the possibility of full employment.

Local research found that most unemployed males are not competitive in either urban or rural labour markets. This could either be due to lack of skills or education levels. Access to basic education in South African has improved, but the quality has not and in the long run, this contributes to people being unemployable. South Africa therefore needs policies to address education at all levels, especially vocational training.

The quality, timeliness, relevance and accessibility of data remain perpetual obstacles for policymaking. Therefore, details on economic growth at a spatially detailed level, that is, a sub-municipal level, would have provided a more meaningful analysis. Current official figures in South Africa are produced at a provincial level only. Besides this, labour market data at a spatially more detailed level would go a long way in getting a better grip on the complexities facing South African society.

This particular contribution has added new knowledge by spatially forecasting unemployment nationally and at a sub-national level. In the process it created a number of new data sets that contain information about variables to facilitate both understanding and addressing the issue of unemployment at a municipal level.

Chapter 9 General synthesis

9.1 Introduction

A study of this nature which works with data for the whole country is very challenging from two perspectives, firstly accessing the data and secondly, working within the framework of the ethos of Economic Geography. Data from various years had to be sourced and converted to a usable format. This was necessary for spatial and non-spatial data. For spatial data, the data had to be standardised to the same projection, a common boundary had to be decided upon and statistical calculations had to be done to rematch attributes to other boundaries. Attribute data had to be standardised in terms of definition and calculated where it did not exist.

Modelling the spatio-temporal facet of unemployment, a topic currently under scrutiny nationally and internationally too, needed consolidation. It would have been ideal to analyse unemployment at a sub-municipal level, but it was clear that the attribute data would limit such a possibility. Unemployment attributes were missing for some enumeration areas in 1991 and 1996. For 2001 and 2007 data, unemployment attributes were never released at an enumeration area level. Data limitations therefore impacted on the level of spatial analysis and modelling.

Grounded in Economic Geography, the study is aligned to the fundamental assumption of discipline of Geography that space is heterogeneous, because places differ – both in environmental location and in socio-economic characteristics. Besides this, the lack of spatial data on migration forced this study to assume findings by Kok et al. (2003) that municipalities with high unemployment levels are expected to be areas of low migration; and by Van der Berg (2002) who postulated that rural populations will have a lower probability to migrate to urban areas. Furthermore, it was assumed that unemployment and other socio-economic data provided by Stats SA was accurate and corrected for under- and over-counting.

9.2 Study objectives

This study set out to find a spatial model for unemployment in South Africa. In doing so, census data from 1991, 1996 and 2001 and the Community Survey data from 2007 were the prime sources of information. The specific study objectives were to:

1. build a spatial representation of unemployment change for South Africa
2. identify areas of high and low unemployment through time
3. analyse trends of spatio-temporal unemployment variation at a local geographical level
4. assess the relationship between unemployment and poverty
5. create methodologies of overcoming census modifiable area unit problems for South Africa
6. build a geographical disaggregated predictive model of future unemployment.

The objectives were addressed in different chapters and supportive data was generated, analysed and modelled. All six the objectives were achieved. The first objective to build a spatial representation of unemployment change for South Africa was achieved in Chapter 5 by integrating unemployment and other socio-economic data at a municipality level into one spatial file. The file consisted of 257 records (one for each municipality) and around 660 variables. From this database it was possible to show geographically where municipalities of, consistently high unemployment were located. This research has contributed to better quality and timeliness of data for improved policy making.

The second objective looked to identify areas of high and low unemployment through time. A combined unemployment ranking was developed in Chapter 5 to make it easier to observe municipalities of high and low unemployment. Municipalities of low unemployment were concentrated in the Western Cape, Northern Cape, Gauteng, parts of Mpumalanga and Limpopo. Since 1991 high unemployment was found in municipalities in Eastern Cape, KwaZulu-Natal and parts of Limpopo.

Objective three analysed trends of spatio-temporal unemployment variation at a local geographical level in Chapter 7. It showed that metropolitan municipalities had unique unemployment characteristics and that dissimilarity between the unemployed and employed had decreased since 1991. The unemployment data for all years was spatially clustered and not randomly distributed. In fact, the spatial clustering of unemployment increased between 1991 and 2007, and the Moran's I value was 0.71 for the 2007 unemployment data. Furthermore, a spatial grouping of municipalities was done and divided the country into six distinct unemployment clusters.

The fourth objective assessed the relationship between unemployment and poverty since many authors believe the two issues are synonymous. This research, in Chapter 6, showed that people can be poor and employed, and also poor and unemployed. The spatial extent of poverty and unemployment was therefore not the same.

Objective five (Chapter 3) created a methodology for overcoming census modifiable area unit problems for South Africa and this was the underlying process for all other objectives. Since the data originated from different spatial features it was subject to the MAUP. To overcome this, areal interpolation was used to transfer data from 1991 and 1996 magisterial districts to the 2005 municipality boundaries. The 2001 and 2007 data easily linked to these boundaries and no interpolation was therefore necessary.

Objective six was to build a geographical disaggregated predictive model of future unemployment. A regression model was used in Chapter 8 to forecast unemployment for 2011. Since the unemployment rate was not normally distributed the square root of unemployment was used. A total of five models were calculated, one at a national level, three for provincial clusters and one for KwaZulu-Natal. The results were verified using the census 2011 data, and showed that the assumptions about linearity and homoscedasticity were met.

9.3 Recommendations

Based on the different chapters of this research a number of recommendations can be made. International research has found that geo-targeting optimises the money allocated for interventions, and it is therefore recommended that such geo-targeting for unemployment interventions should focus on high unemployment ranking municipalities in Eastern Cape, Limpopo and especially those in the northern part of KwaZulu-Natal.

The study found that knowledge about spatial statistics concerning the labour market is essential for the design and evaluation of government programmes, and it should therefore be geared towards employment creation, vocational training, income maintenance, poverty reduction and similar objectives. Since census data provides the most geographically detailed data on South African unemployment and is extremely useful, it is recommended for this purpose.

Unemployment showed a clear spatial pattern over time in South Africa and its regional persistence seemed to be similar to that of Europe, while unemployment trends in the USA seem to be very different. Very high correlations existed over time and confirmed the notion that unemployment has a strong regional character. Policy planning should therefore shy away from the traditional unemployment focus at a national level and rather adopt a regional and local focus when attempt to solve the problem.

Furthermore, spatial autocorrelation analysis showed that unemployment patterns are spatially clustered. Municipalities which had lower unemployment over time were spatially concentrated in Western Cape, Northern Cape, Gauteng and most parts of KwaZulu-Natal. An analysis based on standard deviation classes of unemployment showed that increasingly more municipalities were grouped in the worse off category over time. It is recommended that concern should be given to municipalities that are grouped in the worst off unemployment categories.

High-level findings indicated that both unemployment and poverty were spatially clustered and that unemployment increased in spatial concentration over time. Further to this, the statistical analysis showed that the correlation between poverty and unemployment was continuously strong only in KwaZulu-Natal, Mpumalanga and North West. Interventions targeted at poverty should therefore focus on employment creation. In Gauteng and Free State there was no significant correlation between poverty and unemployment. It was concluded that poverty was therefore determined by factors other than employment. Based on this, it is advocated that poverty alleviation interventions should be targeted wider than mitigating unemployment.

The spatial clustering of municipalities based on unemployment showed a spatial divide between the western and the eastern part of South Africa, and grouped the metropolitan areas as a unique group. Unemployment interventions in metropolitan areas should therefore be different from those in non-metro municipalities. Structural breaks, which are important indicators of why local economies experience unemployment, were evident in all metropolitan areas, except Emfuleni, City of Tshwane and eThekwini. This tendency indicated that factors other than sectoral mix influence unemployment in these three metropolitan areas. It is therefore recommended that spatially more detailed research be done using the 2011 small area layer together with earlier sub-municipal data to understand the situation better.

In the final chapter, the research forecast unemployment for 2011 at a number of spatial levels. The national model consisted of six coefficients which originated from different census periods and the model accounted for 61 per cent of the change in unemployment at the national level. National policies should therefore focus on improving HDI, reducing the ratio of people employed in the agricultural and mining sectors while improving education policies so that there will be fewer people with no formal schooling and empower rural communities, especially women, through education and small business opportunities.

Sub-national models were built for groups of municipalities based on GGP. These models showed a variety of coefficients, and the percentage of people employed in mining and in agriculture in 1991 featured in more than one model. All models were accurate within a 95 per cent confidence level. The different coefficients identified in each model were a further indication of the unique factors of supply and demand that interplay in local labour markets.

Based on these findings. it is advised that policies in the provinces of Gauteng, Western Cape and KwaZulu-Natal should focus their unemployment strategies on reducing the ratio of people older than 20 years with no formal schooling, as well as the ratio of economically active people employed in the agricultural and mining sectors.

Provinces in the Cluster 2 model, namely Eastern Cape, Limpopo and Mpumalanga should focus on job creation strategies by creating economic growth, improving education and creating skills. These provinces should also try to diversify the economic base to reduce dependency on agricultural activities. Cluster 3 provinces, namely North West, Free State and Northern Cape need to improve education in order to reduce dependency ratios and also empower people through small business opportunities, especially in rural areas. KwaZulu-Natal unemployment interventions should first target areas in the north-western part of the province. Second, it should encourage education and skills creation to address unemployment collectively.

9.3.1 LIMITATIONS OF THE STUDY

Although official unemployment statistics are released through the Quarterly Labour Force Survey, data is only available at a provincial level. Since this was too coarse a spatial level of analysis, census data was used as a source for this research. Inaccuracies in the 1991 and 1996 EA data made it difficult to accurately aggregate to higher spatial entities. The compromise was to aggregate data from magisterial districts to municipality boundaries for these years. The resulting data could therefore only be analysed at a municipality level (i.e. 257 records) and disguise underlying unemployment trends.

The study showed that there are enormous challenges related to constructing a time-continuous GIS data set, and time is probably the most important commodity needed. The technique of areal interpolation is based on the assumption that the population is homogeneously distributed across an area. This assumption could be erroneous since it is not always the case. Furthermore, literature acknowledges that areal interpolation will inevitably contain error and its impact will vary from polygon to polygon. Especially since areal interpolation should ideally be done at the spatially most detailed level, but this could not be achieved for this study.

As reiteratively acknowledged, one of the shortcomings of this study is the lack of data at a spatially detailed level. This research is therefore only able to make predictions and recommendations about unemployment at a very coarse level. Since local labour markets are unique, it would be more appropriate to make predictions at a sub-municipality level. Stats SA recently released census 2011 unemployment data at a small area level (SAL). This will increase the possibility of spatial analyses to enhance the understanding of unemployment significantly, since it would be possible to compare unemployment over time at a sub-municipal level for the first time. Future researchers could analyse and model unemployment at a sub-municipal level using 1996 to 2011 data. Other interesting research would be to analyse demand and supply in spatial detail by locating potential employers in relation to the employed and unemployed population.

A further assumption of the study was that unemployment data released by Stats SA is correct. Hence the researcher did not set out to prove the accuracy of the data, however, Stats SA (2003a) did indicate at the time that LFS 2001 should rather be seen as the official labour statistics rather than the census of 2001.

9.3.2 FUTURE RESEARCH

This research has added new knowledge in terms of the spatio-temporal understanding of unemployment in South Africa. It created a methodology to overcome MAUPs and created a longitudinal data set of unemployment and other socio-economic variables. It also used this data to forecast future unemployment spatially and showed that such predictions account for up 60 per cent of change in the unemployment trends at a national level.

This research has underlined the tremendous need for spatially refined data to fully understand the complexities of the South Africa labour market. As a result, it is also recommended that Stats SA should release unemployment statistics at small area levels like enumeration areas or sub-places to enable researchers to analyse and interpret results in a detailed fashion. Since the EA boundaries for Census 2011 changed once again it means that researchers have to recalculate socio-economic data to fit the new features.

To create a new longitudinal data set on unemployment, Census 2011 EA centroids could be used to interpolate attribute data from EAs of earlier years. This will be the first socio-economic longitudinal data at a small area level in post-apartheid South Africa.

Since poverty showed sharp increases in metropolitan areas and these areas were outliers in unemployment data, it will be important to investigate these within sub-municipal geographies in future research. Furthermore, unemployment has increased in cities and they should be targeted specifically with relevant interventions to address the issue. One could also consider the exclusion of district management areas from such an analysis since these only constitute 0.01per cent of the total population.

Future research could apply the spatial grouping done here to smaller areas like sub-places. This will enhance the understanding of local socio-economic trends and allow more accurate planning for local economic development.

Ultimately this study has shown that unemployment problems are intimately linked to other socio-economic problems and that local labour market supply and demand factors are unique. Policies to address poverty and unemployment therefore need to be spatially divergent.

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Appendix A

Table of combined unemployment ranking in 2007

Municipality	Province	Ranking
Mopani	Limpopo	12
Cape Winelands	Western Cape	13
Ehlanzeni	Mpumalanga	17
Sisonke	KwaZulu-Natal	20
Overberg	Western Cape	24
Cederberg Local Municipality	Western Cape	53
uMgungundlovu	KwaZulu-Natal	54
Cape Agulhas Local Municipality	Western Cape	58
Swellendam Local Municipality	Western Cape	58
Bergrivier Local Municipality	Western Cape	61
Witzenberg Local Municipality	Western Cape	66
Thabazimbi Local Municipality	Limpopo	77
Molopo Local Municipality	North West	79
Namakwa	Northern Cape	81
Breede River/Winelands Local Municipality	Western Cape	81
Kgalagadi	Northern Cape	83
Mookgopong Local Municipality	Limpopo	84
Golden Gate Highlands National Park	Free State	88
Theewaterskloof Local Municipality	Western Cape	89
Kannaland Local Municipality	Western Cape	90
Modimolle Local Municipality	Limpopo	96
Hessequa Local Municipality	Western Cape	96
Kou-Kamma Local Municipality	Eastern Cape	97
West Rand	Gauteng	100
Siyanda	Northern Cape	102
Matzikama Local Municipality	Western Cape	102
Swartland Local Municipality	Western Cape	106
Breede Valley Local Municipality	Western Cape	106
Stellenbosch Local Municipality	Western Cape	114
Saldanha Bay Local Municipality	Western Cape	118
Uthukela	KwaZulu-Natal	123
Umjindi Local Municipality	Mpumalanga	123
Overstrand Local Municipality	Western Cape	123
Mossel Bay Local Municipality	Western Cape	134
Merafong City Local Municipality	North West	143
Eden	Western Cape	143
Pixley ka Seme	Northern Cape	147
Drakenstein Local Municipality	Western Cape	148
Kungwini Local Municipality	Gauteng	155
Hantam Local Municipality	Northern Cape	156

Municipality	Province	Ranking
Nokeng tsa Taemane Local Municipality	Gauteng	165
Musina Local Municipality	Limpopo	171
Bitou Local Municipality	Western Cape	173
Knysna Local Municipality	Western Cape	179
Laingsburg Local Municipality	Western Cape	182
Steve Tshwete Local Municipality	Mpumalanga	183
George Local Municipality	Western Cape	184
Potchefstroom Local Municipality	North West	185
Frances Baard	Northern Cape	188
Highlands Local Municipality	Mpumalanga	190
Mtubatuba Local Municipality	KwaZulu-Natal	196
Thaba Chweu Local Municipality	Mpumalanga	196
Khâi-Ma Local Municipality	Northern Cape	196
City of Tshwane Metropolitan Municipality	Gauteng	200
West Coast	Western Cape	201
Govan Mbeki Local Municipality	Mpumalanga	206
Karoo Hoogland Local Municipality	Northern Cape	211
Midvaal Local Municipality	Gauteng	212
City of Cape Town Metropolitan Municipality	Western Cape	216
Nama Khoi Local Municipality	Northern Cape	222
Mogale City Local Municipality	Gauteng	224
KwaDukuza Local Municipality	KwaZulu-Natal	224
Msukaligwa Local Municipality	Mpumalanga	226
Lekwa Local Municipality	Mpumalanga	226
Westonaria Local Municipality	Gauteng	229
Lephalale Local Municipality	Limpopo	230
Chris Hani	Eastern Cape	233
Emadlangeni Local Municipality	KwaZulu-Natal	235
Gamagara Local Municipality	Northern Cape	236
Kgetlengrivier Local Municipality	North West	240
Moqhaka Local Municipality	Free State	243
Mpofana Local Municipality	KwaZulu-Natal	243
Oudtshoorn Local Municipality	Western Cape	244
Kouga Local Municipality	Eastern Cape	245
uMngeni Local Municipality	KwaZulu-Natal	245
Kai !Garib Local Municipality	Northern Cape	245
Kgatelopele Local Municipality	Northern Cape	247
Cacadu	Eastern Cape	248
Emalahleni Local Municipality	Mpumalanga	251
Richtersveld Local Municipality	Northern Cape	254
Greater Kokstad Local Municipality	KwaZulu-Natal	256
!Kheis Local Municipality	Northern Cape	256

Municipality	Province	Ranking
City of Matlosana	North West	256
Bela-Bela Local Municipality	Limpopo	259
Delmas Local Municipality	Mpumalanga	263
Randfontein Local Municipality	Gauteng	267
Tokologo Local Municipality	Free State	272
Matjhabeng Local Municipality	Free State	274
Phokwane Local Municipality	Northern Cape	277
Rustenburg Local Municipality	North West	280
City of Johannesburg Metropolitan Municipality	Gauteng	281
Ventersdorp Local Municipality	North West	282
//Khara Hais Local Municipality	Northern Cape	287
Metsimaholo Local Municipality	Free State	288
Kamiesberg Local Municipality	Northern Cape	293
Letsemeng Local Municipality	Free State	297
Prince Albert Local Municipality	Western Cape	297
Lesedi Local Municipality	Gauteng	298
Mbombela Local Municipality	Mpumalanga	298
Sunday's River Valley Local Municipality	Eastern Cape	299
Dihlabeng Local Municipality	Free State	300
Ekurhuleni Metropolitan Municipality	Gauteng	302
Phumelela Local Municipality	Free State	307
Setsoto Local Municipality	Free State	308
Siyancuma Local Municipality	Northern Cape	308
Baviaans Local Municipality	Eastern Cape	310
Thembelihle Local Municipality	Northern Cape	316
Kwa Sani Local Municipality	KwaZulu-Natal	321
Naledi Local Municipality	North West	321
Kopanong Local Municipality	Free State	332
Masilonyana Local Municipality	Free State	333
Camdeboo Local Municipality	Eastern Cape	334
Mamusa Local Municipality	North West	335
Central Karoo	Western Cape	335
Beaufort West Local Municipality	Western Cape	338
Endumeni Local Municipality	KwaZulu-Natal	340
Mangaung Local Municipality	Free State	341
Richmond Local Municipality	KwaZulu-Natal	341
Umkhanyakude	KwaZulu-Natal	355
Mantsopa Local Municipality	Free State	359
Sol Plaatjie Local Municipality	Northern Cape	361
Ba-Phalaborwa Local Municipality	Limpopo	361
Dipaleseng Local Municipality	Mpumalanga	367
Tswaing Local Municipality	North West	367

Municipality	Province	Ranking
Tsantsabane Local Municipality	Northern Cape	368
Mohokare Local Municipality	Free State	369
Maletswai Local Municipality	Eastern Cape	371
eThekwini Metropolitan Municipality	KwaZulu-Natal	373
Mkhondo Local Municipality	Mpumalanga	373
Umvoti Local Municipality	KwaZulu-Natal	375
Umtshezi Local Municipality	KwaZulu-Natal	377
Nketoana Local Municipality	Free State	378
Lekwa-Teemane Local Municipality	North West	379
Naledi Local Municipality	Free State	380
Emthanjeni Local Municipality	Northern Cape	383
Hibiscus Coast Local Municipality	KwaZulu-Natal	384
Mafube Local Municipality	Free State	385
Ubuntu Local Municipality	Northern Cape	385
uMhlathuze Local Municipality	KwaZulu-Natal	387
Tswelopele Local Municipality	Free State	389
Ngwathe Local Municipality	Free State	392
Molemole Local Municipality	Limpopo	393
Mier Local Municipality	Northern Cape	397
Umdoni Local Municipality	KwaZulu-Natal	400
Local Municipality of Madibeng	North West	400
Siyathemba Local Municipality	Northern Cape	407
Ditsobotla Local Municipality	North West	408
The Big Five False Bay Local Municipality	KwaZulu-Natal	410
Blue Crane Route Local Municipality	Eastern Cape	411
Inxuba Yethemba Local Municipality	Eastern Cape	412
Port St Johns Local Municipality	Eastern Cape	417
Qaukeni Local Municipality	Eastern Cape	423
Ga-Segonyana Local Municipality	Northern Cape	427
Nelson Mandela Bay Metropolitan Municipality	Eastern Cape	428
Ndlambe Local Municipality	Eastern Cape	432
Nkomazi Local Municipality	Mpumalanga	438
uMshwathi Local Municipality	KwaZulu-Natal	442
Emfuleni Local Municipality	Gauteng	448
Maquassi Hills Local Municipality	North West	449
Emnambithi-Ladysmith Local Municipality	KwaZulu-Natal	451
Newcastle Local Municipality	KwaZulu-Natal	452
Greater Tzaneen Local Municipality	Limpopo	454
Renosterberg Local Municipality	Northern Cape	462
Nala Local Municipality	Free State	464
The Msunduzi Local Municipality	KwaZulu-Natal	473
Thembisile Local Municipality	Mpumalanga	477

Municipality	Province	Ranking
Kareeberg Local Municipality	Northern Cape	477
Polokwane Local Municipality	Limpopo	477
King Sabata Dalindyebo Local Municipality	Eastern Cape	481
Mandeni Local Municipality	KwaZulu-Natal	485
Mbizana Local Municipality	Eastern Cape	486
Makana Local Municipality	Eastern Cape	488
Greater Letaba Local Municipality	Limpopo	490
Buffalo City Local Municipality	Eastern Cape	491
Gariep Local Municipality	Eastern Cape	491
Great Kei Local Municipality	Eastern Cape	492
Maruleng Local Municipality	Limpopo	493
Magareng Local Municipality	Northern Cape	496
Abaqulusi Local Municipality	KwaZulu-Natal	499
Greater Groblersdal Local Municipality	Limpopo	499
Mkhambathini Local Municipality	KwaZulu-Natal	500
Dikgatlong Local Municipality	Northern Cape	506
Ikwezi Local Municipality	Eastern Cape	514
Pixley Ka Seme Local Municipality	Mpumalanga	519
Mogalakwena Local Municipality	Limpopo	520
Matatiele Local Municipality	Eastern Cape	524
Umsobomvu Local Municipality	Northern Cape	532
Moretele Local Municipality	North West	535
Kagisano Local Municipality	North West	543
Mafikeng Local Municipality	North West	551
Umhlabuyalingana Local Municipality	KwaZulu-Natal	556
Elundini Local Municipality	Eastern Cape	559
eDumbe Local Municipality	KwaZulu-Natal	559
Makhado Local Municipality	Limpopo	562
Ramotshere Moiloa Local Municipality	North West	563
Moses Kotane Local Municipality	North West	565
Senqu Local Municipality	Eastern Cape	566
Okhahlamba Local Municipality	KwaZulu-Natal	569
Mbonambi Local Municipality	KwaZulu-Natal	569
Jozini Local Municipality	KwaZulu-Natal	570
Albert Luthuli Local Municipality	Mpumalanga	572
Mnquma Local Municipality	Eastern Cape	574
Greater Marble Hall Local Municipality	Limpopo	574
Mutale Local Municipality	Limpopo	590
Inkwanca Local Municipality	Eastern Cape	591
UPhongolo Local Municipality	KwaZulu-Natal	592
Mhlontlo Local Municipality	Eastern Cape	598
Nxuba Local Municipality	Eastern Cape	602

Municipality	Province	Ranking
uMlalazi Local Municipality	KwaZulu-Natal	604
Impendle Local Municipality	KwaZulu-Natal	607
Maluti a Phofung Local Municipality	Free State	608
Mthonjaneni Local Municipality	KwaZulu-Natal	608
Thulamela Local Municipality	Limpopo	612
Nyandeni Local Municipality	Eastern Cape	615
Lepele-Nkumpi Local Municipality	Limpopo	616
Tsolwana Local Municipality	Eastern Cape	618
Dr JS Moroka Local Municipality	Mpumalanga	619
Greater Giyani Local Municipality	Limpopo	621
Lukanji Local Municipality	Eastern Cape	625
Ubuhlebezwe Local Municipality	KwaZulu-Natal	632
Sakhisizwe Local Municipality	Eastern Cape	634
Ingwe Local Municipality	KwaZulu-Natal	635
Amahlathi Local Municipality	Eastern Cape	641
Ndwedwe Local Municipality	KwaZulu-Natal	644
Greater Taung Local Municipality	North West	644
Dannhauser Local Municipality	KwaZulu-Natal	646
Bushbuckridge Local Municipality	Mpumalanga	649
uMuziwabantu Local Municipality	KwaZulu-Natal	650
Aganang Local Municipality	Limpopo	652
Ntambanana Local Municipality	KwaZulu-Natal	656
Blouberg Local Municipality	Limpopo	657
Ezingoleni Local Municipality	KwaZulu-Natal	660
Ratlou Local Municipality	North West	676
Greater Tubatse Local Municipality	Limpopo	681
Umzimvubu Local Municipality	Eastern Cape	689
Maphumulo Local Municipality	KwaZulu-Natal	698
Vulamehlo Local Municipality	KwaZulu-Natal	701
Moshaweng Local Municipality	Northern Cape	701
Indaka Local Municipality	KwaZulu-Natal	702
Imbabazane Local Municipality	KwaZulu-Natal	703
Umzimkhulu Local Municipality	KwaZulu-Natal	707
Hlabisa Local Municipality	KwaZulu-Natal	715
Mbhashe Local Municipality	Eastern Cape	716
Ngqushwa Local Municipality	Eastern Cape	716
Emalahleni Local Municipality	Eastern Cape	719
Ulundi Local Municipality	KwaZulu-Natal	719
Ntabankulu Local Municipality	Eastern Cape	721
Fetakgomo Local Municipality	Limpopo	733
Nkonkobe Local Municipality	Eastern Cape	734
Umzumbe Local Municipality	KwaZulu-Natal	740

Municipality	Province	Ranking
Engcobo Local Municipality	Eastern Cape	741
Makhuduthamaga Local Municipality	Limpopo	755
Intsika Yethu Local Municipality	Eastern Cape	756
Nongoma Local Municipality	KwaZulu-Natal	761
Msinga Local Municipality	KwaZulu-Natal	766
Nquthu Local Municipality	KwaZulu-Natal	781
Nkandla Local Municipality	KwaZulu-Natal	781

Abbreviations

CASASP	Centre for the Analysis of South African Social Policy
CS	Community Survey
CWP	Community works programmes
DMA	District management area
DST	Department of Science and Technology
EA	Enumeration areas
ED	Enumeration Districts
ESRI	Environmental Systems Research Institute
ESTDM	Event-based spatiotemporal data model
GDP	Gross Domestic Product
GGP	Gross Geographic Product
GIS	Geographic Information Systems
GHS	General Household Survey
GVAR	Global Vector Auto Regressive
GWR	Geographically weighted regression
HDI	Human Development Index
HSRC	Human Sciences Research Council
ICLS	International Conference on Labour Statistics
IEC	Independent Electoral Commission
ILO	International Labour Organisation
LC	Living Conditions
LFS	Labour Force Survey
MAPFE	Mean squared absolute percentage forecast error
MAUP	Modifiable areal unit problems
MDG	Millennium Development Goal
MSE	Mean squared error
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
RMS	Root mean squared
SACN	South African Cities Network
SAL	Small area level
SML	Spatial Maximum Likelihood
TTWA	Travel to work areas
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
USA	United States of America